Environmental Protection Investment and Market Value

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Abstract

With the increase of environmental supervision in China, environmental protection investment has become an inevitable investment choice for polluting enterprises. However, whether environmental protection investment can bring value to the enterprise has always been a hot topic of debate. The paper takes the 2008-2016 China A-share heavy polluting industry listed companies as the research object, tests the correlation between environmental protection investment and market value. Using the Ohlson valuation model, it is found that environmental investment has a positive impact on the market value. Further, the paper examines two possible paths of environmental investment impact on market value, and the results show that environmental protection investment increases the earnings persistence, but has no significant impact on the cost of equity capital. Therefore, it is concluded that environmental protection investment is conducive to the increase of market value, and the mechanism of environmental protection investment affecting market value is to improve the sustainability of earnings.

Keywords

Environmental Protection Investment, Market Value, Earnings Persistence, Cost of Equity Capital

1. Introduction

The report of the 19th National Congress of the Communist Party of China proposed to implement the most stringent ecological environmental protection system, so that a good ecological environment will become a support point for sustained and healthy economic and social development. In recent years, China's environmental governance has increased significantly, and government has issued a series of laws and regulations to protection environment. The environ-

mental liability risks and environmental illegal costs of enterprises are increasing. Under the strict environmental supervision system, investment in environmental protection has become an indispensable investment for enterprises.

Can environmental protection investment give enterprises a competitive advantage and value added? Porter [1] believes that appropriate environmental regulatory policies will promote companies to make product or technological innovations. The company's environmental investment behavior not only promotes the innovation and application of clean technology, but also reduces the cost of environmental pollution. At the same time, it may increase productivity and give enterprises a competitive advantage. The Porter hypothesis broke the "pollution paradise hypothesis" and provided a theoretical basis for environmental regulation and corporate environmental protection investment behavior. Part of the research supports the Porter hypothesis, which shows that environmental investment can improve business productivity and financial performance [2] [3]. However, there are also studies that give unfavorable evidence to the Porter hypothesis. For example, Broberg et al. [4] based on the data from five industries in Sweden during 1999-2004, found that the inefficiency is a function of environmental protection investment; Liu and Cui [5] found that environmental protection investment is not conducive to the value of China's heavily polluting industries create.

Overall, the studies show that environmental regulation can promote enterprises to increase investment in environmental protection, and whether environmental investment has promoted the value-added of enterprises, there is still controversy. In order to study the relationship between environmental protection investment and corporate value, this paper tests the impact of environmental protection investment on corporate value, and researches the mechanism of environmental investment to increase corporate value. The results of this study show that under the environmental supervision system of China, environmental protection investment behavior has played a positive role in the sustainable development of enterprises, and the economic incentive for environmental investment to add corporate value may be to increase the earnings of earnings.

The remainder of this paper proceeds as follows. Section 2 reviews the existing literature on environmental protection investment and corporate value, and develops testable hypotheses. Section 3 discusses our research design. Section 4 describes presents descriptive statistics, correlation coefficient and reports our main empirical results. Section 5 presents additional analyses. Finally, Section 6 sets our conclusions.

2. Theoretical Basis and Research Hypothesis

In this section, this paper provides theoretical arguments motivating hypothesis H1 that environmental protection investment is positively valued by markets. Then, based on the Ohlson valuation model, this paper explore the mechanism of environmental protection investment affecting market value, and Propose hypotheses H2 and H3.

2.1. Environmental Protection Investment and Market Value

With the prominent environmental problems such as smog and water pollution, China has paid more and more attention to environmental protection, and the supervision of heavily polluting enterprises has become more and more strict. Enterprises invest in environmental protection to improve severe pollution and meet social expectations. Therefore, companies investing in environmental protection are conducive to legitimacy. Legitimacy is a resource of an enterprise and can bring competitive advantage to the enterprise. López-Gamero *et al.* [6] show that environmental protection investment will reduce the pollution of enterprises and enhance the reputation and image of enterprises, which enable them to obtain more social resources, and ultimately bring ecological innovation compensation.

