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Original Paper

Research on the Impact of Executives' Green Cognition, Green Innovation and Corporate ESG Performance

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Abstract

This paper selects Shenzhen and Shanghai A-share listed companies from 2009 to 2023 as sample data to study the impact of executives' green cognition EGP on corporate ESG performance. The study found that executives' green cognition EGP and corporate ESG performance showed a significant positive correlation, that is, executives' green cognition can significantly promote the improvement of corporate ESG performance, and the results still hold after a series of stability tests; green innovation plays a mediating role in the process of executives' green cognition promoting the improvement of corporate ESG performance, that is, executives' green cognition can promote companies to carry out green innovation, and then green innovation greatly improves the company's ESG performance; further research found that the impact of executives' green cognition on corporate ESG performance varies in different situations, specifically, executives with financial backgrounds and low-paid executives have a more obvious promotion of corporate ESG performance.

Keywords

Executives' green cognition, green innovation, corporate ESG performance

1. Introduction

With the rapid development of the global economy, environmental problems are becoming increasingly serious. Climate change, resource depletion and environmental pollution have become major challenges facing the world. Against this background, the concept of sustainable development has gradually become a consensus of the international community. As the main participants in economic activities, the impact of corporate behavior on the environment cannot be ignored. Therefore, promoting corporate performance in terms of environment, society and governance (ESG) to achieve coordinated development of the economy, society and environment has become an important task at

present. As the planners of corporate plans, the far-sighted strategic decisions of senior executives play a decisive role in promoting corporate performance in terms of environment, society and governance (Luo, Rao, & Chen, 2021). Senior executive green cognition refers to the awareness and actions of senior management of enterprises on environmental protection and sustainable development (Feng, 2024). In the current situation of increasingly severe global environmental crisis, senior executive green cognition has become an important symbol and necessary condition for corporate sustainable development. As the core of corporate decision-making, the level of cognition and action decisions of senior executives will directly affect the strategic direction and sustainable development capabilities of enterprises (Sun, 2009). Senior executives with strong green cognition are more likely to make environmentally friendly decisions in corporate operations, promote the implementation of green strategies by enterprises, and thus improve the ESG performance of enterprises.

the process of executives' green cognition influencing corporate ESG performance , green innovation plays a crucial role (Shen & Wang, 2024). Green innovation refers to the ideas and methods that focus on environmental protection and sustainable resource utilization in the process of technological innovation. It covers innovations in product design, production processes, marketing and other aspects to achieve a win-win situation for the economy and the environment (Xi & Zhao, 2022). With the acceleration of industrialization, the traditional high-energy consumption and high-pollution development model is no longer sustainable. Green innovation has become a key way to promote economic transformation and upgrading and achieve sustainable development. Through green innovation, companies can reduce energy consumption , reduce pollutant emissions, and improve resource utilization efficiency, thereby achieving green development. At the same time, green innovation can also enhance the company's brand image and social responsibility, enhance consumers' trust in the company, and thus benefit the company's long-term development.

ESG rating is a method to measure the performance of enterprises in terms of environment, society and governance (Han, Yang, & Gao, 2024). It comprehensively considers the performance of enterprises in resource utilization, energy consumption, emission reduction (environmental dimension), employee rights, community responsibility, supply chain management (social dimension) as well as corporate governance, transparency, anti-corruption (governance dimension) (Su & He, 2024). The importance of ESG performance to enterprises is self-evident. For investors, ESG rating can help them understand the risks and opportunities of enterprises and provide reference for investment decisions; for enterprises, ESG rating can help them identify areas for improvement and enhance corporate image and competitiveness; for stakeholders, ESG rating can provide information on corporate social responsibility and sustainable development and promote the positive interaction between enterprises and society (Sun & Huang, 2023). In the context of the increasingly severe global environmental crisis and the popularization of the concept of sustainable development, it is of great theoretical and practical significance to study the impact of executives' green cognition, green innovation and corporate ESG performance. By analyzing executives' green cognition, we can reveal its impact mechanism on green

innovation and corporate ESG performance, and provide a basis for enterprises to formulate more reasonable green strategies and ESG management strategies. At the same time, this research will also help promote cooperation and interaction between enterprises, governments and society, and jointly promote the sustainable development of enterprises. Therefore, the study of the impact of executives' green cognition, green innovation and corporate ESG performance is an important topic in the current field of corporate sustainable development and has important theoretical and practical value.

Most of the existing literature studies the economic consequences of ESG, emphasizing that companies should pay attention to ESG performance, establish a good corporate image for the company, ease financing constraints, and improve environmental and financial performance. This study explores the impact of antecedent factors on ESG performance, and helps companies better understand and respond to ESG challenges by exploring the internal factors and mechanisms that affect ESG performance.

