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The Mechanism of the Impact of ESG Performance on the Financial Performance of Environmentally Sensitive Enterprises

-- Based on the Mesomeric Effect of Green Technology Innovation

Meirong Liang[1,*], Xue Wu[2], Xuehan Wang[1], Hongru Zhang[1], Deyu Li[3]

[1] School of Accountancy, Anhui University of Finance and Economics, Bengbu, China

[2] School of Management Science and Engineering, Anhui University of Finance and Economics, Bengbu, China

[3] School of Economics, Anhui University of Finance and Economics, Bengbu, China

[*]Corresponding author: 3159672975@qq.com

Abstract

Based on the data of A-share listed companies in Shanghai and Shenzhen from 2012 to 2021, this paper tests the impact mechanism of ESG performance on the financial performance of environmentally sensitive enterprises under the mesomeric effect of green technology innovation by establishing a panel regression model. The research results indicate that there is a significant negative correlation between ESG performance and financial performance of environmentally sensitive enterprises, meaning that companies with better ESG performance tend to have lower financial performance. Green technological innovation plays a part of the mesomeric effect between the two. The research results provide important ideas and methods for environmentally sensitive enterprises to promote their financial performance in achieving high-quality economic development, and provide a theoretical basis for promoting the development of ESG and green technology innovation in China.

Keywords

ESG Performance; Financial Performance; Environmentally Sensitive Enterprises; Green Technology Innovation.

1. Introduction

Since the 21st century, the world has faced many problems such as environment, social responsibility and corporate governance. Especially since the outbreak of COVID-19, the world has faced more severe challenges. The development of ESG has become the trend of the times. The Fifth Plenary Session of the 19th CPC Central Committee, the 20th National Congress, the 14th Five Year Plan and the Report on the Work of the Government put forward clear requirements on promoting the comprehensive green transformation of economic and social development; So far, foreign countries have established a relatively mature ESG evaluation standard system, and listed companies in Europe and America have implemented mandatory ESG disclosure systems, but the development of ESG in China is relatively lagging behind.

With China's green and sustainable development concept leading the economic and social development, ESG performance and green technology innovation have become important driving forces for high-quality economic development and the implementation of green concepts. The development of ESG focuses on ecological and environmental protection, which can effectively promote enterprises to fulfill their social responsibilities, fully in line with China's "dual carbon" development strategy. Green technology innovation is an inevitable trend

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in technological development, which can not only improve resource utilization, but also enhance the environmental image and social value of enterprises, in line with the concept of green consumption and sustainable development. This paper studies the impact of ESG performance on the financial performance of environmentally sensitive enterprises, and studies its action path with the help of green technology innovation elements. It has important practical significance for the development of domestic ESG theory, balancing corporate environmental responsibility and economic interests, improving the competitiveness and market value of enterprises, and realizing the green transformation and development of social economy.

2. Theoretical Analysis and Hypothesis Proposal

In recent years, domestic and foreign scholars have achieved certain results in their research on the impact of ESG performance on corporate performance. Relatively speaking, foreign research is more advanced than domestic research, mainly focusing on the relationship between ESG performance and corporate value, financing constraints, innovation investment, and other aspects of listed companies. There are few studies on whether ESG performance of environmentally sensitive enterprises will affect green technology innovation and thus corporate financial performance. Green technological innovation is an inevitable trend in technological development, in line with the concepts of green consumption and sustainable development. Incorporating ESG performance and green technology innovation into the research system of corporate financial performance provides new ideas and methods for promoting corporate financial performance under high-quality economic development.

