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THE IMPACT OF ESG PERFORMANCE ON ENTERPRISE PERFORMANCE: BASED ON THE MEDIATING EFFECT OF GREEN INNOVATION

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Abstract: This paper conducts an empirical study on Chinese A-share listed companies from 2009 to 2024 using Huazheng ESG rating data, focusing on how ESG performance affects corporate performance and its underlying mechanism. The empirical results show that the improvement of ESG performance has a significant positive effect on corporate performance, and this impact has a three-period lag effect. In the relationship between ESG performance and corporate performance, green innovation shows a significant partial mediating effect, indicating that the optimization of ESG performance can be transformed into the growth of corporate operating performance through stimulating green innovation. Heterogeneity analysis indicates that the promoting effect of ESG performance on corporate performance is more significant in enterprises in the eastern region and in the manufacturing industry. The research conclusions provide empirical evidence for enterprises to optimize ESG practices and carry out green innovation, as well as for the government to improve ESG supervision and green finance policies.
Keywords: ESG performance; Green innovation; Enterprise performance; Mediating effect

1 INTRODUCTION

Under the backdrop of economic globalization, environmental and carbon emission issues have become increasingly severe, and ESG has become an important aspect of global policies and enterprise evaluations. Among them, the environmental dimension is closely related to green innovation. Green innovation is not only the technical support for enterprises to fulfill their environmental responsibilities, but also a key path to enhance performance. Its mediating effect between ESG and enterprise performance has attracted much attention. Based on this, this paper takes A-share listed companies from 2009 to 2024 as the research object, constructs the research sample, examines the impact of ESG on enterprise performance and the mediating role of green innovation, and analyzes regional and industry heterogeneity, providing empirical evidence for the green transformation and sustainable development of enterprises.

2 LITERATURE REVIEW

After the global financial crisis in the early 21st century, ESG has received extensive attention as an important non-financial disclosure tool. In terms of foreign research, Alareeni and Hamdan conducted multi-dimensional verification based on S&P 500 data and found that high-leverage enterprises have higher ESG disclosures and better performance[1]; Suchart Tripopsakul used the ASEAN sample to confirm that ESG can enhance financial performance through green innovation[2]; Hien Vo Van et al. verified the three-way interaction effect and highlighted the social value of green process innovation[3]; Khan and Liu for the manufacturing industry concluded that ESG has a short-term negative effect and green innovation has a moderating effect[4]; Alma Maria Petcu reviewed the literature and summarized the general rules and research trends of ESG improving performance[5].
Meanwhile, with the promotion of high-quality development and the "carbon neutrality" initiative in China, relevant empirical studies have been continuously enriched. Yang Yang and Lin Xiaonan found significant differences in the impact of ESG dimensions in the new energy vehicle industry[6]; Shi Yiling and Yang Ruibo et al. confirmed the positive effect of ESG based on A-share stocks and introduced innovative mediating and characteristic regulating factors, using a one-period lag[7-8]; Mao Huilin and Hu Lifeng took Yili Dairy as an example and also reached the conclusion that ESG promotes performance[9]; Xue Yan and Li Fei[10], Chen Jing and Luo Yan [11], Tao Xiaolong et al.[12], Peng Manru et al. all discussed the mediating role of innovation[13], verifying the mediating effect brought by different innovations; while Li Jinglin et al. introduced the marketization degree as a moderating variable[14], confirming that ESG improves performance through innovation; Wang Jiajia and Lu Liyao also further constructed a regulated mediating model to discover that digital transformation positively regulates the mediating effect of green innovation, enriching the mechanism research[15].
Looking at the existing results, most domestic and foreign studies have focused on the short-term impact of ESG, such as the current or one-period lag, ignoring the long-term transmission characteristics of ESG investment and green innovation research and development transformation, and insufficient exploration of the long-term value of ESG; at the same time, the differentiated and heterogeneous analysis of core scenarios such as the eastern region and manufacturing industry is not detailed enough. Therefore, this study aims to fill the research gaps in existing studies on the long-term

lag effect of ESG, the mediating role of green innovation, and the heterogeneity of different scenarios, enriching the research on the long-term mechanism of the relationship between ESG and enterprise performance.

