Environmental Regulation, Green Innovation and Enterprise ESG Performance

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Abstract. In order to explore the impact of environmental regulation on corporate ESG performance and its impact mechanism, this paper selects the data of A-share listed companies in Shanghai and Shenzhen from 2011 to 2019, and constructs a multiple regression model for empirical analysis. The study found that environmental regulation can significantly improve the ESG performance of enterprises, and green innovation plays a mediating effect. Therefore, the government should further improve environmental regulations, and enterprises should actively respond to environmental regulations, jointly promote green innovation of enterprises, and then improve enterprise ESG performance.

Keywords: Environmental Regulation · Enterprise ESG Performance · Green Innovation

1 Introduction

The ESG concept is a sustainable development concept about how to coordinate the development of the environment, society and governance. It conveys a development concept that pursues the unification of economic value and social value, and is increasingly recognized by the academic and practical circles.

In order to protect and improve the environment and promote listed companies to practice ESG concepts, the State-owned Assets Supervision and Administration Commission, the China Securities Regulatory Commission, the State Environmental Protection Administration and other departments have issued a series of environmental regulations and related regulations. Under such circumstances, the fulfillment of corporate social and environmental responsibilities will inevitably be affected by environmental regulations. Can environmental regulation act on micro-enterprises to enhance their sustainable development capabilities? What is the impact mechanism of environmental regulation on enterprise ESG performance? These are a series of questions to be explored.

Different from traditional innovation, green innovation emphasizes the use of new technologies and new concepts to achieve efficient use of resources and effective reduction of pollution, which is very important for complying with environmental regulation policies and improving the sustainable development capability of enterprises. Therefore, is green innovation an intermediate hub connecting macro-environmental regulatory policies and micro-enterprise ESG performance? This is also worth exploring.

D. Qiu et al. (Eds.): ICBBEM 2022, AHIS 5, pp. 1500–1508, 2023.
https://doi.org/10.2991/978-94-6463-030-5_150

2 Literature Review

2.1 Related Research on Environmental Regulation and Green Innovation

At present, there is little literature on the impact of environmental regulation on enterprise ESG performance. The existing studies mostly focus on the impact of environmental regulation on corporate green innovation. There are three main viewpoints: First, environmental regulation will promote green innovation of enterprises. Singh et al. (2019) [11] and Abdul-Nassar et al. (2019) [1] empirical research on enterprise-level data shows that the regulatory policies adopted by enterprises can make enterprises invest higher scientific research funds in green innovation, thereby promoting their own Green innovation in response to regulation. Second, environmental regulation will inhibit enterprises from green innovation. The research of Zhijun & Wei (2018) [17] and Song & Yu (2018) [12] shows that the intensity of environmental regulation is different, and the impact on enterprises is also different. When the regulation is too strong, the profits brought by green innovation and promotion of enterprises cannot cover the increase in cost., it will cause enterprises to lose the power of green innovation, which will make enterprises reduce green innovation. Finally, the relationship between environmental regulation and green innovation is uncertain. The research of Guo (2019) [7] and Sun (2020) [13] shows that the impact of environmental regulation on green innovation is not linear, and when the regulation intensity is in different ranges, its impact on green innovation is different.

2.2 ESG Related Research

Domestic scholars' research on ESG is mostly theoretical research on improving the ESG system, focusing on how to improve and improve the ESG system and information disclosure system. Taking into account the characteristics of China's national conditions and the characteristics of domestic enterprises, the Green Finance Research Group of the Industrial and Commercial Bank of China is the first domestic commercial bank to build an ESG green rating system. Chen & Sun (2019) [4] suggested that China should speed up and improve the overall institutional framework for ESG, and promote the transition of companies from voluntary to mandatory ESG information disclosure. Ma et al. (2016) [10] put forward valuable suggestions on establishing and improving the ESG credit system of Chinese listed companies.

Foreign scholars have carried out a large number of empirical studies on ESG, mainly focusing on the relationship between enterprise ESG performance and financial performance, but they have shown two diametrically opposite test results. On the one hand, neoclassical economic theory believes that there are strong externalities in ESG investment by companies and managers may use it as a self-interest tool. Consequently, enterprise ESG performance is negatively or unrelated to financial performance [5]. On the other hand, because enterprise ESG information disclosure can not only enhance corporate transparency, but also reduce corporate financing costs by alleviating information asymmetry and agency problems. Therefore, enterprise ESG performance is positively correlated with financial performance [6].

3 Theoretical Analysis and Hypothesis

3.1 Analysis of the Impact of Environmental Regulation on Enterprise ESG Performance

Mandatory laws and regulations can enable enterprises to adhere to and implement the regulations for legal compliance purposes, forcing enterprises to reduce pollution emissions and actively carry out pollution control [2], which is conducive to improving the pollution discharge status of enterprises, thereby enhancing the environmental performance of the company.

