Original Research Article

ESG performance, R&D investment and financial performance: A case study of special equipment manufacturing enterprises

Abstract

The concept of ESG is a brand-new concept that conforms to the trend of the times and is consistent with the realization of the goals of "carbon peak", "carbon neutrality" and sustainable development. This paper selects the data of special equipment manufacturing enterprises listed in A-share companies from 2018 to 2022 as a sample to explore the effect of ESG performance on the financial performance of enterprises, as well as the moderating role of R&D investment in the relationship between the ESG performance of enterprises and the financial performance of enterprises. It is found that (1) the ESG performance of enterprises and the three dimensions of E(Environmental score), S(Social score) and G(Government score), E has a negative effect on the financial performance of enterprises, and the other dimensions can significantly improve the performance of enterprises. (2)For the listed companies in the special equipment manufacturing industry, the enterprises' enhancing R & D investment can to some extent boost the facilitative role of corporate governance in the enterprise's financial performance.

Keywords: investment in R&D; corporate financial performance; ESG performance; specialized equipment manufacturing industry

I. Background of the study

The criteria for corporate success are no longer limited to the quality of products or services, but also to their impact on society and the environment. Fulfilling social responsibility is not only a basic obligation of enterprises, but also a core element for them to realize long-term and stable development. In order to further enhance the comprehensive strength of listed companies held by central enterprises, the State-owned Assets Supervision and Administration Commission of the State Council issued the "Work Program for Improving the Quality of Listed Companies Held by Central Enterprises" in May 2022, which clearly states that all central enterprises should achieve comprehensive coverage of ESG reports by 2023 and promote the establishment of an ESG rating system, which signifies that ESG plays an strategy, leading enterprises toward environmental protection and sustainability.

The party's twentieth report pointed out: to "accelerate the construction of manufacturing power" "to promote the green development of the manufacturing industry", visible, in the development of manufacturing enterprises, sustainable development is increasingly concerned. Specialty equipment manufacturing is a branch under the broad category of equipment manufacturing industry, which can be subdivided into tobacco, food and life feed special equipment and chemical, mining, metallurgy, non-metallic processing special equipment and so on more than ten items, a clear industrial segmentation of China's infrastructure construction plays a vital role. 2023 International Sustainability Standards Board (ISSB) issued the relevant ESG international financial reporting standards. In 2023, the International Sustainability Standards Board (ISSB) released the relevant ESG International Financial Reporting Standards, and the IMA Institute of Management Accountants (IMA) also released the "Sustainable Survival of China's Manufacturing Industry - Research Report on ESG Industry Practices". It is evident that the global ESG rules are increasingly converging, and the ESG performance has become one of the indicators of industry development that is emphasized by the international community. How to effectively utilize the strategic opportunity of ESG to promote the sustainable development of manufacturing enterprises has also become an issue of concern and importance for company managers.

In recent years, with the improvement of the domestic economic level, the demand for special equipment shows an accelerated upward trend, and its industry profitability is also

increasing. However, compared with some foreign manufacturing powers, China's special equipment manufacturing enterprises do not have a good independent research and development and innovation capabilities, part of the production of equipment need to rely on imported components. In recent years, the state support for manufacturing enterprises, but also to a certain extent to promote the development of enterprises, such as "Made in China 2025" and other policies implemented to a certain extent to accelerate the establishment of the innovation system of the manufacturing enterprises; "Environmental Protection Law" promulgated, so that the special equipment manufacturing industry under the segmentation of related industries, such as environmental protection special equipment manufacturing industry has a more rapid development; through the preparation of the industrial enterprise technological upgrading Upgrading-oriented plan for the preparation of industrial enterprises to provide a clear direction for the special equipment manufacturing enterprises. Specialized equipment manufacturing enterprises are also continuing to increase investment in research and development, the development of new technologies and new products, and constantly upgrading equipment and technology, so that the products and technology to adapt to market demand, and continue to move closer to sustainable development.

This paper is a study of specialized equipment manufacturing companies for the following reasons:

Specialized equipment manufacturing industry belongs to a branch of the manufacturing industry, and is also an important link in the development of China's high-end equipment manufacturing industry. The main characteristics are reflected in: first, its development mainly depends on the demand of the downstream industry, and the macroeconomic policy of the country is of great significance, so the operation and development of the special equipment manufacturing enterprises will be faced with the risk of environmental uncertainty, which in turn affects the economic efficiency of the enterprise. Therefore, the special equipment manufacturing enterprises should improve their own corporate governance, actively undertake social responsibility, practice environmental governance, so as to attract the trust of investors, government and other stakeholders, ease the pressure on enterprise funds, and enhance the economic efficiency of enterprises. Secondly, it requires high integration capacity of technology, supply and sales, and the product production and operation cycle is long (Yan Haoyu and

Yang Hongtao, 2022).Some enterprise managers will reduce R&D investment because they cannot see the short-term intuitive benefits brought by R&D investment, making it difficult for enterprises to achieve high-end development. Therefore, this study is helpful in providing intuitive information to enterprise managers and assisting them in making decisions related to the intensity of R&D investment, such as technology introduction, R&D personnel, and support for property rights, which can effectively improve the economic benefits of enterprises.

