

Environmental Regulations and Corporate Green Investment: Evidence From Heavy Polluting Companies in China

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Abstract. With the rapid development of the global economy, environmental pollution has become one of the main problems facing. As the main carriers of social production, companies create value for the whole society and also occupy the main resources. Heavy polluting companies have serious pollution discharge. They should bear more environmental protection responsibilities. Green investment of heavy polluting companies is the focus of social concern. Therefore, this paper selects 243 listed companies in China's heavy polluting industry as samples to explore the impact of environmental regulations on corporate green investment. This study calculates the green investment amount of companies through the "content analysis method", and divides the environmental regulation into formal environmental regulation and informal environmental regulation. A fixed panel model is constructed for research. The empirical results show that market-incentive environmental regulation and informal environmental regulation have a significantly positive impact on corporate green investment. There is no significant relationship between command-and-control environmental regulation and corporate green investment. According to this conclusion, this paper proposes some suggestions about green finance.

1 Introduction

Since the reform and opening-up, China's economy has maintained stable and rapid growth, but behind the economic growth are excessive resource consumption and serious industrial pollution as well as the continuous deterioration of the ecological environment. In either developed or developing countries, environmental regulation is the preferred tool for environmental governance. According to the experience of the leading countries, environmental regulation will influence all aspects of the economy, industrial structure, and enterprise innovation. In this situation, environmental regulations will inevitably affect the daily production and management activities, environmental governance, and green investment of heavy polluting companies.

Some scholars believe that corporate pollution has a large negative externality, and the supervision of corporate green investment is mainly undertaken and implemented by the government. Currently, corporate green investment of enterprises is mainly characterized by "government regulation" [1]. Many studies have found environmental regulations have a significant impact on corporate green investment, and governments urge companies to consider environmental issues and take green investment into their development strategies [2-5]. Under the pressure of strict environmental regulations and formal media reports and supervision, companies will gradually carry out spontaneous green investment behaviors. Environmental regulations can promote an increase in the scale of corporate green

investment [6-10]. Studies also confirm that if the government does not issue relevant environmental regulatory policies and economic incentives, heavy polluting companies will not invest in pollution control [11]. Some scholars believe that combining different types of environmental regulations can better enhance the enthusiasm of enterprises to take environmental protection behaviors [12]. The supervision and management of the public have a positive effect on guiding firms to practice ecological and environmental protection behaviors [13]. But some researches have shown that environmental regulations and corporate green investment are negatively correlated. Purchasing pollution control facilities and improving environmental protection technologies will result in a reduction in liquidity, making it difficult for companies to obtain profits from green investments and reducing their enthusiasm for participating in environmental governance. Therefore, environmental regulations will inhibit corporate green investment [14-16]. In addition, some scholars find that there is a threshold relationship between environmental regulations and corporate green investment, that is, environmental regulations will first have a positive impact on corporate green investment, and then turn into a negative impact [17].

By summarizing relevant literature, it can be concluded that there is indeed a certain relationship between environmental regulation and corporate green investment, and many scholars have carried out some researches on the influence mechanism between them. But they do not reach a consensus on whether

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environmental regulations will promote firms to increase green investment, and their conclusions of positive correlation, negative correlation, and non-linear correlation have been confirmed within a certain range. Therefore, further empirical evidence is needed to test the relationship. Moreover, there is less empirical research on the impact of different types of environmental regulations on corporate green investment.

This paper will select the green investment behavior of heavy polluting companies as the research objects and explore the influence mechanism of environmental regulations on the green investment behavior of heavy polluting companies in China. The main contributions are summarized in two aspects:

On one hand, there is no uniform and recognized standard for the disclosure of corporate green investment in China, so it is difficult to collect the relevant data. This study uses the “content analysis method” and combines the ESG evaluation system of listed companies to build evaluation indexes and score CSR reports and sustainable development reports qualitatively and quantitatively. On the other hand, this paper innovatively discusses the impact of different types of environmental regulations on the green investment of heavy polluting companies and fills up the gap in this field.

