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Research on the Impact of Environmental Protection Investment and R&D Input on the Financial Performance of Heavily Polluting Industries

Wen Zhang [1] and Lizi Yang [2,*]

[1] *School of Big Data and Artificial Intelligence, Shaanxi Technical College of Finance and Economics, XianYang 712099, China*

[2] *School of Economics and Management, Xi' an University of Technology, Xi' an 710054, China*

Abstract: This paper examines the impact of environmental protection investment and R&D investment on the financial performance of heavily polluting enterprises in China. Using panel data from listed companies in the Shanghai and Shenzhen stock markets from 2008 to 2018, the study constructs multiple regression models to analyze both short-term and long-term effects. The results show: (1) environmental protection investment significantly improves short-term financial performance, and its positive effect becomes stronger in lagged measures; (2) R&D investment enhances short-term financial performance but may hinder long-term performance due to its high risk and the potential for insufficient follow-up investment to become sunk costs; (3) controlling for R&D input reveals a positive synergistic effect: coordinated R&D and environmental investment amplifies the positive impact of environmental investment on performance. The paper concludes with recommendations for firms and policymakers to align green investment with sustained innovation strategies.

Keywords: environmental protection investment; R&D investment; financial performance; synergy effect

1. Introduction

With the proposal of the concept of ecological civilization construction, China has been striving to adjust its economic structure and growth mode. The Amendment to the Environmental Protection Law, which was introduced in 2014, clearly stipulates that enterprises are responsible for the prevention and control of environmental pollution during their business operations and disclose environmental information in accordance with the law. As an important component of market economic activities, enterprises, on the one hand, create economic value by utilizing resources, and on the other hand, inevitably cause damage to the environment. The continuous progress of society has driven the transformation of enterprises' concepts towards the environment. Environmental protection can enhance enterprises' investment attractiveness and market competitiveness, and is conducive to their transformation and upgrading. Therefore, enterprises have gradually become practitioners of environmental protection.

Meanwhile, the increasingly fierce competition among countries and enterprises requires us to cultivate core competitiveness. For enterprises, technological innovation is an important guarantee for long-term development. The research and innovation activities carried out by enterprises can not only promote their own resource

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* Corresponding: Lizi Yang (shiyaoboo@163.com)

allocation efficiency and conversion efficiency, but also influence the economic structure and industrial upgrading of the entire society. Therefore, enterprises need to firmly allocate innovation resources in a market-oriented manner, continuously increase the investment in R&D innovation, and promote enterprises to become the true main body and beneficiary of R&D innovation, as well as the transformation of achievements.

What kind of impact environmental protection investment and R&D innovation have on the financial performance of enterprises is a common concern of scholars and enterprise managers? The research of Russo and Fouts (1997) indicates that environmental performance can positively affect economic performance. That is, enterprises' environmental protection investment helps stimulate enterprises to enhance their innovation capabilities. The innovation benefits can compensate for and create new economic value for enterprises, which is much higher than the cost of environmental protection investment. This relationship will strengthen with the development of the industry [1]. Hart and Ahuja (1996), through empirical tests, hold that environmental protection investment by enterprises is conducive to reducing the pollutant emissions of enterprises, improving the utilization rate of resources, and saving funds for enterprises by improving their environmental performance, which is convenient for enterprises to further reduce costs and affect financial performance [2]. Lopez-Gamero et al. (2010) hold that enterprises' fulfillment of environmental responsibilities can solve the environmental pollution caused during the production process, reduce the environmental protection tax of enterprises, establish a green image among stakeholders such as the government, consumers and investors, obtain the inclination of social resources, and thereby form product advantages. Thereby improving the financial performance of the enterprise [3]. Zvi Griliches (1985) revised the traditional Cobb-Douglas production function model, incorporated technological innovation factors into the model to verify the relationship between R&D innovation and financial performance, and concluded that investment in the field of technological innovation would promote the financial performance of enterprises [4]. Barts (2000) took the manufacturing industry of the United States as the research sample, and took R&D investment and sales revenue as independent variables and dependent variables respectively to explore what kind of impact R&D investment has on enterprise productivity. It proved that the spillover effect of R&D investment can significantly improve the production capacity of enterprises and thereby improve the financial performance of enterprises [5]. Garner, Nam and Ottoot (2002) expanded the sample size to the entire industry in the United States to study the relationship among R&D investment, innovation efficiency and enterprise growth rate. The study found that the speed of marketization largely affects the intensity of enterprise R&D investment and innovation efficiency. Meanwhile, enterprises with higher R&D investment will have a higher growth rate [6]. Sasidharan, Lukose and Komera (2015) and other Indian scholars analyzed the financial data of Indian manufacturing enterprises during the decade from 1911 to 2011 and found that R&D expenditure was positively correlated with operating cash flow, thereby having a positive impact on the financial performance of enterprises [7].