2.1. ESG Performance and Financial Performance

There are currently two opposing views on the correlation between ESG performance and financial performance in academic research. Most scholars believe through empirical research and theoretical analysis that there is a positive correlation between the two. Friede et al. (2015) found through a study of approximately 2200 separate studies that nearly 90% of the research results confirmed a non negative correlation between ESG performance and corporate financial performance, with most of the results confirming a positive correlation between the two. Velte (2017) found that ESG performance has a positive impact on corporate financial performance based on the relationship between ESG performance and financial performance of 412 companies in Germany from 2010 to 2014, but it is not related to Tobin Q. Among them, corporate governance has the greatest impact on financial performance. Li J. L. and Yang Z. et al. (2021) used A-share listed companies in Shanghai and Shenzhen from 2010 to 2017 as research samples, and found that ESG performance and its three levels can improve company performance, and play a mediating role in enterprise innovation and development. Luo J. H. and Zhao B. (2022) used non-financial listed companies in China's A-share market from 2016 to 2019 as research samples and concluded that ESG has no negative impact on short-term financial performance of enterprises, and has a promoting effect on financial performance with one or two lagging periods. But some scholars hold completely different views, believing that there is no correlation or even a negative correlation between the two. Garcia et al. (2017) used data from 365 sensitive industries in the BRICS countries from 2010 to 2012 as research samples and found that companies with the best ESG performance had lower profits, indicating a negative correlation between ESG performance and corporate financial performance. Ruhaya et al. (2018) analyzed data from 54 companies and found that the impact of ESG performance on company performance is not significant. Ruan L. et al. (2021) used ESG rated A-share listed companies in Shanghai and Shenzhen from 2015 to 2019 as research samples to confirm the conclusion that ESG performance has a significant negative impact on corporate performance.

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Due to China being in the early stage of ESG development, the following assumptions are proposed:

H1: Negative correlation between ESG performance and financial performance of enterprises.

2.2. ESG Performance and Green Technology Innovation

Many scholars believe that good ESG performance is beneficial for promoting technological innovation in enterprises, thereby playing a role in improving financial performance. Xu J. et al. (2020) studied data from 223 listed companies in China from 2015 to 2018 and found that ESG performance can increase the number of green innovation patents in enterprises, while ESG performance plays a positive moderating role in the relationship between enterprise R&D investment and green innovation performance. Zhang Y. M. (2021), based on data from A-share listed companies in China from 2015 to 2019, concluded that better ESG performance can actively promote green technology innovation in enterprises. Xue L. et al. (2023) conducted a sample study of A-share listed companies in Shanghai and Shenzhen from 2010 to 2020, and found that ESG performance can promote green technology innovation in enterprises by improving information transparency and strengthening internal supervision. Based on the above research, the following assumptions are proposed:

H2: Good ESG performance of enterprises is conducive to promoting green technology innovation.

2.3. ESG Performance, Green Technology Innovation, and Financial Performance

In recent years, based on the research on the impact of ESG on corporate financial performance, some scholars have deeply studied the role of the impact mechanism. Most of them believe that innovation capability plays a mesomeric effect between the two. A small number of researchers believe that green technology investment will not have a positive impact on enterprise development, but most scholars have confirmed the positive promoting effect between the two through research from the perspective of sustainable development. Mira T. et al. (2012) found through empirical research that managers continuously improve environmental management systems through green technology innovation, improve resource utilization efficiency, and thus improve the economic performance of enterprises. Fan Baoxue and Wang W. J. (2019) used coal listed companies in China from 2012 to 2018 as research samples, and found that environmental investment and green technology innovation have a synergistic positive impact on corporate financial performance, and there is a mutually promoting effect between the two. Gong R. (2022) used the largest coal enterprise in China as an example to examine the positive impact of green technology innovation on corporate financial performance. Li Y. Q. (2022) selected a sample of 1053 A-share listed companies in China from 2012 to 2020 for research. ESG performance and green technology innovation both have a positive impact on the long-term value of enterprises, and found that there is a complementary effect between the two, especially the common effect with a lag of one period is the greatest. Based on the above research, the following assumptions are proposed:

H3: Green technology innovation plays a mesomeric effect in ESG performance and corporate financial performance.

3. Research Design

3.1. Sample Selection and Data Sources

This article selects data from Shanghai and Shenzhen A-share listed companies from 2012 to 2021 as samples, including the original financial data of 1468 listed companies in more than ten industries with high environmental pollution levels, including papermaking and paper

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products, mining, pharmaceutical manufacturing, textile, and chemical fiber manufacturing. The sample data is filtered and screened according to the following standards: 1) Remove the listed companies that were ST or * ST during the sample period. 2) Remove companies with missing main financial data. 3) Companies with less than years of ESG rating data removed. 4) To avoid the impact of extreme values on the results, a 1% and 99% tail reduction treatment is applied to some control variables. 5) Excluding companies that have not applied for green patents for ten consecutive years, a total of 4970 sample observations were obtained from 497 listed companies. The financial data, green patent application volume, and ESG rating studied in this article were obtained from China Taian Database (CSMAR), China Research Data Service Platform (CNRDS), and Wind Financial Database, respectively. Excel and Stata software were used to quantitatively process and analyze the research data.

