

Internal control and environmental protection investment of listed companies in China's high-pollution industries—a test of masking effect based on CSR

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Abstract. The environment serves as the foundation for human survival and development, while enterprises are the core entities in environmental protection governance, with their environmental investments directly determining pollution control outcomes. Taking A-share listed companies in highly polluting industries from 2019 to 2023 as samples, this study investigates from the perspective of internal control: it confirms that internal control can significantly promote corporate environmental investments; however, social responsibility exhibits an inverse masking effect between the two, diverting environmental-related resources and suppressing the positive role of internal control, with this effect being more pronounced in western regions. Based on these findings, the paper proposes targeted optimization suggestions to provide references for stimulating the endogenous motivation of corporate environmental investments.

Keywords: internal control, environmental investment, Corporate Social Responsibility (CSR), mediation effect

1. Introduction

Corporate development and environmental protection has always been a controversial topic. China suffers about \$100 billion in economic losses each year from air and water pollution, about 5.8% of GDP for the same time period, according to the World Bank report entitled "*Environmental Pollution Losses in China*" released in 2007. 80% of environmental pollution is generated by the production and operations of companies [1] and this is the basis from which the practical application of the "polluter pays" principle starts. Thus, the enterprises can be identified as the main source of environmental pollution and the main subject of environmental protection [2]. As the main system of modern corporate governance, internal control is the basic safeguard of company operation and risk prevention, and also the important impetus for companies to fulfill their social responsibilities, achieve sustainable development in the development process [3]. Social responsibility has changed from an "additional project" for enterprises in the past to an important index to measure the comprehensive value of enterprises, including multiple dimensions such as safe production, environmental protection, green and low-carbon transformation. Furthermore, major companies have, in general, integrated it into their strategies for the long term. But many enterprises have a low level of social

responsibility and are only willing to comply with the minimum; they have lacked in investment in environmental protection and other areas. In some enterprises the construction of social responsibility is separated from daily operation and management, and enterprises have not yet completely put social responsibility requirements into the whole process of internal control, which makes it difficult to prevent and control the risk of environmental and other social responsibility matters in the internal control system. Thus, it is of great significance for promoting enterprise development how enterprises can take environmental responsibility, increase environmental protection investment and do the internal control.

2. Literature review

Previous studies have shown that the quality of internal control can have a positive effect on environmental governance of the company, especially in companies that have a high level of pollution, the positive relationship between the quality of internal control and environmental governance is greater [4, 5]. But, the literature of the linkage between internal control and environmental investment is not much. Some research has delved into the correlation between internal control and environmental performance, environmental protection responsibility, and environmental information disclosure.

Internal control has a spillover effect that can be conducive to the improvement of environmental performance [6, 7]. Good internal control helps companies to follow up better and better the relevant environmental laws and regulations, and fulfil their environmental responsibilities [8]. Quality internal control establishes an efficient communication mechanism and supervision system, which can give basic guarantee to the improvement of enterprises' environmental information transparency [9]. Thus, Effective internal control can play a significant role in improving the disclosure of environmental information in companies [10] and reducing the collusion between management and controlling shareholders in environmental investment decisions and maximize the protection of the rights and interests of all stakeholders [11]. Therefore, give reasonable assurance of reliable corporate environmental report and enhance the transparency of environmental information. Moreover, internal environmental factor, information factor and communication factor can have a great influence on enterprise environmental performance, so as to facilitate the authenticity of enterprise environmental information disclosure [12]. Some researchers have also studied aspects such as green innovation [13], enterprise risk [14] and enterprise performance [15, 16] and found that the internal control exercise a strong influence on environmental information disclosure and environmental responsibility, showing that the inner control has the promoting effect of enterprise environmental practice.

As an essential part of social responsibility, environmental responsibility has become enterprises' choice to adapt to the complex environment, ecological and environmental constraints and to ensure sustainable development. In the background of the "dual carbon" goal and the promotion of the construction of ecological civilization in depth, high-pollution industries will be under far greater environmental pressure [17]. During operation, if the amount of investment in environmental protection is inadequate and the amount of resource is large, it will lead to environmental pollution or resource exhaustion. This will result in large compensation, no development opportunities or even business closing [18]. Thus, in order to carry out the duty of environmental protection, high pollution enterprises should have some environmental protection assets and skills, and adopt energy-saving and consumption reducing equipment and technology. Internal control as an important aspect of corporate governance will provide good environment and important guarantee of corporate social responsibility performance [19].

Many studies have been conducted on internal control and social responsibility, one of the most obvious signs is that social responsibility is very important for enterprises, and its performance is determined by the

internal control of the enterprise [20]. Appropriate internal control can help the companies to achieve their social obligations, and enhance management [21]. The higher the quality of internal control of the company, the better the corporate social responsibility becomes standardized and organized in the company. Thus, internal control quality is the assurance for smooth implementation of the corporate social responsibility activities [22]. A good internal control helps to mitigate the losses resulting from opportunistic behavior in the implementation of corporate social responsibility [23]. Minimize the risk of social responsibility, minimize the loss of reputation from negative news, illegal and irregular actions and protect the legit rights and interests of stakeholders [24]. Thus, there is a positive promoting effect of internal control on the corporate social responsibility being fulfilled [25, 26].

Meanwhile, some scholars have also conducted researched on the influencing factors of environmental investment. In terms of internal factors, the more positive the management's attitude towards environmental awareness is, the more positive it is [27]. The greater the stickiness of executive compensation [28], the more positive it is for corporate environmental performance. The less the level of corporate governance, the less, the enterprise is willing to invest in environmental protection [29]. Meanwhile, the level of supervision of enterprises on the environment has also a positive effect on environmental investment [30]. In the eyes of the outside world, government environmental regulation measures also affect corporate environmental investments. The government, for instance, monitors compliance with environmental law enforcement [31], charges environmental taxes [32] and fines heavily any enterprise whose emissions are above allowed limits [33].