Due to the uncertainty of the impact of enterprises' environmental protection investment and R&D input on their financial performance, and the fact that the situations vary within different industries, there are some opposing viewpoints in the current research results. Then, what is the relationship between an enterprise's environmental protection investment, R&D investment and its financial performance, and can they jointly promote the financial performance of the enterprise? This paper takes the theories of sustainable development, corporate social responsibility, stakeholder theory, Porter's innovation compensation hypothesis and technological innovation theory as the theoretical basis. It selects the empirical data of the heavily polluting industries in the Shanghai and Shenzhen stock markets of China from 2008 to 2018 as the samples for empirical research to sort out and study the relationship among enterprises' environmental protection investment, R&D input and financial performance. On this basis, suggestions are put forward for enterprises to improve their financial performance.

2. Research Hypothesis

2.1. The Impact of Environmental Investment on Corporate Financial Performance

Enterprises investing in environmental protection not only include expenses for pollution control, but also include establishing clean production mechanisms, so environmental investment is a special expense. Firstly,

enterprises actively engage in environmental protection practices to prevent and control environmental pollution, which can help reduce pollutant emissions, achieve energy conservation and emission reduction goals, thereby improving asset utilization, reducing production costs, promoting secondary industrial upgrading, and helping enterprises gain competitive advantages. Secondly, fulfilling environmental responsibilities by enterprises can enable them to obtain environmental resource utilization credits from the government, receive environmental subsidies and other policy benefits from the government, and reduce the risk of enterprises being subject to government environmental regulations and fines lawsuits. Finally, environmental investment can help companies establish a good corporate image in society and enhance their market competitiveness. This paper argues that environmental investment by enterprises can reduce environmental risks, cultivate a good reputation, gain government support, ultimately enhance market competitiveness, and improve financial performance.

Hypothesis 1: *Environmental protection investment in heavily polluting industries has a positive correlation with current financial performance, and the positive correlation with financial performance in the lagging period gradually increases*.

2.2. The Impact of R&D Investment on the Financial Performance of Enterprises

The development of science and technology has shortened the product update cycle. An important guarantee for the long-term development of enterprises is to constantly innovate processes, technologies and products and enhance their independent innovation capabilities. On the one hand, the R&D and innovation activities of enterprises can enable them to cope with the constantly changing external demands. Upgrading the existing product processes, management methods and production methods can enable enterprises to form differentiated advantages while reducing production costs and bringing about a technological revolution. Maintain the loyalty of existing customers while exploring new customer groups, thereby expanding the sales volume and market share of the enterprise. On the other hand, enterprise R&D innovation can meet the internal needs of the enterprise. R&D innovation can enhance the innovation quality of enterprise personnel, facilitate the accumulation of knowledge by enterprises, integrate the talent, technology and capital elements of enterprises, and to a large extent increase the value of enterprises and improve their financial performance.