2 Hypothesis

Market incentives environmental regulation means that government will invest budget in pollution control costs each year. According to the theory of signal transmission, if enterprises realize that governments increase investment to improve environmental governance, enterprises will take action to enhance green investment spontaneously after judging based on the costs and benefits. It gives place to hypothesis 1 as follows:

H1: Market incentive environmental regulation can promote corporate green investment.

Command-and-control environmental regulation refers to the relevant laws, regulations, and policies on environmental protection issued every year by the government department or environmental protection agency where the enterprise is located. Mandatory is the main feature of command-and-control environmental regulation. It can be inferred that enterprises will choose to increase green investment to reduce the possible operating costs when command-and-control environmental regulations are strengthened. So we come to hypothesis 2:

H2: Command-and-control environmental regulation can promote corporate green investment.

Informal environmental regulation can influence the decision-making of enterprises and urge them to implement strategies related to environmental protection, energy conservation, and emission reduction. Green investment may become one of the tools for many heavily polluting enterprises to cope with social public pressure. The green investment behavior of heavy polluting companies can quickly be recognized by the public, satisfy the public’s demand and maintain a good reputation. It gives place to hypothesis 3 as follows:

H3: Informal environmental regulation can promote corporate green investment.

3 Data and method

3.1 Samples

Based on the availability of data, this paper takes 243 A-share listed companies for the period 2008-2016 in the heavy pollution industry in China as research samples, excluding the stocks of ST, *ST, and samples with missing financial data. The data of corporate green investment is collected from CSR reports and sustainable development reports. The data of environmental regulations come from the “China Statistical Yearbook on Environment” and “China Statistical Yearbook”. Other data are obtained from CSMAR and Wind.

3.2 Variables

3.2.1 Dependent variables

The dependent variable of this research is enterprise green investment (EI). It is graded based on the “content analysis method” and ESG files [18]. Green investment in the CSR report is divided into six types: environmental governance investment, environmental pollution investment, saving resources investment, climate change investment, environmental business investment, and enterprise environmental protection system investment. Every kind of investment has corresponding secondary indexes. Six types of subdivided investment were scored objectively, with each item assigned a score of 0-3, representing no investment, less investment, medium investment, and sufficient investment, respectively. Finally, the scores of the enterprise under different indicators in each year are added to obtain the total green investment score of the company, which is used to measure the corporate green investment.

3.2.2 Independent variables

Based on the studies [19-20], this paper measures market incentive environmental regulation (MBR) from the perspective of governments’ environmental protection investment. The total number of new environmental protection regulations issued each year by the local government is used to measure command-and-control environmental regulation (CCR) from the perspective of environmental legislation. Income, education level, population density, and age structure in the location of heavy polluting companies are selected by informal environmental regulation to make a comprehensive score by entropy weight method. The specific definition is shown in Table 1.

3.2.3 Control variables

Control variables include cash holdings, capital structure, investment opportunity, firm size, and corporate profitability.

First, cash holdings are liquid cash assets. Companies need to maintain sufficient cash balance to reduce or avoid operational risks and financial risks. The larger the cash holdings, the larger the green investment scale of enterprises, and vice versa. Second, capital structure plays an important role in operations and growth. When a company has a high liabilities to assets ratio, it means the financial risk is increased. The liability ratio will influence the scale of corporate green investment. Third, companies with high growth will face more changes and challenges, and they need to grasp investment opportunities promptly, which means that companies may face more high-quality investment projects. Therefore, the possibility of corporate green investment is improved. Fourth, firm size is an important factor affecting corporate green investment. Large companies have a wider range of business areas and are more resilient to risks than small companies. The large green investment scale always happens in large companies. Finally, corporate profitability shows that the company has less operating pressure. It does pay more attention to the long-term development and social image. Companies with strong profitability often attach great importance to green investment.

Table 1. Definition of all variables.