3.2. Variable Selection

3.2.1. The Dependent Variable

At present, the academic circles mostly choose Tobin Q value, total return on assets ROA, economic value added EVA, net return on assets ROE and other indicators to measure the financial performance of enterprises. Considering that ROE is an important indicator to measure the operating performance of enterprises' assets, which can more intuitively reflect the profitability than other indicators, this paper uses the research method of Lu J. Y. et al. (2020) to measure the financial performance of enterprises using the net return on assets.

3.2.2. Explanatory Variables

ESG performance. The explanatory variables are taken from the Huazheng ESG rating system. This article draws on the method of Huang C. et al. (2023) to assign values of "9-1" to the Huazheng ESG rating "AAA~C" and obtain the ESG variables in the sample data. The higher the score, the better the ESG performance, while the lower the score, the worse the ESG performance.

Table 1. Scoring of different levels of ESG

Grade	AAA	AA	A	BBB	BB	B	CCC	CC	C
Score	9	8	7	6	5	4	3	2	1

3.2.3. Mediating Variables

Green technology innovation. The company's green technology innovation capability is mainly reflected in the number of green patent applications, including green invention patents and green utility model patents. This paper uses the variable selection and measurement method of Xue L. et al. (2023) for reference, and takes the natural logarithm of the company's total green patent applications plus 1 as an indicator to measure the company's green technology innovation.

3.2.4. Control Variables

Based on the research of relevant literature, this article selects control variables for financial performance from multiple dimensions. The control variables include indicators representing the basic characteristics of the enterprise, such as enterprise size (SIZE) and property rights (SOE), as well as indicators representing the financial characteristics of the enterprise, such as asset liability ratio (DR), fixed asset ratio (FIX), enterprise growth ability (Growth), and marginal profit (MP).

The variables and their definitions used in empirical research are shown in Table 2.

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Table 2. Variables and their definitions

Variable type	Variable Name	Symbols for variables	Variable Interpretation
Dependent variable	Financial performance	ROE	Net profit/average net assets
Explanatory variable	ESG performance	ESG	ESG rating, ranging from poor to excellent, with a score of 1-9 points assigned
Mediating variable	Green Technology Innovation	GI	Enterprise green patent applications+1 natural logarithm
Control variable	Property nature	SOE	Virtual variable, 1 for state-owned enterprises and 0 for private enterprises
	Enterprise size	SIZE	The natural logarithm of the total assets of the enterprise
	Asset liability ratio	DR	Total liabilities/total assets
	Fixed asset ratio	FIX	Total fixed assets/total assets
	Enterprise Growth Capability	Growth	(Total assets at the end of the year - total assets at the beginning of the year)/total assets at the beginning of the year
	Marginal profit	MP	Operating profit/main business income

3.3. Model Design

To study the impact of ESG performance on corporate performance, a model was constructed (1):

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

To explore whether green technology innovation is the impact path of ESG performance on corporate performance, this article uses the mediation test method and introduces green innovation technology (GI) as the mediating variable to construct models (2), (3), and (4), which are validated together with model (1).

$$GI_{i,t} = \alpha_0 + \alpha_1 ESG_{i,t} + \sum \alpha_i Control_{i,t} + \varepsilon_{i,t} \quad (2)$$

$$ROE_{i,t} = \alpha_0 + \alpha_1 GI_{i,t} + \sum \alpha_i Control_{i,t} + \varepsilon_{i,t} \quad (3)$$

$$ROE_{i,t} = \alpha_0 + \alpha_1 ESG_{i,t} + \alpha_2 GI_{i,t} + \sum \alpha_i Control_{i,t} + \varepsilon_{i,t} \quad (4)$$

Where, $ROE_{i,t}$ is the net return on assets of the ith company in year t, representing the financial performance indicators of the enterprise, $ESG_{i,t}$ is the ESG score of the i-th company at time t, $\sum \alpha_i Control_{i,t}$ is the sum of multiple control variables, α_0 is a random variable, $\varepsilon_{i,t}$ is a random perturbation term.