Hypothesis 2: *R&D investment in heavily polluting industries can positively affect the financial performance of enterprises.*

2.3. The Synergistic Impact of Environmental Protection Investment and R&D Input on the Financial Performance of Enterprises in Heavily Polluting Industries

Environmental protection investment and R&D investment, as two different flow paths of enterprise resources, can not only meet customer demands but also maintain a competitive edge in the market. Through R&D innovation, enterprises can simultaneously achieve the goals of increasing production and efficiency as well as energy conservation and emission reduction. Meanwhile, government subsidies and policy preferences can reduce operating costs, lower business risks and environmental risks, and enhance the reputation of enterprises. That is to say, enterprises can balance environmental responsibility and innovative development, and convey the concept of green innovation. The two are not mutually exclusive. The synergy effect of environmental protection investment and R&D investment on the financial performance of enterprises will have a more positive impact on the future performance of enterprises to a greater extent. Enterprises need to avoid focusing only on one aspect in the operation process.

Hypothesis 3: *R&D investment in heavily polluting industries can positively regulate the relationship between environmental protection investment and financial performance, and form a synergy effect with environmental protection investment to improve financial performance.*

3. Variable Selection and Basic Model

3.1. Explanatory Variable

(1) Enterprise environmental protection investment. This paper selects the ratio of environmental protection investment to operating income as the measurement index of an enterprise's environmental protection investment (INV).

(2) Enterprise R&D investment. The total R&D investment in this paper includes personnel compensation, depreciation and amortization, material costs, inspection fees, evaluation fees and other expenses directly related to R&D activities. In the empirical study, the natural logarithm of the total R&D investment is used for hypothesis testing.

3.2. Explained Variable

This paper selects return on total assets (ROA) as the explanatory variable. ROA can also relatively comprehensively reflect the profitability, operation and management level, and asset utilization of an enterprise. Meanwhile, since this paper will explore the impact of enterprises' environmental protection investment and R&D input on financial performance from both short-term and long-term perspectives respectively, the market within one year (including one year) is defined as the short-term market, and the market above one year is defined as the long-term market. Therefore, this paper adopts the current ROA and the lagging period ROA respectively as the measurement indicators of short-term and long-term financial performance, and conducts multiple regression analysis together with the explanatory variables.

3.3. Control Variable

(1) Enterprise Size (Size). In this paper, the natural logarithm of the total assets of the enterprise is selected as the proxy variable for the enterprise size.

(2) Financial Leverage (Lev). The magnitude of an enterprise's financial leverage is generally represented by the asset-liability ratio or the financial leverage coefficient. In this paper, the asset-liability ratio is chosen to measure the level of an enterprise's financial leverage (Lev).

(3) Current Ratio (Liq). The current ratio is expressed as the ratio of current assets to current liabilities, considering the repayment sequence of assets when debts mature from the perspective of the strength of asset liquidity.

(4) Equity Concentration (Equity). This paper adopts the shareholding ratio of the top ten shareholders as the measurement indicator of the Equity concentration of an enterprise.

(5) Nature of Property Rights (Pro). In this paper, the nature of property rights (Pro) is set as a dummy variable for control in the model. The property rights attributes of enterprises are judged at the end of the current year as the node. For state-controlled enterprises, it is 1, and for non-state-controlled enterprises, it is 0.

3.4. Empirical Model

In the first part, this paper takes environmental protection investment (INV) as the dependent variable, return on total assets of the enterprise (ROA) as the independent variable, and adds five control variables to construct model (1) to verify Hypothesis 1, that is, the impact of the enterprise's environmental protection investment on the current financial performance and the financial performance in the later period.

In the second part, in order to verify Hypothesis 3, namely the relationship between enterprise R&D investment and financial performance, this paper selects enterprise R&D investment (R&D) and ROA as the dependent variable and independent variable respectively, and adds the above control variables to construct a multiple regression model (2).

The third part builds Models (3) and (4) by adding environmental protection investment (INV) and enterprise R&D investment (R&D) respectively on the basis of Models (1) and (2). And in order to test the moderating effect of R&D investment, model (4) is obtained by adding the crossover term of environmental protection investment (INV) and R&D investment (R&D) on the basis of model (3). Verify Hypothesis 3, namely whether R&D investment can regulate the relationship between environmental protection investment

and financial performance, and form a synergy effect with environmental protection investment to improve financial performance.

