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Does Rent-Seeking Affect Environmental Regulation?

Evidence From the Survey Data of Private Enterprises in China

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ABSTRACT

Resource utilization not only meets the needs of economic development but also has a far-reaching negative impact on the environment. Environmental regulation is regarded as the key measure to solve environmental pollution. However, the rent-seeking behavior of local enterprises will seriously weaken the implementation effect of environmental regulations. Under the background of the development of big data era, the massive micro enterprise data provided by China's private enterprise survey database provides favorable conditions for this paper to study its impact effect from the direction of big data. This paper uses OLS model and Tobit model to investigate the impact of rent-seeking on the implementation effect of environmental regulation. The results show that environmental regulation will make honest enterprises actively reduce output to control the emission level. However, rent-seeking enterprises will further expand their output to gain greater profits because they are sheltered by local governments.

KEYWORDS

Big Data, Environmental Regulation, Private Enterprise Survey, Rent Seeking

1. INTRODUCTION

Since the reform and opening up, China has made remarkable achievements. China's economy has maintained an average annual growth rate of nearly 10%, which is known as the "growth miracle". However, behind the rapid economic growth, there are also high environmental costs (Liu and Lin, 2019; Song, Peng, et al., 2018; Wang et al., 2020; Zhou et al., 2019). According to a research report released by the World Bank in 2016 (Bank et al., 2016), the welfare loss caused by air pollution in China reached 10.9% of GDP. According to the bulletin of the environmental state in China 2015 issued by the Ministry of environmental protection of China, the air quality pollution of 265 cities in China exceeded the standard in 2015, accounting for 78.4%, and the proportion of cities with acid rain reached 40.4%. In the long run, this extensive mode of economic growth is by no means an inexhaustible driving force for sustainable economic development. On the contrary, it not only causes a serious overdraft of China's natural resources and makes the whole society bear high environmental

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costs, but also aggravates the imbalance of China's economic structure (Lin and Tan, 2016; Song et al., 2017).

Ecological and environmental problems have seriously affected China's sustainable economic development and the living environment of residents (Luo et al., 2020). It has even caused major hidden dangers for China's social stability. Given the significant impact of environmental pollution on the economy and society, the Chinese government has paid increasing attention to environmental protection and has included emission reduction of major pollutants in binding targets for economic and social development. In economic development, more emphasis has been placed on shifting from an extensive development model at the cost of a high ecological environment to a green development model (Song et al., 2020).

Environmental regulation refers to the regulation of economic activities by the government through corresponding policies and measures to achieve the win-win goal of environmental protection and economic development. Given the pollution discharge of enterprises, the Chinese government began to implement the pollution charge system in the 1970s by learning from foreign experience. In September 1979, China established China's pollution charge system in law and tried to collect pollution charges in some provinces (cities). In 2003, the State Council of China promulgated the Regulations on the Administration of the Collection and Use of Pollutant Discharge Fees, establishing a system of charging for the total amount of pollutants discharged. In September 2014, China's National Development and Reform Commission, the Ministry of Finance, and the Ministry of Environmental Protection jointly issued the Notice on the Adjustment of Pollutant Discharge Charges and Other Relevant Issues, requiring all provinces (cities) to raise the sulfur dioxide emission fee to no less than 1.26 yuan per kilogram by the end of June 2015.

However, despite the widespread concern of the central government and all sectors of society, there is a phenomenon of increasing environmental pollution in many provinces in China, which releases the signal that environmental problems have not been effectively managed (Economy, 2007; Wang et al., 2021). Although the chaos of environmental problems and environmental governance is related to the development stage of China, the incomplete implementation of environmental regulations by local governments cannot be ignored. This kind of "environmental regulation implementation deviation" is a core problem that perplexes China's environmental governance, and prevails throughout the country (Song, Du, et al., 2018; Wang and Wheeler, 2000). The central government is the maker of environmental regulation in China, while the local governments are the implementers. Under the background of political centralization and fiscal decentralization, due to the inconsistency between the objective function of the central government and the local government, the policy implementation of the local government is often not aimed at public welfare, but out of the self-interest motive of accomplishing the local tax target and the performance assessment target with GDP as the core (Garzarelli, 2004).

Under the above institutional background, due to the limited constraints of environmental regulations and policies, local governments prefer to collude with local enterprises and derive rent-seeking (Stigler, 1971; Treisman, 2000).

At present, there are few studies on rent-seeking and environmental regulation in China, and there is a lack of research on the effect of rent-seeking on the implementation of environmental regulation at the micro-level. Therefore, this study empirically analyzes the impact of rent-seeking on the implementation effect of environmental regulations by using the surveys of Chinese private enterprises in 2006, 2008, 2010 and 2012. The rest of this study is arranged as follows. Section 2 is a literature review. Section 3 constructs a theoretical model of rent-seeking influencing the implementation effect of environmental regulations, which provides theoretical support for empirical analysis. Section 4 introduces the data and variables used in this study. Section 5 empirically estimates the impact of rent-seeking weakening environmental regulation on enterprises' pollution control investment. Section 6 summarizes the content of this study and puts forward some policy suggestions.

2. LITERATURE REVIEW

According to the definition of Tullock (1991), rent-seeking refers to the behavior of using resources to gain privileges through the political process, thus causing more damage to the interests of others than the benefits of rent-holders. From the perspective of local governments, to pursue their fiscal revenue and political development, local governments carry out symbolic environmental regulations that may reduce fiscal revenue and compete to accept the application of polluting industries and technologies in their jurisdictions (Jia, 2017), which leads to a distorted development path of "attaching importance to the growth and ignoring environmental protection" (Song, Wang, et al., 2018). Especially in the supervision of those enterprises, which mainly undertake the tasks of tax, employment, and other local governments, local governments will consider the cost-benefit between economic benefits and environmental pollution (Tilt, 2007). The final result is that the local government often relaxes the intensity of environmental regulation to let enterprises serve the regional economic development (Wang et al., 2018), which will weaken the policy effect of environmental regulation and further increase the level of environmental pollution. Although the central government has incorporated environmental requirements into the performance evaluation of local officials to ensure the smooth implementation of environmental regulation policies, the central government's supervision of local governments is faced with the problem of information asymmetry (Banerjee et al., 2012; Olken and Pande, 2012). Additionally, environmental pollution also has a spatial spillover effect (Xu et al., 2019). Taking air pollution as an example, the strong spillover of air pollution will lead to the ambiguous definition of regional environmental governance responsibilities, which makes local governments naturally have the tendency of "free-riding" in the process of environmental governance. Therefore, it is difficult for the central government to restrain the local government (Shleifer and Summers, 1988).