To summarize, this study takes enterprises in the special equipment manufacturing industry listed on the Shanghai and Shenzhen A-share stock market from 2018 to 2022 as the research object, and uses the least squares method and constructs the quantile regression model to test the mechanism of the role between ESG performance, corporate financial performance, and R&D investment of enterprises in the special equipment manufacturing industry.

The innovation and significance of the research in this paper is:

First, previous literature has mainly investigated the relationship between corporate ESG performance and corporate financial performance, and previous studies have not obtained consistent research conclusions, and most scholars have used ESG performance as a comprehensive single indicator to study its impact on corporate financial performance. Compared with other related literature studies, this paper examines the moderating role of R&D investment in the impact of ESG performance on financial performance, and considers the heterogeneity of enterprises in terms of the nature of property rights and whether ESG reports are disclosed. Since China has not yet established a clear ESG evaluation system and perfect information disclosure standards, this paper adds whether special equipment manufacturing enterprises actively disclose ESG reports as a control variable. In order to study the field of corporate ESG in depth, this paper aims to provide new perspectives and aims to enrich the existing related literature. Second, some scholars have shown that the relationship between corporate performance and ESG performance is affected by performance level. ESG performance of low-performing firms and its three dimensions have more significant effects on performance improvement (Li Jinglin et al., 2021). In order to explore this topic more deeply, this paper selects three key quantile points, 25%, 50% and 75%, and empirically analyzes them using quantile regression models. The purpose is to clarify whether the R&D investment

of enterprises in the specialized equipment manufacturing industry contributes to the strengthening of ESG performance at different performance levels, thus promoting corporate financial performance, and providing a reference for the fulfillment of social responsibility of specialized equipment manufacturing enterprises, as well as corporate decision-making.

II. Theoretical analysis and research hypotheses

(i) Definition of corporate social responsibility and evaluation methods

Corporate Social Responsibility, in a broad sense, refers to the performance or conceptual strategy of enterprises in terms of Environment, Social and Governance. However, its specific connotation in the narrow sense has not been found in the relevant professional and systematic answers. In previous studies by scholars, it is believed that corporate social responsibility is a developmental extension of the concept of green and responsible investment, and a measure of the level of green and sustainable development of enterprises that is currently recognized by most international countries (Samuel Drempetic et al., 2019). Some scholars also argue that corporate social responsibility (ESG) has gradually been engaged by many investors as an investment criterion in their investment decisions (Lo Kar Yee & Kwan Calvin Lee, 2017). There are also scholars who argue that Corporate Social Responsibility can also be used as an effective tool and method to measure the value of the company and the sustainability of the company (Sadok El Ghoul et al., 2017).

With the announcement by the State-owned Assets Supervision and Administration Commission of the State Council in 2021 that ESG will be included in the key work of enterprises in fulfilling their social responsibility, Corporate Social Responsibility is increasingly becoming a green and sustainable management concept that meets the needs of social development, and is attracting more and more attention from both the international and social communities.

Regarding the evaluation method of corporate social responsibility, at present, most of the international community uses the ESG rating system to evaluate corporate social responsibility into different grades. In order to achieve this evaluation goal, numerous rating agencies have emerged in the market, such as ShangDao RongLiGreen, China Securities, RunLing Global, Hexun.com, FTSE Russell, Bloomberg, and so on. These agencies construct their own unique evaluation systems with their specialized skills and knowledge to disclose the social

responsibility of enterprises each year (Kuai Yicheng et al., 2024).

（ii）Research literature on the relationship between ESG performance and financial performance

As far as the relationship between the environmental performance of enterprises and their financial performance is concerned, environmental information disclosure is an important part of corporate social responsibility disclosure and an important basis for evaluating how well a company's environmental governance is. The current academic research on the relationship between corporate environmental disclosure and performance on corporate financial performance concludes that environmental disclosure has different impacts on enterprises with different levels of pollution, but in general, it can improve the resource utilization of enterprises and has a positive effect on the impact of corporate financial performance (Yang Ye and Xie, 2020), therefore, there is a positive relationship between environmental performance and financial performance (DIEM HLC et al. 2022). On the other hand, the higher the quality of environmental information disclosure, the easier it is to gain investors' trust and thus investment, which motivates enterprises to make technological improvements, respond to market demand, and ultimately realize the growth of corporate financial performance. Environmental governance is so important, but it requires a large amount of cost investment, most of the enterprises out of their own short-term economic efficiency considerations, will still take some polluting production methods, which will bring short-term gains to the enterprise, but under the government's regulation, it will also bring some additional costs that affect the financial performance of enterprises. However, on this study of the impact of corporate environmental performance on financial performance, some scholars have come to a different view that the correlation between corporate environmental performance and corporate financial performance is not obvious (Ruhaya Atan et al., 2018).