According to the stakeholder theory, the survival and development of any company is inseparable from the participation of various stakeholders. Environmental protection investment is a manifestation of corporate social responsibility, which can enhance the trust of stakeholders in the company, improve the relationship between shareholders and stakeholders, and thus improve the financial performance of the company. From the perspective of the government, good environmental performance can reduce the risk of environmental violations especially when the intensity of environmental control has reached a high level, and companies that actively invest in environmental protection often receive preferential policies such as tax breaks or government subsidies from the government [7]. From the perspective of employees, environmental protection investment is conducive to reducing pollution emissions, creating a good working environment and public image, which is conducive to attracting talents and motivating excellent employees to promote productivity [8]]. From the perspective of consumers, active investment in environmental protection can help promote the differentiation of products and services, enhance the competitiveness of products and services, and enhance consumers' willingness to purchase. From the perspective of investors, environmentally friendly companies are conducive to attracting investors with high environmental responsibility sensitivity, and are more likely to be favored by more investors [9].

In short, environmental protection investment is conducive to the company's recognition of society and stakeholders, improving reputation and image, and thus promoting value added. Therefore, the first hypothesis is proposed:

H1: Environmental protection investment is positively valued by markets.

2.2. The mechanism of Environmental Protection Investment Affecting Market Value

In hypothesis H1, this paper proposes that environmental investment can promote the increase of corporate value. However, whether environmental investment directly promotes the increase of corporate value or the value increase caused by acting on other variables remains to be discussed. Ohlson [10] shows that if the market value of the firm is the present value of the company's future

dividends, then the market value can be expressed as a function of net profit, net assets, net dividends and other information. If other information is set to zero, the Ohlson (1995) estimation model can be expressed as:

$$MV_t = (1-k)BV_t + k\left(NI_t * R/r - DIV_t\right)$$

where MV_t = market value at the end of year t, BV_t = book value at the end of year t, NI_t = net income for year t, and DIV_t = net dividends for year t. $R = 1 + r$, k is the evaluation multiplier, $k = r * \omega/(R - \omega)$, where r = the cost of equity and ω is 1 + the growth rate in abnormal earnings.

According to Ohlson [11] valuation model, environmental investment may have a direct impact on corporate value as "other information", or it may indirectly affect corporate value by changing the valuation multiplier k. This paper argues that environmental protection investment is more likely to increase corporate value by increasing the valuation multiplier k. The main reasons are as follows: First, environmental protection investment is unlikely to have an impact on the earnings of the investment year, and more affects the future earnings. Second, studies show that environmental investment may have an impact on the cost of equity capital. It can be seen from the model that the valuation multiplier k is determined by w which is autocorrelation coefficient of the residual income and r which is the cost of equity capital. Therefore, following Gregory *et al.* [12] we discuss the impact mechanism of environmental protection investment on the market value of enterprises from the aspects of earnings sustainability and equity capital cost.

First, with respect to earnings persistence, environmental protection investment can improve the company's earnings persistence, mainly reflected in the following three aspects: First, environmental protection investment promotes enterprises to adopt cleaner production methods, and avoid production suspension and rectification. Second, as a long-term investment, environmental investment is more reflected in the outflow of cash in the current period, and the cash inflow brought by it is more reflected in the future. Enterprises investing in new environmental protection projects such as sewage treatment system, recycled lead resource recycling project and slag resource comprehensive utilization project, may invest a large amount of capital, manpower and material resources in the current period of investment construction. However, during the period after it is completed and put into use, it can promote the recycling of resources and reduce the operating costs of enterprises. Third, according to Porter's hypothesis, companies with greater environmental governance investments are more motivated to develop new products and technologies. Through technology or product innovation, environmental companies can enhance their competitive advantage and achieve sustainable development. When the earnings is more sustainable, it can better reflect the future cash flow. The higher the accuracy of the investor's current earnings to predict future earnings, the higher the market value of the company [13]. We therefore hypothesize the following:

H2: Environmental investment increases the market value of the company by

increasing the persistence of the earnings.

