

# Environmental Performance, Industry Concentration And Corporate Financial Performance

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**Abstract:** With the development of the economy and the change of the main theme of the times, China has changed from pursuing rapid economic development to high-quality development, in which environmental issues are particularly critical. Since the 19th National Congress of the Party, the Party Central Committee and the government have repeatedly stressed the need to strengthen the construction of ecological civilization. As the main source of environmental pollution, heavily polluting enterprises should shoulder the heavy responsibility of environmental governance. For them, how to find a balance between business development and environmental protection is very important. There are also many scholars in China who have studied the relationship between environmental performance and financial performance. The conclusions are mainly divided into positive correlation, negative correlation, U-shaped relationship and irrelevance. In addition, some scholars introduced variables that may affect the relationship in order to study the relationship between the two, such as the nature of property rights and company size. However, almost all of these studies have studied the relationship between the two from the micro level of individual enterprises, and their interpretation is relatively one-sided and single. As a participant in social production, the behavior of enterprises will inevitably be affected by competition in the external market, including the performance of environmental responsibilities. Based on this, the paper selects relevant data from 2014 to 2017 of listed companies in the heavily polluting industry on the main board of Shanghai and Shenzhen, and explores the impact of environmental performance on corporate financial performance from the perspective of industrial concentration, and analyzes the differences between companies with different property rights in this regard. The research results show that environmental performance is significantly positively related to corporate financial performance; industrial concentration has a significant moderating effect between environmental performance and financial performance, that is, the higher the degree of industrial concentration, the weaker the degree of market competition, and the smaller the positive impact of environmental performance on corporate financial performance. At the same time, according to the nature of property rights, the adjustment effect of industrial concentration is more prominent in non-state-owned enterprises. The research conclusions of this article will provide theoretical basis and support for the government to formulate relevant environmental protection policies for different heavily polluting industries, and have important theoretical significance and practical value.

## 1. Introduction

In recent years, China's economy has begun to shift to high-quality development, but the environmental problems caused by the previous rapid economic development are still very serious. Since the 19th National Congress of the Communist Party of China, the Party Central Committee and the government have repeatedly emphasized the construction of ecological civilization and the concept of "lucid waters and lush mountains are invaluable assets". To a large extent, environmental pollution is caused by the random discharge of heavily polluting enterprises. In today's prevailing environmental protection, its stakeholders will pay great attention to its production and operation

activities. If enterprises still follow traditional thinking and do not pay attention to the strengthening of environmental management, they are likely to fall behind or even be eliminated. Therefore, it is very important for enterprises to improve their environmental impact while maintaining their normal operation and development.

Since the American scholar Bragdon et al. (1972) put forward the concept of environmental performance, the academic community has conducted extensive research on the relationship between environmental performance and financial performance, but no unified opinion has been formed. In addition, in order to deepen the theoretical model of the relationship between the two, scholars gradually add some moderating variables or intermediary variables, such as company size, company environmental management level, etc., which are all data at the micro level, but very important. Few scholars have explored which macro variables affect the correlation between environmental performance and financial performance. In the context of differences in industry competition, the company's emphasis on environmental management will also be affected. At the same time, the nature of property rights has also become the focus of heated discussion. Under the special economic background of our country, enterprises of different natures will have different strategic choices and business goals.

In view of this, on the basis of existing research, this paper will empirically test the impact of environmental performance on corporate financial performance based on the production characteristics of heavily polluting industries, deeply study the moderating role of industrial concentration in the relationship between the two and analyze the differences in this aspect of enterprises with different property rights. The conclusions drawn from the research will have the following two aspects:

First of all, there have been many similar discussions on the impact of environmental performance on corporate financial performance, but there is no consensus. Many scholars have also added other variables to explore the impact of different variables on the relationship between the two, but few scholars have considered the macro-level impact, such as industrial concentration and other variables. Therefore, further research is needed on the degree of concentration of different heavily polluting industries and the moderating role it plays between environmental performance and corporate financial performance. At the same time, this paper will further divide enterprises into state-owned enterprises and non-state-owned enterprises on this basis, and explore how the nature of property rights affects the moderating effect of industrial concentration.