While pursuing economic development, enterprises need to take into account the impact of society and the environment. On the one hand, environmental regulation will promote enterprises to improve their environmental performance and provide a good ecological environment for the society; on the other hand, environmental regulation will improve enterprises' awareness of environmental protection [16], and stimulate enterprises to make more investment in environmental protection. Provide employees with a safe working environment. In addition, after the government implements stricter environmental regulations, the public media will carry out more obvious and strict supervision over the fulfillment of corporate social responsibility, and promote enterprises to continuously improve their social performance in terms of employees and products. Therefore, environmental regulation will improve corporate social performance [3]. Based on the above comprehensive analysis, hypothesis 1 is proposed:

H1: Environmental regulation can promote the improvement of enterprise ESG performance.

3.2 Analysis of the Mediating Effect of Green Innovation

Based on the Porter hypothesis, environmental regulation will inevitably affect activities such as resource redistribution, capital investment and technological innovation in the production process of enterprises when improving the environmental performance of enterprises. Under the pressure of environmental regulation, green innovation is a necessary condition for enterprises to achieve the goal of reducing pollution emissions.

When the government implements environmental regulations, enterprises will conduct green innovations for the purpose of reducing pollution costs and improving production efficiency. On the one hand, when the cost of pollutant discharge that the enterprise needs to pay reaches or even exceeds the present value of the cost of using green production technology, the enterprise will spontaneously carry out green technology innovation to reduce the pollution discharge in the production process and reduce the cost of pollutant discharge. On the other hand, green innovation can significantly improve the production efficiency of innovative entities. Li et al. (2017) [8] pointed out that green innovation can reduce the energy use intensity of product production and waste recycling process, which to a large extent means that green innovation can effectively improve the utilization efficiency of production input factors. To sum up, environmental regulation urges enterprises to achieve the goal of energy conservation and emission reduction through green innovation, thereby improving the environmental performance of enterprises. At the same time, green innovation can provide a safe workplace for

employees, and improve the social performance of enterprises by providing green products to the public, thereby improving the ESG performance of enterprises. Based on the above analysis, hypothesis 2 is proposed in this paper:

H2: In the process of environmental regulation improving the ESG performance of enterprises, green innovation plays an intermediary effect.

4 Study Design

4.1 Sample Selection and Data Sources

This paper selects Shanghai and Shenzhen A-share listed companies from 2011 to 2019 as the research sample, and processes the samples as follows: (1) Eliminate the sample of listed companies in the financial industry; (2) Eliminate the sample with missing data in variables; (3) Eliminate ST, *ST and PT samples; (4) Winsor processing is performed on all continuous variables at the 1% quantile.

Data sources: The Bloomberg Database, CNRDS, China Urban Statistical Yearbook, CSMAR Database, etc.

4.2 Variable Definition

Dependent variable - enterprise ESG performance: Select the enterprise ESG score from the Bloomberg database to measure enterprise ESG performance. The score ranges from 0.1 to 100 points.

Independent variable - environmental regulation: Refer to Ye et al. (2018) [15] to measure the intensity of environmental regulation with the comprehensive index of pollution emissions of prefecture-level cities. The calculation steps are as follows:

(1) Linearly standardize the unit pollutant emissions of each city. This paper mainly calculates the discharge of waste water, SO2, and smoke and dust pollutants.

$$UE_{\mathrm{ij}}^{\mathrm{s}} = [\mathrm{UE}_{ij} - \min(\mathrm{UE}_j)]/[\max(\mathrm{UE}_j) - \min(\mathrm{UE}_j)]$$

UE_{ij} represents the pollutant discharge per unit output value of pollutants of category j in i city; $UE_{\mathrm{ij}}^{\mathrm{s}}$ is the standardized value of the indicator.

(2) Use adjustment factors to approximate differences in pollutant properties.

$$W_j = UE_{ij}/\overline{UE_{ij}}$$

$\overline{UE_{ij}}$ is the urban average level of emission per unit of output value of j-type pollutants during the sample period.

(3) Calculate the intensity of command-type environmental regulation in each city.

$$ER_i = \frac{1}{3}\sum\nolimits_{j=1}^{3} W_j UE_{ij}^{s}$$

ER_i is the environmental regulation intensity of i city.

Table 1. Descriptive Statistics of Main Variables

Var	Mean	SD	Min	Med	Max
ESG	21.712	7.120	9.917	20.661	46.281
ER	0.297	0.102	0.098	0.295	0.533
GTI	1.361	1.178	0.000	1.099	5.011
Size	23.426	1.363	20.835	23.318	27.387
Age	2.862	0.352	1.099	2.890	3.807
ROA	0.047	0.054	−0.126	0.038	0.223
Lev	0.500	0.187	0.097	0.515	0.873
Growth	0.179	0.380	−0.366	0.112	2.475
Top1	0.376	0.165	0.081	0.364	0.788
Board	2.198	0.203	1.609	2.197	2.708
Indep	0.375	0.057	0.333	0.364	0.583
Dual	0.188	0.391	0.000	0.000	1.000
SOE	0.548	0.498	0.000	1.000	1.000

Mediating variable - green innovation: Referring to the practice of Li & Zheng (2016) [9], the number of green patent applications is used to measure the green innovation of enterprises.