From the perspective of enterprises, to expand production and increase profits, when there is pressure to discharge pollution, enterprises are motivated to bribe local governments to avoid being punished for polluting behaviors. On the one hand, such receipts of the bride by the local governments weaken the intensity of supervision in the performance of their duties, which leads to the weakening of the effectiveness of environmental regulation (Damania et al., 2003). This phenomenon is more obvious in areas with a higher industrial scale. The lobbying group which compose of traditional polluting enterprises has more resources to persuade environmental officials to abandon or distort the implementation of environmental policies (Fredriksson and Svensson, 2003). On the other hand, bribed officials provide effective shelter for enterprises to engage in informal economic activities, and the expansion of the scale of the informal economy leads to the improvement of pollution levels. At the same time, enterprises will use part of the profits for bribery, which will also increase the economic benefits of local government officials. The collusion between government and enterprise will meet the needs of local government officials in pursuit of political and economic interests, and also meet the needs of enterprise profit maximization because they have the common goal of expanding enterprise output. The expansion of output will make enterprises gain more profits, and local government officials will get more political promotion opportunities due to the rapid growth of local GDP. Therefore, the higher the degree of rent-seeking, the worse the policy effect of environmental regulation (Wilson and Damania, 2005).

The abuse of official power and the resulting corporate bribery and rent-seeking has always been an important problem troubling the international community, especially the economies in transition. At present, the research on rent-seeking mainly focuses on two aspects: one is resource allocation. On the one hand, bribery can shorten the administrative approval process, improve the service quality (Bayley, 1966; Leys, 1965; Lui, 1985), and obtain scarce resources (Beck and Maher, 1986; Lien, 1986). When the lack of a market system or excessive regulation leads to resource mismatch, the rent-seeking behavior of enterprises can ensure the allocation of resources (Leff, 1964; Lui, 1985). On the other hand, the rent-seeking behavior of enterprises can help enterprises escape some plunder. For example, the protection of property from infringement, tax relief, and increase of financial

subsidies (Acemoglu and Johnson, 2005; Cai et al., 2011; Shleifer and Vishny, 1994). The other is enterprise development. From the accounting point of view, rent-seeking behavior reduces the free cash flow of enterprises. Theoretical and empirical studies show that the lack of free cash flow will lead to insufficient investment and reduce investment efficiency (Richardson, 2006). Therefore, the market is very sensitive to the rent-seeking behavior of enterprises (Fisman and Svensson, 2007). From the perspective of corporate governance, rent-seeking is a signal of poor corporate governance mechanism(Yermack, 2006), which may increase the degree of information asymmetry between enterprises and external investors, thus aggravating the dilemma of investment constraints, forcing managers to give up good investment projects, resulting in underinvestment (Myers and Majluf, 1984).

At present, researches on rent-seeking and environmental regulation with China as the object of investigation are rare. The existing studies mainly focus on the impact of rent-seeking on economic growth, investment, and income from the macro-level (Mo, 2001; Wu and Zhu, 2011; Zheng and Xiao, 2020). There are few research studies on rent-seeking at the micro-level. The researches based on the micro data of enterprises mainly focus on the influence of enterprise political association on enterprise resource allocation and enterprise development, and the lack of researches on the effect of rent-seeking on the implementation of environmental regulations. With the continuous strengthening of China's environmental regulation, due to the central government's difficulties in local environmental supervision, the motivation of local enterprises to seek political asylum will be further strengthened, which will have a greater impact on the implementation effect of environmental regulation. Therefore, it is of great practical significance to study the implementation effect of environmental regulation from the perspective of rent-seeking. With the development of big data applications, micro information at the enterprise level can help policymakers and researchers adjust and formulate policies more effectively, and explore the internal relationship between rent-seeking and the implementation effect of environmental regulation. The space and time span of enterprise-level data is large, and there are close internal relations among enterprises. The correct use of enterprise big data for analysis can make the research conclusions more reliable and comprehensive, and provide more effective suggestions for the effective implementation of environmental regulation. Based on the survey data of private enterprises in China, this study empirically analyzes the impact of rent-seeking on the implementation effect of environmental regulations by selecting the survey data in 2006, 2008, 2010 and 2012. The possible innovations of this study are reflected in two aspects: firstly, this study systematically analyzes the impact mechanism of rent-seeking weakening policy effect of environmental regulation in theory, and integrates environmental pollution with political economy, thus expanding the research boundary of this field. Secondly, this study empirically tests the impact of rent-seeking weakening environmental regulation on corporate pollution control investment for the first time and provides empirical evidence and policy suggestions for enterprises' pollution control from the political perspective.

3. THE THEORETICAL MODEL CONSTRUCTION OF RENT-SEEKING EFFECT ON THE IMPLEMENTATION OF ENVIRONMENTAL REGULATION

In this study, a two-stage game model is used to describe the game behavior of local government and enterprises to maximize their respective utility, to reveal the interaction between environmental regulation, local government, and enterprise output. The model proposed in this study is still under the framework of the imperfect competition market adopted by Barrett (1994). Suppose that a country contains i cities, each city has a rent-seeking enterprise and an honest enterprise, and the enterprises compete in the city according to the output. Suppose that all enterprises produce only one product, and the product has a linear demand function $q = a - p$, where a represents the market size, p and q represent price and output respectively. The cost of the enterprise includes production cost and pollution control cost, and these two kinds of costs are proportional to the output. Under the above assumptions, the enterprise profit function of the city i can be expressed as Eq.(1) and Eq.(2).

$$\pi_i^d = \left(a_i - q_i^d - q_i^f\right) \times q_i^d - c_i^d q_i^d - \theta_i^d e_i q_i^d, i = 1,2,\cdots,n \tag{1}$$

$$\pi_i^f = \left(a_i - q_i^f - q_i^d\right) \times q_i^f - c_i^f q_i^f - \theta_i^f e_i q_i^f - g_i^f e_i q_i^f, i = 1,2,\cdots,n \tag{2}$$

Where π and c are profit and production cost per unit output respectively, θ is the function of environmental protection input per unit output of enterprises, and θ is related to environmental regulation intensity e, which is a monotonic increasing function, satisfying the conditions of $\theta'\left(\cdot\right) > 0$ and $\theta''\left(\cdot\right) > 0$. For the same environmental regulation intensity $\overline{e}$, due to the existence of the rent-seeking enterprise, there is $\theta_i^f\left(\overline{e}\right) < \theta_i^d\left(\overline{e}\right)$. g is the rent-seeking expenditure of the rent-seeking enterprise, which is a monotonic increasing function, satisfying $g'\left(\cdot\right) > 0$ and $g''\left(\cdot\right) > 0$.

For the objective function of the government, the total utility of the local government corresponds to the basic function of the government, which is to maximize consumer surplus, corporate profits, and environmental benefits.

$$U_i\left(q_i^f, q_i^d, e_i\right) = \frac{\left(q_i^f + q_i^d\right)^2}{2} + \pi_i^d + \pi_i^f + D\left(e_i\right) \tag{3}$$

Where $\frac{\left(q_i^f + q_i^d\right)^2}{2}$ is the consumer surplus under the linear demand function, π_i^d and π_i^f are the profits of the honest enterprise and the rent−seeking enterprise respectively, $D\left(e_i\right)$ is the environmental benefits under the environmental regulation intensity e.