2. Theoretical Analysis and Research Hypothesis

2.1 Executives' Cognition and Corporate ESG Performance

In 1984, Hambrick et al. first proposed the theory of the top echelon, which states that corporate executives who have been in a certain field for a long time will have relevant selective cognition, and when they make decisions, they will think based on this cognition, which makes corporate executives more inclined to their own experience and relevant cognition when making decisions (Zhang, Xu, & Chen, 2021); Liang Min et al.'s research also reached the same result, believing that executive cognition has a great influence on organizational behavior and performance level. To a certain extent, the strategic decision of the organization is a reflection of the executive's values, thinking patterns and ideology (Liang, Cao, & Wang, 2022). Banerjee believes that corporate executives with better environmental cognition and green values may pay more attention to environmental, social and governance issues, and will actively promote the implementation of environmental protection measures and sustainable development strategies (Banerjee, 2001).

Based on the above theories and research results, this paper argues that the green cognition of corporate executives can significantly affect the ESG performance of enterprises. First, executives with strong green cognition are more likely to make environmentally friendly decisions, such as investing in green technologies, promoting energy conservation and emission reduction, and implementing sustainable development strategies. These decisions help reduce the negative impact of enterprises on the environment and improve resource utilization efficiency, thereby improving the environmental performance of enterprises (Maloney, 1973). Second, executives' green cognition is also reflected in their fulfillment of social responsibilities. They are more likely to pay attention to the social impact of enterprises, such as employee welfare, community relations, product safety, etc. In order to improve the interests of all parties and achieve harmonious and stable development of enterprises, they will actively enhance corporate social awareness and environmental awareness and meet the demands of all stakeholders (Xi & Zhao, 2022). By actively fulfilling social responsibilities, enterprises can establish a

good social image, enhance brand reputation, and thus improve the social performance of enterprises (Huang, Wang, Han et al., 2022). In addition, executives' green cognition also involves the optimization of corporate governance structure. They are more likely to promote the establishment of a sound internal control mechanism and improve the transparency and efficiency of corporate governance. A good corporate governance structure helps reduce corporate risks and improve the stability and sustainable development capabilities of enterprises. Therefore, this paper proposes the following hypothesis:

H1: Executives' green cognition has a positive impact on corporate ESG performance.

2.2 The Mediating role of Green Innovation

Green innovation refers to environmentally friendly technologies used to prevent and control pollution at the process innovation and product innovation levels, including pollution prevention, energy conservation and green product design. Green technology innovation is a key variable in achieving green development and the "dual carbon" goals [14], and is also an important driving force for achieving sustainable development of enterprises. Executives' green cognition can drive enterprises to carry out green innovation to meet increasingly stringent environmental regulations and market demands. Specifically, executives' cognition of environmental protection will affect the allocation of corporate resources, give priority to green innovation projects, and promote sustainable development of enterprises (Zou, Xin, Chao et al., 2019). At the same time, executives' cognition of environmental protection can also help enterprises take green innovation as a strategic development direction, enhance corporate image and market competitiveness, and accelerate the promotion of green innovation. Furthermore, in terms of the environment, green innovation helps enterprises reduce carbon emissions, improve resource utilization efficiency, reduce waste generation, etc., thereby improving the environmental performance of enterprises (Peng, Chen, & Yin, 2023). By adopting environmentally friendly technologies and equipment, enterprises can reduce the consumption of natural resources and environmental damage, and improve environmental performance; in terms of society, green innovation can promote enterprises to fulfill their social responsibilities, such as improving employee benefits, improving supply chain relationships, and improving product safety and quality, thereby enhancing the social performance of enterprises (PANE, OYLER, & HUMPHR, 2009). The green innovation behavior of enterprises can also enhance their image in the minds of consumers and strengthen their trust and loyalty. In terms of governance, green innovation requires enterprises to strengthen corporate governance and ensure that conflicts of interest between the board of directors, senior management and other stakeholders are effectively managed (Shen & Wang, 2024). Through green innovation, enterprises can establish a more complete ESG information disclosure mechanism, improve transparency and reduce information asymmetry risks. Based on this, this paper proposes the hypothesis:

H2 : Executive cognition can enhance the green innovation capabilities of enterprises, thereby improving the ESG performance of enterprises.

3. Research Design

3.1 Sample Data Selection and Source

This paper selects Shenzhen and Shanghai A-share listed companies from 2009 to 2023 as sample data, among which the explanatory variable executive green cognition comes from the annual report of listed companies, the corporate ESG performance data comes from the Huazheng ESG score data, the mediating variable green innovation data comes from the State Intellectual Property Office , and the rest of the data comes from the Guotai An (CSMAR) database. In order to ensure the reliability of the data analysis results, the sample data is processed as follows: exclude samples of listed companies in the financial industry; exclude samples of listed companies such as ST and *ST; exclude missing values of variables; and perform 1% and 99% quantile shrinkage on the sample data. Through the selection and processing of the above data sample data, 32,758 valid sample data are finally obtained.