$$ROA_{i,t}=\alpha_0+\alpha_1 INV_{i,t}+\alpha_2 Size_{i,t}+\alpha_3 Lev_{i,t}+\alpha_4 Liq_{i,t}+\alpha_5 Equity_{i,t}+\alpha_6 Pro_{i,t}+\varepsilon_1 \quad (1)$$

$$ROA_{i,t}=\beta_0+\beta_1 R\&D_{i,t}+\beta_2 Size_{i,t}+\beta_3 Lev_{i,t}+\beta_4 Liq_{i,t}+\beta_5 Equity_{i,t}+\beta_6 Pro_{i,t}+\varepsilon_2 \quad (2)$$

$$ROA_{i,t}=\gamma_0+\gamma_1 INV_{i,t}+\gamma_2 R\&D_{i,t}+\gamma_3 Size_{i,t}+\gamma_4 Lev_{i,t}+\gamma_5 Liq_{i,t}+\gamma_6 Equity_{i,t}+\gamma_7 Pro_{i,t}+\varepsilon_3 \quad (3)$$

$$ROA_{i,t}=\delta_0+\delta_1 INV_{i,t}+\delta_2 R\&D_{i,t}+\delta_3 INV_{i,t}*R\&D_{i,t}+\delta_4 Size_{i,t}+\delta_5 Lev_{i,t}+\delta_6 Liq_{i,t}+\delta_7 Equity_{i,t}+\delta_8 Pro_{i,t}+\varepsilon_4 \quad (4)$$

In the above model, the subscripts *i* and *t* respectively represent the i-th company and the year, which are the intercepts of the regression equation, that is, the constant term, and α_0 represents the regression coefficients of each variable, indicating the random error term.

4. Descriptive Statistics of Data

Table 1 shows the descriptive statistical results of the research samples. The standard deviation of the ROA in the heavily polluting industry is 0.0819, which is greater than the mean 0.0467. The coefficient of variation is greater than 1. The minimum value and the maximum value are −2.5551 and 1.1261 respectively, all reflecting the significant differences in profitability among specific enterprises within the heavily polluting industry. The average value of environmental protection investment (INV) is 0.0243, which is greater than the median of 0.0051. The standard deviation is greater than the mean, and the coefficient of variation is greater than 3. It can be seen that the scale of environmental protection investment within heavily polluting industries varies greatly. The environmental protection investment of most enterprises in the industry is lower than the industry average. The overall awareness of environmental protection practice is poor, and the intensity of environmental protection investment needs to be strengthened.

Among the control variables, the financial leverage (Lev) ranges from 0.0075 to 3.1656, with an average value of 0.3956. Both the level of financial leverage and financial risk are relatively moderate. The coefficient of variation of the enterprise current ratio (Liq) is around 2. The high degree of dispersion of this variable indicates that there are significant differences in the current ratio within heavily polluting industries. Moreover, the median is lower than the mean and the critical value of 2 under the common view, suggesting that there are a large number of enterprises with poor short-term debt-paying ability within the industry. The mean value of the total asset Size (Size) of enterprises is 22.1449, and the standard deviation is 1.3436, indicating that the degree of dispersion of this value is low. The enterprise scales in heavily polluting industries are relatively large and concentrated in distribution.

Table 1. Descriptive statistics of main variables.

Variable	Mean	Median	Standard Deviation	Minimum Value	Maximum Value	Observation Numbers
ROA	0.0467	0.0436	0.0819	−2.5551	1.1261	6513
INV	0.0243	0.0051	0.0999	0.0000	1.2073	831
R&D	17.5179	3.2700	1.5199	5.0938	23.7699	6285
Size	22.1449	21.9101	1.3436	18.7602	28.5200	6507
Pro	0.3696	0	0.4827	0	1	6513
Liq	2.9611	1.6519	5.3269	0.0747	190.8692	6513
Lev	0.3956	0.3814	0.2130	0.0075	3.1656	6513
Equity	4.0704	4.1228	0.2897	1.2776	4.6053	6512

