Can Environmental Regulation Improve the Corporate Environmental Performance of Heavy-Polluting Enterprises of China?

Yi Zhang[a] Min Xia[a*] Hongyu Hu[a]

[a] College of Business Administration
Hunan University of Technology and Business
Changsha, Hunan 410205, P. R. China

Abstract

The "Porter Hypothesis" proposes that environmental regulation positively affects corporate performance through technological innovation, but the existing literature has discrepancies in this hypothesis. Based on this, we construct an intermediary model in which government environmental regulations and corporate environmental performance, and select 165 listed companies in heavily polluting industries as research samples to explore the mediating role of environmental strategy. The empirical results show that environmental regulations have a positive impact on corporate environmental performance; environmental strategies completely mediate the impact of environmental regulations on corporate environmental performance. The research conclusions support the application of the "Porter Hypothesis" in China's heavy-polluting industries, and also provide useful enlightenment for the government to use environmental regulations to guide enterprises to implement active environmental management strategies.

Keywords: Environmental regulation; corporate environmental performance; Environmental strategy; the "Porter Hypothesis"

1. Introduction

The 19th National Congress of the Communist Party of China pointed out that "China has achieved a moderately prosperous level in general, but problems such as unbalanced and insufficient development are still prominent, and the problems of environmental pollution and ecological damage are very serious." On the one hand, China's industrialization development level has been significantly improved, which greatly meets the material needs of mankind; on the other hand, the extensive development model has caused serious negative effects on resources and the environment. In order to build a harmonious and symbiotic relationship between man and nature and promote sustainable social development, the state has successively promulgated a series of articles and regulations such as the "Ten Articles on Atmosphere", "Ten Articles on Water", and the new "Environmental Protection Law" (2015), restricting relevant laws from the legal level. The pollutant discharge behavior of the subject. As the main polluters, enterprises in heavy pollution industries will inevitably be forced to comply with compliance requirements and have to pay attention to their own environmental behavior (Delmas &Toffel, 2008).

In 1991, Porter put forward the famous "Porter Hypothesis" through case analysis, which believed that appropriate government environmental regulations can encourage enterprises to practice active environmental management behaviors. This behavior will make the company's pollution control ability and product damage in the long run. The level of science and technology has been greatly improved (Porter, 1991; Porter & Van Der Linde, 1995). However, this theory has not been fully verified in the Chinese context. Some research results show that environmental regulation has a positive effect on corporate environmental performance (Ramanathan et al., 2017), but some scholars believe that environmental regulation has no effect on corporate environmental performance (Li, 2019), and even have an inhibitory effect (Yuan & Xiang, 2018). In view of this, this research is based on the differences in Porter's hypothesis, and constructs an intermediary model of government environmental regulations affecting corporate environmental performance, and empirically tests the mediating role of corporate environmental strategy.

Specifically, this article has the following three research contributions. First, this article uses micro-level city and enterprise data as the research basis, which is different from most macro-industry or inter-provincial research. Second, using second-hand data such as listed companies, compared to questionnaire surveys, the information presented is more objective and fair. Third, taking China's heavily polluting companies as an example to explore the black box of environmental regulations affecting corporate environmental performance can further support the application of the "Porter Hypothesis" in the Chinese context.

2. Literature Review and Hypotheses

2.1The effect of environmental regulation on corporate environmental performance

Environmental regulation is considered to be one of the important means of environmental management, mainly refers to the government's supervision of the links that may cause environmental problems in the production and operation of enterprises (Oliver, 1991). Previous studies have shown that environmental regulations will bring environmental pressure to companies and promote the improvement of environmental performance. For example, combined with the social background of China's transformation, some scholars verified the positive correlation between environmental regulations and environmental performance from a meso and macro perspective, and believed that The government environmental regulation forces enterprises to improve the efficiency of factor allocation, promote technological innovation and reduce pollutant emissions（Li&Tao,2012; Zhang& Qu,2013; Chen ,2017）. Therefore, when companies face environmental regulatory pressure from the government, this will urge them to improve their environmental performance.