Second, with respect to cost of equity capital, prior work argues that environmental investment may reduce investor risk expectations from both systemic risk and risk sharing. First of all, for environmentally friendly companies, investors' perceived risk is significantly lower and the required return on investment is lower. Ghoul *et al.* [14] believe that companies actively undertake social environmental responsibility, which is conducive to reducing the operational risks brought about by environmental scandals, and thus reducing the company's cost of equity. Second, heavily polluting companies that invest in environmental protection may have more investor bases than heavily polluting companies that do not invest in environmental protection, which reduces the systemic risk shared by investors. Heinkel *et al.* [15] theoretically show that the exclusionary investment of green investors will lead polluters to attract only investors from neutral investors. Therefore, polluting companies have fewer investor bases than green ones. To retain a small number of neutral investors, polluting companies must provide higher expected returns for neutral investors. Li Wenjing and Lu Xiaoyan [16] shows that environmental protection investment has a positive effect on institutional investors' shareholding ratio, indicating that investors are more inclined to invest in enterprises with higher environmental protection investment. In summary, companies with lower equity capital costs have higher market value, and it is expected that the cost of equity capital of environmental investment companies is lower. Based on this, hypothesis 3 is proposed:

H3: Environmental investment increases the market value of the company by reducing the cost of equity capital.

3. Research Method

3.1. Research Variables and Economic Models

If market value, MV, is the present value of future expected dividends, then Ohlson (1989) show that value will be a linear combination of book value (BV), net income (NI), dividends (DIV), as shown in model (1). In order to examine the relationship between environmental investment and market value, following Rees and Valentincic [17], we add the environmental investment variable and intersections of it with the other three variables to model (1), yielding the following model (2):

$$MV_{it} = \alpha_0 + \alpha_1 BV_{it} + \alpha_2 NI_{it} + \alpha_3 DIV_{it} + \varepsilon \tag{1}$$

$$\begin{aligned} MV_{it} = {} & \alpha_0 + \alpha_1 BV_{it} + \alpha_2 NI_{it} + \alpha_3 DIV_{it} + \alpha_4 EI_{it} + \alpha_5 EI_{it} * BV_{it} + \alpha_6 EI_{it} * NI_{it} \\ & + \alpha_7 EI_{it} * DIV_{it} + \text{Industry} + \text{Year} + \varepsilon \end{aligned} \tag{2}$$

where *EI* is the amount of environmental protection investment of the enterprise, which is measured by the increase in the current period of environmental protection projects under construction. If environmental investment can increase market value, then in the regression result of model (2), the coefficient of *EI* is significantly positive, or the coefficient of intersection of *EI* and the other

three variables is significantly positive.

Follow the method used in most articles, we build the model (3) to examine the impact of environmental investment on the relationship one period ahead earnings and current earnings. Further, control other variables that may affect the persistence of earnings, and obtain the model (4). If environmental investments increase market value by increasing earnings persistence, then the coefficients of $EI*NI$ are expected to be significantly positive in the regression results of model (3) and model (4).

$$NI_{it+1} = b_0 + b_1 NI_{it} + b_2 EI_{it} + b_3 EI_{it} * NI_{it} + \text{Industry} + \text{Year} + \varepsilon \quad (3)$$

$$NI_{it+1} = b_0 + b_1 NI_{it} + b_2 EI_{it} + b_3 EI_{it} * NI_{it} + b_4 SIZE_{it} + b_5 LEV_{it} + b_6 INTAN_{it} \\ + b_7 GROWTH_{it} + b_8 LOSS_{it} + \text{Industry} + \text{Year} + \varepsilon \quad (4)$$

In order to test the impact of environmental protection investment on the cost of equity capital, following to Xiao Zuoping [18], this paper builds model (5):

$$R_{it+1} = \gamma_0 + \gamma_1 EI_{it} + \gamma_2 BP_{it} + \gamma_3 ROA_{it} + \gamma_4 SIZE_{it} + \gamma_5 LEV_{it} + \text{Industry} + \text{Year} + \varepsilon \quad (5)$$

where R_{it+1} is the cost of equity of the enterprise, measured by three methods which are R_PEG calculated by PEG model, R_OJN calculated by OJN model and average number R_AVE of two above. If the assumption 3 is true, then the coefficient of EI is expected to be significantly negative.

As in Gregory *et al.* (2016), we estimate all models deflated by number of shares. All variables are defined in Table 1.