4. Empirical Results

4.1. Descriptive Statistics

The descriptive statistical analysis results of variables are shown in Table 3.

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Table 3. Descriptive Statistics of Variables

Variable	N	Mean	Med	Sd	Min	Max
ROE	4970	0.049	0.061	0.667	-45.740	0.876
ESG	4970	4.123	4.000	1.097	1.000	8.000
GI	4970	1.170	0.693	1.250	0.000	6.931
SOE	4970	0.437	0.000	0.496	0.000	1.000
SIZE	4970	22.470	22.270	1.316	19.340	28.640
DR	4970	0.404	0.406	0.187	0.0110	0.979
Growth	4970	0.164	0.086	0.650	-0.628	24.43
FIX	4970	0.240	0.215	0.145	0.003	0.808
MP	4970	0.071	0.066	0.170	-3.199	1.602

The descriptive statistical results of the main variables in this article are shown in Table 3. The average value of the net return on assets (ROE) is 0.049, the standard deviation is 0.061, the minimum value is -45.740, and the difference from the maximum value is close to 47, which indicates that the internal financial performance of the sample enterprises is quite different. The average ESG performance reached 4.123, with a median of 4.000, a maximum of 8.000, and a minimum of 1.0000, indicating that the ESG rating of the sample companies is not high. While pursuing their own financial performance, companies have a slight lack of awareness of environmental protection, social responsibility, and corporate governance. The average value of green technology innovation (GI) is 1.170, with a standard deviation of 0.693, a maximum value of 6.931, and a minimum value of 0.0000. This indicates that the sample companies have significant differences in green technology innovation, with most of them concentrated at lower levels and need further improvement. The median property ownership (SOE) is 0.496, indicating a relatively high proportion of private enterprises in the sample. The average size of the enterprise (SIZE) is 22.470, with a standard deviation of 1.316. The difference between the maximum and minimum values is small, indicating that only a small number of enterprises are relatively large in scale. The average asset liability ratio (DR) is 0.404, with a median of 0.406, indicating that the financial risk of the sample enterprises is generally high. The average growth ability of enterprises is 0.164, with a median of 0.086. The difference between the maximum and minimum values exceeds 25, indicating that a small number of enterprises have high or negative development ability and generally have positive and good development. The average marginal profit (MP) is 0.071, the standard deviation is 0.170, the maximum value is 0.150, and the minimum value is -3.199, indicating that the marginal profit of the sample enterprises is generally not high.

4.2. Correlation Analysis

The correlation analysis results of variables are shown in Table 4.

Table 4. Correlation Analysis

	ROE	ESG	GI	SOE	SIZE	DR	Growth	FIX	MP
ROE	1.000								
ESG	0.019	1.000							
GI	0.002	0.231***	1.000						
SOE	0.0140	0.165***	0.194***	1.000					
SIZE	0.024*	0.230***	0.434***	0.300***	1.000				
DR	-0.077***	0.034**	0.314***	0.272***	0.432***	1.000			
Growth	0.030**	-0.0100	-0.00300	-0.0150	0.047***	0.00700	1.000		
FIX	-0.032**	0.088***	0.0100	0.140***	0.204***	0.187***	-0.025*	1.000	
MP	0.225***	0.135***	-0.055***	-0.051***	0.0110	-0.306***	0.068***	-0.075***	1.000

Note: * * *, * *, * respectively represent significant levels at 1%, 5%, and 10%.

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The correlation between variables obtained through Pearson correlation coefficient test in this article is shown in Table 4. Pearson correlation coefficients between the main variables are less than 0.5, indicating that there is no multicollinearity in the model. The dependent variable ROE showed no significant positive correlation with the explanatory variables ESG and green technology innovation GI, respectively, and further analysis and validation of hypotheses 1 and 2 are needed. With regard to Hypothesis 3, the mesomeric effect of ESG performance in improving corporate financial performance by promoting green technology innovation will be further analyzed in linear regression.

4.3. Regression Analysis

The regression analysis results of the impact of ESG performance on corporate financial performance are shown in Table 5.

