

# Effect of Investment in Environmental Protection on Green Development of Industrial Enterprises: Evidence from Central China

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**Abstract:** China's industrialization and urbanization process is advancing rapidly. While using natural resources, the country also generates a large amount of waste, causing serious environmental pollution and affecting further development of human society. Expanding the scale of investment in environmental protection has gradually become an effective means to address the problem. China is continuously increasing investment in environmental protection, actively improving environmental conditions, and achieving the dual goals of promoting high-quality development and environmental protection. Six provinces in central China were taken as research objects and the regional differences in their investments in environmental protection were analyzed. A panel entropy weight model was used to calculate the green development level of industrial enterprises, and a panel regression model was employed to calculate the impact of investment in environmental protection on the degree of influence of the green development of industrial enterprises. Results show that the six provinces in central China have significant differences in their investment in industrial environmental pollution control. The unreasonable allocation of environmental protection investment funds has led to the insignificant improvement of environmental pollution caused by industrial enterprises in the six central provinces of investment in environmental protection. R&D expenditure of industrial enterprises, the total import, and export volume of foreign-invested enterprises, and the fixed asset investment of the entire society have a positive role in promoting the green development of industrial enterprises. The added value of the secondary industry has a significant negative effect on the green development of industrial enterprises. Conclusions can be used as a reference for encouraging industrial enterprises to increase investment in environmental protection and promote green development.

**Keywords:** central China; green development; industrial enterprises; investment in environmental protection

## 1 INTRODUCTION

With the rapid advancement of industrialization and urbanization, China's industries have discharged a large amount of waste while using natural resources, causing serious environmental pollution and affecting further development of the regional green development and the entire society. China is at the stage of deepening industrialization, but the extensive economic development mode has brought serious problems such as excessive consumption of resources and energy, destruction of the environment, and insufficient innovation capability. Green innovation for industrial enterprises is not only a requirement for China's coordinated development, but it also conforms to global green development trends. Therefore, studying how to establish a system of coordination and symbiosis between the ecosystem and the economic system is important.

However, the contradiction between economic growth and the quality of the environment has become increasingly prominent. Behind the high growth is the excessive consumption of natural resources and the increasingly serious environmental pollution. China's industrial environmental pollution emissions are extensive, and environmental pollution is becoming increasingly serious. The emissions of major pollutants, such as sulfur dioxide, are still at a relatively high level, and the environmental carrying capacity is close to the upper limit.

As the main source of pollution, industrial enterprises account for approximately 70% of the total. The pollution of industrial enterprises has become a bottleneck that severely restricts green development. The six provinces in central China are regions with a relatively backward industrial base, and industrial environmental pollution is serious. Environmental investment in this region mainly includes industrial pollution control, sewage treatment plants and other infrastructure, and capacity building for an environmental protection agency.

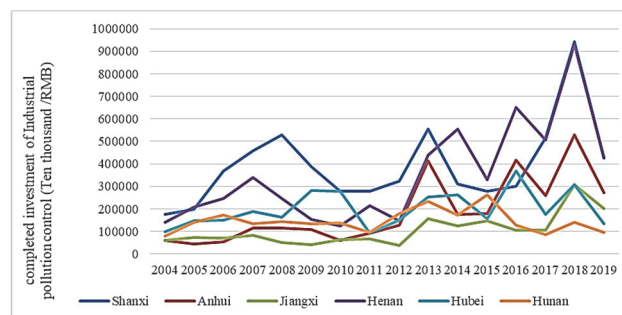


Figure 1 Investment in industrial pollution control in six provinces of central China from 2004 to 2019