In terms of the relationship between the social performance of enterprises and the financial performance of enterprises, some scholars have shown that the better the status of enterprises in fulfilling their social responsibility, the better the signals released to external stakeholders, which will help enterprises realize long-term value (Gregoryetal et al., 2013). The social performance of the enterprise will form a certain invisible contract between the enterprise and investors, consumers and other stakeholders, so

that the enterprise can obtain more stakeholder resources in society, thus promoting th e sustainable development of the enterprise (Wang et al., 2019). Additionally, some sch olars have discovered that enterprises can indirectly accumulate the sense of trust with investors through social performance, thereby reducing their own financial risks and ind irectly promoting the improvement of enterprise financial performance.(Liang Wei and G e Hongxiang, 2023; Zhu Qingxiang et al., 2019).

In terms of the relationship between the corporate governance performance of enterprises and the financial performance of enterprises, first of all, the internal control of corporate governance, the equity structure, the purpose and role of the incentive system are all aimed at improving the financial performance. Among them, the ownership structure has a greater impact on financial performance, and there are differences in the concentration of different equity structures on the impact of the financial performance of the enterprise, compared with the first two, if the enterprise pays more attention to the setting of the equity structure, the establishment of corporate incentive mechanisms, and the improvement of the internal control of the enterprise can promote the improvement of the financial performance of the enterprise (Tian Guoshuang and SHA Sh, 2019). Secondly, improving the corporate governance capacity of listed enterprises can improve and meet the social requirements for the sustainable development of listed companies, enhance the value of the company and increase the performance of the enterprise (Wang Yaqin, 2022). Some more scholars have found that both external and internal corporate governance stimulate CSR participation, and CSR participation increases firm value (Jo H and Harjoto M A , 2011).

In terms of the relationship between the ESG performance of enterprises and the financial performance of enterprises, some scholars believe that the value of enterprises with good ESG performance is lower instead (SASSEN R, 2016), and in the short term the responsibility fulfillment of corporate social responsibility will increase the cost of the enterprise in this regard, thus negatively affecting the financial performance of the enterprise; in the long term, a good performance in corporate social responsibility can establish a good reputation and social value of the enterprise, promote the relationship between the enterprise, investors and other stakeholders, and reduce the risk of the enterprise, thus positively affecting the financial performance of the enterprise (Wang Shuangjin et al., 2022). The enhancement of

corporate ESG performance is also conducive to social stakeholders judging the social status and capital power of the enterprise through the degree of corporate ESG performance, increasing trust in the enterprise, thus promoting the enhancement of the enterprise's financial performance (Broadstock et al., 2021; Azmi et al., 2021), which in turn improves suppliers' trust in the enterprise. Some scholars have also found that corporate social responsibility performance can play a mediating role in the middle in analyzing the impact of government subsidies on the innovation performance of manufacturing firms, indirectly promoting the innovation performance of firms by improving the quality of ESG disclosure (Xuemei Guan,Min Shen, 2023).

Therefore, the following hypotheses are proposed in this paper:

Hypothesis H1: There is a negative influence effect of firm's environmental performance on firm's financial performance.

Hypothesis H2: There is a positive influence effect of firm's social performance on firm's financial performance.

Hypothesis H3: There is a positive influence effect of firms' corporate governance performance on firms' financial performance.

Hypothesis H4: There is a positive impact effect of firms' ESG performance on firms' financial performance.

（iii）Research literature on the moderating role of R&D inputs

Many scholars have extensively discussed the relationship between R&D investment and enterprise financial performance, and most scholars believe that R&D investment has a positive impact on enterprise financial performance. Some scholars take the data of the China Securities Regulatory Commission on A-share listed high-tech enterprises in 2019-2022 as a research sample, and utilize multiple linear regression models to conduct empirical analysis, and finally conclude that enterprise R&D expenditure has a significant positive effect on enterprise financial performance (Liang Hongdan, 2023). Some scholars have also screened 19 eligible data-driven enterprises from the top 50 enterprises in 2016-2018 to study the impact of R&D investment on their financial performance, and concluded that the R&D investment of data-driven enterprises has a facilitating effect on the business performance of the enterprise, and it is lagged, and it is more significant in the lag two period (Yue Yujun and

Meng Miao, 2022). Some scholars have used the robust standard OLS estimation method in their research and found that R&D investment has a significant positive effect on a company's financial performance. The conclusion also indicates that this effect still holds true in the analysis of company heterogeneity. Through in-depth research, it was found that there is an inverted "U" relationship between R&D intensity and company financial performance, which indicates that companies should maintain appropriate R&D intensity when investing in R&D. In addition to empirical research, many scholars have also drawn the same conclusion through case analysis. Taking BYD Company as an example, it is concluded that R&D investment has a very positive impact on the financial performance of the enterprise (Ke Xing and Li Junying, 2024). And by analyzing the data relationship of Ideal Automobile from 2018 to 2022, it is concluded that R&D investment has a positive impact on financial performance (Gu Qiangping and Chen Haoying, 2024). Meanwhile, some scholars also put forward the opposite viewpoint, using the panel threshold model, the study of manufacturing enterprises, and finally came to the conclusion that the short-term financial performance of enterprises and R & D investment are negatively correlated when the salary is above 13.974 (Ding Hua et al., 2021).