Control variables: enterprise size (Size), enterprise age (Age), profitability (ROA), financial leverage (Lev), growth ability (Growth), shareholding ratio of major shareholders (Top1), board size (Board), The proportion of independence directors (Indep), the chairman is concurrently the general manager (Dual), the annual dummy variable (Year) and the industry dummy variable (Ind).

4.3 Model Construction

Model (1) is constructed for testing H1 as follows:

$$ESGi,t = \alpha 0 + \alpha 1ERi,t + \alpha 2Controlsi,t + \sum Ind + \sum Year + \varepsilon i, t \quad (1)$$

To test H2, referring to the research of Wen et al. (2004) [14], the following model was constructed:

$$GTIi,t = \beta 0 + \beta 1ERi,t + \beta 2Controlsi,t + \sum Ind + \sum Year + \varepsilon i,t \quad (2)$$

$$ESGi,t = \lambda 0 + \lambda 1ERi,t + \lambda 2GTIi,t + \lambda 3Controlsi,t + \sum Ind + \sum Year + \varepsilon i,t \quad (3)$$

5 Empirical Analysis

5.1 Descriptive Statistics

Table 1 shows the descriptive statistical characteristics of enterprise ESG performance, environmental regulation, green innovation and other variables, with a total of 3935

Table 2. Regression Results.

	(1)	(2)	(3)
	ESG	GTI	ESG
ER	3.725***	0.363**	3.652***
	(3.729)	(2.117)	(3.655)
GTI			0.203**
			(2.173)
Size	2.761***	0.401***	2.679***
	(28.063)	(23.776)	(25.466)
Age	1.633***	−0.347***	1.703***
	(5.104)	(−6.322)	(5.299)
ROA	2.006	1.161***	1.771
	(0.934)	(3.147)	(0.823)
Lev	−3.603***	−0.091	−3.584***
	(−4.938)	(−0.727)	(−4.915)
Growth	−0.923***	−0.053	−0.912***
	(−3.514)	(−1.171)	(−3.474)
Top1	0.393	−0.953***	0.587
	(0.598)	(−8.441)	(0.884)
Board	0.137	0.029	0.131
	(0.245)	(0.304)	(0.235)
Indep	−0.371	0.297	−0.432
	(−0.194)	(0.901)	(−0.225)
Dual	−0.773***	0.078*	−0.788***
	(−3.016)	(1.769)	(−3.078)
SOE	0.600**	0.074*	0.585**
	(2.561)	(1.840)	(2.498)
Industry	Yes	Yes	Yes
Year	Yes	Yes	Yes
N	3935	3935	3935
adj. R^2	0.321	0.270	0.322
F	54.214	42.521	52.889

Note: Significance is expressed as *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

samples. Among them, the mean of ESG is 21.712, the median is 20.661, the mean is greater than the median, and ESG is distributed to the right, indicating that some

companies have high ESG performance; the standard deviation is 7.12, indicating that there are large differences in ESG performance among different companies. The mean of ER is 0.297, the median is 0.295, and the mean of GIT is 1.361, and the median is 1.099, all of which are right-skewed distributions, indicating that enterprises have higher levels of environmental regulation and green innovation.

5.2 Analysis of Regression Results

5.2.1 The Impact of Environmental Regulations on Enterprise ESG Performance

Regression analysis is performed on model (1) to verify whether hypothesis H1 holds. It can be seen from the column (1) of Table 2 that the coefficient of ER is 3.725, which is significant at the 1% level. This shows that environmental regulation is significantly positively correlated with enterprise ESG performance, that is, H1 is proven.

5.2.2 The Mediating Effect of Green Innovation

In order to further analyze the impact mechanism of environmental regulation on enterprise ESG performance, regression analysis was carried out on model (2) and model (3). The coefficient of ER in column (2) of Table 3 is 0.363, which is significant at the 5% level; the coefficient of GIT in column (3) is 0.203, which is significant at the 5% level, indicating that there is a mediating effect. Further analysis found that the coefficient of ER is 3.652, which is smaller than the influence coefficient of ER in column (1) of 3.725, and is significant at the 1% level, indicating that in the process of environmental regulation improving the ESG performance of enterprises, green innovation plays an intermediary effect, assuming that H1 is proven.

6 Conclusion

This paper takes the 2011–2019 A−share listed companies in Shanghai and Shenzhen as the research sample, and empirically tests the impact of environmental regulation on enterprise ESG performance. The study found that environmental regulation is positively correlated with enterprise ESG performance, and green innovation plays a mediating effect in it. Based on the research conclusions, this paper puts forward the following policy recommendations:

The government should further improve the policies and regulations of environmental regulation. The government can promote the green innovation of enterprises through effective and reasonable environmental regulation, and then carry out pollution control, instead of taking the road of pollution first and then treatment.

Enterprises should actively respond to environmental regulations, from passive emission reduction to active green innovation. Responding to environmental regulations can not only improve corporate ESG performance, but also convey a proactive environmental governance concept to the outside world, enhance corporate reputation, and gain higher market evaluations.

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