As shown in Fig. 1, investment in industrial pollution control in the six central provinces increased from 2004 to 2019. Shanxi, Anhui, Jiangxi, Henan, Hubei, and Hunan provinces emitted industrial pollution during this period. In order to ease environmental pressure, local governments have issued policies to promote industrial pollution control. For example, Henan Province's "2021 National Economic and Social Development Plan" puts forward the development requirements of "green reduction and quality improvement" for cement, coal power, aluminum processing and other industries; The Anhui Provincial Government issued the "Implementation Opinions on Comprehensively Strengthening Ecological Environmental Protection and Resolutely Fighting the Tough Battle of Pollution Prevention and Control" and in-depth implementation of the industrial sewage treatment action plan; "Jiangxi Province's 14th Five-Year Plan for Ecological Environmental Protection" plans to promote the construction of chemical parks and special rectification activities for "scattered, disorderly, and polluted" enterprises, etc. With the joint efforts of local governments and industrial enterprises, the investment in environmental protection in the six central provinces is supplemented by governance and protection improvement. The reason is that the economic development of the six central provinces has been overly dependent on the development of resources

and energy for a long time, which has a huge impact on their environmental condition.

With the continuous development of investment in environmental protection, the concept of investment in environmental protection is gradually strengthened. As a special investment, it is conducive to the common development of the economy, environment, and technology. This kind of investment in environmental protection is not only limited to resources and the environment but also extends to economic and technological areas. The benefits generated by investment in environmental protection can be quantified both in terms of environmental and economic aspects.

## 2 STATE OF THE ART

Studies on environmental protection investment and corporate green development mainly focus on the former promotion of the latter. A large number of studies agree that moderate investment in environmental protection can promote enterprise technological innovation, thereby improving enterprise production efficiency, expanding market share, and obtaining absolute green development competitive advantages. Rondinelli et al. [1] believed that the future environmental clean-up and protection costs in Central and Eastern Europe will be huge, and private investment can play an important role in reversing environmental degradation and ensuring that manufacturers will protect the environment more responsibly in the future. Klassen [2] believed that increasing the level and form of investment in environmental technology by enterprises can enhance the core competitiveness of these businesses. Increasing investment in environmental protection by enterprises provides an important way to expand the implementation of pollution prevention. According to the findings of Sueyoshi et al. [3], the environmental investment in the US power industry has had a positive impact on the financial performance of power companies. Madsen [4] conducted an empirical study on investment in the international automobile industry, and their findings showed that attracting business investment and protecting local environmental quality can be achieved at the same time. Duran et al. [5] believed that the global industry is developing rapidly, consuming a large amount of fuel, and greater investment in environmental protection investment should create a cleaner and less polluting environment. Environmental regulation has always been regarded by the government as an important tool to improve air quality and promote green development. Due to policy ambiguity, conflict of interest and the cadre assessment system, local governments have weak enforcement of environmental regulation. In order to better play the role of environmental regulation, the Chinese government not only needs to establish a strict local law enforcement and supervision mechanism, but also needs to provide continuous incentives for local governments and enterprises through economic means [6]. The formulation of environmental regulations by the government will increase the intensity of environmental supervision and restrict the financing activities of enterprises in the process of green transformation. However, environmental regulations can improve the innovation of green technologies of