3 THEORETICAL ANALYSIS AND RESEARCH HYPOTHESES

By studying the theories of sustainable development and signal transmission, it can be understood that excellent ESG performance can enhance the enterprise's performance from multiple dimensions: in the environmental aspect, energy conservation and pollution prevention can reduce costs and long-term risks; in the social aspect, fulfilling social responsibilities can improve the brand image and market advantages; in the governance aspect, improving the governance structure can enhance decision-making efficiency and reduce agency costs[11]. At the same time, high-quality ESG performance is more likely to gain capital trust and reduce financing costs. Therefore, this paper proposes:

Hypothesis H_1 : Good ESG performance has a positive impact on enterprise performance.

Based on the theory of green technological innovation, the pressure of ESG ratings promotes enterprises to increase investment in green technological research and development, promoting the green transformation of enterprise production; on the other hand, enterprises with excellent ESG performance are more likely to obtain policy support and green financial resources, providing financial guarantees for green innovation[12]. Green innovation not only enables enterprises to achieve cost reduction and efficiency enhancement, but also meets the market's preference for green products and services. Therefore, this paper proposes:

Hypothesis H_2: ESG performance can drive green innovation to further improve enterprise performance.

According to the theory of signal transmission, ESG performance realizes the transmission of ESG concepts through the key signal of green innovation, thereby guiding enterprises to strengthen green technology and translate it into performance growth. The significant mediating transmission role of green innovation between the two is an important path for the transformation of ESG value. Therefore, this paper proposes:

Hypothesis H_3: The strengthening of green innovation has a positive mediating effect on enterprise performance.

4 RESEARCH DESIGN AND MODEL CONSTRUCTION

4.1 Data Sources and Variable Settings

This paper selects Chinese A-share listed companies from 2009 to 2024 as the sample. The data comes from CSMAR, CNRDS and Huazheng ESG rating system. After excluding special treatment enterprises, deleting missing values, truncating at the 1% level and processing the ESG data by lagging three periods, a total of 31,014 valid observations are obtained.

As shown in Table 1: The core explanatory variable is the lagged three-period Huazheng ESG score, the dependent variable is the Tobin Q value and a robustness test is conducted using the lagged three-period ROA. The mediating variable is the logarithm of the number of green patent authorizations plus one. The control variables include company size, debt-to-equity ratio, etc., and fixed effects of industry and year are also controlled.

Table 1 Variable Names and Measurement Methods

	Variable name	Variable symbol	Variable explanation
Variable being explained	Enterprise performance	TobinQ	Enterprise market value / End-of-period total assets
Explained variable	ESG rating score	ESG_l3	Comprehensive weighting of Huazheng ESG scores for the three periods lagged behind
Metavariable	Green innovation	LnGreen_Grant	The natural logarithm of the total authorized quantity of invention and utility model green patents plus 1
Controlled variable	Company size	Size	The natural logarithm of total assets
	Asset-liability ratio	Lev	Total liabilities / Total assets
	Cash flow ratio	Cashflow	Net cash flow generated from operating activities / Total assets
	Fixed asset ratio	FIXED	Net fixed assets / Total assets
	Revenue growth rate	Growth	(This year's current period amount of operating revenue - Last year's same period amount of operating revenue) / Last year's same period amount of operating revenue
	Equity concentration	Top1	Equity concentration index 1 / 10
	Enterprise performance		

4.2 Model Construction

4.2.1 Baseline regression model

Based on the research approach proposed by Li Jinglin[14], this paper formulates the research hypothesis H_1: Good ESG performance has a positive impact on enterprise performance. This paper constructs the following baseline

regression model (1) using the two-way fixed effects model:

$$TobinQ_{i,t}=a_0+a_1 ESG\_Lag3_{i,t}+\sum a_j Controls_{i,t}+\mu_i+\delta_{ind}+\varepsilon_{i,t} \quad (1)$$