Next, under the background of environmental protection as the main theme, the environmental performance of the heavily polluting industries is very important, but most of the heavily polluting enterprises pay too much attention to the performance of the business performance and ignore the environmental responsibility that the enterprises themselves need to undertake during the operation process, which will affect the the realization of the maximum benefit of the enterprise. With the prevalence of environmental protection concepts, enterprises attach importance to environmental management, which can not only make full use of resources, but also help to improve the image and competitiveness of enterprises, and are favored by investors and consumers. At the same time, due to the different competitive environment of the industry in which the company operates and the nature of the company itself, management's decision-making in environmental protection investment may be different, which may ultimately affect the relationship between environmental performance and corporate financial performance. Therefore, the research content of this paper will provide theoretical support and practical reference for enterprises to improve environmental performance and government to formulate corresponding policies.

## 2. Literature review

### 2.1. Environmental performance and financial performance

In the research on the relationship between environmental performance and financial performance, the conclusions of the academic community are not uniform, and the research is summarized as follows:

Many scholars believe that the company's investment in environmental protection will bring additional costs, resulting in an increase in the overall cost of the company, a decline in profits, and a disadvantaged position in the competition. Tommy and Zhou (2017) used the panel data of Swedish enterprises from 2002 to 2008 to study the impact of environmental performance on enterprise performance using the DEA method. The results show that improving environmental performance and increasing environmental protection investment limit the production efficiency of enterprises in the next period. Many domestic scholars have also drawn similar conclusions: some scholars have studied the data of some enterprises in the CDP report as samples, and the results show that the efforts of enterprises to improve carbon performance in the short term cannot be recognized by the market (Zhou Zhifang et al., 2017).

Some scholars believe that there is a positive correlation between the two, and a significant improvement in environmental protection can help companies gain the favor of consumers, gain unique competitive advantages, and establish a good image of responsibility for companies. Based on the national level, some foreign scholars, such as Dafna M.DiSegni (2015), compare the financial performance and sustainability index of all American companies, and analyze their environmental contribution and financial performance, believing that companies that actively fulfill their environmental responsibilities can get higher profits. Other scholars have conducted research based on the industry level. For example, Ilias Alexopoulos et al. (2018) investigated the relationship between the Greek manufacturing environment and financial performance, stating that companies can achieve better financial performance without improving the level of environmental management. Carmen Fernández Cuesta et al. (2018) selected relevant data of listed companies in 16 European countries. The research shows that the better the carbon performance of industrial companies, the easier it is to obtain more long-term financial debts to provide funds for their production and operations. That is, there is a positive correlation between environmental performance and financial performance.

Domestic scholars Wang Jia et al. (2020), Xu Liyun et al. (2018), Yang Xia et al. (2017) and Zhang Changjiang et al. (2016) believe that the improvement of corporate environmental management level can promote corporate reputation advantages, enhance investor trust, and win competitive advantages, enabling enterprises to more fully and effectively utilize resources and market opportunities to improve their financial performance. Hu Quying (2012) and others believe that the traditional profit maximization principle and environmental end governance behavior in the past are no longer in line with the development trend of the new era. Only by actively carrying out environmental preventive management can the company's competitive advantage be maintained and improved. Some scholars have shown that the implementation of green innovation can significantly improve the level of corporate financial performance and enhance the company's competitive advantage (Xu Wen, 2020).

In addition to some simple linear relationships, there is also a view in academic circles that there is a more complex curve relationship between environmental performance and corporate financial performance. Christoph Trumpp et al. (2017) selected data from 2361 companies from 2008 to 2012 for analysis and found that the relationship between environmental performance and financial performance is an inverted U shape. Hengky Latan et al. (2018) conducted an empirical analysis with Indonesian companies that have passed ISO14001 certification as a sample and came to the same conclusion as the former. Domestic scholars have also conducted similar research. Jia Chunxiang et al. (2018) selected relevant data of listed companies in China's manufacturing and mining industries from 2014 to 2016 to conduct research and found that there is a U-shaped relationship between corporate environmental performance and financial performance.

In addition to the above-mentioned viewpoints, it has also been suggested that there is no significant link between environmental performance and financial performance. Kimitaka Nishitani et al. (2017) used data from a questionnaire survey of Indonesian companies to study the relationship between the two and found that the improvement of environmental performance did not affect the financial performance of enterprises. Petitjean (2019) found that there is no evidence to support the hypothesis that environmental performance is linked to financial performance, and the implementation of corporate environmental strategies does not affect corporate financial performance.