The game process between enterprises and local government can be divided into two stages. In the first stage, the local government establishes the local environmental standard e.In the second stage, the honest enterprise and the rent-seeking enterprise choose their output according to local environmental standards to maximize profits. The equilibrium of this game problem can be analyzed by backward induction. Enterprises regard the environmental standard e set by the government as a constant and choose the optimal output under the condition of profit maximization. By taking the derivative of the output, the following first-order conditions can be obtained.

$$\frac{\partial \pi_i^d}{\partial q_i^d} = q_i^{d*} = \frac{1}{2}\left[a_i - q_i^f - c_i^d - \theta_i^d\left(e_i\right)\right] = 0 \tag{4}$$

$$\frac{\partial \pi_i^f}{\partial q_i^f} = q_i^{f*} = \frac{1}{2}\left[a_i - q_i^d - c_i^f - \theta_i^f\left(e_i\right) - g_i^f\left(e_i\right)\right] = 0 \tag{5}$$

From the above equation, we can get Eq.(6) and Eq.(7).

$$\frac{\partial \pi_i^d}{\partial q_i^d} = q_i^{d*} = \frac{1}{3}\left[a_i + c_i^f + \theta_i^f\left(e_i\right) - 2c_i^d - 2\theta_i^d\left(e_i\right)\right] = 0 \tag{6}$$

$$\frac{\partial \pi_i^f}{\partial q_i^f} = q_i^{f*} = \frac{1}{3}\left[a_i + c_i^d + \theta_i^d\left(e_i\right) - 2c_i^f - 2\theta_i^f\left(e_i\right) - 2g_i^f\left(e_i\right)\right] = 0 \tag{7}$$

Take the partial derivative of q_i^{d*} with respect to e_i ,and we can get Eq.(8).

$$\frac{\partial q_i^{d*}}{\partial e_i} = \frac{1}{3}\frac{\partial \theta_i^f\left(e_i\right)}{\partial e_i} - \frac{2}{3}\frac{\partial \theta_i^d\left(e_i\right)}{\partial e_i} \tag{8}$$

According to the hypothesis, $\frac{\partial q_i^{d*}}{\partial e_i} < 0$ is always true, so we can get proposition 1: for the honest enterprise, due to the existence of the rent-seeking enterprise, the government's strengthening environmental regulation will reduce the output of the honest enterprise.

Take the partial derivative of q_i^{f*} with respect to e_i , and we can get Eq.(9).

$$\frac{\partial q_i^{f*}}{\partial e_i} = \frac{1}{3}\frac{\partial \theta_i^d\left(e_i\right)}{\partial e_i} - \frac{2}{3}\frac{\partial \theta_i^f\left(e_i\right)}{\partial e_i} - \frac{2}{3}\frac{\partial g_i^f\left(e_i\right)}{\partial e_i} \tag{9}$$

There is an environmental regulation intensity $\dot{e}$, which makes $\frac{\partial \theta_i^d\left(e_i\right)}{\partial e_i} = 2\left(\frac{\partial \theta_i^f\left(e_i\right)}{\partial e_i} + \frac{\partial g_i^f\left(e_i\right)}{\partial e_i}\right)$ hold, so that when $e_i > \dot{e}$, there are $\frac{\partial q_i^{f*}}{\partial e_i} > 0$, and $\frac{\partial q_i^{d*}}{\partial e_i} < 0$. So we can get proposition 2: when the intensity of environmental regulation reaches a certain level, it will lead to the adverse development of market share, which will increase the market share of the rent-seeking enterprise and reduce the market share of the honest enterprise.

The environmental investment of the honest enterprise and the rent-seeking enterprise is defined as FD_i^d and FD_i^f respectively, and we can get Eq.(10) and Eq.(11).

$$FD_i^d = q_i^{d*}\theta_i^d\left(e_i\right) \tag{10}$$

$$FD_i^f = q_i^{f*}\theta_i^f\left(e_i\right) \tag{11}$$

Take the partial derivative of FD_i^d and FD_i^f with respect to environmental regulation intensity e_i respectively, and we can get Eq.(12) and Eq.(13).

$$\frac{\partial FD_i^d}{\partial e_i} = \frac{\partial q_i^{d*}}{\partial e_i}\theta_i^d\left(e_i\right) + \frac{\partial \theta_i^d\left(e_i\right)}{\partial e_i}q_i^{d*} \tag{12}$$

$$\frac{\partial FD_i^f}{\partial e_i} = \frac{\partial q_i^{f*}}{\partial e_i}\theta_i^f\left(e_i\right) + \frac{\partial \theta_i^f\left(e_i\right)}{\partial e_i}q_i^{f*} \tag{13}$$

In the above equation, the first term on the right is the output effect, and the second term on the right is the intensity effect. We can get proposition 3: for the rent-seeking enterprise, due to the existence of rent-seeking, environmental regulations do not make the enterprise invest more in environmental governance costs. For honest enterprise, the output effect may lead to the decline of environmental investment.

4. DATA AND DESCRIPTIVE STATISTICS

4.1. Data

Based on the availability of data and the principle of maximizing the use of data, in order to explore the impact of rent-seeking on the implementation of environmental regulations from the perspective of big data, this study selects the survey data of private enterprises in China in 2006, 2008, 2010, and 2012[1]. The data was jointly obtained by the United Front Work Department of the Central Committee of the Communist Party of China, the All-China Federation of Industry and Commerce, the State Administration for Industry and Commerce, and the China Private Economic Research Association. Relying on the federations of industry and commerce and bureaus of industry and commerce of various provinces (regions and cities), the survey has conducted multi-stage sampling at a certain proportion across China every two years since 1993.First, counties and cities were selected according to the level of social and economic development, and then the investigated enterprises were selected according to the distribution of urban and rural areas, the scale structure and industry structure of private enterprises, with a sampling ratio of 1/10000, covering 31 provinces, cities, and autonomous regions of China. The investigated enterprises were distributed in 19 industry categories defined by the National Bureau of Statistics of China, with wide coverage and strong representativeness. Each province selects six cities or counties, including one provincial capital city, one prefecture-level city, one county-level city and three counties. The number of private enterprises selected by each province depends on its proportion in the national private enterprises. The survey method is that the affiliated system of the All-China Federation of Industry and Commerce conducts surveys on the legal representatives of private enterprises, and randomly selects different enterprises as the survey samples each time. The questionnaire included not only the business situation of the enterprise, but also the personal characteristics of entrepreneurs. The business situation of the enterprise includes the type of enterprise, capital composition, development history, economic benefits and financing situation, etc. Entrepreneurs' personal information mainly includes age, gender, education background, previous work experience and social activities, family situation and so on. The data basically reflect the business situation, living environment, and future development trend of China's private enterprises in recent years. Due to a large number of indicators and the huge amount of data, we first use the big data method for data research. Through data collection, data cleaning and other data analysis means to collect and analyze relevant data, to provide valuable information for empirical research. This study identified the city and province of the surveyed enterprises by their postcode and matched the survey data of private enterprises in China with the China City Statistical Yearbook and the environmental

regulation data of prefecture-level cities to form the data sample of empirical regression in this study. Finally, a total of 17,627 sample observations were obtained.