In the above model (1), $TobinQ_{i,t}$ represents the TobinQ value of enterprise i in the t-th year, indicating the enterprise performance, and is the dependent variable in this study; the core explanatory variable ESG is expressed as $ESG\_Lag3_{i,t}$ which is the three-period lagged value of the ESG comprehensive score of enterprise i in the t-th year; $\sum a_j Controls_{i,t}$ is the set of control variables; μ_i is the enterprise fixed effect; δ_{ind} is the industry fixed effect; $\varepsilon_{i,t}$ is the random disturbance term;

4.2.2 Mediation effect model

Based on the research literature by Chen Jing and Shi Yiling[7,11], this paper further introduces mediating variables on the basis of the benchmark regression model. To test the research hypotheses H_2: ESG performance can drive green innovation to further enhance enterprise performance, and hypotheses H_3: Green innovation has a positive mediating effect on enterprise performance, the following mediating effect models (2) and (3) are constructed in this paper:

$$LnGreen\_Grant_{i,t}=\beta_0+\beta_1 ESG\_Lag3_{i,t}+\sum \beta_j Controls_{i,t}+\mu_i+\delta_{ind}+\varepsilon_{i,t} \quad (2)$$

$$TobinQ_{i,t}=\gamma_0+\gamma_1 ESG\_Lag3_{i,t}+\gamma_2 LnGreen\_Grant_{i,t}+\sum \gamma_j Controls_{i,t}+\mu_i+\delta_{ind}+\varepsilon_{i,t} \quad (3)$$

Among them, $LnGreen\_Grant_{i,t}$ represents the mediating variable of green innovation, which is the logarithm of the authorization amount of enterprise i in the t-th year plus one.

5 EMPIRICAL RESULTS ANALYSIS

5.1 Descriptive Statistical Analysis

This study focuses on A-share listed companies from 2009 to 2024. After data screening, 31,014 observations were obtained. As shown in Table 2: Descriptive statistics show that the average ESG score for the three periods ahead was 4.168, with a standard deviation of 1.032. There were significant differences among enterprises, and the overall level was at a medium level, with room for improvement. The mean value of the explained variable TobinQ was 2.026, indicating a significant difference in long-term performance among enterprises. Among the control variables, enterprise size, debt ratio, operating cash flow, fixed asset ratio, revenue growth rate, and equity concentration were distributed reasonably and were consistent with the characteristics of Chinese listed companies. Overall, the distribution of each variable met expectations, with no extreme outliers, providing a reliable data basis for subsequent regression analysis.

Table 2 Descriptive Statistics of Variables

Variable	Mean	Standard Deviation	Median	Minimum Value	Maximum Value	Sample Size
TobinQ	2.026	1.328	1.612	0.789	16.647	31014
ESG_13	4.168	1.032	4.000	1.000	8.000	31014
Size	22.508	1.294	22.318	19.563	26.452	31014
Lev	0.441	0.199	0.436	0.035	0.935	31014
Cashflow	0.050	0.065	0.048	-0.199	0.266	31014
FIXED	0.215	0.158	0.183	0.002	0.725	31014
Growth	0.121	0.367	0.071	-0.654	3.808	31014
Top1	0.328	0.147	0.303	0.074	0.758	31014

5.2 Correlation Analysis

Before conducting the regression analysis, a correlation test was carried out. As shown in Table 3, ESG_13 was significantly negatively correlated with Tobin Q at the 1% level, with a correlation coefficient of -0.0602. Among the control variables, enterprise size, debt ratio, etc. were significantly negatively correlated with Tobin Q, while growth rate was significantly positively correlated, which is consistent with the literature. Univariate correlation is prone to be affected by confounding factors. In the subsequent analysis, the true impact of ESG on enterprise performance will be more accurately identified through control variables and fixed effects.