## **2.2. The impact of industry concentration on environmental performance and financial performance**

There are two distinct voices on industrial concentration and environmental information disclosure. Some scholars believe that in the case of fierce competition, enterprises are more inclined to disclose environmental information to obtain competitive advantages. Tan Xue (2017) found that the motivation of companies to disclose social responsibility information has a significant positive relationship with the level of competition in the industry, and environmental information is an important aspect of social responsibility information. Other scholars believe that in industries with low industrial concentration and fierce market competition, the greater the business risks faced by enterprises, the higher the requirements for enterprises to rationally allocate resources. With the development of enterprises, it is difficult for enterprises to improve the level of environmental management in the later stage. The empirical test of Li Qiang et al. (2017) shows that with the continuous increase of competitive pressure, the quality of environmental information disclosure of enterprises will decline in the later stage.

In addition, some scholars have also conducted research based on the SCP theory to link industry concentration with market performance. Zheng Fei's (2019) study found that there is a significant positive correlation between market concentration and market performance in industrial sub-sectors. The research results of Li Xiaozhong et al. (2017) show that the concentration of information industry and manufacturing industries in Zhejiang Province is negatively correlated with industrial performance. There are many related literatures, but there is still no unified conclusion between the two.

To sum up, it can be seen that there are many scholars who link industry concentration with environmental information disclosure or market performance for research, but few scholars link these three together for research. Although environmental information disclosure can reflect corporate environmental responsibility to a certain extent, it cannot fully reflect an enterprise's environmental management level, and environmental performance can better reflect the effectiveness of an enterprise's environmental management. At the same time, market performance cannot well reflect the results achieved by a single enterprise. As an individual participating in social production to seek profit, the behavior of an enterprise will inevitably be affected by the external market competition environment, including the performance of environmental responsibilities. Therefore, on the basis of studying the environmental performance and financial performance of heavily polluting enterprises, this paper will explore the moderating effect of industrial concentration on the relationship between the two.

## **3. Hypothesis development**

The sustainable development theory pursues the harmony between man and nature. This theory emphasizes that natural resources and environmental bearing capacity are limited, and the continuous development of human society must be based on respect for nature and the economic development model must be constantly transformed to high quality. When enterprises carry out environmental governance after production activities, it is difficult to recover the environmental pollution caused by production activities. Compared with the end-stage treatment of environmental pollution, proactive

environmental management and source prevention and control can greatly reduce the cost of corporate environmental pollution and improve the company's own environmental governance level.

The stakeholder theory proposes that in addition to shareholders, there are many people who are closely related to the development of the enterprise. Among them, there are employees who are dedicated to the development of the enterprise, and there are also external personnel who always pay attention to the dynamics of the enterprise. What an enterprise needs to do is not only to maintain stable operations, but also to consider how to balance the interests of all parties. The theory of social responsibility believes that the development of an enterprise is inseparable from the efforts of internal employees and the help of external organizations and personnel. Therefore, when an enterprise achieves certain achievements, it needs to assume certain social responsibilities. A company with high environmental performance indicates that its managers are responsible and able to meet the needs of stakeholders. Such enterprises also generally have a high reputation for environmental protection, and can win the favor of investors and consumers in the market, obtain policy support from the government and achieve better economic benefits. Based on the above analysis, the following assumptions are put forward:

**H1:** There is a positive correlation between the environmental performance and financial performance of listed companies in heavily polluting industries.

According to the SCP model of "market structure-market behavior-market performance", market competition affects management's business decisions through external channels. The management's decision is reflected in the performance of environmental responsibilities, and the performance of environmental responsibilities directly affects the performance of enterprises. In an environment with a relatively low degree of industrial concentration, that is, a relatively fierce market competition, the industry tends to be fragmented, and the competitive pressure of enterprises is greater, and price wars are the norm in industry competition. With the continuous intensification of competition, products and services will gradually develop towards homogeneity, enterprises will gradually lose their brand effect, and with the entry of external enterprises, the operating costs of the entire industry will rise. At this time, if a company invests in environmental protection, it can establish a company image that actively fulfills its environmental responsibilities, meet customers' needs for green consumption, and win the favor of the public and the media. On this basis, it is easier to raise funds to improve operations.