Table 5. The impact of ESG performance on corporate financial performance

Variable	OLS	FE	RE
	ROE	ROE	ROE
ESG	-0.013	-0.026**	-0.013
	(0.009)	(0.012)	(0.009)
GI	0.005	-0.025*	0.005
	(0.008)	(0.014)	(0.009)
SOE	0.038*	0.000	0.039*
	(0.020)	(.)	(0.020)
SIZE	0.015*	0.069***	0.016*
	(0.009)	(0.022)	(0.009)
DR	-0.107*	-0.427***	-0.111*
	(0.060)	(0.116)	(0.061)
Growth	0.015	0.006	0.014
	(0.014)	(0.015)	(0.014)
FIX	-0.082	-0.229	-0.085
	(0.066)	(0.154)	(0.068)
MP	0.857***	0.900***	0.860***
	(0.059)	(0.069)	(0.059)
_cons	-0.261	-1.203**	-0.274
	(0.181)	(0.485)	(0.185)
N	4970.000	4970.000	4970.000
r2	0.053	0.053	
F	34.722	35.948	

Note: * * *, * *, * respectively represent significant values at the 1%, 5%, and 10% levels, with t values in parentheses for the mixed OLS and FE columns and z values in parentheses for the RE column.

Based on the study of relevant data, this article selected regression analysis using mixed OLS estimation, fixed effects, and random effects models. Firstly, the mixed OLS estimation and fixed effect model are selected through the F-test, and the P value is zero, thus rejecting the original hypothesis that the mixed OLS estimation is better, that is, the fixed effect model is better than the mixed OLS model; Furthermore, using Breusch Pagan LM test, mixed OLS estimation and random effects model selection were performed, and a P-value of zero was obtained, indicating

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that the model has random effects; Finally, the Hausman test method was used to select the fixed effects model and the random effects model, and the result was Prob>chi2=0.0001, thus negating the original hypothesis that the random effects model was better, and a fixed effects regression model was selected. In conclusion, this paper can use the fixed effect regression model to construct the test method of mesomeric effect.

4.4. Mesomeric Effect Test

See Table 6 for the test results of the mesomeric effect of green technological innovation.

Table 6. Test of mesomeric effect of green technology innovation

	(1)	(2)	(3)	(4)
	ROE	GI	ROE	ROE
ESG	-0.027**	0.042***		-0.026**
	(0.012)	(0.013)		(0.012)
SOE	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)
SIZE	0.057***	0.472***	0.067***	0.069***
	(0.021)	(0.022)	(0.022)	(0.022)
DR	-0.429***	0.081	-0.408***	-0.427***
	(0.116)	(0.125)	(0.116)	(0.116)
Growth	0.008	-0.062***	0.006	0.006
	(0.015)	(0.016)	(0.015)	(0.015)
FIX	-0.221	-0.316*	-0.220	-0.229
	(0.154)	(0.165)	(0.154)	(0.154)
MP	0.902***	-0.105	0.894***	0.900***
	(0.069)	(0.074)	(0.069)	(0.069)
GI			-0.027*	-0.025*
			(0.014)	(0.014)
_cons	-0.963**	-9.556***	-1.269***	-1.203**
	(0.466)	(0.501)	(0.484)	(0.485)
N	4970.000	4970.000	4970.000	4970.000
R^2	0.053	0.109	0.052	0.053

Note: * * *, * *, * respectively represent significant levels at 1%, 5%, and 10%.

The results of regression testing based on the above models (1) to (4) are shown in Table 5. First of all, ROE of net return on assets is negatively correlated with ESG performance at a significant level of 5%, with a correlation coefficient of -0.027, indicating that ESG performance has a negative impact on corporate financial performance, which is consistent with Hypothesis 1. With the proposal of ESG, enterprises are facing more cost pressure, leading to signs of financial performance decline for enterprises in the early stages of ESG development. Secondly, the GI of green technology innovation shows a positive correlation with ESG performance at a significance level of 1%, with a correlation coefficient of 0.042, indicating that good ESG performance can effectively promote green technology innovation in enterprises, consistent with hypothesis 2. ESG performance requires companies to take on more social responsibility, have a high awareness of environmental protection, and encourage them to focus on investing in green technology innovation. Moreover, the ROE of net return on assets has a negative correlation with the GI of green technology innovation at a significant level of 10%, with a correlation coefficient of -0.027, indicating that the increase of green technology innovation investment will lead to the reduction of corporate financial performance. Finally, test whether