In terms of the relationship between the environmental performance of enterprises, R&D investment and corporate financial performance, better environmental performance helps enterprises to obtain more social recognition, and under this external environmental trend, many enterprises have strengthened their R&D investment in green technology innovation and product innovation in order to obtain social recognition, and improve their environmental performance in production, operation and other aspects, so as to enhance their overall corporate value and alleviate the financing pressure on enterprises (Shen Hongtao and Ma Biao, 2014).Some scholars have also found that the implementation of corporate social responsibility measures cannot be separated from the ability to continuously prevent and manage environmental pollution in key areas, so corporate environmental governance will push enterprises to increase their R&D investment and promote their green technological innovation (Jia Yue, 2024), thus enabling them to improve their competitiveness in their own fields. However, the increase in investment will inevitably lead to an increase in costs, some scholars through empirical research, corporate environmental governance needs to invest in a large number of governance costs, and even some companies invested in environmental

research and development costs are much higher than the environmental benefits, thus reducing the financial performance of the enterprise (He Yue, 2023).

In terms of the relationship between corporate social performance, R&D investment and corporate financial performance, some scholars have shown that the behavior of corporate social responsibility is an important reason for good ESG performance, and that corporations need to increase R&D investment and iterate green products according to the market and the needs of the public when assuming social responsibility (Jia Yue, 2024). According to the stakeholder theory, the production and operation of enterprises have a close relationship with the society, such as social investors, employees, suppliers, the government and so on, which are all stakeholders in the process of enterprise development. If enterprises want to obtain the support of stakeholders, they need to actively undertake social responsibility to stakeholders, and to promote the enterprise's scientific and technological innovation (Wei Zhihong et al., 2022). Secondly, in companies with high levels of information asymmetry and significant financing constraints, their social responsibility reports have a more significant impact on improving innovation performance. It can be seen that good social performance can alleviate problems in the innovation process and provide enterprises with more financial support. Thus, it can increase R&D investment (Yang Jinkun, 2021) and enhance the competitiveness of enterprises in the market.

In terms of the relationship between the corporate governance performance of enterprises, R&D investment and the financial performance of enterprises, most scholars believe that good corporate governance has a facilitating effect on the R&D innovation of enterprises (Zhu Desheng and Zhou Xiaopei, 2016). Other scholars explore the impact of corporate governance on corporate R&D investment from three perspectives, namely, equity concentration, equity incentives, and board size, respectively. Their findings show that good corporate governance can promote corporate R&D investment, which is further analyzed to conclude that there is a partial difference in the impact of corporate governance on corporate R&D investment by different property rights nature (Xiao Liping, 2016). Good corporate governance is the institutional foundation for good ESG performance, and corporate governance can directly affect the investment in R&D expenses and the importance of

technological innovation by corporate decision makers. Therefore, corporate governance can realize the foundation of innovation and development in enterprises, and is also a key factor for enterprises to obtain market competitiveness.

In terms of the relationship between an enterprise's ESG performance, R&D investment and financial performance, some scholars have argued that better ESG performance can enable an enterprise to establish a good brand image in society, attract more professional and technical talents for the enterprise, and at the same time, facilitate the strengthening of business cooperation with other enterprises, which can further enhance the enterprise's industry status, reduce the risk of the enterprise's R&D investment, and incentivize the enterprise to increase its R&D investment (Pan Lu Di, 2023). In addition, good ESG performance can also reduce the agency cost of the auditor, relatively reduce the agency cost of choosing the Big 4 as the auditor, and enhance the digitization of the enterprise, which will jointly promote the enterprise's R&D investment (Xu Wenning, 2024). In addition, some foreign scholars have also conducted research on the impact of ESG performance on enterprise R&D investment, from four perspectives of the environment, society, corporate governance and comprehensive ESG performance. They confirm that positive ESG performance can meet the needs of social stakeholders for sustainable development of the enterprise, increase the help of funds, policies and technologies to enterprises, so as to increase the enterprise's R&D investment, and promote the realization of enterprise innovation and development, to enhance the enterprise's innovation ability, and to achieve financial and technological development. Enhance the innovation ability of enterprises and realize the growth of financial performance. (Wang F, Sun Z,2022)

In summary, it can be learned that there are relatively few academic studies on whether R&D investment plays a moderating role in the relationship between ESG performance and corporate financial performance, and most of them conclude a positive relationship. However, whether this is the case and whether there is a difference in this moderating role in the impact of ESG performance and its three dimensions, this paper will continue to do in-depth investigation.

Therefore, the following hypotheses are proposed in this paper:

Hypothesis H5: There are different moderating effects of R&D investment in firms' ESG

performance and its three dimensions in relation to firm performance, with more significant performance in the dimension of corporate governance.