enterprises. At the same time, the government can better understand enterprises in the process of implementing and supervising environmental regulations. This will help enterprises to carry out green transformation and development [7]. Leiter et al. [8] showed that the government's strict environmental supervision policy has had a positive but weakening effect on the investments of industrial enterprises. The findings of Zhonghua et al. [9] showed that the complexity of the ecological economic system makes system behaviours vary greatly in the short-term and long-term. Although the importance of ecological environmental protection has been affirmed by the society and the government, people's attitudes towards different environmental policies and environmental protection objects are obviously heterogeneous in the process of ecological environmental protection, which will lead to differences in the implementation of environmental protection policies [10]. Only under a certain proportion of environmental protection investment allocation conditions can enable the entire economic ecosystem to grow steadily and sustainable in the long term. Maoliang [11] studied environmental protection investment and total factor productivity using enterprises in 12 cities in China as a sample. The empirical results show a stable and significant positive correlation between the effects of environmental regulation and its intensity on productivity at the same time, and environmental protection investment and productivity can achieve a win-win situation. Vasile et al. [12] showed that environmental protection investment can prevent, reduce, and eliminate pollution and other forms of environmental degradation caused by the production process or consumption of goods and services. Activities and actions will ultimately help enterprises increase their market share and gain a competitive advantage. However, some scholars have found that societal expectations are too high due to the mandatory disclosure of GHG emissions data, which can adversely affect otherwise reputable enterprises [13]. Salomaa [14] studied the timing of total investment in the Finnish industry from 1995 to 2008 and its relationship with total investment. The results showed that at the industry level, clean technology investment is largely related to high total investment. Clean technology investment has effectively improved the environmental pollution caused by industrial enterprises. Sueyoshi et al. [15] stated that Japanese manufacturing need to reduce greenhouse gas emissions and air pollutants through investment in technological innovation, and suggested that the capital be allocated to areas with pollution control and high investment efficiency. Nagev et al. [16] studied the main differences between environmental management investment and other project financings. The results showed that a region's investment policy in environmental protection is mainly based on current results. Implementing environmental policies based on environmental audit results may be more effective, and national environmental protection measures have achieved more significant effects. Zhang et al. [17] analyzed the impact of environmental protection investment on green technology innovation based on panel data from 30 provincial administrative regions in China from 2008 to 2016. The results show that environmental pollution control investment has a significant inhibitory effect on green technology innovation with a high degree of

environmental decentralization, and the inhibitory effect of industrial pollution source control investment and "three simultaneous" construction project investment is particularly obvious. Jiang et al. [18] believed that the environmental protection behaviour of companies is important in reducing negative environmental effects, and environmental protection expenditures can achieve the dual goal of increasing corporate interests and ecological environmental protection. Farooq et al. [19] believed that environmental subsidies encourage the industrial sector to carry out green production, and the active industrial investment of the enterprises can achieve the improvement of green productivity.

At present, scholars have conducted a large number of studies on the green development of industrial enterprises and investment in environmental protection, and have achieved fruitful results. These research results provide useful references for related research in the future. Most of the findings in the literature tend to support the view that enterprise environmental protection investment has a common positive effect on environmental governance, and can alleviate the production of industrial pollution to a certain extent. Therefore, this study takes six provinces in central China as the research object, analyzes the impact of the environmental protection investment of these six provinces from 1998 to 2016 on the green development of industrial enterprises, and realizes the effective use of resources for Chinese industrial enterprises and reduces harmful substances. Emissions, living in harmony with the environment, and relying on capital accumulation and technological progress are actions that can provide a reference for sustainable development.

### 3 METHODOLOGY

The current assessment of industrial green development mainly includes two aspects: industrial environmental efficiency and industrial green development level. The green development of industrial enterprises requires that in the process of engaging in production activities, these enterprises must minimize their dependence on natural resources, achieve effective use of resources, reduce the emission of harmful substances, live in harmony with the environment, and rely on capital accumulation and technological progress to sustain sustainable development. According to the aforementioned industrial green development requirements, combined with the actual situation in China, the indicator system for green development evaluation of industrial enterprises is determined. This study uses the panel entropy weight model [20] to calculate the green development level of industrial enterprises in the six provinces of central China. First, negative normalization treatment on industrial wastewater discharge, industrial sulfur dioxide discharge, and industrial smoke (dust) discharge is conducted, as shown in Eq. (1).

$$Z_{\alpha ij} = \frac{x_{\max} - x_{\alpha ij}}{x_{\max} - x_{\min}} \quad (1)$$

where the mathematical expression each represents the maximum value and minimum value of the item index, and

the mathematical expression represents the value of the item index before and after the standardized processing. Then, the index is normalized, as shown in Eq. (2).

$$P_{\alpha ij} = \frac{Z_{\alpha ij}}{\sum_{\alpha=1}^m \sum_{i=1}^k Z_{\alpha ij}} \quad (2)$$

Then, the entropy value is calculated as shown in Eq. (3).

$$E_j = -k_1 \sum_{\alpha=1}^m \sum_{i=1}^k P_{\alpha ij} \ln P_{\alpha ij} \quad (3)$$