The dependent variable of this study is the pollution control behavior of private enterprises, including environmental investment, output, and environmental investment intensity. The environmental investment refers to the sum of the pollutant discharge fee and the investment in treatment facilities, and the intensity of the environmental investment refers to the ratio of the investment to the output. When the environmental regulation is strengthened, enterprises can choose to expand the environmental investment and the intensity of the environmental investment, or choose to reduce the output, which can effectively control the emission level of enterprises.

The independent variable of this study is environmental regulation. At present; there are great differences in the selection of environmental regulation measurement methods. The measurement of environmental regulation by domestic and foreign scholars is mainly considered from the following perspectives: First, start from the environmental regulation policy to construct the evaluation index of environmental regulation. For example, Chen et al. (2018) used the total number of words in government work reports as a proxy variable for the intensity of environmental regulations. Zhong et al. (2021) use the number of environmental protection recommendations adopted by the local government to measure the intensity of environmental regulations. However, this method faces the issue of the effectiveness of the implementation of environmental policies. To measure environmental regulations by the number of policies or the importance of environmental protection can only reflect the theoretical intensity of regulations, but not the actual implementation effects of regulations. In addition, environmental regulation involves policy tools for different actors implemented by different government departments, and it is difficult to uniformly measure policy documents. Second, use the pollutant treatment rate as a proxy indicator for environmental regulation. In researches, pollutant indicators such as wastewater discharge compliance rate, sulfur dioxide removal rate, solid waste comprehensive utilization rate, dust removal rate and other pollutant indicators are often used to construct environmental regulation evaluation indicators (Aiken and Pasurka Jr, 2003; Cole and Elliott, 2003; Levinson, 1996). Using pollutant treatment rate as an evaluation index may have a single-dimensional problem, but considering that the Chinese government's regulation of exhaust gas is mainly concentrated on sulfur dioxide, the deviation caused by this method is not serious. Third, use pollution control investment as a proxy indicator of environmental regulation (Keller, 2002). However, this indicator construction method is greatly affected by the characteristics of corporate pollution. Given the same intensity of environmental regulations in a region, companies with high levels of industrial pollution will also invest more in pollution control. In addition, the operating cost of pollution control facilities is increasing year by year, and pollution control investment varies greatly in different years. In some regions, environmental investment indicators may include both self-financing of enterprises and government expenditures, so there will be certain measurement errors. Since the first method has the shortcoming that the indicators are difficult to reflect the actual implementation effect, and the third method has the shortcoming of measurement error, we believe that the second method is more appropriate to measure environmental regulations. Based on the ideas of Cole and Elliott (2003), Aiken and Pasurka Jr (2003) and the availability of data, this paper establishes an environmental regulation index system composed of sulfur dioxide and soot removal rate.

Since the survey data of private enterprises in China only have the information of the city where the enterprises are located, this study first uses the zip code to identify the specific city where the enterprises are located, and then uses the standard value of the sulfur dioxide and soot removal rate of the city to measure the intensity of environmental regulation. Generally speaking, the more stringent the urban environmental regulation is, the higher the removal rate of industrial sulfur dioxide and industrial dust is. The specific calculation method is as follows.

Firstly, the removal rates of sulfur dioxide and soot in the city were linearly standardized.

$$P_{ckt}^{s} = \frac{P_{ckt} - Min\left(P_{kt}\right)}{Max\left(P_{kt}\right) - Min\left(P_{kt}\right)} \tag{14}$$

P_{ckt} is the k pollutant discharged by city c in the period t, $Max\left(P_{kt}\right)$ and $Min\left(P_{kt}\right)$ are the maximum and minimum values of k pollutant discharged by all cities in the period t, and P_{ckt}^{s} is the standardized value of k pollutant discharged by city c in the period t.

Secondly, the standard values of sulfur dioxide and soot removal rate of the city are summed up with equal weight to get the environmental regulation value $Regu$.

$$Regu_{ct} = \frac{1}{2}\sum_{k=1}^{2} P_{ckt}^{s} \tag{15}$$

The degree of rent-seeking mainly measures the interest exchange behavior between the regulator and the regulated. Due to the illegality and secrecy of rent-seeking expenditure, it is difficult to find an accurate indicator to measure rent-seeking from the financial information of enterprises. In the existing representative studies on Chinese cases, Cai et al. (2011) use business entertainment expenses and travel expenses to describe the corruption expenditure of Chinese enterprises. Zhu and Wu (2014) used enterprise entertainment expenses to depict its bribery expenditure. Referring to the practices of this literature and combining with the availability of data, we approximate the rent-seeking behavior of enterprises with the public relations cost, which reflects the initiative of rent-seeking behavior.

Control variables include legal person level, enterprise-level, and city-level control variables. The control variables at the legal person-level include gender, age, education level, whether the legal person is a Party member, and whether the legal person is a former leader of a state-owned enterprise. Where the legal person's education level is a college degree or above is marked as 1, otherwise, it is 0. The control variables at the enterprise level include the number of employees, R&D investment, charity investment, and political connection. The political connection of the enterprise is measured by whether the legal person is a deputy to the National People's Congress or a member of the Chinese people's Political Consultative Conference. If the legal person of the private enterprise is a deputy to the National People's Congress or a member of the Chinese people's Political Consultative Conference, the enterprise is a political connection, which is recorded as 1, otherwise, it is 0. The control variables at the city level include per capita GDP and urban population.

4.2. Descriptive Statistics

To have a preliminary understanding of the samples studied; this study makes a descriptive analysis of the relevant variables, including the mean value, standard deviation, and the maximum and minimum value of the main variables. The results are shown in Table 1.