On the contrary, in industries with high industrial concentration, products are not easily replaced. The competition pressure of enterprises is relatively small, and the performance of environmental responsibilities is only based on the requirements of laws and regulations rather than their own economic motives. Enterprises also have more financing channels, and can use the many resources and information advantages at their disposal to curb the entry of inefficient competitors. Such enterprises have a high degree of "consensus" in strategic decision-making, so the competitive environment at this time is not conducive to the exertion of corporate governance effects. Based on the above analysis, the following assumptions are put forward:

**H2:** The higher the degree of industrial concentration, the weaker the market competition, and the smaller the positive impact of the environmental performance of the heavily polluting enterprises on the financial performance.

## **4. Research design**

### **4.1. Variable selection**

#### (1) Environmental performance

Most of the variables used by foreign scholars have systematic data sources, such as TRI or IRRC in the United States. However, there is no relevant and complete database of corporate environmental responsibility in my country, and it is difficult to collect data, so there is no unified measurement index. Some scholars use the comprehensive scoring method to conduct comprehensive scoring according to the selected criteria. However, this approach is subjective and arbitrary and not rigorous

enough. Therefore, this paper takes the specific economic value, that is, the pollutant discharge fee per unit of operating income, as the proxy variable of environmental performance. The pollutant discharge fee per unit of revenue reflects the amount of pollutants produced by the enterprise while creating a certain income. The lower the unit pollutant discharge fee, the better the environmental performance of the enterprise.

(2) Financial Performance

By going through a large number of literature studies, it can be found that the indicators for measuring financial performance can generally be divided into two categories, namely market-based and accounting-based indicators. The research comparison found that the market-based Tobin's Q value can better reflect the company's value and the company's growth. Based on this, this paper selects Tobin's Q value as a measure of the financial performance of enterprises in my country's heavily polluting industries.

(3) Industrial concentration

The most common indicators to measure the industrial concentration are the Herfindahl-Hirschman index (HHI) and the concentration ratio( $CR_n$ ).

The HHI index represents the sum of the squares of the market share ( $S_i$ ) of each company among the 50 largest companies in the industry. The smaller the value, the lower the industry concentration and the more intense the competition. The HHI index can reflect the information of the whole industry well, but sometimes it is not intuitive.

$$HHI = S_1^2 + S_2^2 + \dots + S_K^2 = \sum_{i=1}^K S_i^2$$

Another indicator concentration ratio ( $CR_n$ ) is the accumulated share of the n largest enterprises in the market, and the calculation method is as follows:

$$CR_n = \sum_{i=1}^r (x_i / x) = \sum_{i=1}^r s_i \quad (i=1,2,\dots,r)$$

Among them,  $x_i$  is the sales of the i-th company in the industry after ranking from high to low in sales. The concentration ratio is easy to understand and relatively simple to calculate, but it cannot reflect the overall competition in the industry and does not reflect the market distribution of the n largest companies.

Many domestic scholars have compared these two indicators. Yan Xiaofei et al. (2016) used  $CR_4$ ,  $CR_8$  and HHI index to measure the coal industry of each province respectively. They found that the degree of concentration of the responses of the three indicators is basically the same, but the HHI indicator can better explain the distribution of industries. Comparing the advantages and disadvantages of the two, this paper will use the HHI index to measure the industrial concentration.

(4) Control variable

In order to eliminate the influence of other variables, this paper draws on the research results of Hu Quying (2012), Yang Xia et al. (2017) and many other scholars. Select company size, financial leverage, operating efficiency, development capability, and year and industry as control variables. The specific variable descriptions are shown in Table 1.

Table.1. Variable Definitions

Variable	Definitions
TBQ	Market value / total assets at the end of the period (market value = equity market value - net debt market value)
CEP	Divide the current year's sewage charge by the current year's operating income
HHI	Herfindahl-Hirschman index
LEV	Assets and liabilities
GROW	Operating income growth rate
TH	
SIZE	The natural logarithm of the firm's total assets
CE	Operating cost ratio

YEAR	1 for the current year, 0 otherwise
IND	Adopt the industry classification standard of China Securities Regulatory Commission, the industry is 1, otherwise it is 0

## 4.2. Sample selection

The focus of this paper is on the moderating effect of industrial concentration. However, the definition of heavily polluting industries is relatively broad, and it is difficult to collect specific data. Therefore, based on the existing literature and relevant regulations of government departments, this paper selects 16 heavily polluting industries. Specifically broken down into three-level classifications with industry codes, including "B-mining industry", "C13-agricultural and sideline food processing industry" until "C33-metal products industry" and "D-electricity, heat, gas and water production and supply industry".