From the literature reviewed, it is found that few studies combined internal control, social responsibility, corporate environmental investment for research. So, what is the impact of the environmental investment in high-pollution industries under various levels of internal control effectiveness in the enterprises? Does it make any difference if companies are socially responsible when it comes to environmental investment? All these need to be studied more. This paper will try to build a panel data model to deeply discuss the causal relationship between the three, so as to provide evidence for environmental management research.

This paper makes the following major contributions. (1) More studies into the economic implications of internal control. Today's research primarily focuses on the economic effects of internal control from financing costs and corporate performance. This study also revealed that internal control has positive and significant effect on the environmental investment, which proves that internal control has certain social effect. (2) The study with regard to the economic consequences of social responsibility has been added. The moderating role of social responsibility has been mainly investigated within the context of existing studies. This paper takes "social responsibility" as the mediating variable to analyze the causal transmission effect of the influence of "internal control" on "environmental protection investment", and enrich the research results about the social responsibility. (3) The research of the influencing factors of environmental protection investment has been enriched. Previous studies primarily address the effects of environmental policies and regulations, internal governance and other aspects on environmental protection investment. The paper is based on study of the effects of internal control on the investment of environmental protection, this is a useful supplement to the existing study. (4) A more detailed regional heterogeneity analysis. Previous studies were mostly on the nature of property rights and rarely referred to the regional factors. The unbalanced regional economic development leads to the unbalanced development of enterprises. This study focuses on how the classification of heavily polluting industries into regions can expand the research about the factors of environmental investment of the region, and further explores whether or not social responsibility can serve as an intermediary link to the regional environmental investment.

3. Hypotheses development

3.1. Internal control and environmental investment

The high pollution industries pollute the environment, they destroy the environment. These effects entail social costs for people around the processing plant and environmental vulnerability of the area [34]. All of these consequences are converted from the already existing environmental risks. Thus, it is necessary to enhance the environmental risk prevention measures in enterprises. Protecting the environment is one of internal control. Therefore, enterprises in the implementation of internal control, the investment and protection of the environment must be paid attention. Environmental protection can be enhanced to mitigate the environment-related risks to enterprises. But during the operation of enterprise, if environmental protection investment is stepped up, it can impact the enterprise profit. Conversely, since investing in the environment is relatively costly, the main reason for investing is to gain social and environmental returns, but not economic ones. Hence, the enterprise does not have enthusiasm to do environmental protection investment [35]. Mylonakis and Tahinakis [36] demonstrated that in the early phase of enterprise development the environmental investment is not actually intended to enhance the environment but more likely to benefit the corporate profit. Pei W. P. and Pei W. R. [6] think that under the profit maximization principle, enterprises are inclined to decrease the investment in environmental protection and neglect the effect of environmental pollution. This renders the internal control of enterprises useless and has great social consequences. The purpose of the establishment of internal control is to control the negative effect of environment uncertainty within relatively appropriate range, make social contract, reduce transaction cost after the event [37] and effectively prevent and contain all kinds of the risk behavior harmful to enterprise [38] and encourage enterprise to actively invest in environment protection, enhance enterprise's environmental effect. Thus, the strengthening of internal control exerts a great promotion to companies' positive investment in environmental protection [5].

Upper Echelons Theory states that due to complexity in internal and external environment, managers are incapable of understanding all aspects of the environment. The manager is able to view only a portion of the phenomenon in his field of vision. The enterprise development decision will be based on the manager's cognitive, perception and values. The environmental protection investment is primarily to get social benefits instead of economic benefits. When it comes to environmental protection investment, the manager will certainly have the phenomenon of short-term investment behavior, just select the investment project that can get economic benefit quickly, and minimize the amount of environmental protection investment [39]. Internal control is a system of enterprise self discipline. This sort of short-term thinking investment conduct can be effectively prevented by the basic norm of enhancing managers' self-discipline. Shin and Park [40] revealed that if the internal control was reasonable, the firm would exert pressure on the management so that the management would make more effective investment decision, increase the sensitivity of investment expenditure and investment opportunities, and decrease the possibility that the investment expenditure deviated from the investment opportunity due to the personal interest of the management. This further increases the magnitude of environmental protection investment.

From the above argument the authors are proposing the following first hypothesis.

Hypothesis 1: Internal control level of high-pollution industries is significantly and positively correlated with environmental protection investment.

3.2. Internal control and social responsibility

Article 4 of the "Application Guidelines for Enterprise Internal Control" provides relevant regulations on the internal control of corporate social responsibility, including environmental protection, in the section on social

responsibility application guidelines. The specific path of these provisions is as follows. (1) From the perspective of sustainable development, internal control focuses on the interaction between enterprises and society, the environment, and the economy. Therefore, sustainable economic growth requires that the development strategy of enterprises be coordinated with their environmental responsibilities [41]. (2) Corporate internal control emphasizes that the object of internal control is extended from financial information to non-financial information, including social responsibility information. Establishing a sound internal control system can better promote corporate social responsibility performance [42]. (3) One of the essential functions of internal control is to control risks. It can effectively prevent all kinds of risk behaviors that damage corporate reputation and image and reduce the probability of events that damage corporate social responsibility performance to improve the level of corporate social responsibility performance [43]. Therefore, the basic norms of internal control in China, as enterprises' institutional norms, have a series of spillover effects, such as the social responsibility effect [44]. The most important factor determining whether a company can actively undertake social responsibility is corporate governance [45]. An effective internal control system serves as the foundation for the functioning of corporate governance structure and can provide guarantees for enterprises to fulfill their social responsibilities. Zhang et al. [46] showed that a higher quality of internal control would promote enterprises to become law-abiding corporate citizens and better fulfill their environmental responsibility. Environmental legitimacy has become a focus of concern for stakeholders in the process of economic transformation, and institutional pressure is the determining factor for enterprises to obtain legitimacy [47]. Institutional pressure can significantly promote the improvement of corporate environmental responsibility, and internal control positively regulates the relationship between institutional pressure and corporate environmental responsibility [48]. Therefore, to transmit information from legal operations to investors, enterprises should take the initiative to bear social responsibility and increase environmental protection investment to reduce public doubt. Based on the above analysis, the authors propose the second hypothesis.