Types	Symbol	Descriptions
Dependent variable	EI	Green investment score under the content analysis method
Independent variable	MBR	Natural logarithm of governments' environmental investment
	CCR	Number of newly promulgated environmental protection legislation
	IER	Scores of income, education level, population density, and age structure calculated by entropy method
Control variable	Cash	The ratio of total cash to total assets
	Lev	The ratio of total debt to total assets
	Tobin Q	Tobin Q value
	Size	Natural logarithm of total asset
	ROA	The ratio of net income to the average total assets

3.3 Models

In order to study the impact of three types of environmental regulations on corporate green investment, three fixed effect models are constructed as follows:

$$EI = \alpha + \beta_1 MBR + \sum_{j=3}^5 \beta_j Control + \sum Industry + \sum Year + \varepsilon \quad (1)$$

$$EI = \alpha + \beta_1 CCR + \sum_{j=3}^5 \beta_j Control + \sum Industry + \sum Year + \varepsilon \quad (2)$$

$$EI = \alpha + \beta_1 IER + \sum_{j=3}^5 \beta_j Control + \sum Industry + \sum Year + \varepsilon \quad (3)$$

4 Empirical results

4.1 Descriptive analysis

It can be seen from Table 2 that there is still a large gap between heavy polluting enterprises in green investment (EI), with an average value of 9.39 and a standard deviation of 5.33. The average MBR of market incentive environmental regulation (MBR) is 26.328, and the average CCR of command-and-control environmental regulation (CCR) is 2.05. From the perspective of other control variables, the average corporate profitability (ROA), asset-liability ratio (Lev), investment opportunity (TobinQ), size of total assets (size), and cash holding ratio (Cash) is 0.058, 48%, 1.59, 23.10 and 13%, respectively.

Table 2. Descriptive statistics.

Name	Mean	Std.	Min	Max
EI	9.391	5.333	0	35
MBR	26.328	0.7967	19.519	27.979
CCR	2.057	2.599	0	19
IER	40.65	13.41	13.54	76.71
Cash	0.132	0.113	0	0.740
Lev	0.481	0.199	0.0100	1.110
Tobin Q	1.594	1.481	0.100	12.59
Size	23.10	1.525	18.76	28.51
ROA	0.0576	0.0727	-0.430	0.440

4.2 Correlation test

From the results of Table 3, there is a great correlation between independent variables and dependent variables. The correlation among independent variables does not exceed 0.7, which indicates that the variable selection in this paper is relatively reasonable, and there is no serious collinearity between them.

Table 3. Correlation test results.

	EI	MBR	CCR	IER
MBR	0.166***			
CCR	0.041	0.029		
IER	0.199***	0.074***	0.023	
Cash	-0.139***	-0.159***	-0.031	-0.083***
Lev	0.082***	0.077***	0.005	0.004
Tobin Q	-0.216***	-0.213***	-0.022	-0.087***
Size	0.368***	0.174***	0.012	0.209***
ROA	-0.081***	0.028	-0.022	-0.126***
	Cash	Lev	TobinQ	Size
Lev	-0.540***			
Tobin Q	0.465***	-0.549***		
Size	-0.320***	0.449***	-0.511***	
ROA	0.404***	-0.490***	0.478***	-0.121***

t-statistics in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

4.3 Regression analysis

Table 4-6 and Figure 1 show the regression results of three types of environmental regulations and green investment of heavy polluting companies. First, the coefficient of MBR is 0.999, which is significant at the

statistical level of 99%. Market incentive environmental regulation can promote corporate green investment. Second, the correlation coefficient of command-and-control environmental regulation (CCR) was 0.0189, but it was not significant. Third, informal environmental regulation (IER) obtained by entropy weight analysis is positively correlated with green investment at 1% level.

Market incentive environmental regulation is beneficial to “digest” the cost of environmental regulation. It is mainly through the government’s investment in environmental pollution control, aiming to guide enterprises’ pollution discharge level with the help of signals, to promote enterprises to achieve the goal of energy conservation and emission reduction.

However, the command-and-control environmental regulation is mainly manifested in tough rules and regulations. Government regulations need higher supervising requirements. The “one-size-fits-all” approach is less efficient in promoting cleaner production of heavy polluting companies.