5. Empirical Test

Firstly, a regression test is conducted on Hypothesis 1. The models (1) and (2) in Table 2 respectively present the full sample regression results of the models regarding environmental protection investment and the current financial performance and the lagging financial performance of the current period. It can be seen from the regression results of Model (1) that environmental protection investment has a significant positive correlation with the ROA at the 10% level, indicating that enterprises' active environmental protection investment can have a positive promoting effect on improving the current financial performance of enterprises. The regression results of the lagging impact of environmental protection investment are shown in Model (2). The lagging environmental protection investment by one period is significantly positively correlated with the ROA at a confidence level of 5%. By comparing the regression results of Models (1) and (2), it can be seen that the coefficient of the lag period increases (0.0604 > 0.0446), and the significance level significantly enhances from the 10% level to the 5% confidence level. Therefore, Hypothesis 1 passed the statistical test, that is, the environmental protection investment of enterprises in heavily polluting industries can positively affect financial performance, and the positive impact on long-term financial performance is more significant, with the positive correlation gradually increasing.

Table 2. Regression results of corporate environmental investment and financial performance.

Variable	Model (1)	Variable	Model (2)
$INV_{i,t}$	0.0446 *	$INV_{i,t-1}$	0.0604 **
	(1.86)		(2.43)
Size	0.0234 ***	*Size*	0.0316 ***
	(3.05)		(3.81)
Lev	−0.1985 ***	*Lev*	−0.2832 ***
	(−7.81)		(−10.09)
Liq	−0.0015	*Liq*	−0.0015
	(−0.77)		(−0.86)
Equity	−0.008	*Equity*	−0.0572 ***
	(−0.43)		(−2.64)
Pro	−0.0025	*Pro*	−0.0108
	(-0.06)		(−0.26)
Constant	−0.3168 *	**Constant**	−0.2649
	(−1.75)		(−1.41)
Observations	831.00	**Observations**	789.00
Number of code	219.00	**Number of code**	216.00
R-squared	0.20	**R-squared**	0.25

Note: ***, **, * denote statistical significance at the 1%, 5%, and 10% levels, respectively. The values in parentheses are *t*-statistics.

To verify Hypothesis 2 and explore the relationship between R&D investment and enterprise financial performance, this paper conducts a regression analysis of the relationship between the two. The regression results are shown in Table 3. Models (3) and (4) are the regression test results of enterprise R&D investment and current financial performance and long-term financial performance, respectively. It can be seen from the regression results of Model (3) that the enterprise's R&D investment (R&D) and the current ROA have passed the significance test, with a regression coefficient of 0.0089 and a significant correlation at the 1% confidence level. This indicates that there is a significant positive correlation between the enterprise's R&D investment and the current return on total assets. R&D innovation can meet the internal and external demands of the enterprise.

Gain a competitive edge in the market and thereby positively influence the current financial performance. Model (4) examined the relationship between enterprise R&D investment (R&D) and the ROA of the lagging period. The sign of the regression coefficient changed from positive to negative, changing from a significant positive correlation at the 1% confidence level to a significant negative correlation at the 5% level, indicating that the positive impact of R&D investment on financial performance only exists in the current period. It has a negative impact on the financial performance in the lag period.

Table 3. The regression results of the impact of enterprise R&D investment on financial performance.

Variable	Model (3)	Variable	Model (4)
$R\&D_{i,t}$	0.0089 ***	$R\&D_{i,t-1}$	−0.0040 **
	(5.23)		(−2.1)
Size	0.0263 ***	*Size*	0.0459 ***
	(9.22)		(13.84)
Lev	−0.3381 ***	*Lev*	−0.3820 ***
	(−42.42)		(−41.29)
Liq	−0.0018 ***	*Liq*	−0.0018 ***
	(−8.68)		(−7.06)
Equity	0.0291 ***	*Equity*	0.0043
	(4.65)		(0.56)
Pro	0.0142	*Pro*	0.0104
	(1.46)		(0.9)
Constant	−0.6356 ***	**Constant**	−0.7189 ***
	(−10.75)		(−10.28)
Observations	6278	**Observations**	5253
Number of code	1056	**Number of code**	1011
R-squared	0.2890	**R-squared**	0.3120

Note: *** and ** denote statistical significance at the 1% and 5% levels respectively. The values in parentheses are *t*-statistics.