Figure 1 shows the average environmental investment of various industries, the average environmental investment of various industries reflects the pollution characteristics of different industries. The figure shows that the average value of the environmental investment in various industries is quite different. Mining, manufacturing, accommodation, and catering industries have the largest environmental investment, while information service, education, and resident service industries have the smallest environmental investment, which is consistent with our cognition. Because the mining industry and manufacturing industry are the main sources of industrial pollutants, the environmental investment of these two industries is the largest. The wastewater of the accommodation and catering industry is generally discharged directly into the sewer without any treatment. Due to the composition of the wastewater produced by this industry which contains a large amount of COD, phosphorus, and

Table 1. Descriptive statistics of variables

Variable	Symbol	Sample size	Min	Max	Mean	Std. Dev
Environmental investment	ln_fdfee	15703	-11.513	9.903	0.272	1.858
Enterprise output	ln_output	15703	-2.303	21.976	6.080	2.841
Environmental investment intensity	ln_eii	15703	-20.367	3.689	-2.488	3.586
Environmental regulation	Regu	14730	0.207	0.985	0.703	0.152
Public relations costs	ln_corru	15712	-3.912	9.876	1.392	1.676
Gender	Sex	15641	0	1	0.157	0.363
Age	Age	15555	16	93	45.438	8.751
Education level	Edu	15712	0	1	0.542	0.498
Whether the legal person is a Party member	Communist_p	15712	0	1	0.355	0.479
Whether the legal person is a deputy to the NPC or a member of the CPPCC	Poli	15712	0	1	0.416	0.493
Whether the legal person is a former leader of a state-owned enterprise	Ex_lead	15712	0	1	0.264	0.441
R&D investment	ln_RD	15712	-2.303	14.509	1.117	1.907
The number of employees	ln_employ	15712	0	10.878	3.700	1.756
Charity investment	ln_chari	15712	-11.513	9.067	0.763	2.127
Per capita GDP	ln_GDP	15664	8.004	11.298	9.931	0.672
Urban population	ln_popu	15698	3.835	7.973	6.404	0.791
Airflow coefficient	Ln_flow	15626	4.436	8.922	7.716	0.533

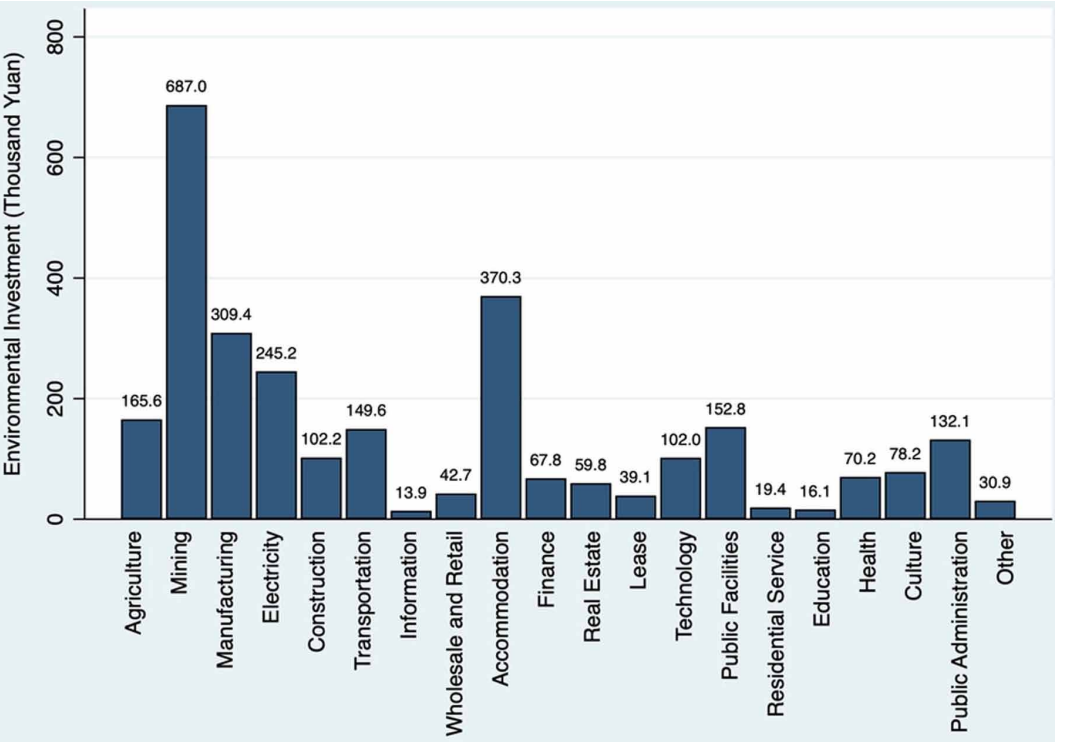
oil (Guobin, 2013), there is also a large environmental investment in the accommodation and catering industry. The information service industry, education industry, and resident service industry are all tertiary industries, and the pollution of these industries is small, so the environmental investment of enterprises is small.

Table 2 shows the regional and temporal distribution characteristics of the samples. From the perspective of regional distribution, the size of samples of private enterprises in eastern China is the largest; accounting for 60.19%, followed by the size of samples in central China, and the size of samples in western China is the least. The distribution of sample size is consistent with the characteristics of more Chinese enterprises in the eastern region and less in the western region. From the perspective of time distribution, from 2005 to 2011, the size of samples of private enterprises increased year by year, which was in line with the development trend of increasing the number of Chinese enterprises year by year. Therefore, the sample selection in this study is reasonable, the enterprise coverage is extensive, and it has a good national representative.

4.3. Empirical Analysis Based on Survey Data Of Private Enterprises In China

To verify the conjecture in the theoretical model, for rent-seeking and honest enterprises, whether the same level of environmental regulation will have a differential impact on enterprise pollution control behavior, this study divides the sample enterprises into rent-seeking enterprises and honest enterprises. Because of the huge data of private enterprises in China, the industry and region span are large, the level of rent-seeking of enterprises in different regions and industries is not consistent, and the level of rent-seeking of enterprises has strong regional and industrial characteristics. Therefore, in order

Figure 1. Average environmental investment of various industries[2]



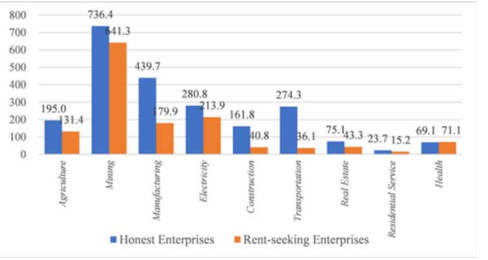
to ensure the accuracy of the results, this study uses the big data method to adjust the rent-seeking level of enterprises. Therefore, this study regresses the fixed effects of cities and industries with the public relations costs of enterprises, takes the residual as the rent-seeking value of enterprises after removing the regional and industrial characteristics, and calculates the average value of the residual, defines the enterprises higher than the average value as rent-seeking enterprises, and the enterprises lower than the average value as honest enterprises.

Figure 2 shows the comparison of environmental investment between rent-seeking enterprises and honest enterprises in different industries. On the whole, the environmental investment of honest enterprises is generally higher than that of rent-seeking enterprises, which preliminarily verifies the theoretical model proposition of this study.