Hypothesis 2: The better the internal control quality of high-pollution industries, the more conducive they are to strengthening corporate social responsibility performance.

3.3. Internal control, social responsibility, and environmental protection investment

The 19th National Congress of the Communist Party of China proposed that enterprises should develop in an ecological and green way. Sustainable economic growth requires that the development strategy of enterprises must be coordinated with their environmental responsibilities. The Committee of Sponsoring Organizations of the Treadway Commission (COSO) emphasizes that the object of internal control extends from financial information to non-financial information, including social responsibility information [49]. Therefore, while pursuing profit maximization, enterprises will also be required to assume corresponding social responsibilities and invest more efforts in environmental protection to improve and govern the environment [50]. The environmental responsibility of a company is measured through environmental investment [28]. A good internal control system can strengthen the ethical concept of environmental protection in enterprises, reshape the values related to environmental protection, enhance environmental awareness, and promote enterprises to increase environmental investment. The relevant social responsibility section of the *"Internal Control Supporting Guidelines"* also proposes to include environmental protection in the scope of internal control of enterprises, and to use environmental protection behavior as an important indicator to measure the quality of internal control of enterprises. This indicates that internal control has a certain social effect, that is, improving the quality of internal control will encourage enterprises to increase the scale of environmental protection investment [51].

At the same time, there is a certain implicit contract between enterprises and the public. If enterprises want to be recognized by the public, they must assume more social and environmental protection responsibilities. That is to say, enterprises actively fulfilling their social obligations is an important way for them to transmit their business legitimacy to the public and relevant regulatory departments, and public supervision promotes the implementation of this legitimacy [52]. On the other hand, both "expense-based" and "investment-based" environmental investments are manifestations of corporate social responsibility. The former is achieved through end-of-pipe treatment and payment of fines, while the latter is achieved through technological improvement and product innovation. Compared with enterprises with lower internal control quality, enterprises with higher internal control quality can better fulfill their social responsibilities. Therefore, the role of environmental investment in reducing the second type of agency costs will be stronger [51, 53]. According to the agency theory, managers need to actively disclose environmental information to shareholders to reduce the cost of supervision. Managers show their environmental responsibility performance to shareholders by increasing environmental investment expenditure [52].

However, some scholars have also put forward opposite research conclusions. Although internal control can effectively promote a company's responsibility towards suppliers, its impact on the responsibility of other stakeholders is not significant [54]. Especially, the impact on employee responsibility and corporate environmental responsibility is not significant [55]. When corporate social responsibility increases, it to some extent increases the management and operating costs of the enterprise, making it difficult to achieve economic benefits in the short term [56]. Establishing and operating a high-quality internal control system incurs substantial implementation costs. These costs can divert resources that the enterprise might otherwise allocate towards social responsibility initiatives, thereby inhibiting the fulfillment of corporate responsibility. Ultimately, this results in internal controls failing to promote, or even negatively impacting, the enterprise's assumption of relevant responsibilities. Enterprise managers may consider the economic output benefits of environmental investment while complying with national requirements, resulting in a reduction in environmental investment intensity [57]. Li et al. [58] analyzed the five elements of internal control and found that risk assessment factors are not related to Corporate Social Responsibility (CSR), and therefore cannot strengthen corporate environmental investment.

Based on the above analysis, internal control has a "double-edged sword" effect on environmental protection investment: it can promote investment through governance mechanisms, but it may also inhibit actual investment due to resource crowding or strategic compliance. So the authors put forward the third hypothesis.

Hypothesis 3: In the impact of internal control on environmental protection investment in enterprises in highly polluting industries, social responsibility plays a mediating role and manifests as an inhibitory effect.

4. Research design

4.1. Sample selection and data sources

According to the industry classification of A-share listed companies issued by the China Securities Regulatory Commission, this paper selects companies in high-pollution industries from 2019 to 2023 as research objects. The above industries are thermal power, pharmaceuticals, steel, mining, chemical, and paper industries. Given the integrity of the data, the authors exclude special-treatment and incomplete-data companies from the sample. After the above exclusions, 2,390 observations are in the sample. The internal control data are provided by Dibo's internal control database. The sources of the environmental protection investment are the China Stock Market and Accounting Research (CSMAR) database, corporate environmental reports and listed

companies' annual reports. The social responsibility data are provided by Rankins CSR Ratings (RKS), the company's social responsibility report and the sustainable development report. All the data for the environmental investment were manually collected and sorted, and then processed by Winsorisation at the upper and lower 1% quartiles.