III. Research design

(i) Study sample and period

According to the 2013 National Economic Industry Classification (GB/T 4754-2011), combined with the United Nations International Standard Industrial Classification of All Economic Activities (ISIC Rev. 4), it can be seen that the category of special equipment manufacturing industry is C-35, which includes the manufacturing of mining, metallurgy, construction, chemical industry, timber, non-metal processing, food, beverage, tobacco, feed production, printing, pharmaceutical, daily chemical and daily necessities production and many other special equipment manufacturing. production, printing, pharmaceuticals, household chemicals and daily necessities production, and many other specialized equipment manufacturing.

This paper selects China's A-share listed companies in the specialized equipment manufacturing industry from 2018-2022 as the research sample. The data mainly comes from the CSMAR database, Shanghai Huasheng database and query Juchao information network annual reports to collect, for the financial data missing and ST of the specialized equipment manufacturing enterprises for mentioning and removing the processing. The sample covers 167 specialized equipment manufacturing enterprises, for total of 835 first-year finally.

（ii）Research methodology

Least squares and quantile regression models were used.

(iii) Research model

In order to verify the impact of corporate ESG performance on corporate financial performance and the moderating role of R&D investment in the relationship between the two, the research model constructed in this paper is as follows:

$$ROA_{i,t}=\alpha_0+\alpha_1 ESG_{i,t}+\alpha_2 Size_{i,t}+\alpha_3 Age_{i,t}+\alpha_4 Debt_{i,t}+\alpha_5 REVEAL_{i,t}+\varepsilon_{i,t}$$

The effect of ESG performance on corporate financial performance. In order to test hypotheses H1-H4, the following main effects model was constructed:

The model is the main effects regression of this paper, where α_0 is the intercept term,

andα_i (i=1 to 5) are the coefficients of the variables, andε is the residual term. If hypothesis H4 holds, the coefficientsα_1 should be significantly greater than 0, indicating that ESG performance promotes corporate financial performance, and at the same time will replace the explanatory variables ESG as environmental performance (E), social performance (S), and corporate governance (G) on the basis of this model, respectively, to explore the impact of each of the three dimensions on corporate financial performance, as a way of verifying hypotheses H1, H2, and H3.

Moderating effect of R&D investment. In order to test hypothesis H5, referring to the study of (Zang et al., 2019), the following model is constructed on the basis of model (1):

$$ROA_{i,t}=\beta_0+\beta_1 RD_{i,t}+\beta_2 ESG_{i,t}+\beta_3 RD*ESG_{i,t}+\beta_4 Size_{i,t}+\beta_5 Age_{i,t}+\beta_6 Debt_{i,t}+\beta_7 REVEAL_{i,t}+\varepsilon_{i,t}$$

Ifβ_3 significant, then hypothesis H5 holds. Ifα_1 andβ_3 have the same sign, the moderating variable R&D investment strengthens the main effect and plays a positive moderating role; ifα_1 andβ_3 are different signs, the moderator variable R&D investment will weaken the main effect and play a negative moderating role. Meanwhile, on the basis of this model, we replace the explanatory variables ESG with environmental performance, social performance, and corporate governance to investigate the effects of each of the three dimensions on the financial performance of enterprises under R&D investment.

(iv) Main variables

1. Explained variables

Corporate financial performance (ROA): as a measure of financial performance, can more comprehensively reflect the operating ability of the enterprise (Yang Ruibo et al., 2023).

2. Explanatory variables

Corporate ESG Score (ESG): The data used in this paper is the CSI ESG rating data that has the widest coverage and the most frequent update in the current domestic rating system (Xie Hongjun and Lv Xue , 2022). Meanwhile, the environmental dimension score (Env), social dimension score (Soc), and governance dimension score (Gov) are used as indicators to measure the performance of pharmaceutical manufacturing enterprises in fulfilling environmental protection, social responsibility, and corporate governance, and to

further analyze the impacts of these three dimensions of pharmaceutical manufacturing enterprises on the financial performance and the moderating effect of government subsidies.

3. Moderating variables

Research and development investment (RD): R&D investment refers to the investment of capital, manpower and time, etc. made by enterprises in scientific and technological research, development, testing and promotion. R&D investment is often used as one of the important indicators of a country or enterprise's innovation ability and scientific and technological strength (Pan Lu Di, 2023). Since personnel input is difficult to quantify, only the amount of R&D input is considered in this paper.

4. Control variables

In order to rigorously examine the relationship between ESG and the financial performance of specialized equipment manufacturing firms and the moderating effect of R&D investment in the relationship between ESG and the financial performance of specialized equipment manufacturing firms, this paper uses for control variable factors that may have an impact on the research model, and the specific variables are described below:

Enterprise Size (Size): Enterprise size reflects an enterprise's market position and ability to control resources; larger enterprises tend to have better financial performance (Liang Hongdan Liang Hongdan, 2023). There is a positive correlation between enterprise size and enterprise financial performance. Therefore, this paper takes the natural logarithm of the total assets of the enterprise as the enterprise size.