3.2. Sample and Data

Considering the environmental protection policies in China, this paper takes the 2008-2017 A-share heavily polluting industry companies as research samples. According to the catalogue of classified management of environmental checking industry of listed companies in China, 16 types of heavily polluting industries will be included in the scope of sample research. We choose 2008 as our final year because in 2008 green financial policy began to be implemented in China. In addition, we delete the sample companies of ST and ST*, and delete the sample companies for missing values.

We hand-collect the environmental protection investment data from the notes of the annual report disclosed by the companies, calculated by the amount of construction-in-progress that belongs to the environmental protection in the current period. The data of other variables are all from the CSMAR database.

4. The Empirical Results

4.1. Descriptive Statistics

Table 2 shows the statistical description results for the variables. As can be seen from Table 2, the average value of market value per share (MV/n) is 29.811, the minimum value is 3.730, and the maximum value is 195.202. The average net profit per share (NI/n) is 0.721, and the average dividend per share (DIV/n) is 0.225, but the amount of environmental investment per share (EI/n) is only

Table 1. Research variables.

Variable	Code	Definition
Market value	MV	The number of shares at the end of the period multiplied by the price of per share
Environmental investment	EI	Increased amount of Environmental Protection Projects in Construction Projects
Cost of equity	R	Calculated by PEG model and OJN model
Net income	NI	Current net profit reported by the enterprise
Book value of equity	BV	Book value of equity at the end of the current period
Dividends	DIV	Cash dividends declared by enterprises in the current period
Growth	GROWTH	(Current Operating Revenue − Last Operating Revenue)/Last Operating Revenue
Loss	LOSS	If the current net profit is less than 0, make LOSS = 1, otherwise = 0
Intangible assets	INTAN	The proportion of intangible assets to total assets at the end of the current period
Leverage	LEV	The ratio of end of period liabilities to total assets
Book-to-market	BP	The ratio of end of period net assets to end of period market value
Size	SIZE	Logarithm of total assets at the end of period
Return on Assets	ROA	Ratio of net profit to average total assets

Table 2. Descriptive statistics.

Variable	Sample	Mean	SD	Min	Median	Max
MV/n	5192	29.811	38.621	3.730	15.822	195.202
EI/n	5192	0.028	0.086	0.000	0.000	0.470
NI/n	5192	0.721	1.104	−0.957	0.362	4.987
R_PEG	1882	0.137	0.103	0.014	0.109	0.463
R_OJN	1823	0.160	0.107	0.039	0.128	0.497
R_AVE	1808	0.151	0.104	0.032	0.121	0.482
BV/n	5192	8.675	8.827	0.777	5.591	42.070
DIV/n	5192	0.225	0.394	0.000	0.074	2.000
GROWTH	5192	0.138	0.300	-0.401	0.101	1.432
INTAN	5192	0.776	0.919	0.007	0.458	4.499
LOSS	5192	0.105	0.307	0	0	1
LEV	5192	0.422	0.208	0.056	0.424	0.848
BP	5192	0.872	0.779	0.114	0.598	3.542
SIZE	5192	22.02	1.212	19.76	21.83	25.13
ROA	5192	0.047	0.06	-0.112	0.04	0.218

The data of environmental investment is hand-collected from the notes of the companies' annual report, the data of other variables are all from the CSMAR database.

0.028, indicating a significant portion of the profit is used to distribute dividends, and only a very small portion is used for environmental investments. In addition, using the PEG model and the OJN model to calculate the cost of equity capital requires three consecutive periods of financial data, resulting in fewer sample sizes. The mean values of the variables R_PEG and R_OJN for measuring equity capital are 0.137 and 0.160, respectively, which are compared with Li Huiyun and Liu Wei (2016) using the PEG model and Xiao Zuoping (2016) using the OJN model to calculate the cost of equity capital. The mean values of 0.14 and 0.148 are similar.

4.2. Correlation Coefficient between Main Variables

Table 3 is a table of correlation coefficients for the main variables. It can be seen from the table that the company's environmental investment (EI/n) has a significant positive correlation with market value (MV/n) and earnings (NI/n), which is related to This paper assumes that the expectations of 1 match. In addition, from Table 3, it can be seen that the three different equity capital cost proxy variables are significantly positively correlated, and the correlation coefficient (0.991; 0.998) is close to 1, indicating that the measurement methods of the three equity capital costs are consistent and reasonable. At the same time, it can be seen from the correlation coefficient table that there is no serious collinearity problem.