This paper selects the relevant data of listed companies on the Shanghai and Shenzhen main boards from 2016 to 2020, and makes the following adjustments: (1) Select relevant companies according to the above industry codes, and exclude ST or \*ST listed companies. (2) Exclude listed companies that do not disclose sewage charges, have missing data or have extreme values in their annual reports. After screening, a total of 662 groups of samples were obtained, including 273 non-state-owned enterprise sample values and 389 state-owned enterprise sample values.

In addition, the data in this article are mainly from the Guotai'an database, and some of the sewage fee data are manually sorted.

## 4.3. Research model

In order to verify hypothesis 1, this paper establishes model (1):

$$TBQ = \alpha_0 + \alpha_1 CEP + \alpha_2 LEV + \alpha_3 GROWTH + \alpha_4 SIZE + \alpha_5 CE + \alpha_6 YEAR + \alpha_7 IND + \varepsilon \quad (1)$$

At the same time, on the basis of the above model, the cross term of environmental performance and industrial concentration (CEP\*HHI) is introduced to construct model (2). To explore the moderating effect of industrial concentration on the relationship between the two.  $\alpha_i$  and  $\beta_i$  in the model are regression coefficients, and  $\varepsilon$  is the residual.

$$TBQ = \beta_0 + \beta_1 CEP + \beta_2 HHI + \beta_3 CEP * HHI + \beta_4 GROWTH + \beta_5 SIZE + \beta_6 CE + \beta_7 YEAR + \beta_8 IND + \varepsilon \quad (2)$$

## 5. Findings

### 5.1. Descriptive statistics

First, descriptive statistics are performed on the data in this paper, as shown in Table 2.

Table.2. Descriptive Statistics

Variables	Full sample				State-owned sample		Non-state-owned sample	
	Min	Max	Mean	Std	Mean	Std	Mean	Std
TBQ	0.1528	8.7916	1.9326	1.1305	1.7658	1.0400	2.1702	1.2109
HHI	0.0137	0.5133	0.0829	0.0651	0.0889	0.0519	0.0743	0.0795
CEP	0.0000	0.0226	0.0025	0.0024	0.0026	0.0026	0.0024	0.0021
LEV	0.0156	1.1110	0.4920	0.2053	0.5545	0.2009	0.4029	0.1769
GROWTH	-0.5884	4.7125	0.1357	0.4163	0.0770	0.3441	0.2194	0.4903
SIZE	19.5269	25.7670	22.5280	1.1256	22.8532	1.2082	22.0648	0.7939
CE	0.0741	1.0819	0.7707	0.1609	0.8023	0.1486	0.7257	0.1672

In the whole sample, the sewage charge per unit operating income is between 0 and 0.0226, with a mean of 0.0025 and a standard deviation of 0.0024. It can be seen that the attitudes of enterprises towards environmental governance are quite different. Although there is a general awareness of environmental management, the degree of implementation is far different. Tobin's Q value is between

0.15 and 8.79, with a mean of 1.93 and a standard deviation of 1.13, indicating that there is a large difference in the operating results of enterprises. The minimum value of industry concentration is 0.0137, the maximum value is 0.5133, and the average value is 0.0829. It can be seen that the industry competition in the heavily polluting industries is quite different, and the industry concentration of most companies is low. The asset-liability ratio is 1.56% to 111.1%, with an average value of 49.36%; the minimum operating income growth rate is -0.59, the maximum is 4.71, and the average value is 0.13, indicating that some companies have a worrying development prospect, but overall they are still developing well. . The scale of the enterprise ranges from 19.53 to 25.77, with an average value of 22.53, which is not much different; the operating cost ratio is 0.07 to 1.08, with an average value of 0.77, and the operating costs of enterprises are generally high.