Under the influence of informal environmental regulation, heavy polluting companies can satisfy the environmental protection requirements of the public by green investment, which sends a positive signal of taking the initiative to bear social responsibility and maintain the reputation of companies.

Table 4. Regression results of model(1).

	Coefficients	t-statistics
<i>MBR</i>	0.999***	(0.210)
<i>Cash</i>	1.004	(1.288)
<i>Lev</i>	0.499	(1.431)
<i>Tobin Q</i>	0.0196	(0.0860)
<i>Size</i>	2.455***	(0.373)
<i>ROA</i>	1.862	(2.476)
<i>Constant</i>	73.43***	(9.871)
<i>Industry</i>	control	
<i>Year</i>	control	
<i>Number of observations</i>	1319	
<i>Within R²</i>	0.158	

t-statistics in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 5. Regression results of model(2).

	Coefficients	t-statistics
<i>CCR</i>	0.0189	(0.0384)
<i>Cash</i>	1.994	(1.274)
<i>Lev</i>	0.933	(1.402)
<i>Tobin Q</i>	0.00846	(0.0911)
<i>Size</i>	2.868***	(0.357)
<i>ROA</i>	1.296	(2.497)
<i>Constant</i>	56.32***	(8.399)
<i>Industry</i>	control	
<i>Year</i>	control	
<i>Number of observations</i>	1319	
<i>Within R²</i>	0.140	

t-statistics in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 6. Regression results of model(3).

	Coefficients	t-statistics
<i>IER</i>	0.154***	(0.0220)
<i>Cash</i>	0.664	(1.242)
<i>Lev</i>	1.387	(1.424)
<i>Tobin Q</i>	0.112	(0.0875)
<i>Size</i>	0.809*	(0.450)
<i>ROA</i>	5.347**	(2.382)
<i>Constant</i>	16.45*	(9.799)
<i>Industry</i>	control	
<i>Year</i>	control	
<i>Number of observations</i>	1319	
<i>Within R²</i>	0.219	

t-statistics in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

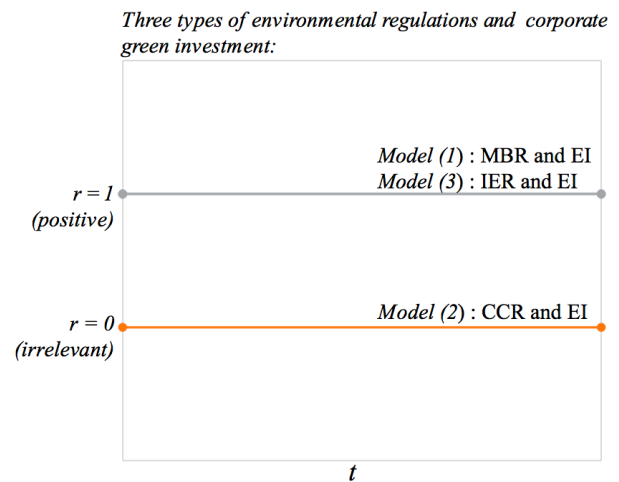


Fig. 1. Regression results of model(1)-(3).

5 Conclusions and suggestions

There is a significantly positive relationship between market incentive and informal environmental regulation and corporate green investment, while command-and-control environmental regulation has no significant impact on corporate green investment. It shows that the mandatory laws of environmental protection in China can’t play an effective regulatory role. This paper argues that the current government supervision of companies has changed from direct control to use means of direct and indirect control, and encourages the public and stakeholders to participate in the supervision. According to the above conclusions, suggestions for companies, governments, and the public are proposed:

Companies need to accelerate investment in pollution control, climate change, and use the capital accumulated in the early stage to transform to green production as soon as possible. Governments should change the situation that command-and-control environmental regulation is dominant and promote corporate green investment by market-incentive environmental regulation. The public should improve the awareness to actively supervise the environmental performance of heavy polluting companies.

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