4.3. Main Regression Results

Table 4 shows the regression results for model (1) and model (2). The second column is the regression result of Ohlson's (1995) valuation model, model (1). It can be seen that the coefficients of corporate net assets (BV), net profit (NI) and dividends (DIV) are all significantly positive. The third column is the regression result of the model (2). It can be seen that although the coefficient of the environmental investment variable EI is negative but not significant. The coefficient of the environmental investment variable EI and the net profit variable NI intersection is 0.995, which is significantly positive at the 5% level. This shows that for each additional unit of EI, the positive effect of net profit NI on market value increases by 0.995 units, that is, environmental protection investment increases the valuation coefficient before net profit by 0.995 units. Therefore, environmental investment promotes the increase of market value by increasing the positive effect of net profit on market value.

According to the Ohlson (1995) valuation model, the increase in the valuation coefficient before the net profit NI may be due to the change in the residual income growth rate w or the equity capital cost r. Therefore, the results in Table 4 initially prove that environmental investment can promote the increase of market value, and the path of environmental investment to increase market value may be to make the earnings continue to grow or reduce the cost of equity capital.

Table 3. Pearson correlation coefficient of main variables.

Variable	MV/n	BV/n	NI/n	DIV/n	EI/n	R_PEG	R_OJN	R_AVE
MV/n	1							
BV/n	0.790***	1						
NI/n	0.781***	0.788***	1					
DIV/n	0.680***	0.691***	0.791***	1				
EI/n	0.081***	0.139***	0.095***	0.078***	1			
R_PEG	−0.265***	−0.178***	−0.211***	−0.190***	0.071***	1		
R_OJN	−0.266***	−0.183***	−0.231***	−0.212***	0.064***	0.991***	1	
R_AVE	−0.274***	−0.184***	−0.225***	−0.202***	0.065***	0.998***	0.998***	1

The data of environmental investment (EI) is hand-collected from the notes of the companies' annual report, the data of other variables are all from the CSMAR database. Figures in parentheses indicate t-values. ***, **, * represent statistical significance at 1%, 5%, 10%, respectively (two-tail).

Table 4. Environmental protection investment and enterprise market value.

	Model (1)	Model (2)
BV	2.348***	2.349***
	(46.28)	(45.39)
NI	8.759***	10.265***
	(18.33)	(20.04)
DIV	10.812***	10.516***
	(9.45)	(8.19)
EI		−0.394
		(−0.13)
EI*BV		0.044
		(0.43)
EI*NI		0.995**
		(2.16)
EI*DIV		−2.683
		(−1.54)
cons	11.42	11.41
	(1.47)	(1.47)
Year effects	Yes	Yes
Industry effects	Yes	Yes
Adj-R2	0.760	0.761
N	5192	5192

The data of environmental investment (EI) is hand-collected from the notes of the companies' annual report, the data of other variables are all from the CSMAR database. Figures in parentheses indicate t-values. ***, **, * represent statistical significance at 1%, 5%, 10%, respectively (two-tail).

4.4. Channels through Which Reputation Affects the Cost of Equity

Table 5 shows the regression results of model (3) and model (4). First, it can be seen that the coefficients of the EI*NI intersection are significantly positive regardless of which regression method is used. Second, the coefficients of the EI*NI intersection are also significantly positive, whether or not the control variable is added. This shows that environmental investment can increase the earnings persistence, and this result is robust. Specifically, model (3) examines the effect of environmental protection investment on the sustainability of net profit without adding control variables. When using OLS mixed regression, the coefficient of EI*NI is 0.017, at 5% level significantly. Therefore, the regression results of model (3) and model (4) verify the establishment of hypothesis 2, that is, environmental protection investment increases the market value of the enterprise by increasing the earnings persistence.