In Eq. (3),  $k_1 = \frac{1}{\ln(m \times k)}$ . Then, we calculate the redundancy of each index as shown in Eq. (4).

$$D_j = 1 - E_j \quad (4)$$

Then, we calculate the weight of each index, as shown in Eq. (5).

$$W_j = \frac{D_j}{\sum_{j=1}^n D_j} \quad (5)$$

The green development index (*Gdi*) of industrial enterprises in the six provinces of central China each year is shown in Eq. (6).

$$Gdi = P_{\alpha ij} \times W_j \quad (6)$$

This study constructs the following multiple panel regression model as shown in Eq. (7).

$$Gdi_{ij,t} = \beta_0 + \beta_1 Epi_{ij,t} + \beta_2 RD_{ij,t} + \beta_3 Tie_{ij,t} + \beta_4 Inv_{ij,t} + \beta_5 Vsi_{ij,t} + \varepsilon_{ij,t} \quad (7)$$

In Eq. (1),  $Gdi_{ij,t}$  is the explained variable, that is, the green development index of industrial enterprises in the six central provinces measured by Eq. (6).  $Epi_{ij,t}$  is an explanatory variable expressed in terms of environmental protection investment (100 million/RMB) in the six central provinces.  $RD_{ij,t}$  is a control variable expressed as the R&D expenditure (10,000/RMB) of industrial enterprises above the designated size in the six central provinces.  $Tie_{ij,t}$  is a control variable that represents the total import and export volume of foreign-invested enterprises (thousand dollars).  $Inv_{ij,t}$  is the control variable expressed by the fixed asset investment of the entire society (100 million/RMB).  $Vsi_{ij,t}$  is a control variable expressed by the added value of the secondary industry (100 million/RMB).  $\beta_0$  represents the constant term of the regression equation,  $\beta_{i(i=1, 2, \dots, 5)}$  is the regression equation coefficient, and  $\varepsilon_{ij,t}$  represents the error term. This study examines six provinces in central China, namely, Shanxi, Anhui, Jiangxi, Henan, Hubei, and Hunan.

The sample period is from 1998 to 2016. The data are mainly obtained from the database of the National Bureau of Statistics of China (<https://data.stats.gov.cn/>).

#### 4 RESULT ANALYSIS

Tab. 1 shows that the minimum investment in environmental protection in the six central provinces is 60 million RMB, and the maximum is 35.01 billion RMB. This finding reflects that the investments of the six central provinces in industrial environmental pollution control are still quite different, indicating that their environmental protection is obvious. The investments in pollution control are relatively small, which also shows that the investment in pollution control in various regions at this stage is quite different, especially in some areas where the investment in environmental governance is insufficient. It is also

necessary to further implement the concept of green development and give full play to the main role of local governments in environmental protection and pollution control. Based on indicators such as the added value of the secondary industry, the fixed asset investment of the whole society, the total import and export volume of foreign-invested enterprises, and the R&D expenditure of industrial enterprises above the designated size, the differences among the six central provinces are not small.

Considering that the logarithmic processing of variables can eliminate heteroscedasticity but does not change the relationship between variables, this study has performed logarithmic processing on all variable data. Then, the Hausman test is used to screen whether the model adopts a random effect model or a fixed-effect model, as shown in Tab. 2.

Table 1 Descriptive statistics of variables

Variable name and unit	Minimum	Max	Average Value	Standard Deviation	Median
Industrial wastewater discharge (10000 tons)	25855	150406	80221	31308	72984
Industrial sulfur dioxide emissions (10000 tons)	24	147	70	32	60
Industrial smoke (dust) emissions (10000 tons)	26	212	79	41	65
Environmental protection investment (100 million RMB)	1	350	37	52	18
Added value of secondary industry (100 million RMB)	608	18987	5942	4963	4143
Investment in fixed assets of entire society (100 million RMB)	401	40415	9013	9768	4844
Total import and export volume of foreign-invested enterprises (thousand US dollars)	124512	52090864	7459569	12203324	2578395
R&D expenditure of industrial enterprises above designated size (10000 RMB)	85412	6354124	1491804	1625649	798355