4.2. Definition of variables

4.2.1. *Dependent variables*

This paper takes environmental investment as the dependent variable for empirical analysis. According to the social dictionary, environmental investment refers to the total expenditure for the maintenance, restoration, protection, and development of the environment to prevent environmental pollution and prevent, reduce, or eliminate the decline of environmental quality. However, under the current accounting system in China, enterprises have not yet formed a special measurement method for environmental protection investment. Therefore, there are many measurement methods for environmental protection investment. Wang and Liu [59] define environmental protection investment as the expenditure related to environmental protection investment in the detailed accounts of construction in progress in the annual reports of listed companies, which is added up as expenses. Peng et al. [60] believe that environmental investment includes not only end of pipe investment, but also investment in clean production technology. To avoid the impact of environmental subsidies on environmental investment, the amount of environmental subsidies was deducted from the investment. In addition, some scholars have adopted environmental cost [6, 36] as alternative variables of environmental investment. Because environmental protection investment is a kind of investment in natural capital, on the one hand, the environment as an asset will increase in value over time, on the other hand, the benefits of environmental protection investment are not only reflected in the economic benefits of enterprises but also reflected in social and environmental benefits. Therefore, the previous scholars' definition analysis, whether based on the definition of cost or from the perspective of investment benefit, is more one-sided to the concept of environmental protection investment.

Referring to the viewpoint of Tang and Li [61], the authors comprehensively divide environmental protection investment into three aspects from the perspectives of investment and governance: (1) investment in environmental protection equipment, mainly including investment and renovation of various environmental protection equipment in projects under construction or fixed assets; (2) investment in environmental protection technology, mainly including investment in various environmental protection products and technologies for research and development expenditure; (3) investment in environmental governance, mainly including pollution control, environmental taxes, and fees and ecological expenditure. This kind of definition method has concise and comprehensive content, and there is no duplication. It can better understand the connotation of investment from the perspective of enterprises. In this study, the dependent variables were manually sorted and collected. At the same time, the natural logarithm of the dependent variable is used to avoid the impact of enterprise scale and extreme values on the data.

4.2.2. *Independent variables*

The authors take internal control as the independent variable. The variables to measure the quality of internal control refer to the viewpoints of scholars such as Yin et al. [55] and adopt the Dibo Internal Control Index of China's Listed Companies. China's "*Basic Norms of Internal Control*" stipulate that internal control is divided into five objectives: strategic, business, legal, and compliance, reporting, and asset safety objectives. Dibo's internal control index aims to realize the five objectives of internal control to evaluate the degree. Therefore, the authors take the Dibo internal control evaluation index as the substitute variable of Internal Control (IC).

4.2.3. Mediating variable

The authors take CSR as the mediating variable. The sustainable development of enterprises must be related to their development strategies and environmental responsibilities. While pursuing the goal of profit maximization, enterprises will also be required to assume corresponding social responsibilities and invest more in environmental costs to improve and govern the environment. From the existing studies, the measurement of CSR mainly focuses on two methods: one is for scholars to build relevant content and use social responsibility performance index [55], and scale analysis for measurements [62]; the second is to use the social responsibility database index of investment institution evaluation research, such as Rankins CSR Ratings (RKS) and *Hexun* (www.Hexun.com) *Social Responsibility Report of Listed Companies*. In the analysis, the authors focus on the comprehensiveness of corporate social responsibility. RKS data is an evaluation system for independent research in China. The system carries out comprehensive ratings from four dimensions of integrity, compatibility, technology, and industry with three indexes with high comprehensiveness. Many scholars have used the rating results to conduct empirical studies and verify the reliability of the rating data [43, 63, 64]. Therefore, the authors take RKS as the alternative variable of CSR.

In further analysis, the subdivision of different aspects of social responsibility is considered. The professional evaluation system of Hexun's corporate social responsibility report includes five aspects: shareholder responsibility, employee responsibility, supply chain (suppliers, customers, and consumers' rights) responsibility, environmental responsibility, and social responsibility. In each category, 13 second-level indicators and 37 third-level indicators were set to evaluate social responsibility. The evaluation of five sub-responsibilities in this system has been recognized by some scholars [65-67]. Therefore, the authors chose the Hexun social responsibility report of the listed companies as an alternative variable in further research.

4.2.4. Control variables

Based on prior research, the control variables selected in this paper are as follows. (1) Operating results (Earnings Per Share, EPS): A good operating situation of an enterprise can bring abundant cash flow to the enterprise and benefit the development of the enterprise so that it can have more funds to invest in environmental protection. Earnings Per Share (EPS) is as the alternative variable of operating results. (2) Enterprise Growth (GROWTH): The enterprise's growth represents the enterprise's development status. The company has advantages over its peers if the enterprise develops well. The scale of the company is expanding year by year, and the economic benefits are increasing continuously. The Growth rate of total assets (GROWTH) is as the substitution variable of enterprise growth. (3) Corporate Cash Flow (CF): An enterprise with sufficient cash flow is a prerequisite for environmental investment. The ratio of net Cash Flow to total assets of an enterprise (CF) is as a substitute variable for corporate cash flow. (4) Management Characteristics (EC): As corporate managers, management often has more information about the company than shareholders. When executive compensation is better, management will reduce short-sighted investment behavior, focus on the long-term development of the company, and promote investment in environmental protection. Executive Compensation (EC) is as a substitute variable for management characteristics. (5) Company Size (SIZE): The company's size determines its material basis, the strength of environmental investment, and the ability to resist risks. The Size of total assets (SIZE) is as the substitution variable of the company size. (6) Corporate Debt Level (DEBT): The debt situation of an enterprise reflects its financing and specific investment capacity. To some extent, the greater the degree of debt, the more significant the financial impact on the enterprise, and the more likely the enterprise is to fall into financial deterioration without money to invest in environmental protection, only developing short-term interests. The asset-liability ratio (DEBT) is as the substitution variable of debt degree.

To sum up, the main variable definitions in this paper are shown in Table 1.