The environmental performance of a company refers to the environmental protection effect achieved by the company in each production link, which includes the reduction of pollutant emissions, the improvement of resource utilization efficiency, compliance with environmental regulations and other environmental performance. Lanoie et al (2007) believe that environmental regulation policies from the government can reduce energy consumption and pollution emissions of enterprises, and improve environmental productivity. Therefore, we speculate that environmental regulations, such as environmental policies, will put pressure on the production and operation of companies, prompting companies to pay more attention to environmental protection.

The "Porter Hypothesis" believes that scientific and appropriate environmental regulations will help enterprises to carry out environmental innovation, and then at the same time improve the environmental productivity of enterprises, and its effects have begun to take place in China (Porter, 1991). Appropriate environmental regulations will help optimize the allocation of corporate resources and improve the technological level of enterprises, and stimulate the regulated enterprises to implement environmental management, thereby improving their environmental performance. With the promulgation and implementation of government environmental policies, heavily polluting companies will work hard to improve their pollution emissions out of legal considerations. Therefore, companies under environmental pressure will definitely take actions to achieve energy conservation and emission reduction targets, which will help improve their environmental performance. In summary, certain environmental regulatory pressures can indeed solve the environmental problems of enterprises. Hence, we propose hypothesis 1:

Hypothesis 1: Environmental regulation has a positive effect on corporate environmental performance.

2.2The mediating effect of environmental strategy

Corporate environmental strategy refers to the corporate code of conduct formulated by corporate managers to deal with the relationship between production and operation and the natural environment, which specifically involves the behavior of companies to comply with external environmental regulations and reduce environmental pollution (Sharma, 2000). Enterprises implement environmental strategies for two main purposes: one is to enable the organization to meet compliance requirements. The second is to enable the organization to gain a competitive advantage. Based on the above implementation objectives, corporate environmental strategies can be roughly divided into two categories: forward-looking environmental strategies and reactive environmental strategies (Sharma & Vredenburg, 1998). The former refers to the organization's active response to changes in the external environment; the latter refers to the organization's passive implementation of environmental behaviors. Organizations that implement forward-looking environmental strategies can quickly respond to environmental issues in the production and operation process, thereby enhancing organizational competitiveness and maintaining the sustainable development of the organization (Aragón-Correa, 1998; Aragón-Correa & Sharma, 2003).

Previous studies have shown that environmental regulation is the main motivation for companies to practice environmental strategic behavior. In the face of a stricter external regulatory environment, companies will increase investment in environmental management to cope with rising environmental compliance thresholds, and at the same time, to obtain greater control Flexibility, companies will voluntarily carry out the transformation and upgrading of environmental strategies, and implement more forward-looking environmental strategies (oliver, 1991; Elkington, 2013). Second, some studies have pointed out that the implementation of forward-looking environmental strategies can directly promote the energy conservation and emission reduction of enterprises, and have a positive impact on the environmental performance of enterprises (Hart, 1996;).

Porter's hypothesis believes that scientific and reasonable environmental regulations will help enterprises to carry out green innovation, thereby prompting organizations to solve environmental pollution problems caused by illegal operations through environmental innovation, and meet or exceed the government's environmental protection compliance threshold. The corporate environmental strategy caused by environmental regulations will make the company invest more energy in green management, so that the organization can accumulate cost advantages and gain a good reputation, and ultimately have a positive impact on the company's economic, environmental and social performance.

Therefore, we speculate that government environmental regulations can have an indirect impact on corporate environmental performance through environmental strategies. Under the pressure of the system, companies are forced or proactively to choose more forward-looking environmental strategies, so that companies can focus on technological innovations such as pollution prevention and control, product supervision, end-of-line governance, and green development, which will directly promote energy conservation and emission reduction. Have a positive impact on environmental performance.Therefore, we hypothesize that:
Hypothesis 2: Environmental strategy mediates the effect of environmental regulation on corporate environmental performance.

Based on the above analysis, this research establishes the conceptual model in following figure 1.