Age: There is a correlation between the age of a company and its financial performance. The profitability and productivity of a company show different trends at different ages (Liang Hongdan 2023), so this paper adopts enterprise age as one of the control variables. The age of enterprises in this study is taken as the natural logarithm of the number of years of existence of enterprises.

Debt-to-Equity Ratio (DEBT): since the financial performance of a firm is influenced by many different financial indicators (Wang Shuangjin, 2022), this study takes the ratio of total liabilities to total assets as one of the control variables.

Whether enterprises proactively disclose ESG reports (REVEAL): ESG reports are important documents for enterprises to publicize their performance, commitment and progress

in environmental protection, social responsibility and corporate governance. Through the disclosure of ESG reports, enterprises can demonstrate the implementation results of their sustainable development strategies, improve transparency, and enhance communication and cooperation with various stakeholders. Enterprises are also gradually recognizing that good ESG performance can send a strong signal to the public about their sound and sustainable operations, which in turn helps them win wide external recognition (Du, 2024). Most existing studies show that ESG disclosure can lead to improved financial performance (Xu, Guanghua et al., 2022; Zhou, Lingyan et al., 2024), so if companies want to send a signal to the public about their sound and sustainable operations, they should actively engage in ESG governance and disclose their ESG reports in order to promote the improvement of their financial performance. Therefore, this paper includes whether enterprises actively disclose ESG reports as one of the control variables and sets it as a dummy variable, with enterprises' disclosure of ESG reports assigned a value of 1 and enterprises' non-disclosure of ESG reports assigned a value of 0.

The variables are defined as shown in Table 1.

Table 1 Definition of variables

Variable type	variable name	variable symbol	Description of variables
explanatory variable	Corporate financial performance	ROA	Net margin/total assets
explanatory variable	Corporate ESG Score	ESG score	CSI ESG Rating Score
	Environmental dimension score	E	CSI E Rating Score
	Social Dimension Score	S	CSI S Rating Score
	Governance dimension score	G	CSI G Rating Score
moderator variable	R&D investment	RD	Ratio of R&D investment to total assets at the beginning of the period

control variable	Enterprise size	Size	Natural logarithm of total business assets
	Age of business	Age	Natural logarithm of the number of years the enterprise has been in existence
	gearing	DEBT	Total liabilities/total assets
	Whether companies disclose ESG reports	REVEAL	Dummy variable, 1 for disclosure and 0 for non-disclosure

IV. Findings

（i）descriptive statistics

Table 2 Descriptive statistics

variant	sample size	math mean value	(statistics) standard deviation	minimum value	P25	upper quartile	P75	maximum values
ROA	835	0.037	0.074	-0.269	0.011	0.037	0.069	0.228
ESG score	835	72.899	5.118	55.920	70.139	73.300	76.320	83.324
E	835	59.671	7.014	45.810	55.140	59.490	64.335	77.550
S	835	77.136	7.836	54.280	72.250	77.857	82.480	93.580
G	835	77.426	7.308	48.690	74.720	79.523	82.090	88.130
RD	835	6.355	3.950	0.890	3.890	5.270	7.560	24.280
DEBT	835	0.424	0.175	0.102	0.288	0.423	0.551	0.829
SIZE	835	22.045	1.126	20.157	21.197	21.892	22.715	25.261
AGE	835	20.628	5.058	10.970	17.184	20.140	23.677	35.151
REVEAL	835	0.228	0.419	0.000	0.000	0.000	0.000	1.000

Table 2 shows that the maximum value of financial performance ROA is 0.228, the minimum value is -0.269, and the standard deviation is 0.074, indicating that the differences in financial performance between the samples are smaller and more stable; the maximum value of ESG rating is 83.324, the minimum value is 55.920, and the standard deviation and the mean are 5.118 and 72.899, respectively, indicating that the sample enterprises' ESG performance The maximum value of ESG rating is 83.324, the minimum value is 55.920, and the standard deviation and mean are 5.118 and 72.899 respectively, indicating that the ESG

performance of the sample enterprises is relatively centralized but overall better; the mean and median of research and development investment are 6.355 and 5.270 respectively, which indicates that the RD investment of the sample enterprises is more concentrated and less different. Control variables, enterprise size standard deviation and maximum value of 1.126 and 25.261, indicating that the overall size of the sample enterprise is larger, but there are still differences in scale; enterprise age standard deviation of 5.058, the maximum value of 35.151, reflecting that the sample enterprise was established earlier in the overall time, which reflects that most of the special equipment manufacturing enterprises have stepped into the Growth or maturity stage.

（ii）base regression analysis

Table 3 Regression results of ESG performance on firms' financial performance

	(1) ROA	(2) ROA	(3) ROA	(4) ROA	(5) ROA
ESG score	0.003***	0.002***			
	(6.718)	(3.733)			
E			-0.001***		
			(-3.014)		
S				0.001***	
				(2.854)	
G					0.002***
					(5.049)
_cons	-0.200***	-0.400***	-0.265***	-0.350***	-0.410***
	(-5.649)	(-6.967)	(-4.967)	(-6.482)	(-7.428)
N	835	835	835	835	835
R^2	0.0514	0.2581	0.2539	0.2530	0.2682

Note: * denotes p<0.1, ** denotes p<0.05, *** denotes p<0.01, and the value of the t-test statistic is in parentheses, below.