Table 1. Studies the definition of variables

Variable type	Variable	Variable description
<i>DV</i>	<i>EPI</i>	LN (total annual environmental protection investment)
<i>IV</i>	<i>IC</i>	DB internal control evaluation index
<i>MV</i>	<i>CSR</i>	RKS score
	<i>EPS</i>	Net profit/total share capital
	<i>GROWTH</i>	(Growth amount of total assets this year/total assets last year) × 100%
<i>CV</i>	<i>CF</i>	(Net Cash Flow/Total Assets) × 100%
	<i>EC</i>	LN (Salary + bonus + long term incentive compensation)
	<i>SIZE</i>	LN (total assets)
	<i>DEBT</i>	(Total liabilities/Total assets) × 100%

4.3. Model construction

Based on the above hypothesis and the mediating effect analysis method proposed by Fang et al. [68], different models are established through the following steps for analysis. This is to test whether social responsibility promotes the mediating effect of environmental protection investment.

To verify Hypothesis 1, the authors construct Model 1, represented by Equation (1), to ascertain the impact of internal control on environmental protection investment. If the coefficient is significantly positive, it indicates that the quality of internal control will have a significant positive impact on environmental protection investment.

$$EPI = \alpha_0 + \alpha_1 IC_{i,t} + \sum \alpha_i Control_{i,t} + \varepsilon_{i,t} \quad (1)$$

To verify the specific channels of influence of internal control quality on environmental investment, this paper constructs a mediating variable model to identify a mediating effect. Model 2 is the model with social responsibility as the dependent variable, and hypothesis 2 is tested, presented by Equation (2). Model 3 is to verify hypothesis 3, namely whether social responsibility plays a mediating role in the impact of internal control on environmental investment, presented by Equation (3). If α_1 , β_1 , λ_1 , and λ_2 are all significant, and simultaneously, if $\beta_1\lambda_2$ and λ_1 are the same sign, it indicates that social responsibility has a partial mediating effect on the impact of internal control on environmental protection investment. If $\beta_1\lambda_2$ and λ_1 are different, it means that social responsibility has a masked effect on the impact of internal control on environmental protection investment.

$$CSR = \beta_0 + \beta_1 IC_{i,t} + \sum \beta_i Control_{i,t} + \varepsilon_{i,t} \quad (2)$$

$$EPI = \lambda_0 + \lambda_1 IC_{i,t} + \lambda_2 CSR_{i,t} + \sum \lambda_i Control_{i,t} + \varepsilon_{i,t} \quad (3)$$

The above model, *IC* represents the internal control variable, *EPI* represents the environmental protection investment variable, *CSR* represents the social responsibility variable, *Control* represents all control variables, *i* represents different enterprises, and *t* represents different years. *i, t* represents the variable value of different enterprises in different years, and ε is the random disturbance term.

5. Results and discussion

5.1. Full sample regression analysis

The regression analysis results of the whole sample are shown in Table 2. The adjusted R^2 square is 0.935, and F is significant, indicating that the overall fit of the model is good. The tolerances among the explanatory variables are all greater than 0.1, and the variance inflation factors are all less than 7, indicating that the sample does not have multicollinearity. The regression coefficient of the internal control level on the environmental protection investment of enterprises is 0.392, which is significant at the level of 1%, further verifying Hypothesis 1. This indicates that the internal control level of the listed companies in high-pollution industries has a significant positive effect on their environmental protection investment.

Table 2. Full sample regression

Model (1)	Coef.	S.E.	T	Sig	Tolerance	VIF
<i>IC</i>	0.392***	0.000	7.222	0.000	0.247	4.050
<i>EPS</i>	0.190***	0.124	3.009	0.003	0.183	5.477
<i>GROWTH</i>	-0.049	0.007	-1.588	0.116	0.777	1.288
<i>CF</i>	-0.063*	61.944	-1.872	0.065	0.635	1.576
<i>EC</i>	-0.012	0.000	-0.395	0.694	0.762	1.312
<i>SIZE</i>	0.403***	0.042	8.623	0.000	0.333	3.001
<i>DEBT</i>	-0.158***	0.003	-3.660	0.000	0.390	2.561
<i>Year</i>			Controlled			
<i>Industry</i>			Controlled			
<i>Adj-R²</i>			0.935			
<i>F</i>			184.334***			

Note: The superscript asterisks ***, and * denote statistical significance at the 1%, and 10% levels, respectively.

5.2. Mediating effect analysis

As shown in Table 3 of the regression results, the impact coefficient of internal control on social responsibility is 0.316 and is statistically significant at the 10% level. Therefore, with an improvement in the quality of internal control, the company will be more willing to undertake social responsibility and thus satisfy Hypothesis 2.

The coefficient of the effect of social responsibility on corporate environmental investment is -0.157, and it is statistically significant at the 1% level. According to Fang et al. [68], when the indirect effect of the level of social responsibility is significant, further investigation should be conducted to determine whether the direct effect of internal control on corporate environmental investment in Model 3, λ_1 is significant, and whether the sign direction of the indirect effect of the mediating variable $-\beta_1 * \lambda_2$ and λ_1 is consistent. As shown in Tables 2 and 3, it can be concluded that the direct effect of internal control on enterprise environmental protection investment is $\lambda_1 = 0.442$, and it is statistically significant at the 1% level. The indirect effect was $\beta_1 * \lambda_2 = 0.316 * (-0.517) = -0.0496$, and thus the indirect and direct effects had opposite signs. At the same time, the total effect $\alpha_1 = \lambda_1 + \beta_1 * \lambda_2 = 0.392$ was smaller than the direct effect $\lambda_1 = 0.442$. It was found that the social responsibility effect was not due to a mediation effect of internal control and environmental protection investment; rather, it was a masking effect, and its size was $|\beta_1 * \lambda_2 / \lambda_1| = 0.112$.

Based on the above tests, it can be confirmed that Hypothesis 3 is correct. In other words, social responsibility does not add an extra link to the path of internal control and environmental investment; instead, it serves as a cover. Social responsibility can act as a "brake" on the internal control of environmental investment, and strengthening controls over social responsibility will improve the effectiveness of internal controls for environmental investment.