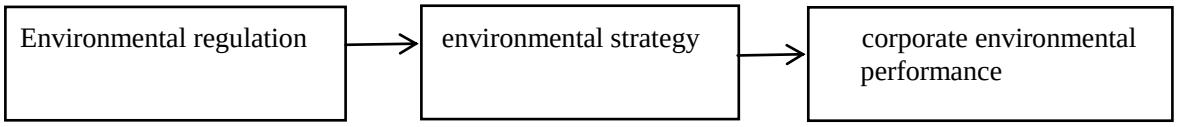

Figure 1

3. Research Design

3.1Data source and processing

The research object of this paper is selected according to Corporate environmental information disclosure index （executive summary of 2017）.It is based on a comprehensive analysis of the 2016 reports of heavy polluting enterprises listed on the Shanghai Stock Exchange. The data samples involve 172 enterprises and 14 industries. On how to define the connotation of heavy polluting enterprises, the report gives specific instructions, including 14 industrial fields including thermal power, paper making, metallurgy, iron and steel, petrochemical, mining, building materials, textile, coal, chemical, brewing, pharmaceutical, cement and fermentation.

Considering the availability of environmental information data of Chinese enterprises, this study collects relevant data in 2016 as sample data. The process of data processing is as follows:(1) Eliminate the research object of environmental regulation data leakage and other problems;(2) The research objects of ST and *ST facing financial crisis or delisting risk were excluded. Finally, 165 sample enterprises in 14 industries were selected, and the environmental regulation index data was obtained based on the China urban statistical yearbook.

3.2 Measures

(1) Independent variable: environmental regulation
Adjust the indicators based on the research of Fu & Li (2010), and finally select the comprehensive utilization rate of industrial solid waste, the removal rate of industrial soot (dust), the removal rate of industrial Sulphur Dioxide, the treatment rate of domestic sewage, and the rate of harmless treatment of domestic garbage. Five indicators are used to calculate the intensity of environmental regulations. All index data comes from the "China City Statistical Yearbook", the data is processed, and the classification index of the five index items is objectively weighted through the entropy method.

(2) Intermediary variable: corporate environmental strategy
According to the practice of Tian &Wang (2019) , the measurement indicators of the corporate environmental strategy in this study are derived from the "Corporate Environmental Information Disclosure Index (2017)". The index report evaluated and scored the environmental management of 172 listed companies in 14 pollution-intensive industries on the "Shanghai Stock Exchange" in 2016 based on information publicly disclosed through official channels such as corporate annual reports, social responsibility reports, and sustainability reports, and finally formed The environmental index scores of companies in heavy pollution industries. The higher the score, the more forward-looking the company's environmental strategy.

(3) Dependent variable: corporate environmental performance
The evaluation of environmental performance is carried out based on the method of content analysis in the corporate social responsibility report, which comes from the GoldenBee (China Social Responsibility Report Database). Specifically, the environmental performance measurement is considered from the four aspects of the company’s sustainability report, environment and sustainable development, safety production and pollution fees, and problems in the company’s production and operation. If there are corresponding items, one point will be added. The performance score range is 0-4 points (Yin et al., 2019).
(4) Control variable
According to the research results of Xieet al.(2014), this study treats the age of the company, the size of the company, the integration of two jobs, the region and the debt-to-asset ratio as control variables.

3.3. Data Analyses

This study uses SPSS23.0 and Process, and uses multiple linear regression model to analyze the impact of environmental regulation on enterprise environmental performance. Considering that there may be a certain degree of correlation between independent variables, the study first makes a multicollinearity test. The results show that the tolerance of independent variables is greater than 0.1, and the variance expansion factor VIF is less than 3, which indicates that there is no collinearity problem between independent variables. The model has good adaptability and can be used for further regression analysis.

4. Results

4.1 Descriptive statistics and correlation analysis

Descriptive statistics and bivariate correlations for all study variables are reported in Table 1. In line with past research, environmental regulation were positively associated with environmental strategy(γ= .133, p< .05). environmental regulation(γ= .118, p< .05) and environmental strategy(γ= .437, p< .01) were positively associated with work withdrawal behavior.

Table 1 Means, Standard Deviations, and Correlations Among Study Variables

Variable	M	SD	1	2	3	4	5	6	7
1.age	19.076	4.672							
2.size	10.028	.643	-.093						
3.dual	.157	.365	.017	-.101					
4.area	1.581	.749	-.048	-.152*	.071				
5.lev	.493	.216	.108	.078	-.043	-.042			
6.ER	.858	.079	.133	-.098	-.038	.087	-.076		
7.ESTR	41.526	16.383	.016	.395**	-.088	-.001	.203**	.133*	
8.CEP	.564	.986	-.112	.326**	-.036	-.051	.077	.118*	.437**

Note.ER=environmental regulation, ESTR= environmental strategy, CEP=Corporate environmental performance
***p＜0.001 ; **p＜0.01 ; *p＜0.05

4.2 Hypothesis testing

Main effect test.