Table 2. Distribution characteristics of samples[3]

Region	Sample size	Proportion (%)	Year	Sample size	Proportion (%)
The eastern region	9457	60.19	2005	3467	22.07
The central region	3437	21.88	2007	3666	23.33
The western region	2818	17.94	2009	4047	25.76
Total	15712	100.00	2011	4532	28.84

Figure 2. Comparison of environmental investment of different types of enterprises



5. RENT-SEEKING AND THE EFFECT OF ENVIRONMENTAL REGULATION: A PRELIMINARY STUDY

In order to test the impact of rent-seeking weakening environmental regulation on enterprises' investment in pollution control, this study established an OLS regression model with enterprises' pollution control behavior as the dependent variable and environmental regulation as the independent variable. At the same time, other factors that may have influence are also controlled. The econometric model set in this study is as follows.

$$\ln Pc_{ijct} = \alpha_1 Regu_{ct} + \alpha_2 X_{ijct} + \alpha_3 Z_{ct} + \gamma_j + \theta_c + \delta_t + \varepsilon_{ijct} \tag{16}$$

Where subscripts i, j, c, t represent enterprise, industry, city, and year respectively. $\ln Pc_{ijct}$ represents the pollution control behavior of enterprises, including enterprise environmental investment, output, and environmental investment intensity. $Regu_{ct}$ represents the environmental regulation intensity of the city where the enterprise is located. X_{ijct} is the control variable at the enterprise level and the legal person level, and Z_{ct} is the control variable at the city level. $\gamma_j, \theta_c, \delta_t$ are industry, city, and time fixed effects respectively, ε_{ijct} is the random error term.

Table 3 reports the regression results of the OLS model. The dependent variables of columns 1 and 2 are enterprise environmental investment (*ln_fdfee*), the dependent variables of columns 3 and 4 are enterprise output (*ln_output*), the dependent variables of columns 5 and 6 are enterprise environmental investment intensity (*ln_eii*), the samples of column 1, column 3, and column 5 are honest enterprises, and the samples of column 2, column 4 and column 6 are rent-seeking enterprises. As can be seen from the results of columns 1 and 2, for rent-seeking enterprises, due to the existence of rent-seeking, environmental regulations have no significant impact on the investment of enterprises in environmental protection, and the strengthening of environmental regulations does not cause enterprises to invest more in environmental governance costs. This empirical result verifies proposition 3. As can be seen from the results of columns 3 and 4, when the environmental regulation is strengthened, honest enterprises will take the initiative to reduce output to control the emission level of enterprises under the influence of pollution control policies, while rent-seeking enterprises will further expand output to obtain greater profits due to the protection of local governments. Under emission control, the collusion between local government and rent-seeking enterprises is more conducive to rent-seeking enterprises to expand output and increase market share. The empirical results verify proposition 1 and proposition 2. As can be seen from the results of columns 5 and 6, when environmental regulation is strengthened, the environmental investment intensity of rent-seeking enterprises will decrease significantly, which may be caused by the expansion of the output of rent-

Table 3. OLS regression results

	(1)	(2)	(3)	(4)	(5)	(6)
	ln_fdfee	*ln_fdfee*	*ln_output*	*ln_output*	*ln_eii*	*ln_eii*
Regu	-0.294	-0.408	-1.021***	1.118*	-0.295	-0.714*
	(-0.69)	(-0.80)	(-4.37)	(1.77)	(-0.71)	(-1.86)
ln_corru	0.068***	-0.006	0.257***	0.270***	-0.040	-0.362***
	(4.31)	(-0.13)	(6.11)	(4.75)	(-1.37)	(-6.69)
Sex	-0.068	-0.057	-0.087	-0.152**	0.075	-0.002
	(-1.56)	(-1.06)	(-1.14)	(-2.10)	(0.78)	(-0.02)
Age	-0.002	-0.001	0.002	0.012	-0.008	-0.008*
	(-0.55)	(-0.94)	(0.68)	(1.33)	(-1.45)	(-1.88)
Edu	0.032	0.022	0.102	0.036	0.045	0.112*
	(0.72)	(0.72)	(1.44)	(0.59)	(0.72)	(2.05)
Communist_p	0.115***	0.076***	0.112**	0.112	0.033	-0.201***
	(3.46)	(3.39)	(2.40)	(1.70)	(0.68)	(-4.01)
Poli	0.018	0.040	0.210***	0.342***	-0.210***	-0.265***
	(0.25)	(0.83)	(3.31)	(5.78)	(-4.00)	(-3.11)
Ex_lead	0.112***	0.017	0.182**	-0.013	0.053	0.004
	(3.43)	(0.35)	(2.64)	(-0.26)	(0.84)	(0.04)
ln_RD	0.052**	0.076***	0.079***	0.213***	-0.205***	-0.197***
	(2.48)	(3.61)	(5.33)	(14.78)	(-4.43)	(-5.79)
ln_employ	0.142**	0.140***	0.563***	0.704***	-0.469***	-0.270***
	(2.45)	(3.88)	(16.17)	(22.40)	(-14.22)	(-12.15)
ln_chari	0.150***	0.091***	0.174***	0.096***	0.014	0.005
	(6.06)	(5.02)	(11.80)	(4.10)	(0.39)	(0.19)
ln_GDP	-0.732**	-0.300	0.690	-0.818	-0.825	0.131
	(-2.51)	(-0.59)	(1.35)	(-1.32)	(-0.45)	(0.19)
ln_popu	0.378	-0.234	1.241	-0.526	1.018	0.248
	(0.79)	(-0.29)	(1.56)	(-0.68)	(0.34)	(0.31)
Consant	4.250	4.454	-9.762	12.701	0.948	-5.246

continued on next page

Table 3. Continued

	(1)	(2)	(3)	(4)	(5)	(6)
	ln_fdfee	*ln_fdfee*	*ln_output*	*ln_output*	*ln_eii*	*ln_eii*
	(0.83)	(0.49)	(-1.09)	(1.30)	(0.03)	(-0.66)
Industry fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
City fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
N	6906	6791	6906	6791	6906	6791
R^2	0.23	0.15	0.54	0.42	0.20	0.22

Robust standard errors in parentheses, * p<0.1, ** p<0.05, *** p<0.01

seeking enterprises, while environmental regulation has no significant impact on the environmental investment intensity of honest enterprises.