In theory, in the internal control system and the process of enterprise operation, social responsibility is the social responsibility and obligation that enterprises must undertake and fulfill. Corporate social responsibility will lead to the weakening of the enterprise's competitiveness and help improve the image of the enterprise, attract more customers, and improve the economic benefits of the enterprise. However, the results of the empirical study show that the strengthening of corporate social responsibility will have a "restraining effect" between internal control and environmental investment. Possible reasons include the following.

First, the *"Application Guide of Corporate Internal Control—No. 4 Social Responsibility"* stipulates that social responsibilities mainly include production safety, product quality (including services), environmental protection, resource conservation, employment promotion, employee rights protection, and so on. Hexun social responsibility report professional evaluation system also includes shareholder responsibility, employee responsibility, supply chain (supplier, customer, and consumer rights and interests) responsibility, environmental responsibility, and social responsibility. Some scholars also represent social responsibility from the stakeholders' perspective as the social responsibility of enterprises to stakeholders such as monetary capital, human capital, social capital, and ecological capital [55], all of which indicate that social responsibility includes many responsibilities. However, when the quality of internal control enhances the quality of social responsibility, the degree of impact on environmental responsibility may decline [58], leading to a decline in the proportion of enterprises' investment in the environmental protection scale. At this point, the authors select five aspects of the social responsibility report of listed companies published by hexun to regress model 2. The result shows that the impact coefficient of internal control quality on environmental responsibility is 0.223, but not significant, which indicates that while internal control strengthens social responsibility, the improvement of environmental responsibility is not apparent.

Second, investment in environmental protection mainly includes investment in intangible assets such as research and development of environmental protection technology, and investment in fixed assets such as the purchase of environmental protection equipment. These investments are one-time. Before the emergence of equipment without new technical representatives, enterprises generally do not make repeated investments. Their investment depends on the operation and cash flow status of enterprises to a certain extent. As can be seen from Table 2, the cash flow and the environmental protection investment coefficient of the sample enterprises are -0.063 , and the same index coefficient in Table 3 is -0.034 , both of which are negatively correlated. Although not significant, they can show that the larger the enterprise's cash flow, the smaller the amount invested in environmental protection. This further verifies the above; that is, when the social responsibility increases, the enterprise assumes other social responsibilities. Although the cash flow will increase, the investment in environmental protection is only one aspect of the enterprise investment, so the amount invested in environmental protection will decrease.

Table 3. Mediating effect test

Variable	Model 2 CSR		Model 3 EPI	
	Coef	T	Coef	T
<i>IC</i>	0.316*	1.860	0.442***	9.086
<i>CSR</i>			-0.157***	-5.062
<i>EPS</i>	-0.117	-0.591	0.172***	3.094
<i>GROWTH</i>	0.064	0.671	-0.039	-1.432
<i>CF</i>	0.190*	1.791	-0.034	-1.112
<i>EC</i>	0.011	0.116	-0.010	-0.386
<i>SIZE</i>	0.194	1.327	0.434***	10.464
<i>DEBT</i>	-0.190	-1.406	-0.188***	-4.901
<i>Year</i>	Controlled		Controlled	
<i>Industry</i>	Controlled		Controlled	
<i>F</i>	8.311***		212.935***	
<i>Adj R²</i>	0.365		0.950	
<i>N</i>	2,390		2,390	

Note: The superscript asterisks ***, and * denote statistical significance at the 1%, and 10% levels, respectively.

5.3. Robustness test

To make the study more convincing and further analyze the interaction between variables, the authors use independent substitution variables to conduct a robustness test. Internal control is divided into five goals, strategic goals being the first goal of internal control to determine the development direction of the enterprise. Therefore, the investment in the enterprise environment depends on the business strategy of the enterprise to some extent. The authors replace the Internal Control (IC) evaluation index with the Strategic Objective index (ICSO) of the internal control sub-objective index of DIB, and the results are shown in Table 4. The regression results in the table show that: in Model 1, the influence coefficient of internal control on its environmental protection investment is 0.339, indicating a positive correlation and significance at the 1% level. In Model 2, the influence coefficient of internal control on social responsibility is 0.312, significantly positive at the 10% level. In Model 3, the influence coefficient of internal control on environmental protection investment is 0.447, positively correlated at the 1% level. However, the influence coefficient of social responsibility on environmental protection investment is -0.155, negatively correlated at the 1% level. In Model 3, the influence coefficient of internal control on environmental protection investment is 0.447, positively correlated at the 1% level. However, the influence coefficient of social responsibility on environmental protection investment is -0.155, negatively correlated at the 1% level. Therefore, in the robustness test, the direct effect $\lambda_1 = 0.447$ and the indirect effect $\beta_1 * \lambda_2 = 0.312 * (-0.155) = -0.0484$ of internal control on enterprise

environmental protection investment, indicating that the indirect and direct effects have different signs. Meanwhile, the total effect $\alpha_1 = 0.399$ is smaller than the direct effect $\lambda_1 = 0.447$. This showed that the social responsibility is not on the relationship between the internal control and environmental protection investment "mediation effect", but "mask effect", its masking effect is: $|\beta_1 * \lambda_2 / \lambda_1| = 0.121$. Therefore, after replacing the independent variables, the results of the empirical analysis are consistent with those above, indicating that the above research conclusions are relatively reliable.