Table 3 Variable Correlation Analysis

Variable	TobinQ	ESG_13	Size	Lev	Cashflow	FIXED	Growth	Top1
TobinQ	1.000	-	-	-	-	-	-	-
ESG_13	-0.0602***	1.000	-	-	-	-	-	-
Size	-0.4179***	0.1956***	1.000	-	-	-	-	-
Lev	-0.3092***	-0.0310***	0.4552***	1.000	-	-	-	-
Cashflow	-0.1044***	0.0587***	0.0844***	-0.1677***	1.000	-	-	-
FIXED	-0.1169***	-0.0458***	0.0871***	0.0598***	0.2055***	1.000	-	-
Growth	0.0729***	0.0045	0.0401***	-0.0221***	0.0526***	-0.0419***	1.000	-
Top1	-0.0803***	0.0917***	0.2341***	0.0645***	0.1107***	0.1043***	0.0161***	1.000

Note: * p<0.1, ** p<0.05, *** p<0.01.

5.3 Multicollinearity Test

To assess the presence of multicollinearity in the model, this study conducted VIF tests on core variables, with specific results presented in Table 4. The test results indicate that all variables exhibit VIF values below the critical threshold of 10 and remain statistically significant. The overall average VIF value for the model is 1.16, demonstrating no significant multicollinearity between independent and dependent variables.

Table 4 VIF Test Results for Primary Variables

Variable	VIF	1/VIF
ESG_13	1.07	0.937283
Size	1.44	0.696072
Lev	1.36	0.733342
Cashflow	1.12	0.889507
FIXED	1.07	0.935231
Growth	1.01	0.992239
Top1	1.08	0.929303
Mean VIF	1.16	

5.4 Regression Analysis with Base Line

This study employs a two-way fixed effects model to examine the impact of ESG indicators on firm performance after lagging them by three periods. As shown in Table 5: The regression results show that when the industry fixed effects are not controlled, the ESG coefficient is 0.0267; after controlling for the effects, the coefficient increases to 0.0300, both being statistically significant at the 1% level, and the goodness of fit improves accordingly. The results support H_1, indicating that ESG performance significantly positively enhances firm performance.

Table 5 Benchmark Regression Results

	(1) TobinQ	(2) TobinQ
ESG_13	0.0267***	0.0300***
	(0.0065)	(0.0065)
Size	-0.6052***	-0.6252***
	(0.0182)	(0.0183)
Lev	0.0456	0.0519
	(0.0759)	(0.0739)
Cashflow	1.2172***	1.2278***
	(0.1215)	(0.1210)
FIXED	-0.2088**	-0.2257**
	(0.0990)	(0.0957)
Growth	0.1718***	0.1701***
	(0.0176)	(0.0169)
Top1	-0.1928*	-0.2431**
	(0.1142)	(0.1110)
_cons	15.5428***	15.9950***
	(0.4142)	(0.4156)
N	31014	31014
Ind	NO	YES
R-squared	0.6292	0.6338
Adj R-squared	0.5792	0.5833
F	224.9472	229.6741

Note: The values in parentheses represent t-values, with * p<0.1, ** p<0.05, and *** p<0.01.

5.5 Robustness Test

To test the robustness of the benchmark regression, this paper adopts the method of replacing the dependent variable, replacing Tobin's Q with the lagged three-period ROA. As shown in Table 6: The results show that the ESG_13 coefficient remains significantly positive at the 1% level, consistent with the benchmark conclusion. After controlling for the fixed effect of industries, the coefficient is 0.0051, and the goodness of fit improves, indicating that the positive effect of ESG on enterprise performance is robust and does not depend on a single performance indicator.

Table 6 Results of Robustness Test

	(1) ROA_l3	(2) ROA_l3
ESG_13	0.0053***	0.0051***
	(0.0004)	(0.0004)
Size	0.0058***	0.0060***
	(0.0008)	(0.0008)
Lev	-0.0826***	-0.0818***

	(0.0042)	(0.0042)
Cashflow	-0.0265***	-0.0270***
	(0.0063)	(0.0063)
FIXED	-0.0151***	-0.0146***
	(0.0051)	(0.0052)
Growth	-0.0036***	-0.0036***
	(0.0010)	(0.0010)
Top1	0.1179***	0.1183***
	(0.0061)	(0.0061)
_cons	-0.1041***	-0.1086***
	(0.0176)	(0.0185)
N	31014	31014
Ind	NO	YES
R-squared	0.4660	0.4706
Adj R-squared	0.3939	0.3976
F	127.0783	125.8105

Note: The values in parentheses represent t-values, with * p<0.1, ** p<0.05, and *** p<0.01.