In the grouped descriptive results, compared with non-state-owned enterprises, state-owned enterprises have a smaller mean TBQ and a larger mean CEP, indicating that state-owned enterprises have poorer economic benefits but better environmental performance. In terms of industrial concentration, the average HHI of state-owned enterprises (0.0889) is greater than that of non-state-owned enterprises (0.0743), indicating that the industries in which state-owned enterprises are located tend to be slightly concentrated.

## 5.2. Correlation analysis

Then, the correlation analysis of the samples was carried out in this paper, as shown in Table 3. In general, the larger the correlation coefficient, the closer the relationship between variables, but if the correlation coefficient is too large, it means that there is multicollinearity. In this table, the correlation coefficients are all less than the critical value of 0.5, so there is no multicollinearity problem between the variables selected in this paper.

Table.3. The results of the correlation test of the variables

	TBQ	HHI	CEP	LEV	Growth	SIZE	CE
TBQ	1						
HHI	-0.143***	1					
CEP	-0.110***	-0.070*	1				
LEV	-0.447***	0.182***	0.037	1			
Growth	0.038	0.004	-0.061*	-0.075	1		
SIZE	0.450***	0.240***	0.012	0.421***	-0.038	1	
CE	-0.381***	0.020	-0.016**	0.431***	-0.145***	0.133***	1

Notes: . See Table 1 for variable definitions\*\*\*, \*\*, \* refer to significance at the 1, 5, and 10 percent levels, respectively. Significance levels are based on two-tailed tests

It can be seen from the results that the coefficient between Tobin's Q value and the sewage charge per unit of revenue is -0.11, which is significant at the 1% level. It shows that the lower the pollutant discharge fee per unit of revenue, the better the environmental performance, and the H1 is preliminarily verified. The moderator variable HHI was significantly negatively correlated with the dependent variable at the 1% level, with a correlation coefficient of -0.143. Among the control variables, except for developmental ability, the rest were significantly correlated with the dependent variable at the 1% level. In order to draw more accurate conclusions, this paper will perform regression analysis and test on the data.

## 5.3. Analysis of linear regression results

After the correlation analysis, this section will carry out regression analysis on the two models to explore the relationship between environmental performance and financial performance and the moderating effect of industrial concentration. The regression results are shown in Table 4.



Table.4. The regression results of the impact of environmental performance on financial performance

Variables	Full sample		State-owned sample		Non-state-owned sample	
	(1)	(2)	(3)	(4)	(5)	(6)
CEP	-0.074*** (-6.372)	-0.049*** (-5.034)	-0.061** (-2.462)	-0.038** (-2.182)	-0.076*** (-7.465)	-0.059*** (-6.505)
HHI		-0.229* (-1.944)		-0.322 (-1.706)		-0.217 (-1.062)
CEP*HHI		0.013** (2.074)		0.017* (1.825)		0.010** (2.218)
LEV	-0.106** (-2.144)	-0.107** (-2.149)	-0.113** (-2.234)	-0.116** (-2.243)	-0.081* (-1.952)	-0.083* (-1.983)
Growth	0.089 (0.826)	0.088 (0.823)	0.056 (0.443)	0.069 (0.552)	0.072 (0.602)	0.066 (0.554)
SIZE	0.033* (1.792)	0.034* (1.804)	0.030* (1.754)	0.031* (1.761)	0.048* (1.821)	0.043* (1.819)
CE	-0.182** (-2.359)	-0.176** (-2.498)	-0.165 (-0.755)	-0.146 (-0.631)	-0.206*** (-3.014)	-0.196*** (-2.978)
YEAR FE	Yes	Yes	Yes	Yes	Yes	Yes
IND FE	Yes	Yes	Yes	Yes	Yes	Yes
N	662	662	389	389	273	273
Adjusted R <sup>2</sup>	0.242	0.248	0.246	0.259	0.250	0.271
F Value	119.582	109.497	74.402	79.426	48.526	44.384

Notes: . See Table 1 for variable definitions\*\*\*, \*\*, \* refer to significance at the 1, 5, and 10 percent levels, respectively.

Overall, the F values of all regression results passed the 1% significance test, and it can be considered that the selected variables meet the modeling requirements.