This study uses the method of hierarchical regression analysis to verify the hypothesis, as shown in Table 4, enterprise age , enterprise scale, CEO duality, area and asset-liability ratio as a control variable into the regression model. Then, the stepwise entry method is used to put environmental regulation into the regression model. As shown in Table 2, environmental regulation was positively correlated with corporate environmental performance significantly (β=.173, P＜0.05, M2). Thus, hypothesis 1 is supported.

The mediating role of negative emotion.

According to Baron and Kenny (1986), a mediating effect must meet three conditions: 1) The independent variable is associated with the dependent variable and the mediator; 2) the mediator has a significant effect on the dependent variable; and 3) when the independent variable and the mediator are simultaneously substituted into the regression equation to explain the dependent variable, the effect of the mediating variable is significant and the effect of the independent variable disappears (the fully mediating effect) or weakens (partial mediating effect).

According to the stepwise regression method (Baron & Kenny, 1986), the mediating effect of environmental strategy is tested. As shown in Table 2, environmental regulation is positively correlated with environmental strategy(β=.178, P< .05, M6). Meanwhile, environmental strategy is positively correlated with corporate environmental performance (β=.375, p＜0.001, M3). Finally, when environmental regulation and environmental strategy were simultaneously entered into the regression equation, the positive effect of environmental strategy is not significant (β=.106, P> .05, M4), butM2 is significant (β=.379, p ＜ 0.001). These results reveal that environmental strategy plays a fully mediating role between environmental regulation and corporate environmental performance. Therefore, hypothesis 2 is supported.

Table 2 The Main and Mediating Effects

Type of the Variable		CEP			ESTR		
		M1	M2	M3	M4	M5	M6
Control variable	enterprise age	-.071	-.094	-.105	-.090	.013	-.011
	enterprise scale	.323***	.335***	.165*	.187*	.377***	.389***
	CEO duality	.004	.013	.018	.031	-.058	-.048
	area	-.02	-.034	-.032	-.063	.093	.078
	asset-liability ratio	.062	.077	-.001	.010	.162*	.178*
Independent	ER		.173*		.106		.178*
mediator	ESTR			.375***	.379***		
F		4.482**	4.726***	8.222***	8.071***	7.210***	7.215***
R^2		.124	.152	.230	.265	.185	.215
ΔR^2		.096	.120	.202	.232	.159	.185

Note.ER=environmental regulation, ESTR= environmental strategy, CEP=Corporate environmental performance
***p＜0.001；**p＜0.01；*p＜0.05

BOOTSTRAP test for mediation effect.

For further analyze the mediating role of validation of environmental strategy, this research uses SPSS PROCESS of macro program (Hayes, 2013), the data is 5000 times repeated data sampling, under the 95% confidence interval, the BOOTSTRAP method is used to further test the mediation effect of environmental strategy, and report the mediation variable path and control after the intervening variable, the direct effect of the independent variable on the dependent variable. As shown in Table 3, the mediating effect of the test results is.838, and the confidence interval [.155,1.893]does not include 0, indicating that the mediating effect of environmental strategy is significant. In addition, after controlling the environmental strategy of mediating variables, the direct effect of independent variable environmental regulation on dependent variable corporate environmental performance was 1.316 and the confidence interval [-.545,3.176] include 0. Therefore, environmental strategy plays a fully mediating role between environmental regulation and corporate environmental performance.

Table 3 Bootstrap test for mediation effect

Mediator Environmental strategy	ER（X）→ESTR（M）→CEP（Y）			
	effect	SE	LLCI	ULCI
direct effect	1.316	.942	-.545	3.176
indirect effect	.838	.425	.155	1.893

5. Discussion

This paper mainly focuses on the effect of environmental regulation on corporate environmental performance, especially on the mediating role of environmental strategy. It shows that:(1) environmental regulation significantly has a positive effect on corporate environmental performance;(2) environmental regulation significantly has a positive effect on environmental strategy;(3) environmental strategy significantly has a positive effect on corporate environmental performance;(4)environmental strategy mediates the main effect positively.