Table 6 shows the regression results of model (5). Among them, the second column is the regression result when the cost of equity capital R is R_PEG. It can be seen that the coefficient of the environmental investment variable EI is −0.012, but it is not significant. The third column and the fourth column are regression results obtained when R is taken as R_OJN and R_AVE, respectively, and it is noted that the coefficient of EI is still negative but not significant at this time. It can be seen from Table 6 that in any of the three methods of measuring

Table 5. Environmental protection investment effect on earnings persistence.

	Model (3)	Model (4)
NI	0.565***	0.465***
	(66.88)	(55.01)
EI	−0.287***	−0.292***
	(−2.70)	(-3.14)
EI*NI	0.017**	0.013*
	(1.99)	(1.84)
SIZE		0.063***
		(7.17)
LEV		−0.451***
		(-8.64)
INTAN		0.183***
		(16.75)
GROWTH		0.526***
		(17.76)
LOSS		−0.600***
		(-20.99)
cons	0.11	−1.183***
	(0.35)	(−3.65)
Year effects	Yes	Yes
Industry effects	Yes	Yes
Adj-R2	0.543	0.654
N	4535	4535

The data of environmental investment (EI) is hand-collected from the notes of the companies' annual report, the data of other variables are all from the CSMAR database. Figures in parentheses indicate t-values. ***, **, * represent statistical significance at 1%, 5%, 10%, respectively (two-tail).

Table 6. Environmental investment and cost of equity.

	Model (5)		
	R_PEG	R_OJN	R_AVE
EI	−0.012	−0.035	−0.026
	(−0.44)	(−1.26)	(−0.94)
SIZE	−0.001	−0.004	−0.002
	(−0.44)	(−1.26)	(−0.74)
BP	0.035***	0.037***	0.036***
	(6.44)	(6.44)	(6.42)
LEV	0.073***	0.077***	0.072***
	(4.82)	(4.81)	(4.63)
ROA	−0.092*	−0.124**	−0.107**
	(−1.87)	(−2.38)	(−−2.10)
cos	0.214**	0.085	0.026
	(2.49)	(0.76)	(0.24)
Year effects	Yes	Yes	Yes
Industry effects	Yes	Yes	Yes
N	1471	1419	1407
Adj-R2	0.242	0.252	0.254

The data of environmental investment (EI) is hand-collected from the notes of the companies' annual report, the data of other variables are all from the CSMAR database. Figures in parentheses indicate t-values. ***, **, * represent statistical significance at 1%, 5%, 10%, respectively (two-tail).

the cost of equity capital, the regression coefficient of environmental protection investment on the cost of equity capital is not significant. The regression results cannot support the establishment of Hypothesis 3, so it is impossible to conclude that environmental protection investment increases market value by reducing the cost of equity capital.

Combined with the results of Tables 4-6, it can be concluded that environmental investment is conducive to the increase of market value, and value added by increasing the sustainability of earnings.

5. Conclusions

In order to better understand the value of environmental protection investment and clarify the effectiveness of environmental supervision policies, this paper examines the relationship between environmental protection investment and corporate market value by using A-share listed companies in the heavily polluting industry in 2008-2016 as research samples. The main conclusions are as follows: 1) Environmental investment is conducive to increase market value. Based on the Ohlson (1995) valuation model, the paper builds a model to examine the impact of environmental investment on market value. The regression results show that the coefficient of intersection of environmental investment and earnings is significantly positive, indicating that environmental investment can increase

the valuation multiplier, indicating that environmental investment has a positive effect on the market value of the enterprise. 2) Environmental investment increases the market value of the company by increasing earnings persistence. According to the Ohlson (1995) valuation model, the increase in valuation multiplier may be due to the increase in earnings persistence or the reduction in the cost of equity capital. When using the regression model empirical test, the results show that environmental protection investment is conducive to increasing earnings persistence, but the impact of environmental protection investment on the cost of equity capital is not significant. Therefore, combined with the first conclusion, environmental investment has contributed to the increase in market value by increasing earnings persistence.

The research conclusions of this paper show that a strict ecological environmental protection system will promote enterprises to invest in environmental protection, promote production methods, and achieve synergy between development and environmental protection. Although environmental protection investment currently occupies corporate resources and leads to cash outflows, in the long run, environmental protection investment will help stabilize the operation of the company and make the company's earnings more persistent.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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