Table 2 Model test results

Inspection type	Inspection purpose	Test value	Test results
F test	Comparison and selection of FE model and POOL model	$F(5103) = 37.352, p = 0.000$	FE model
BP test	Comparison between RE model and POOL model	$\chi^2(1) = 179.119, p = 0.000$	RE model
Hausman test	Comparison and selection of FE model and RE model	$\chi^2(5) = 3.374, p = 0.643$	RE model

Table 3 Summary of panel model results

Regression term	Coef	Std. Err	<i>t</i>	<i>p</i>	95% CI
<i>intercept</i>	0.612	0.069	8.804	0.000**	[0.476, 0.748]
<i>Epi<sub>it</sub></i>	0.020	0.075	0.263	0.792	[-0.128, 0.167]
<i>RD<sub>it</sub></i>	0.070	0.065	1.073	0.283	[-0.058, 0.197]
<i>Tie<sub>it</sub></i>	0.014	0.080	0.172	0.864	[-0.143, 0.170]
<i>Inv<sub>it</sub></i>	0.523	0.18	2.900	0.004**	[0.169, 0.876]
<i>Vsi<sub>it</sub></i>	-0.405	0.139	-2.923	0.003**	[-0.677, -0.134]
$\chi^2(5) = 34.404, p = 0.000$					
$R^2 = 0.242, \text{Adjustment } R^2 = 0.206$					

Note: \* $p < 0.05$  \*\* $p < 0.01$

In Tab. 2, the *F* test showed a 5% level of significance ( $F(5103) = 37.352, p = 0.000 < 0.05$ ), which means that the FE model is better than the POOL model. The BP test showed a 5% level of significance ( $\chi^2(1) = 179.119, p = 0.000 < 0.05$ ), which means that the RE model is better than the POOL model. Hausman test did not show significance ( $\chi^2(5) = 3.374, p = 0.643 > 0.05$ ), which means that the RE model is better than the FE model. Based on the preceding analysis, this study takes the RE model as the final result.

Tab. 3 shows that the regression coefficient of environmental protection investment is 0.020, but the regression coefficient is not significant. This result indicates that the environmental protection investment of the six central provinces has improved the green development of industrial enterprises to a certain extent, reflecting that the environmental protection investment of the six central provinces has a certain effect on the

improvement of environmental pollution caused by industrial enterprises.

(1) The conclusion that the regression coefficient is not significant is also consistent with some existing research documents. The main reason is that with the continuous investment in environmental protection funds, environmental problems have not been effectively and quickly resolved. The main reason for this situation is that the allocation of environmental protection investment funds is not reasonable enough, and the utilization efficiency of environmental protection investment funds needs to be further improved.

The regression coefficient of industrial enterprise R&D expenditure is 0.070, but the regression coefficient is not significant. This result shows that industrial enterprises can improve the green development level of industrial enterprises through technological R&D. This conclusion is in line with the conclusions of most studies in the literature. Industrial enterprises actively carry out green technological innovation, upgrade production processes, and accelerate production process transformation to ensure compliance with policies and regulations.

(2) With the continuous application of new technologies, the efficiency of enterprise production and operation is improved, and the increase in revenue can effectively make up for the increase in environmental governance costs and form an innovation compensation effect. Industrial enterprises perform green technological innovation, accelerate the R&D of new products,

effectively expand the market share of products, and fully apply first-mover advantages to enhance their competitiveness.

The regression coefficient of the total import and export volume of foreign-invested enterprises is 0.014, but the regression coefficient is not significant. As a country where the industry is in urgent need of development by attracting foreign investment, China can encourage foreign companies to introduce green technologies for industrial production.