3.2 Variable Definition

Explanatory variable: Executive green cognition. The green cognition of executives was measured by referring to Liang Min (Liang, Cao, & Wang, 2022). Based on the three dimensions of green competitive advantage awareness, corporate social responsibility awareness, and external environmental pressure awareness, the following keywords were selected: energy conservation and emission reduction, environmental protection strategy, environmental protection concept, environmental management agency, environmental education and environmental technology development, environmental audit, energy conservation and environmental protection, environmental protection policy, environmental protection department, environmental protection inspection, low-carbon environmental protection, environmental protection work, environmental protection governance, environmental protection and environmental governance, environmental protection facilities, environmental protection-related laws and regulations, and environmental pollution control. The environmental cognition variable of executives of listed companies was constructed by the frequency of the above words appearing in the company's annual report, which was used to measure the green attention of corporate managers in decision-making.

Explained variable: corporate ESG performance. Based on the research of Su Ling et al. (Su Ling & He, 2024) selects Huazheng ESG performance as the explained variable. Huazheng ESG evaluation system refers to the international ESG evaluation system and is adjusted based on the actual situation of the Chinese market, so the conclusions drawn are more reliable.

Mediating variable: innovation performance. Refer to the research method of Li Jinhua (Liu, Wang, & Yan, 2024) et al. All patent data of listed companies are obtained through the State Intellectual Property Office, and then according to the International Patent Classification (IPC) classification number. Secondly, these IPC classification numbers are carefully compared with the classification numbers in the International Patent Classification Green List published by the World Intellectual Property Organization (WIPO). If the IPC classification number of a patent is consistent with the classification number in the list, the patent is identified as a green patent.

For control variables, based on existing research, we select variables such as enterprise age (Size), enterprise scale (Age), debt-to-asset ratio (Lev), board size (Board), equity balance (Shares), management shareholding ratio (Manage), independent director ratio (Indep), and dual-position director ratio (Dual) as control variables.

Table 1. Variable Definition Table

Variable Types	Variable Name	Variable Symbols	Variable Description
Explanatory variables	Executives' green awareness	EGP	Word frequency statistics of the parent company's annual report
Explained variable	Corporate ESG Performance	ESG	Huazheng ESG Rating
Mediating variables	Green Innovation	GTI	The natural logarithm of the number of green patent applications
Control variables	Company age	Size	Take the natural logarithm of the total assets of the enterprise
	Enterprise scale	Age	The natural logarithm of the time since the company went public plus 1
	Debt-to-asset ratio	Lev	Asset liability ratio
	Board size	Board	Natural logarithm of the number of board members
	Equity Balance	Shares	Shareholding ratio of the 2nd to 5th largest shareholders/shareholding ratio of the largest shareholder
	Management shareholding ratio	Manage	Ratio of management shareholding to total equity
	Percentage of independent directors	Indep	Number of independent directors/number of board members
	Two jobs in one	Dual	the two positions combined?

3.3 Model Construction

Regarding the relationship between executives' green cognition and corporate ESG performance, the following baseline regression model (1) is established :

$$ESG_{it} = \alpha_0 + \alpha_1 EGP_{it} + \alpha_2 Controls_{it} + \sum \mu + \varepsilon_{it} \quad (1)$$

Among them, Controls is the enterprise-level control variable, μ represents the two-way fixed effect model controlling for individual enterprises and years, and ε is the residual value. Secondly , in order to

consider the mechanism path influence of the mediating effect brought by green innovation , this paper establishes model (2) and model (3):

$$GTI_{it} = \alpha_0 + \alpha_1 ESG_{it} + \alpha_2 Controls_{it} + \sum \mu + \varepsilon_{it} \quad (2)$$

$$ESG_{it} = \alpha_0 + \alpha_1 EGP_{it} + \alpha_2 GTI_{it} + \alpha_3 Controls_{it} + \sum \mu + \varepsilon_{it} \quad (3)$$

4. Empirical Analyses

4.1 Descriptive Analysis

Through descriptive analysis, it is found that the maximum value of corporate ESG performance in the sample data is 6.75, the minimum value is 1, the mean is 4.16, the standard deviation is 0.926, and the median is 4. The mean and median are close. The selected samples show a nearly normal distribution in this value, and there is no excessive left or right skewness. The maximum value of executive green cognition is 3.332, the minimum value is 0, the mean is 0.983, the standard deviation is 0.887, and the median is 0.693. The sample data has a large difference, and the green cognition performance of executives in the sample data is inconsistent, so it has great practical significance. The descriptive analysis of the remaining variables is shown in Table 2 Descriptive Analysis.