The regression results of the first part are shown in Table 4. After comparing Model (1) with Model (5), it is found that the enterprise's environmental protection investment (INV) is still significantly positively correlated with the current return on total assets at the level of 10%, but the correlation coefficient expands from 0.0446 to 0.0537, which can partially indicate that under the condition of controlling the R&D investment, The positive impact coefficient of environmental protection investment on the current financial performance gradually increases, partially verifying Hypothesis 3.

By comparing Model (1) with Model (6), the regression coefficient of environmental protection investment and the current return on total assets expanded significantly from 0.0446 and at the 10% level to 0.4375 and at the 5% confidence level. After comparing Model (5) and Model (6), it was found that after adding the interaction term, both the magnitude and significance of the correlation coefficient between the enterprise's environmental protection investment and the current return on total assets have improved. Specifically, the correlation coefficient has significantly expanded from 0.0537 and at the 10% level to 0.4375 and at the 5% confidence level. The coefficient of R&D investment increased from 0.0033, which was not significant, to 0.013 and was significant at the 5% significant level. Moreover, the coefficient of the crossover term was positive, indicating that the synergy between the two had a positive impact on the financial performance of enterprises.

Table 4. Regression results of the synergistic impact of environmental protection investment and R&D investment on financial performance.

Variable	Model (5)	Variable	Model (6)
$INV_{i,t}$	0.0537 *	$INV_{i,t}$	0.4375 **
	(1.7)		(2.54)
$R\&D_{i,t}$	0.0033	$R\&D_{i,t}$	0.0130 **
	(0.81)		(2.58)
		$INV_{i,t}$*$R\&D_{i,t}$	0.0368 **
			(2.16)
Size	0.0243 **	*Size*	0.0281 **
	(2.38)		(2.39)
Lev	−0.2987 ***	*Lev*	−0.2979 ***
	(−8.09)		(−8.10)
Liq	−0.0023	*Liq*	−0.0025
	(−1.09)		(−1.21)
Equity	−0.0130	*Equity*	−0.0116
	(−0.54)		(−0.49)
Pro	−0.0225	*Pro*	−0.0214
	(−0.46)		(−0.44)
Constant	−0.0507	**Constant**	−0.0718
	(−0.21)		(−0.30)
Observations	605	**Observations**	605
Number of code	195	**Number of code**	195
R-squared	0.232	**R-squared**	0.2440

Note: ***, **, * denote statistical significance at the 1%, 5%, and 10% levels, respectively. The values in parentheses are *t*-statistics.

6. Robustness Test

To ensure the reliability and credibility of the regression results, in this paper, the return on equity (ROE) of the enterprise is used instead of the ROA as the proxy variable of the enterprise's financial performance, and the regression test is conducted through repeated experiments using the original model and control variables. ROE of an enterprise is also a commonly used indicator for evaluating the operating conditions of an enterprise, reflecting the level of return on net assets. It has long been valued by listed companies in China and is also a measurement standard for enterprises to obtain the qualification for refinancing. The test results are listed as follows (as shown in Tables 5–7).

Table 5. Hypothesis 1 robustness test result.

Variable	ROE (1)	Variable	ROE (2)
$INV_{i,t}$	0.1374 *	$INV_{i,t-1}$	0.2146 **
	(1.72)		(2.58)
Size	0.0649 **	*Size*	0.0953 ***
	(2.54)		(3.43)
Lev	−0.6239 ***	*Lev*	−0.8232 ***
	(−7.37)		(−8.76)
Liq	−0.0102	*Liq*	−0.0087
	(−1.60)		(−1.51)
Equity	−0.0382	*Equity*	−0.1689 **
	(−0.62)		(−2.33)
Pro	0.1084	*Pro*	−0.0398
	(0.77)		(−0.29)
Constant	−0.8764	**Constant**	(0.8445)
	(−1.45)		(−1.34)
Observations	831	**Observations**	789
Number of code	219	**Number of code**	216
R-squared	0.164	**R-squared**	0.187

Note: ***, **, * denote statistical significance at the 1%, 5%, and 10% levels, respectively. The values in parentheses are *t*-statistics.