5.6 Heterogeneity Analysis

This paper conducts heterogeneity analysis from both regional and industry perspectives. As shown in Table 7: The regression results show that the ESG coefficient of enterprises in the eastern region is 0.0322, which is significant at the 1% level. It is higher than that of the central and western regions (0.0255) and is only significant at the 5% level. This indicates that the ESG of the eastern region has a stronger promoting effect on performance, which is related to its more complete market and institutional environment. At the industry level, the ESG coefficient of the manufacturing industry is 0.0333 and is significant at the 1% level. That of the non-manufacturing industry is 0.0238 and is significant at the 5% level. Due to the stronger environmental and social attributes of the manufacturing industry, ESG practices can be more easily transformed into performance improvement. Overall, the positive impact of ESG shows significant regional and industry heterogeneity.

Table 7 Regression Results of Heterogeneity Analysis

	(1) Eastern Region	(2)Non-Eastern Region	(3)Manufacturing Industry	(4)Non-Manufacturing Industry
	TobinQ	TobinQ	TobinQ	TobinQ
ESG 13	0.0322***	0.0255**	0.0333***	0.0238**
	(0.0080)	(0.0115)	(0.0085)	(0.0102)
Size	-0.6837***	-0.5030***	-0.6314***	-0.6582***
	(0.0232)	(0.0277)	(0.0212)	(0.0338)
Lev	0.0404	0.0802	0.0735	0.0160
	(0.0848)	(0.1413)	(0.0909)	(0.1170)
Cashflow	1.0885***	1.6035***	1.5201***	0.6485***
	(0.1410)	(0.2288)	(0.1574)	(0.1813)
FIXED	-0.1888	-0.2569*	-0.4068***	0.3248**
	(0.1211)	(0.1496)	(0.1174)	(0.1591)
Growth	0.1930***	0.1254***	0.2442***	0.1031***
	(0.0210)	(0.0275)	(0.0229)	(0.0250)
Top1	-0.4133***	-0.0765	-0.4554***	0.0624
	(0.1370)	(0.1745)	(0.1367)	(0.1762)
_cons	17.3645***	13.1738***	16.1835***	16.6433***
	(0.5298)	(0.6245)	(0.4818)	(0.7671)
N	21851	9163	20138	10845
Ind	YES	YES	YES	YES
R-squared	0.6312	0.6497	0.6200	0.6693
Adj R-squared	0.5781	0.6035	0.5635	0.6239
F	167.1639	66.1502	185.5938	62.8482

Note: The values in parentheses represent t-values, with * p<0.1, ** p<0.05, and *** p<0.01.

5.7 The Mediation Effect of Inspection

This paper follows the three-step method of the mediating effect to test the mediating role of green innovation between ESG and enterprise performance. As shown in Table 8: The regression results show that the total effect of ESG on enterprise performance is 0.0300, which is significantly positive at the 1% level; the coefficient of ESG on green innovation is 0.0159, also significantly at the 1% level. After including both in the regression, the direct effect of ESG is 0.0288, and the mediating effect of green innovation is 0.0738, both highly significant. After controlling for the industry fixed effect, the impact coefficients further increase. The results indicate that green innovation plays a significant positive mediating role in enhancing enterprise performance through ESG. Hypotheses H_2 and H_3 have been verified. In the context of green development, ESG performance effectively enhances enterprise competitiveness and improves operating performance by promoting green innovation.