Firstly, the correlation between environmental performance and corporate financial performance is analyzed. From column (1) in the table, we can see that the coefficient of Tobin's Q value and unit revenue sewage charge is -0.074, and the Sig. value is 0.01. This is consistent with the conclusion of the correlation analysis, indicating that the lower the pollutant discharge fee per unit of revenue, the better the environmental performance of the enterprise, and its financial performance will also be significantly improved. Hypothesis H1 is verified. From the point of view of control variables, except for enterprise development ability, other control variables are significantly correlated with Tobin's Q value.

Secondly, the moderating effect of industrial concentration on the relationship between environmental performance and financial performance is examined. Based on model (1), this paper introduces moderator variables and their interaction terms, and constructs model (2). From the regression in column (2), it can be seen that Tobin's Q value is still significantly negatively correlated with sewage charges per unit of revenue, which is consistent with the previous conclusion. The moderator variable HHI coefficient was -0.229 and passed the significance test. The coefficient of the interaction term CEP\*HHI is significantly positive, indicating that the industrial concentration has a significant moderating effect on the relationship between the two. Since the sign of its interaction term is opposite to that of the independent variable, it indicates that the industrial concentration plays a role in weakening the positive impact of environmental performance on the financial performance of enterprises, which is consistent with H2.

The heavily polluting enterprises are further divided according to the nature of property rights, and the two groups of samples are respectively regressed. The third to sixth columns in the table are the regression results. Columns (3) and (5) show that in model (1), the regression coefficients between Tobin's Q value and unit revenue of sewage charges have passed the significance test, and the significance of non-state-owned enterprises is higher. Columns (4) and (6) show that CEP\*HHI is significant in both groups of samples, but it is more significant in the samples of non-state-owned enterprises. It shows that industrial concentration has a greater moderating effect on the relationship between the two in non-state-owned enterprises, which verifies H3.

#### 5.4. Robustness test

Through the above analysis, the assumptions of this paper have been verified, and the content of this section will be tested for robustness to ensure the robustness of the conclusions. Since the data of environmental performance proxy variables in this paper is difficult to collect, it is not realistic to adjust the time interval of the sample, and it is more complicated to change the regression method. Therefore, this paper will use the method of replacing the explained variable, and use the net profit ratio of total assets (ROA) as a surrogate variable for Tobin's Q value for regression analysis. The results are shown in Table 5.

Table.5. The stability test of environmental performance to financial performance

Variables	Full sample		State-owned sample		Non-state-owned sample	
	(1)	(2)	(3)	(4)	(5)	(6)
CEP	-0.391*** (-4.087)	-0.324*** (-3.985)	-0.312** (-2.199)	-0.301** (-2.367)	-0.408*** (-3.998)	-0.353*** (-3.463)
HHI		-0.116** (-2.115)		-0.154* (-1.726)		-0.109** (-2.018)
CEP*HHI		0.038** (2.306)		0.041* (1.804)		0.030** (2.269)
LEV	-0.073*** (-7.054)	-0.074*** (-7.142)	-0.074*** (-6.420)	-0.076*** (-6.571)	-0.049** (-2.348)	-0.050** (-2.390)
Growth	0.029 (0.713)	0.028 (0.795)	0.033 (1.086)	0.032 (1.047)	0.022 (0.709)	0.020 (0.645)
SIZE	0.004*** (2.654)	0.006*** (2.936)	0.006*** (3.443)	0.007*** (3.292)	0.003 (0.871)	0.004 (0.981)
CE	-0.180*** (-6.894)	-0.178*** (-6.034)	-0.109** (-2.734)	-0.103** (-2.650)	-0.195*** (-5.039)	-0.189*** (-4.850)
YEAR FE	Yes	Yes	Yes	Yes	Yes	Yes
IND FE	Yes	Yes	Yes	Yes	Yes	Yes
N	662	662	389	389	273	273
Adjusted R <sup>2</sup>	0.214	0.218	0.232	0.233	0.208	0.213
F Value	114.516	104.799	71.069	67.415	46.716	49.441

Notes: . See Table 1 for variable definitions\*\*\*, \*\*, \* refer to significance at the 1, 5, and 10 percent levels, respectively.