(3) Realizing the companies' active development of green technology innovation through funds can speed up the optimization of the production process and improve the efficiency of resource utilization. At the same time, the green technological innovation of industrial enterprises involves risks and uncertainties, and sufficient import and export trade of foreign enterprises is needed to support domestic enterprises to continuously increase environmental protection investment, accelerate product and production process innovation, and contribute to the progress of green technological innovation. Accelerating the development of enterprises and enhancing the sustainable competitiveness of enterprises are important steps.

(4) The regression coefficient of fixed asset investment in society is 0.523, and the regression coefficient is significant at the 1% significance level. As China vigorously develops industrial enterprises, it has attracted a large amount of capital to invest in industrial enterprises. The Chinese government encourages local governments to leverage fixed asset investment in pollution control and environmental protection by changing the mode of capital investment, and by using more funds to leverage additional social capital in pollution control and environmental protection.

(5) The regression coefficient of the added value of the secondary industry is  $-0.405$ , and the regression coefficient is significant at the 1% significance level. As China is still in the stage of industrial development, it has to build a large number of industrial enterprise facilities and increase the income from industrial development, which causes the added value of China's secondary industry to increase rapidly. At the stage of rapid industrial development, the large scale will reduce the level of green development of industrial enterprises. This also inspired the Chinese government to further increase the adjustment of industrial structure, rationally guide enterprises to optimize production processes, accelerate equipment upgrades, and effectively reduce discharge pollutants and enhance the competitiveness of enterprises in the market, not simply by pursuing the rapid growth of industrial GDP, but also by achieving the coordination of the two goals of industrial high-quality development and ecological environmental protection.

## 5 DISCUSSION AND RECOMMENDATION

### 5.1 Changing the Development Concept of Industrial Enterprises and Promoting the Transformation and Upgrading of these Enterprises

Over time, the requirements for environmental protection are constantly increasing, and traditional development concepts need to be updated. China has

entered a period of "carbon neutralization and carbon peak" where adjustment, transformation, and upgrading have become the keywords. Local governments have regarded industrial transformation and upgrading as an important issue in this period, urging enterprises to adjust traditional development concepts and incorporate environmental protection into corporate strategic management. They cannot take the economic benefits as a single pursuit nor can they take environmental destruction as the price of economic development. The development of a low-end industrial chain into a high-end industrial chain has always been one of the important ways for enterprises to develop green. By extending the industrial chain, the industry can be promoted; the whole chain develops in the direction of low energy consumption and low pollution. Taiyuan City has built twelve strategic advantageous industrial chains for this purpose, and has built a green industrial system by extending the industrial chain of special metal materials, strengthening the industrial chain of rail transit, and laying out the industrial chain of information technology application innovation industry. The investment of an enterprise can also not be limited to the scope of the original enterprise's products but can be placed in emerging fields to expand its portfolio. This approach not only promotes the improvement of the overall income of the enterprise but also improves the enterprise's ability to manage risks. Industrial enterprises can change traditional processes, upgrade technological processes and production equipment, reduce pollution emissions, adopt more advanced energy-saving technologies, and increase the added value of products. These methods can promote the transformation and upgrading of industrial enterprises and achieve green development.

### 5.2 Innovating the Environmental Protection Investment Mechanism of Industrial Enterprises and Building an Environmental Evaluation System for Industrial Enterprises

The field and direction of environmental protection investment of industrial enterprises should be closer to the industrial structure and the environmental innovation needs of enterprises and industries. The direction of environmental protection investment should be further clarified, and the optimization of the industrial structure and overall industrial transformation or upgrading should be promoted. At the same time, reducing environmental protection investment will contribute to environmental protection innovation. The hysteresis of the leading role realizes the seamless connection between environmental protection investment projects and the innovations of enterprises and industries in environmental protection. To formulate environmental protection development strategies, established government has to guide the whole society in environmental protection investment. While gradually increasing direct investment, a diversified environmental protection investment structure has to be constructed and improved, and an environmental protection investment system that includes the division of labor and cooperation between the government, enterprises, and scientific research institutions can be formed. It is necessary to scientifically and rationally evaluate the performance of environmental protection

investment in industrial enterprises, and conduct a scientific classification evaluation system for the regional environment, which is divided into various environmental pollution sources, such as wastewater treatment input, waste gas treatment input and waste residue treatment input to develop an evaluation system. According to different environmental categories, the effective indicators and performance evaluation systems in different categories have to be set up.