In terms of control variables, the political connection has a significant positive impact on enterprise output and a significant negative impact on the intensity of environmental investment. The political connection can help enterprises to obtain a lot of resources, help enterprises compete with other enterprises in the market and survive, and improve the long-term performance of private enterprises. Therefore, as an important social capital of private enterprises, the political connection can significantly improve the output of enterprises. Besides, the political connection between the private enterprises and the government not only makes the enterprises avoid the possibility of being occupied but also is the way for enterprises to give priority to government subsidies, financing opportunities, and tax relief. Out of the motivation of rent-seeking, enterprises will use this relationship to seek benefits for themselves. In the aspect of environmental protection and pollution control, priority is given to the preferential policy of exemption of sewage charges, to reduce the environmental investment intensity of enterprises. The enterprises whose legal person is a party member have a significant positive impact on environmental investment. The possible reason is that the party organization of the private enterprise includes the grass-roots party committee and the party branch, and the superior non-public economic party committee can supervise, coordinate and promote the production and operation of the enterprises. At the same time, the party organization within the private enterprise is also conducive to enhancing the enterprise's awareness of social responsibility and whereas it also helps increase the enterprise's environmental investment. The number of employees has a significantly positive impact on the environmental investment, a significantly positive impact on the output, and a significantly negative impact on the intensity of environmental investment. The number of employees represents the scale of an enterprise. The larger the size of an enterprise, the more likely it is to form a production scale effect. Therefore, although the expansion of enterprise-scale increases the absolute value of enterprise environmental investment, it can still reduce the intensity of enterprise environmental investment based on the expansion of output due to the effect of scale economy.

5.1. Rent Seeking and The Effect of Environmental Regulation: Robustness Analysis

The dependent variable in this study is the pollution control behavior of private enterprises, including the enterprise environmental investment, output, and environmental investment intensity. However, there are a large number of enterprises with zero environmental input in the sample of this study.

Table 4. Tobit regression results

	(1)	(2)	(3)	(4)	(5)	(6)
	ln_fdfee	*ln_fdfee*	*ln_output*	*ln_output*	*ln_eii*	*ln_eii*
Regu	0.301	-1.301*	-1.130***	1.231*	-0.650	-8.611
	(0.47)	(-1.82)	(-4.21)	(1.80)	(-0.20)	(-0.91)
ln_corru	0.134***	0.332***	0.260***	0.271***	-0.252	-2.365
	(3.04)	(3.13)	(6.07)	(4.23)	(-0.60)	(-1.23)
Sex	-0.342**	-0.230**	-0.087	-0.168**	-0.127	-49.503
	(-2.44)	(-2.01)	(-1.14)	(-1.96)	(-0.08)	(-0.00)
Age	0.002	0.015***	0.002	0.013	-0.148*	-0.071
	(0.38)	(4.21)	(0.52)	(1.35)	(-1.73)	(-0.39)
Edu	0.060	0.009	0.102	0.023	1.179	-41.004
	(0.71)	(0.11)	(1.44)	(0.35)	(0.97)	(-0.00)
Communist_p	0.202***	0.317***	0.115**	0.109	0.295	3.307
	(3.52)	(4.23)	(2.41)	(1.56)	(0.28)	(0.97)
Poli	0.115	0.229*	0.209***	0.333***	3.130*	-34.938
	(1.10)	(1.94)	(3.28)	(5.30)	(1.66)	(-0.00)
Ex_lead	0.219***	0.052	0.185***	-0.030	0.130	0.828
	(3.16)	(0.41)	(2.66)	(-0.54)	(0.12)	(0.25)
ln_RD	0.139***	0.214***	0.079***	0.218***	0.197	-6.860
	(4.50)	(9.42)	(5.50)	(13.10)	(0.79)	(-1.54)
ln_employ	0.565***	0.641***	0.572***	0.746***	0.375	0.115
	(12.93)	(17.22)	(17.70)	(24.38)	(0.86)	(0.11)
ln_chari	0.263***	0.190***	0.173***	0.085***	-0.145	0.515
	(7.84)	(6.80)	(11.78)	(3.29)	(-0.61)	(0.55)
ln_GDP	-1.081	0.011	0.689	-0.922	-0.711	0.056
	(-1.02)	(0.01)	(1.34)	(-1.52)	(-0.78)	(0.02)
ln_popu	0.827	-0.845	1.256	-0.558	-0.472	-1.662
	(0.53)	(-0.32)	(1.56)	(-0.70)	(-0.58)	(-0.86)
constant	1.284	0.803	-9.794	13.665	-1.183	-4.030
	(0.07)	(0.03)	(-1.08)	(1.40)	(-0.13)	(-0.19)
Industry fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
City fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
N	6902	6795	6902	6795	6902	6795

Robust standard errors in parentheses, * p<0.1, ** p<0.05, *** p<0.01

In this case, the regression of the whole sample using the ordinary least square method (OLS) may lead to biased and inconsistent estimation results. This is because the probability density of the dependent variable will change after the tail is broken. When the dependent variable is intercepted data, although there are all observation data, some observation data are compressed on one point, so the probability distribution of the dependent variable becomes a joint distribution composed of a discrete point and a continuous distribution. Tobit model can overcome this problem, so this study uses the Tobit model for the robustness test.

Table 4 reports the regression results of the Tobit model. The dependent variables of columns 1 and 2 are enterprise environmental investment (*ln_fdfee*), the dependent variables of columns 3 and 4 are enterprise output (*ln_output*), the dependent variables of columns 5 and 6 are enterprise environmental investment intensity (*ln_eii*), the samples of column 1, column 3, and column 5 are honest enterprises, and the samples of column 2, column 4 and column 6 are rent-seeking enterprises. As can be seen from the results of columns 1, 2, 3, and 4, the strengthening of environmental regulation level makes rent-seeking enterprises reduce their environmental investment and expand their output, while honest enterprises reduce their output. The direction of the coefficients in the table is consistent with the OLS regression results, which shows that the empirical results of this study are relatively robust.

5.2. Re-examination of The Impact of Rent-seeking on The Implementation of Environmental Regulations: Endogeneity Test

Since some omitted variables may simultaneously affect the formulation of environmental regulation policies and the environmental protection behavior of enterprises, resulting in the endogenesis of environmental regulation, this study takes the airflow coefficient as the instrumental variable of environmental regulation to solve the endogenesis problem by referring to the practice of Hering and Poncet (2014). According to the global wind speed and boundary layer height data on a 0.75 °× 0.75 ° grid at a height of 10 metres provided by the ERA-Interim databases. This study matches the airflow coefficient of each grid year with the cities in the sample to get the airflow coefficient of each city in different years.Theoretically, cities with low airflow coefficient tend to adopt strict environmental regulations when air pollutants are the same. Although we try to comprehensively measure the degree of urban environmental regulation, the environmental regulation variables we use are actually related to air pollution control. Therefore, it can be considered that there is a correlation between the environmental regulation variables and the airflow coefficients. As the airlow coefficient only depends on natural phenomena such as regional climate conditions, there is no other mechanism for the airflow coefficient to affect enterprises' pollution control behavior except by influencing the degree of environmental regulation. Therefore, the airflow coefficient is exogenous as an instrumental variable of environmental regulation.