Table 3 shows the regression results of ESG performance on firms' financial performance. The paper starts by regressing regression model (1) Column (1) in Table 3 shows the empirical results without adding the control variables and the results show that ESG enhances firms' financial performance at the 1% significant level. After adding the control variables listed in the previous section, as shown in column (2), ESG is significant at the 1% level and the coefficient is 0.002, which indicates that ESG performance significantly enhances the financial performance of firms regardless of whether the control variables are added or not, and this

empirical result confirms the hypothesis. After this paper, environmental performance, social performance and corporate governance were regressed on the ROA of corporate financial performance, and the corresponding empirical results are shown in columns (3) (4) (5) of Table 2, which found that environmental performance is negatively significant at the 1% level in the professional equipment manufacturing enterprises, while social performance and corporate governance are positively significant at the 1% and 2% levels, respectively. level of positive significance. This indicates that environmental performance inhibits the financial performance of specialized equipment manufacturing firms, while social performance promotes the financial performance of firms more than corporate governance.

Table 4 Moderating role of R&D inputs

	(1) ROA	(2) ROA	(3) ROA	(4) ROA
RD	-0.003***	-0.004***	-0.003***	-0.004***
	(-5,539)	(-6,430)	(-5,411)	(-6,637)
ESG score	0.002***			
	(3,836)			
RD x ESG	0.000			
	(1,559)			
E		-0.001***		
		(-3,874)		
RD x E		-0.000***		
		(-2,767)		
S			0.001***	
			(2,853)	
RD×S			0.000	
			(0,024)	
G				0.002***
				(5,846)
RD x G				0.000***
				(3,941)
_cons	-0.357***	-0.211***	-0.309***	-0.371***
	(-6,264)	(-3,999)	(-5,759)	(-6,860)
N	835	835	835	835
R^2	0.2858	0.2901	0.2786	0.3095

Table 4 shows the results of the moderating role of R&D investment in the process of ESG for financial performance of specialized equipment manufacturing firms. The regression results show that R&D investment plays a negative and significant role in the effect of environmental

performance on financial performance, on the contrary, R&D investment is positive and significant for the effect of corporate governance on financial performance, while it is not significant for social performance. Therefore, quantile regression was conducted to explore whether there is a special case.

（iii）quantile regression analysis

Table 5 Quartile regression results of ESG performance on firms' financial performance

	P25				P50				P75			
variables	（1）	（2）	（3）	（4）	（1）	（2）	（3）	（4）	（1）	（2）	（3）	（4）
	ROA											
ESG score	0.001*** （3.54）				0.001*** （4.11）				0.002*** （5.02）			
E		-0.001 （-1.31）				-0.000 （-0.52）				-0.000* （-1.86）		
S			0.001*** （3.21）				0.001*** （4.16）				0.001*** （3.86）	
G				0.002*** （4.74）				0.001*** （4.12）				0.001*** （3.82）
Control variables	control	control	control	control	control	control	control	control	control	control	control	control
cons	-0.333*** （-5.43）	-0.187*** （-2.95）	-0.302*** （-4.99）	-0.339*** （-5.76）	-0.141*** （-3.50）	-0.103*** （-2.48）	-0.124*** （-3.26）	-0.172*** （-4.31）	-0.226*** （-4.23）	-0.560 （-0.95）	-0.145*** （-2.60）	-0.175*** （-3.12）
N	835	835	835	835	835	835	835	835	835	835	835	835
R^2	0.0987	0.0896	0.0989	0.1047	0.1366	0.1240	0.1350	0.1337	0.1922	0.1799	0.1882	0.1908

According to the above table, it can be concluded that the ESG score, social performance and corporate governance of the firms are positively significant whether at the 25% quartile, 50% quartile or 75% quartile, and as these indicators increase, the financial performance of the firms will become better and better environmental performance, on the other hand, is the opposite and does not have a significant effect on firms' financial performance.

Table 6 Quartile regression results for the moderating effect of R&D inputs

	P25				P50				P75			
variables	（1）	（2）	（3）	（4）	（1）	（2）	（3）	（4）	（1）	（2）	（3）	（4）
	ROA											
RD× ESG	0.000 （1.22）				0.000* （1.86）				0.000*** （3.26）			
RD×E		-0.000* （-1.83）				-0.000** （-2.11）				0.000 （0.90）		
RD×S			-0.000 （-0.15）				0.000 （0.11）				0.000 （0.99）	
RD×G				0.000*** （4.43）				0.000*** （4.19）				0.000*** （3.42）
Control variables	control	control	control	control	control	control	control	control	control	control	control	control
cons	-0.271*** （-4.58）	-0.114** （-2.17）	-0.239*** （-3.87）	-0.303*** （-5.21）	-0.161*** （-3.44）	-0.064 （-1.48）	-0.091** （-2.14）	-0.181*** （-4.06）	-0.227*** （-4.06）	-0.058 （-0.93）	-0.133** （-2.25）	-0.146*** （-2.65）
N	835	835	835	835	835	835	835	835	835	835	835	835
R^2	0.1222	0.1155	0.1176	0.1359	0.1454	0.1382	0.1443	0.1512	0.2044	0.1879	0.1925	0.2066