Table 8 Shows the Regression Results of the Mediating Effect

	(1) TobinQ	(2) TobinQ	(3) LnGreen_Grant	(4) LnGreen_Grant	(5) TobinQ	(6) TobinQ
ESG 13	0.0267***	0.0300***	0.0157***	0.0159***	0.0256***	0.0288***
	(0.0065)	(0.0065)	(0.0046)	(0.0046)	(0.0065)	(0.0065)
LnGreen_Grant	-	-	-	-	0.0710***	0.0738***
					(0.0087)	(0.0087)
Size	-0.6052***	-0.6252***	0.5654***	0.5658***	-0.6453***	-0.6669***
	(0.0182)	(0.0183)	(0.0104)	(0.0106)	(0.0202)	(0.0202)
Lev	0.0456	0.0519	-0.1240***	-0.1131***	0.0544	0.0603
	(0.0759)	(0.0739)	(0.0425)	(0.0423)	(0.0756)	(0.0736)
Cashflow	1.2172***	1.2278***	0.0294	0.0296	1.2151***	1.2256***
	(0.1215)	(0.1210)	(0.0649)	(0.0647)	(0.1214)	(0.1209)
FIXED	-0.2088**	-0.2257**	0.0653	0.0314	-0.2135**	-0.2280**
	(0.0990)	(0.0957)	(0.0639)	(0.0639)	(0.0985)	(0.0952)
Growth	0.1718***	0.1701***	-0.0849***	-0.0881***	0.1778***	0.1766***
	(0.0176)	(0.0169)	(0.0099)	(0.0099)	(0.0176)	(0.0169)
Top1	-0.1928*	-0.2431**	-0.4944***	-0.5262***	-0.1577	-0.2042*
	(0.1142)	(0.1110)	(0.0735)	(0.0739)	(0.1139)	(0.1106)
cons	15.5428***	15.9950***	-11.7156***	-11.7119***	16.3741***	16.8598***
	(0.4142)	(0.4156)	(0.2374)	(0.2431)	(0.4530)	(0.4532)
N	31014	31014	31014	31014	31014	31014
Ind	NO	YES	NO	YES	NO	YES
R-squared	0.6292	0.6338	0.7638	0.7665	0.6301	0.6348
Adj R-squared	0.5792	0.5833	0.7319	0.7343	0.5801	0.5844
F	224.9472	229.6741	511.0969	501.0589	200.4832	204.1196

Note: The values in parentheses represent t-values, with * p<0.1, ** p<0.05, and *** p<0.01.

6 CONCLUSION AND RECOMMENDATIONS

This study takes the Chinese A-share listed companies from 2009 to 2024 as the sample to confirm that ESG performance has a significant positive three-period lagging impact on corporate performance. Green innovation plays a partial mediating role between the two, and the robustness test verifies the conclusion's stability. ESG promotes green innovation to transform into a competitive advantage for enterprises, ultimately enhancing their business performance. Group testing shows that the performance promoting effect of ESG performance is more significant in the eastern region and manufacturing samples, indicating that the conditions of ESG performance's impact on corporate performance are closely related to regional environment and industry characteristics.

Based on the research findings, this paper proposes the following suggestions from the practical perspective: Enterprises should fully recognize the importance of ESG construction, actively integrate ESG concepts into the entire process of strategic decision-making and business management, improve information disclosure and reasonably control investment, implement differentiated development strategies based on industry and regional differences, and increase investment in green innovation, optimize production and governance structures, thereby promoting continuous performance improvement. The government should improve ESG policy regulations and rating systems, establish industry-specific information disclosure standards, formulate differentiated assessments based on regional realities, and reduce the cost of green innovation through tax incentives and fiscal support, accelerate the transformation of achievements, and strengthen green finance and market guidance to create a favorable development environment. Investors should focus on the green innovation achievements and ESG value transformation capabilities of enterprises in their decision-making, combine regional and industry heterogeneity for investment layout, focus on high-quality enterprises in the eastern region and the manufacturing sector, and explore the growth potential of non-eastern and non-manufacturing enterprises to enhance investment effectiveness.

COMPETING INTERESTS

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