Table 6. Hypothesis 2 robustness test result.

Variable	ROE (5)	Variable	ROE (6)
$R\&D_{i,t}$	0.0169 ***	$R\&D_{i,t-1}$	−0.0100 **
	(3.89)		(−2.09)
Size	0.0926 ***	*Size*	0.1288 ***
	(11.54)		(13.76)
Lev	−0.9289 ***	*Lev*	−0.9890 ***
	(−40.75)		(−38.67)
Liq	−0.0062 ***	*Liq*	−0.0054 ***
	(−10.15)		(−7.40)
Equity	0.0488 ***	*Equity*	−0.02
	(2.72)		(−0.69)
Pro	0.0536 *	*Pro*	0.03
	(1.95)		(0.93)
Constant	−1.9666 ***	**Constant**	−2.0101 ***
	(−11.64)		(−10.05)
Observations	6340	**Observations**	5314
Number of code	1056	**Number of code**	1011
R-squared	0.26	**R-squared**	0.28

Note: ***, **, * denote statistical significance at the 1%, 5%, and 10% levels, respectively. The values in parentheses are t-statistics.

Table 7. Hypothesis 3 robustness test result.

Variable	ROE (9)	Variable	ROE (10)
$INV_{i,t}$	0.1844 **	$INV_{i,t}$	1.4340 ***
	(2.02)		(2.88)
$R\&D_{i,t}$	0.0172	$R\&D_{i,t}$	0.0181 **
	(1.47)		(2.19)
		$INV_{i,t}*R\&D_{i,t}$	0.0477 **
			(2.53)
Size	0.0432	*Size*	0.0473
	(1.46)		(1.63)
Lev	−0.8474 ***	*Lev*	−0.8502 ***
	(−7.93)		(−8.00)
Liq	−0.0096	*Liq*	−0.0104 *
	(−1.55)		(−1.71)
Equity	−0.0261	*Equity*	−0.0202
	(−0.38)		(−0.29)
Pro	0.0881	*Pro*	0.0911
	(0.6200)		(0.6500)
Constant	−0.1673	**Constant**	−0.1947
	(−0.24)		(−0.29)
Observations	605	**Observations**	605
Number of code	195	**Number of code**	195
R-squared	0.2260	**R-squared**	0.2410

Note: ***, **, * denote statistical significance at the 1%, 5%, and 10% levels, respectively. The values in parentheses are *t*-statistics.

7. Conclusions

This paper establishes a multiple regression model and uses empirical data from heavy pollution industries in China's Shanghai and Shenzhen stock markets from 2008 to 2018 as research samples to explore the relationship between corporate environmental investment, R&D investment, and financial performance. The following research conclusions are drawn:

First, Environmental investment in heavily polluting industries has a significant positive impact on short-term financial performance, and the positive correlation with lagged financial performance gradually strengthens. It indicates that over time, the positive impact of environmental investment on corporate financial performance will become more prominent.

Second, R&D investment in heavily polluting industries is positively correlated with current financial performance, but negatively affects long-term financial performance. Specifically, R&D investment in heavily polluting industries can have a positive impact on short-term financial performance but a negative impact on long-term financial performance. The reason may lie in the high risk and long cycle of R&D innovation, and many companies may have insufficient subsequent investment in R&D. If R&D investment fails to reach a certain scale, the initial investment is prone to become sunk costs, which not only fails to continuously create benefits for the enterprise, but also causes financial burden, thereby affecting long-term performance.

Third, by controlling R&D investment, the positive relationship between environmental investment and corporate financial performance can be regulated, which means that environmental investment and R&D investment in heavily polluting industries can form a synergistic effect. Intensifying R&D innovation can not

only enable enterprises to respond to constantly changing internal and external demands and form differentiated advantages, but also enable them to simultaneously achieve the goals of increasing production and efficiency, as well as energy conservation and emission reduction, positively promoting the impact of environmental investment on financial performance.

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The authors declare no conflict of interest.

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