5.1Theoretical implications

Our research mainly contributes to the literature in three aspects. First, there are few studies on the relationship between environmental regulation and corporate environmental performance based on enterprise individual level in the context of China（Yuan&Xiang,2018）. Our findings in support of environmental regulation significantly have a positive effect on corporate environmental performance of heavily polluted enterprises. Hence, our findings support the application of Porter hypothesis in China. Second, In this study, environmental strategy was used as mediating variables for the first time to explore the mechanism between environmental regulation and corporate environmental performance, revealing the black box between them. Finally, most of the research on environmental regulation focuses on the field of green technology innovation in the past（Ramanathan et al.,2017;Lanoie et al.,2007）, but less on environmental strategy. The study of environmental regulation in the context of environmental strategy is also a major contribution to this research.

5.2 Management implications

First of all, on the whole, scientific and reasonable environmental policies are the guarantee for promoting the long-term development of enterprises, and heavy-polluting enterprises are more sensitive to environmental regulatory pressures. When formulating relevant environmental protection policies, the government should fully meet the environmental demands of all stakeholders, and strive to achieve coordinated development of social benefits, economic development and other factors. At the same time, it should also consider the carrying capacity of heavy-polluting companies to achieve compliance thresholds, and according to the company's expectations. The specific implementation of the environmental protection situation adjusts and improves related laws and policies.

Secondly, in the process of government pressure in promoting the development of corporate performance, it is undeniable that environmental strategies play a key role in it. Therefore, the government should provide assistance and guidance in corporate environmental management. First, we can start from the perspective of environmental protection awareness to create an atmosphere where the whole society respects environmental protection; second, encourage enterprises to increase investment in environmental protection process innovation and environmental protection technology innovation, and give economic rewards to major environmental innovations; third, foster environmental innovation Talent. Talents provide endless driving force for enterprise development.

Finally, companies should pay attention to the government's environmental policy requirements and take the initiative to operate within the scope of environmental compliance. Enterprises must fully understand the original intention of the government to formulate environmental policies, and strive to develop their own forward-looking thinking mode, based on the long-term development of the enterprise rather than temporary pros and cons. The research conclusions of this article also show that the environmental benefits of enterprises can be satisfied. Therefore, companies can consider long-term environmental benefits when formulating environmental strategies, and take advantage of the opportunity of industrial transformation and upgrading to adjust and improve internal environmental technology development to achieve corporate development.

5.3Limitations and directions for future research

Although this research has verified the positive impact of environmental regulations on corporate environmental performance and the mediating role of environmental strategies, there are still the following shortcomings. Next, I will explain the limitations of this paper and propose future research prospects. First, the limitations of variable measurement. The measurement of environmental strategy is based on the comprehensive evaluation scores of each enterprise in the corporate environmental disclosure report. This is not a direct measurement of the corporate environmental strategy, and there may be a certain degree of measurement error. When measuring the variable of environmental regulation, this article adopts the comprehensive index method, which only measures the intensity of environmental regulation, and does not involve its various types of tools. Therefore, I believe that future research can incorporate the types of regulations and the intensity of regulations into the same research framework for consideration, and more comprehensively, meticulously and accurately explore the behavioral responses of companies under different regulatory intensities and types and differences in corporate performance. Secondly, although the cross-sectional data used in this study constructs the lag period variable of corporate performance, it fails to fully study the lagging influence of the intensity of environmental regulations on corporate environmental strategic behavior and corporate triple performance. Because it is a cross-sectional static data, it does not fully prove that the "Porter Hypothesis" is suitable for interpretation in the context of China's heavy pollution industry. Therefore, the important direction of future research is to verify the long-term impact of the government's environmental protection policies and the far-reaching impact of corporate environmental strategies based on dynamic panel data. Moreover, based on the consideration of policy effects and the lag in the implementation of strategies, the state and society should provide continuous environmental information disclosure data for many years for researchers to explore the lag effect between variables.

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