Table 4. Robustness test

Variable	Model 1 EPI		Model 2 CSR		Model 3 EPI	
	Coef	T	Coef	T	Coef	T
<i>ICSO</i>	0.399***	7.265	0.312*	1.813	0.447***	9.095
<i>CSR</i>					-0.155***	-5.025
<i>EPS</i>	0.186***	2.940	-0.116	-0.584	0.168***	3.016
<i>GROWTH</i>	-0.047	-1.542	0.067	0.702	-0.037	-1.362
<i>CF</i>	-0.061*	-1.823	0.194*	1.833	-0.031	-1.036
<i>EC</i>	-0.009	-0.287	0.013	0.131	-0.007	-0.254
<i>SIZE</i>	0.399***	8.543	0.192	1.307	0.429***	10.343
<i>DEBT</i>	-0.156***	-3.601	-190	-1.400	-0.185***	-4.818
<i>Year</i>	Controlled		Controlled		Controlled	
<i>Industry</i>	Controlled		Controlled		Controlled	
<i>F</i>	185.244***		8.271***		213.177***	
<i>Adj R²</i>	0.935		0.364		0.950	
<i>N</i>	2,390		2,390		2,390	

Note: The superscript asterisks ***, and * denote statistical significance at the 1%, and 10% levels, respectively.

5.4. Regional classification analysis

Due to China's economic development and regional differences, different areas in its economic development, transportation, and ecological environment have different degrees of influence on the development of enterprises. To distinguish between different regions of the internal control quality for the enterprise to influence the degree of the environmental protection investment, based on the east and the west of China, has carried on the back. The results are shown in Tables 5 and 6. By comparing Tables 5 and 6, it can be concluded that: (1) the analysis results of Model 1 show that the impact coefficients of internal control on environmental investment in eastern and western China are 0.416 and 0.235, respectively. Both of them are positive and significant at the 1% level, indicating that the impact of internal control on enterprise environmental investment has a promoting effect in the eastern and western of China. (2) As shown in Table 5, the analysis results of Model 2 show that the influence coefficient of internal control on social responsibility in the eastern part of China is 0.279, but it is not significant. According to scholars such as Fang et al. [68], in the mediation effect analysis, if the coefficient of the independent variable to the dependent variable in Model 2 is not significant, the Bootstrap method should be used to test it again. Therefore, model 2 in eastern China was further tested with a 95% confidence interval of the Bootstrap method. The specific results were as follows. In the eastern regions, when the self-help sampling results are based on 5,000 self-help samples and a 95% confidence interval, the lower limit of the internal control on environmental protection investment is -0.016, and the upper limit is 0.069, which further indicates that the independent variable internal control has no

significant impact on the dependent variable social responsibility. Therefore, the indirect effect of the mediating effect of social responsibility is not significant in eastern China. In Table 6, the coefficient of internal control on social responsibility in the western region of Model 2 is 0.724. There is a significant positive correlation at the level of 5%, indicating that the influence of internal control on social responsibility plays a mediating role in the Western region. (3) For Model 3, Table 6 shows that the indirect effect is not significant in Model 2; the analysis in eastern China is stopped according to Fang et al. [68]. In Table 6, internal control in western China has a significant positive correlation with environmental protection investment at the 1% level, and its direct effect is 0.305. As an intermediary variable, social responsibility impacts the environmental protection investment of -0.096 and a significant negative correlation of 1%. Therefore, the indirect effect is $\beta_1 * \lambda_2 = 0.724 * (-0.096) = -0.0695$. The results showed that the indirect and direct effects had different signs, and the total effect $\alpha_1 = 0.235$ was smaller than the direct effect $\lambda_1 = 0.305$. Therefore, consistent with the above analysis, in the western region of social responsibility the relationship between internal control and environmental protection investment is the "mask effect", its masking effect is: $|\beta_1 * \lambda_2 / \lambda_1| = 0.2278$.

Therefore, in Eastern China and Western China, the impact of internal control on corporate environmental protection investment is positive, indicating regional differences in the impact of internal control of listed companies on corporate environmental protection investment. However, in analyzing the mediating effect of social responsibility, the masking effect in Western China is more significant. Combined with the analysis results of various variables, the main reasons are as follows.

First, the economic development of Eastern China is unbalanced with Western China. The economic development of eastern China is stronger than that of western China. Therefore, listed companies also have specific differences in their CSR commitments. It can be seen in Model 2 from Table 5 and Table 6 that the influence of internal control on social responsibility is 0.279 positive but not significant in the central and eastern regions, and 0.724 positive and significant in the western regions. It shows that the internal control of listed companies in eastern China impacts social responsibility, but the impact is not significant. On the contrary, internal control has a significant positive impact on social responsibility in Western China.

Secondly, the development of enterprises in western China is relatively backward due to the relatively backward economy. Specifically, Model 1 in Table 5 shows a positive correlation of 0.114 but is not significant to the scale of investment in environmental protection. In Model 3, the coefficient of investment in environmental protection is 0.063 after the addition of social responsibility, which is still positive but not significant. In Table 6, the same index showed a significant positive correlation of 0.315 and 0.297. The regression results show that when internal control is implemented in Western China and social responsibility is strengthened through internal control, the management will first pay attention to improving the economic benefits of enterprises through social responsibility. Only when the economic benefit of the enterprise is improved and the enterprise develops well will the environmental protection benefits be considered, and the environmental protection responsibility be assumed. Therefore, the strengthening of corporate social responsibility in western China usually starts from non-environmental responsibility. Even if some enterprises voluntarily carry out environmental protection, most of them can reduce the cost of environmental compliance. This shows that social responsibility in Western China for the internal control of corporate environmental investment has a masking effect.

In conclusion, the results of regional studies show that regions do not restrict the positive impact of internal control on corporate environmental protection investment. However, through further research, it is concluded that social responsibility has a specific inhibiting effect on internal control of environmental investment. The

inhibiting effect is evident in the western region due to the regional influence. This conclusion has not appeared in previous studies, reflecting the research value and contribution of this paper.