Table 5 reports the estimated results after using the instrumental variable. Compared with the results estimated by the OLS model, although environmental regulation can significantly increase the environmental investment of rent-seeking enterprises, the impact of environmental regulation on the environmental investment intensity of rent-seeking enterprises changes from a significant negative effect to no significant effect after the endogenous effect is eliminated. Therefore, in the context of enterprise rent-seeking, the strengthening of environmental regulations does not make enterprises increase more environmental input per unit of output, which further proves the third proposition. On the one hand, to develop the economy, the government symbolically implements the environmental regulations of rent-seeking enterprises; on the other hand, the enterprises bribe the local government to avoid being punished for pollution discharge, which leads to the lack of willingness of rent-seeking enterprises to increase the intensity of environmental investment. Therefore, after controlling for the endogeneity in the model, the above core conclusion is still robust.

6. CONCLUSION AND POLICY RECOMMENDATIONS

At present, China is in the critical stage of economic transformation, and the traditional pollution industry still occupies an important position in the national economy. In this case, the lobbying

Table 5. Iv regression results

	(1)	(2)	(3)	(4)	(5)	(6)
	ln_fdfee	*ln_fdfee*	*ln_output*	*ln_output*	*ln_eii*	*ln_eii*
Regu	2.643	10.297**	-0.181	0.023	-5.928	-8.550
	(0.54)	(2.55)	(-0.04)	(0.00)	(-0.58)	(-0.74)
ln_corru	0.069***	-0.042	0.258***	0.272***	-0.039	-0.336***
	(4.21)	(-1.09)	(6.39)	(4.12)	(-1.55)	(-4.13)
constant	11.007	33.331***	-10.251	7.912	-12.463	-24.418
	(1.06)	(3.35)	(-1.11)	(0.30)	(-0.42)	(-0.78)
Industry fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
City fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
N	6883	6785	6883	6785	6883	6785

Robust standard errors in parentheses, * p<0.1, ** p<0.05, *** p<0.01

group which composed of polluting enterprises still has strong bribery capital to influence the implementation quality of environmental policies. Based on the survey data of private enterprises in China from 2006 to 2012, this study theoretically and empirically explores the impact of rent-seeking on the implementation effect of environmental regulation. The main findings of this study are as follows: firstly, the theoretical research results show that the strengthening of environmental regulation can not make rent-seeking enterprises increase environmental investment but can make rent-seeking enterprises expand output and honest enterprises reduce output, leading to the reverse development of market share. Secondly, the empirical results show that when the environmental regulation is strengthened, honest enterprises will actively reduce output to control the emission level of enterprises under the influence of pollution control policies, while rent-seeking enterprises will further expand output to obtain greater profits due to the protection of local governments. This conclusion is still robust after changing the model and solving the endogeneity problem.

Based on the above research findings, from the perspective of rent-seeking, the conclusions of this study provide useful policy implications for China's environmental governance practice. First, the effective implementation of environmental regulation is not only related to the policy design of the central government but also related to the implementation of environmental policies by local governments. The higher the degree of rent-seeking, the greater the negative impact of rent-seeking on the environment, environmental pollution control is inseparable from the clean construction of local government. Therefore, it is necessary to strengthen the self-discipline ability of government officials and formulate a reasonable appointment and supervision mechanism of local officials, to curb the occurrence of corruption, which is of great significance for China's economic growth and environmental quality improvement. Second, the fundamental reason for the collusion between polluting enterprises and local governments is that local officials and local enterprises have the common goal of expanding output. Under the incentive of political promotion oriented by GDP, local

government officials usually indulge the pollution behavior of enterprises to seek promotion chips. Local officials' preference for economic growth replaces the preference for environmental pollution control and regulation within their jurisdiction. The zero-sum game of political competition leads to vicious economic competition characterized by sacrificing the environment in the region. Rent-seeking encourages local government officials to relax their environmental regulatory responsibilities in exchange for more short-term enterprise output to boost local economic growth, thus winning rare opportunities for political promotion. Therefore, only by changing the promotion mechanism which only takes GDP as the measurement index, and incorporating environmental governance into the assessment requirements, and establishing the political and performance view of "green GDP", can the collusion between government and enterprises be fundamentally changed.In addition, extensive growth can increase the chips for local officials' political promotion in the shortest time, but the spatial spillover effect of environmental pollution is difficult to solve, and the external cost of the environment is difficult to internalize. Therefore, it should be the focus of environmental policy to design reasonable environmental performance assessment methods, weaken the chain reaction between neighboring regions, reasonably narrow the development gap between neighboring regions, and strengthen the process of regional integration and cooperation, to avoid the "free-riding" tendency in the process of local environmental governance. Third, enterprises' environmental governance can also be realized through market regulation measures, such as emission trading and tax reduction for green innovation. This is augured by encouraging enterprises to rely on green technology and management innovation to realize the integration of resources and reasonable allocation of factors, to realize the adjustment and upgrading of industrial structure, thereby making up for the limitations of policy-oriented regulation. Fourth, this study provides possible findings and suggestions on how to encourage enterprises to increase environmental investment. For example, the fact that the legal person is a Party member has a significant positive impact on the environmental investment of enterprises, starting from the political construction of enterprises, the establishment and improvement of the internal party branches of enterprises, and the strengthening of the social responsibility awareness education of Party members will enable enterprises to better undertake the social responsibility of environmental protection.

There are two main limitations of this study. Firstly, due to the limitation of research data, this study can only obtain the cross-sectional data of private enterprises for four years.the robustness of the conclusion may be further improved. Secondly, there are some defects in the measurement of environmental regulation based on the removal rate of sulfur dioxide and soot. The measurement indicators of environmental regulation are usually faced with multi-dimensional problems, but due to the problem of data availability, it is difficult to build comprehensive indicators. This study does not provide reference materials on how to improve the environmental regulation and solve the rent-seeking problem, which is also the direction of further research in the future. Future research can combine the pollution data, output data and promotion mechanism of regional officials to explore the performance of pollution emissions and rent-seeking of private enterprises under different policies, so as to provide reference for improving environmental regulation and solving the problem of rent-seeking.

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ENDNOTES

[1] The survey years were 2006, 2008, 2010 and 2012, and the data actually occurred in the year before the survey.

[2] Agriculture represents Agriculture, forestry, animal husbandry and fishery industry, Electricity represents Electric power, coal, gas and water industry, Information represents Information service industry, Accommodation represents Accommodation and catering industry, Technology represents scientific research and technology industry, Culture represents Culture and sports industry.

[3] According to the division standard of the China Bureau of statistics, this study divides the sample data into three regions according to geographical location and economic development level. The eastern region includes Beijing, Tianjin, Hebei, Liaoning, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong, Guangxi and Hainan; the central region includes Shanxi, Inner Mongolia, Jilin, Heilongjiang, Anhui, Jiangxi, Henan, Hubei and Hunan; the western region includes Sichuan, Chongqing, Guizhou, Yunnan, Shaanxi, Gansu, Ningxia Qinghai, Xinjiang and Tibet.

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