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green technology innovation GI plays a full mesomeric effect or part of mesomeric effect in ESG performance and corporate financial performance. The regression results show that the regression coefficient of ESG performance to ROE of net return on assets is -0.026, which is significant at the level of 5%. The regression coefficient of green technology innovation GI to ROE of net return on assets is -0.025, which is significant at the level of 10%. Analysis of the mesomeric effect test procedure of Wen Z. L. et al. (2004) shows that green technology innovation GI plays a part of intermediary role in ESG performance and enterprise financial performance, A good ESG performance can lead to a decrease in corporate financial performance, while green technology innovation can promote corporate financial performance by alleviating the cost pressure faced by enterprises or enhancing their environmental image, verifying hypothesis 3.

4.5. Robustness Test

In order to test the robustness of the model, this paper selects the method of reducing the sample size. By removing company data from some industries in the sample data, 2500 sample observations were obtained, and the conclusion is consistent with the above. The results show that ROE of net return on assets is negatively correlated with ESG performance at a significant level of 5%, and the correlation coefficient is -0.053; The GI of green technology innovation shows a positive correlation with ESG performance at a 10% significance level, with a correlation coefficient of 0.030; The regression coefficient of ESG performance to ROE of net return on assets is -0.051, which is significant at the level of 5%, and the regression coefficient of green technology innovation GI to ROE of net return on assets is -0.060, which is significant at the level of 5%, That is, green technology innovation plays a part of the mesomeric effect in the process of the impact of ESG performance on corporate financial performance.

5. Conclusion and Suggestions

This article is based on the concept of "dual carbon" and green development, and uses companies listed on the Shanghai and Shenzhen A-shares from 2012 to 2021 as sample data. By constructing a panel fixed effect regression model, we empirically test the impact mechanism of ESG performance on the financial performance of environmentally sensitive enterprises. The research shows that there is a significant negative correlation between ESG performance and corporate financial performance, and green technology innovation plays a part of the mesomeric effect between the two. The robustness test was conducted through further sample screening, and the results obtained were consistent with the main regression results. This means that environmentally sensitive enterprises may bear more environmental protection responsibilities due to their high attention to the environment, leading to the need to invest more environmental costs and facing risks such as environmental fines and litigation, which in turn has a negative impact on the financial performance of the enterprise. However, green technology innovation can reduce environmental costs and risks for enterprises by saving energy, improving energy utilization efficiency, and reducing production pollution to the environment. It can also achieve a good corporate environmental image, improve corporate competitiveness and brand value, and promote the improvement of corporate financial performance in the context of the prevalence of green development concepts.

Based on the above research results, this article proposes the following suggestions: firstly, the government should timely improve the ESG evaluation system and information disclosure system for enterprises based on the current development status of the domestic economic market environment, strengthen the rewards and punishments for ESG performance of enterprises, provide moderate economic preferential policies and rewards for enterprises with good performance, such as tax cuts and credit interest rate cuts, and impose corresponding punishments and sanctions on underperforming enterprises. In addition, the government

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should strengthen supervision and investment in environmental protection, formulate and improve policies and laws and regulations related to green technology innovation, improve economic incentive mechanisms and mandatory management strategies, actively guide and promote enterprise green technology innovation and research and development, and practice environmental protection (E), social responsibility (S), and corporate governance (G). Secondly, all enterprises, especially environmentally sensitive enterprises, should enhance their ESG responsibility awareness and actively pay attention to their own ESG performance and green sustainable development strategies. Due to the relatively late start of ESG in China, enterprises are facing the pressure of economic downturn caused by transformation and development in the early stages of ESG development. It is even more necessary to reshape their competitiveness through ESG concepts, actively explore green technology innovation paths, improve enterprise innovation systems, enhance enterprise technology levels, expand market share, and avoid environmental risks, and coordinate various stakeholders in society to promote the improvement of enterprise financial performance and sustainable development. Thirdly, investors should attach importance to the impact of ESG performance in decision-making, and always implement the ESG concept in investment activities. This includes non-financial indicators such as environmental protection, social responsibility, and corporate governance in the investment and financing value measurement system, allowing more funds to be injected into the green industry, assisting China's green economic development, and achieving green economic transformation.

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