Table 5. Test results of mediating effect in central and eastern regions

Variable	Model 1 EPI		Model 2 CSR		Model 3 EPI	
	Coef	T	Coef	T	Coef	T
<i>ICD</i>	0.416***	5.507	0.279	1.313	0.478***	7.856
<i>CSR</i>					-0.223***	-4.856
<i>EPS</i>	0.114	1.050	-0.229	-750	0.063	0.729
<i>GROWTH</i>	-0.093**	-2.037	0.223*	1.738	-0.043	-1.151
<i>CF</i>	-0.096*	-1.912	0.238*	1.674	-0.043	-1.050
<i>EC</i>	-0.022	-0.470	0.067	0.514	-0.007	-0.186
<i>SIZE</i>	0.407***	5.290	0.556**	2.564	0.531***	8.072
<i>DEBT</i>	0.-199***	-2.705	0.032	0.154	-0.192***	-3.308
<i>Year</i>	Controlled		Controlled		Controlled	
<i>Industry</i>	Controlled		Controlled		Controlled	
<i>F</i>	87.832***		6.464***		126.702***	
<i>Adj R²</i>	0.932		0.465		0.958	
<i>N</i>	825		825		825	

Note: The superscript asterisks ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 6. Test results of mediating effects in Western China

Variable	Model 1 EPI		Model 2 CSR		Model 3 EPI	
	Coef	T	Coef	T	Coef	T
<i>ICD</i>	0.235***	2.829	0.724**	2.456	0.305***	3.565
<i>CSR</i>					-0.096**	-2.172
<i>EPS</i>	0.315***	4.789	-0.186	-0.797	0.297***	4.699
<i>GROWTH</i>	0.113**	2.227	-0.139	-0.774	0.100**	2.044
<i>CF</i>	-0.037	-0.900	0.040	0.277	-0.033	-0.844
<i>EC</i>	-0.153***	-3.508	-0.004	-0.028	-0.154***	-3.689
<i>SIZE</i>	0.449***	9.062	-0.224	-1.276	0.427***	8.858
<i>DEBT</i>	-0.129***	-2.807	-0.282*	-1.729	-0.156***	-3.426
<i>Year</i>	Controlled		Controlled		Controlled	
<i>Industry</i>	Controlled		Controlled		Controlled	
<i>F</i>	121.651***		4.792***		117.723***	
<i>Adj R²</i>	0.950		0.376		0.955	
<i>N</i>	1,565		1,565		1,565	

Note: The superscript asterisks ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

6. Conclusion and implication

Taking listed companies in high-pollution industries from 2019 to 2023 as samples, the authors examine the impact of internal control on corporate environmental investment and further study social responsibility as an intermediary variable. The empirical results showed that internal control significantly promoted corporate environmental investment, while the strengthening of social responsibility inhibited the increase of internal control on corporate environmental investment. In addition, this masking effect is more evident in western China.

First, optimize the internal control system in a hierarchical manner to establish a solid foundation for environmental protection investment. For listed companies in highly polluting industries, the authors embed the rigid requirements for environmental protection investment into the entire process nodes of internal control: allocate a dedicated budget for environmental protection in the capital budgeting phase to prevent non-essential operational expenditures from crowding out environmental protection funds; establish a real-time pollution emission control mechanism throughout the entire production process, and incorporate environmental compliance risks into the internal control assessment red line. At the same time, the authors issue differentiated internal control guidelines for highly polluting enterprises of different sizes to avoid increasing the compliance burden on small and medium-sized enterprises with uniform rules, maximizing the positive role of internal control in promoting environmental protection investment.

Second, breaking down the reverse masking effect of social responsibility and opening up the positive transmission path of "responsibility-investment". Currently, some enterprises have alienated the construction of social responsibility into an "image promotion tool", excessively investing resources in public welfare donations, brand public relations, and other aspects, which in turn squeezes the financial space for actual environmental protection transformation. It is suggested that regulatory authorities issue detailed rules for social responsibility disclosure in high-pollution industries, explicitly requiring enterprises to separately list the proportion of environmental protection-related investments in their social responsibility reports, and prohibiting the substitution of generalized public welfare investments for substantive environmental protection governance. At the same time, enterprises should be guided to shift the focus of social responsibility construction towards green production, with environmental responsibility as the core indicator for social responsibility evaluation, to avoid deviating from the core goal of environmental protection governance in social responsibility construction, and to eliminate its reverse inhibitory effect on internal control to promote environmental protection investment.

Thirdly, targeted measures should be implemented in the western region to mitigate the specific impact of the regional masking effect. Given the more pronounced masking effect in the western region, it is necessary to avoid directly copying the policy requirements of the eastern region. On the one hand, special subsidies for environmental protection investment and green tax relief policies should be provided to high-polluting enterprises in the west to reduce the cost pressure on their environmental protection investments. On the other hand, the evaluation orientation of social responsibility for western enterprises should be optimized by reducing the weight of non-environmental social responsibility indicators, guiding enterprises to prioritize investing their limited resources into local pollution control and green transformation projects, and preventing enterprises from consuming their already limited environmental protection funds just to "boost their social responsibility scores", so as to fully realize the positive effects of the internal control system.

Fourth, establish a dynamic incentive mechanism tailored to regional differences. Based on the distinct characteristics of highly polluting industries in the eastern, central, and western regions, a dynamically adjusted environmental protection investment incentive list should be established: the eastern region can focus on guiding enterprises to increase Research and Development (R&D) investment in cutting-edge green

technologies, the central region should prioritize promoting environmental protection renovations in traditional production processes, and the western region should concentrate on assisting enterprises in addressing shortcomings in basic pollution control facilities. Simultaneously, a cross-regional environmental protection experience sharing platform should be established to enable enterprises across different regions to find environmental protection investment paths that suit their own business conditions, thereby comprehensively enhancing the initiative of environmental protection investment across the entire industry.

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