Overall, the F values in the models passed the 1% significance test, indicating that the models maintained the previous level of effectiveness. In column (1), the coefficient of pollutant discharge fee per unit revenue is -0.391 and is significant, indicating that environmental performance is positively correlated with financial performance. In column (2), the coefficient of CEP\*HHI is significantly positive at the level of 5%, and the sign of the coefficient of pollutant discharge fee per unit of revenue is negative, indicating that industrial concentration has a significant negative adjustment effect on environmental performance and financial performance. Columns (3) and (5) show that both environmental performance and financial performance are significantly positively correlated, and the significance of non-state-owned enterprises is higher. Columns (4) and (6) show

that the coefficient of CEP\*HHI is more significant in the non-state-owned enterprise sample, indicating that the industrial concentration has a greater moderating effect in the non-state-owned enterprise sample. This is consistent with the above regression analysis results, so it can be considered that the regression results pass the robustness test.

## 6. Conclusion

This paper selects the relevant data from 2014 to 2017 of listed companies in the heavily polluting industries on the Shanghai and Shenzhen main boards. Based on the relevant theories such as sustainable development, social responsibility and SCP, combined with the characteristics of the heavily polluting industries, the following conclusions are obtained through data testing:

(1) There is a positive correlation between corporate environmental performance and corporate financial performance in heavily polluting industries. Under the current background of advocating the protection of the environment, the investment of enterprises in environmental protection technology can effectively improve the ability of enterprises to control pollutants, reduce the cost of environmental regulation, and make full and effective use of resources. And then increase production output, and ultimately promote the improvement of corporate financial performance. For enterprises that do not pay attention to environmental management, their environmental pollution costs are likely to rise instead of falling, and they will become the key observation objects of environmental protection departments, and may eventually be eliminated by the market.

(2) Industrial concentration has a significant negative moderating effect on the relationship between environmental performance and financial performance of heavily polluting enterprises. In industries with high industrial concentration, enterprises have sufficient financing channels and sufficient resources to curb the entry of inefficient competitors, and enterprises lack sufficient economic incentives to improve environmental performance. In industries with low industrial concentration, there are many competitors, and companies urgently need to find new competitive advantages to enhance brand awareness. The improvement of environmental performance can not only win the favor of consumers and investors, but also effectively alleviate the strong impact of reputation constraints on enterprises. On this basis, it is easier for enterprises to raise funds and improve the operating environment to improve financial performance. When enterprises are in a highly competitive market, SOEs are vulnerable to more protection from financial institutions such as banks, making them less responsive to the external environment. Non-state-owned enterprises need to pay attention to their own long-term development. When the market competition becomes more intense, they are more willing to improve their environmental performance to gain a competitive advantage. Therefore, in non-state-owned enterprises, the moderating effect of industrial concentration on the relationship between environmental performance and financial performance is more significant.

There is a significant positive correlation between corporate environmental performance and financial performance in heavily polluting industries. For enterprises, while paying attention to business development, they also need to improve their own environmental management level, fulfill their environmental protection responsibilities, and seek a balance between environmental protection and business performance. Second, since the degree of industrial concentration will have a significant negative moderating effect on the relationship between corporate environmental performance and financial performance, government departments should formulate more detailed environmental protection policies to encourage green development of enterprises. In heavily polluting industries with low industrial concentration, enterprises are under greater pressure to invest in environmental protection. It is recommended that government departments reduce the taxation of environmental protection enterprises and increase one-time government subsidies for some environmental governance projects. In industries with a high degree of industrial concentration, companies have greater decision-making power over product prices and are less affected by external public opinion. The government can carry out macro-control, try to make the competition in some industries more relaxed, and promote the diversified operation and development of enterprises.

Third, state-owned enterprises should take into account their own actual conditions and follow the principle of cost-effectiveness when treating environmental pollutants. Do not undermine the overall economic efficiency of the company by overly fulfilling its environmental responsibilities. For the government, while paying attention to the development of state-owned enterprises, it should also increase subsidy measures for non-state-owned enterprises to reduce the pressure of their capital investment in environmental protection. Last but not least, improve the information disclosure mechanism. At present, there is no relatively formal environmental information integration and disclosure platform in my country, and environmental data is extremely difficult to obtain. Government departments should issue more complete normative requirements on environmental information disclosure, in order to implement environmental supervision and lay the foundation for the development of environmental research in my country.

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