### 5.3 Promoting Technological Innovation of Industrial Enterprises and Encouraging Innovation and Development of Industrial Enterprises

Sound environmental regulations play a positive role in promoting sustainable development. Effective and standardized environmental regulations will have a positive impact on enterprise technological innovation, and a sound environmental protection incentive mechanism can encourage industrial enterprises to innovate. Thus, green technological innovation system with enterprises as a unit has to be established, and industrial enterprises should be urged to invest in technological innovation, so that industrial enterprises can gain competitive advantages. The Hebei Provincial Government has grasped the technological innovation status of innovative (pilot) enterprises and promoted the high-quality development of innovative enterprises through the investigation of the annual report of technological innovation of innovative (pilot) enterprises; The Hunan Provincial Government issued the "Guiding Opinions on Promoting the Construction of Industrial Technology Innovation Strategic Alliances", by promoting the construction of industrial technology innovation strategic alliances to achieve a high degree of integration of industry-university-research and to guide innovation elements to gather in advantageous enterprises. Pursuing the innovation-led and in-depth implementation of the innovation-driven development strategy is crucial, and both the government and enterprises should regard technological innovation as the main driving force to lead the development of the industry. At this stage, the industry presents new characteristics of stable operation, accelerated transformation, and improved quality. Accelerating the cultivation of innovation entities, pooling innovation advantages, establishing innovation platforms, optimizing the innovation environment, and promoting industrial quality and efficiency are necessary endeavors.

### 5.4 Strengthening the Education on Industrial Pollution and Establishing an Environmentally Friendly Image of Industrial Enterprises

Industrial enterprises have further enhanced their environmental protection publicity and delivered environmental protection knowledge to the whole society by organizing and conducting environmental protection lectures, environmental protection education courses, and public service advertisements. Other important efforts are giving full play to the supervisory role of residents and the media, disclosing environmental pollution incidents on time, and urging enterprises to actively implement energy-saving and emission-reduction policies to increase their

sustainable competitiveness. Industrial enterprises will continue to consume resources in the process of production and operation, thereby generating a large amount of waste and causing damage to the natural environment. Companies have to actively take responsibility for environmental protection, continuously increase investment in environmental protection and speed up the replacement of environmental protection equipment. They also have to formulate and improve sustainable development strategies, strictly abide by environmental protection policies and measures, improve environmental governance capabilities, establish a good environmental image, enhance product recognition, achieve the unity of economic and environmental benefits, and ensure long-term development of the company. Enterprises should speed up green technology innovation, improve production and operation efficiency, reduce resource waste, speed up new product R&D, and enhance market competitive advantages.

## 6 CONCLUSIONS

Investment in environmental protection has gradually become an effective means to improve environmental protection. This study takes six provinces in central China as the research object and uses a panel regression model to measure the impact of government investment in environmental protection on the green development of industrial enterprises, and obtains the following conclusions:

(1) The six provinces in the central region have significant differences in the investment in industrial environmental pollution control.

(2) The allocation of environmental protection investment funds is not reasonable, resulting in the low effectiveness of investments to address the environmental pollution caused by industrial enterprises.

Although according to the conclusions obtained in this study, some valuable managerial implications are obtained to promote investment in environmental protection and green development of industrial enterprises, there are still some research limitations in this study. For example, only selecting six provinces in central China as the research object may affect the applicability of the analysis results. In the future, we can continue to conduct in-depth research on the differences in the effectiveness of local environmental governance at various levels of green development, the threshold setting for enterprises to obtain environmental protection subsidies, and the temporal and spatial differences in the scale of environmental protection investment in different provinces in China.

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