Table 6 shows the results of quantile regression analysis of R&D investment in the

process of ESG's impact on corporate financial performance. The regression results show that with the increase of quartiles, R&D investment in the impact of ESG on firms' financial performance is gradually significant and positive, the more R&D investment,the better the firms' financial performance. For environmental performance, it reaches the peak of negative significance at 50% quartile and is not significant at the latter 75% quartile. And in the process of social performance on the financial performance of the firms, it is insignificant at either quartile. On the contrary, for corporate governance, R&D investment presents a positive and significant, indicating its close relationship and profound impact.

（iv）robustness check

1. Substitution of variables

Robustness test is conducted by replacing the total net asset margin (ROA) with return on equity (ROE). Table 7 shows that. ESG performance and G dimension are significant at 1% level, and E and S dimensions are significant at 5% level; the significant results are similar to those in Table 3, which support the previous hypotheses H1~H4, i.e., ESG performance and its S and G dimensions positively affect financial performance, and the E dimension negatively affects financial performance, which indicates that the results of this study are robust to a certain extent.

Table 7 Results of robustness regression analysis

variant	(1)	(2)	(3)	(4)
	ROE			
ESG score	0.003***			
	(3.120)			
E		-0.002**		
		(-2.421)		
S			0.001**	
			(2.273)	
G				0.003***
				(4.435)
control variable	containment	containment	containment	containment
_cons	-0.844***	-0.613***	-0.754***	-0.871***
	(-7.100)	(-5.555)	(-6.747)	(-7.613)
N	835	835	835	835
R^2	0.206	0.202	0.202	0.215
Adj. R^2	0.201	0.197	0.197	0.210

2. Lag phase II

In order to enhance the reliability of the findings of this paper and eliminate the endogenous interference caused by reverse causality, this paper lags all independent variables by one period and two periods, and re-conducts a regression analysis of the main findings to verify the robustness of hypotheses H1-H4,. The results of the regression analysis are shown in Table 8, and it is found that the regression conclusions are consistent with the foregoing, proving that the conclusions of this paper have robustness.

Table 8 Results of hysteresis test

variant	ROA_{it-1}				ROA_{it-2}			
ESG score	0.001**				0.002***			
	(-2.497)				(-3.264)			
E		-0.001**				-0.001**		
		(-2.455)				(-2.314)		
S			0.001*				0.001*	
			(-1.688)				(-1.866)	
G				0.001***				0.001***
				(-3.257)				(-3.815)
control variable	containment	containment	containment	containment	containment	containment	containment	containment
_cons	-0.425***	-0.319***	-0.383***	-0.432***	-0.459***	-0.319***	-0.392***	-0.456***
	(-6.574)	(-5.251)	(-6.302)	(-6.873)	(-6.262)	(-4.622)	(-5.653)	(-6.421)
N	668	668	668	668	501	501	501	501
R2	0.259	0.259	0.256	0.264	0.275	0.267	0.264	0.280

V. Conclusions of the study

This paper selects China's A-share listed companies in the specialized equipment manufacturing industry as the research object, and adopts the least squares method and quantile regression to study the effect of corporate ESG performance on its financial performance and the moderating role of R&D investment in the relationship between the two, and draws the following conclusions: First, the fulfillment of ESG performance by listed companies in the specialized equipment manufacturing industry has a positive impact on the

financial performance of the enterprise, especially in the aspects of social performance and corporate governance, while environmental performance has a negative impact on financial performance. Secondly, for listed companies in the specialized equipment manufacturing industry, increasing R&D investment has a positive impact on corporate governance (G) dimension. And, R&D investment also has a negative and significant effect on financial performance.

Based on the conclusions of the study, we put forward the following suggestions: (1) Special-purpose equipment manufacturing enterprises should focus on the construction of corporate governance, optimize the organizational structure and related policies, which can greatly promote their financial performance results; at the same time, they should also focus on assuming the social responsibility to establish the trust of stakeholders, so as to enhance the enterprise's financial performance. (2) Specialized equipment manufacturing enterprises should pay attention to the construction related to environmental protection. The concepts of circular economy and energy conservation, such as environmental protection and green supply chain, should be integrated into daily business management to enhance organizational competitiveness and stability. At the same time, enterprises should also increase investment in green technology innovation, which is likely to achieve economic benefits in the future. (3) Different performance of the special equipment manufacturing enterprises in the development of ESG strategy, the need to take into account a variety of factors, combined with its own financial performance results. need to comprehensively consider various factors, combined with their own actual situation and stage of development, to develop a sustainable development strategy that meets the expectations of society and can enhance corporate performance. This will help enterprises maintain their leading position in the fierce market competition and realize long-term stable development.

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