Table 2. Descriptive Analysis

Variable	N	Mean	Max	SD	p50	Min
ESG	32758	4.16	6.75	0.926	4	1
EGP	32758	0.983	3.332	0.887	0.693	0
Age	32758	2.951	3.705	0.343	2.992	1.3
Size	32758	8.447	1 2.78	1.309	8.257	5.603
Lev	32758	0.424	0.935	0.206	0.417	0.0313
Board	32758	1.474	2.197	0.182	1.386	1.099
Shares	32758	0.773	2.962	0.615	0.617	0.0173
Manage	32758	14.12	70.87	19.65	1.343	0
Indep	32758	37.61	57.14	5.336	36.36	25
Dual	32758	0.312	1	0.463	0	0
Ins	32758	43.49	93.69	24.73	44.5	0.121

4.2 Correlation Analysis

Table 3 shows the correlation analysis and multicollinearity analysis between sample data and variables. Table 3 shows that the explanatory variable executive green cognition EGP and other variables are significant at the 1% level, indicating that the selected control variables are reasonable. The VIF values of multicollinearity analysis are all below 2, indicating that there is no multicollinearity between the selected variables. In summary, the reliability and rationality of variable selection are verified through

correlation analysis and multicollinearity analysis.

Table 3. Correlation Analysis and Multicollinearity Analysis

	ESG	EGP	Age	Size	Lev	Board	Shares	Manage	Indep	Dual	Ins	VIF	1/VIF
ESG	1												
EGP	0.069***	1										1.06	0.946554
Age	-0.038***	0.110***	1									1.16	0.861017
Size	0.218***	0.215***	0.239***	1								1.67	0.598037
Lev	-0.101***	0.089***	0.201***	0.491***	1							1.43	0.701251
Board	0.046***	0.079***	0.056***	0.256***	0.195***	1						1.43	0.701251
Shares	-0.005	-0.033***	-0.018***	-0.084***	-0.126***	-0.099***	1					1.14	0.878263
Manage	0.081***	-0.080***	-0.242***	-0.341***	-0.326***	-0.255***	0.209***	1				1.97	0.508079
Indep	0.075***	-0.042***	-0.012**	-0.002	-0.024***	-0.106***	-0.028***	0.069***	1			1.03	0.970671
Dual	0.004	-0.061***	-0.095***	-0.168***	-0.149***	-0.178***	0.058**	0.241***	0.118***	1		1.1	0.911617
Ins	0.103***	0.076***	0.021**	0.404***	0.177***	0.226***	-0.193***	-0.622***	-0.064***	-0.173***	1	1.91	0.522685

4.3 Regression Analysis

The sample data selected in this paper is panel data, and the Hausman test is performed on the sample data before the regression numerator. Table 4 shows the results of the Hausman test. The results of Table 4 show that the P value is 0.000, so this paper will use a fixed effect model when performing regression analysis on the sample data. At the same time, considering that the sample data involves the influence of two dimensions, the year of the enterprise and the industry, the two-way fixed effect model is finally adopted, the purpose of which is to alleviate the model error caused by the year and industry.

Table 4. Hausman Test

	Coefficients			
	(b)	(B)	(bB)	sqrt(diag (V_b -V_B))
	f	re	Difference	Std. err.
EGP	0.0459365	0.0352016	0.0107349	0.0032353
Age	-0.33361	-0.2210109	-0.1125991	0.0205129
Size	0.2003569	0.2005432	-0.0001863	0.0066096
Lev	-0.8477219	-0.9064313	0.0587094	0.0190368
Board	0.1245252	0.1412381	-0.0167128	0.0344127
Shares	-0.0761702	-0.0546659	-0.0215044	0.0074504
Manage	0.0065981	0.0078581	-0.00126	0.0003115
Indep	0.0106404	0.0110709	-0.0004305	0.000528
Dual	-0.0198452	-0.008641	-0.0112042	0.005847
Ins	0.0018973	0.003391	-0.0014937	0.0002675
chi2(10)	172.85	Prob > chi2	0.0000	

In the regression analysis of Table 5, the first column (1) shows the regression results without adding control variables and fixing the year and industry. The green cognition EGP of executives has a significant positive effect on the ESG performance of enterprises at the 1% level. In order to consider the impact of omitted variables, the second column of Table 5 adds relevant variables such as enterprise age (Size), enterprise scale (Age), debt-to-asset ratio (Lev), board size (Board), equity balance (Shares), management shareholding ratio (Manage), independent director ratio (Indep), and dual-position (Dual). After adding various control variables, the green cognition EGP of executives is still significantly effective at the 1% level for the ESG performance of enterprises. The hypothesis H1 of this paper has been preliminarily verified. Based on the first two columns, the year and industry are fixed, and the sample data are subjected to two-way fixed effects and the endogeneity of the sample data is preliminarily tested. The green cognition EGP of executives is still significantly effective at the 1% level for the ESG performance of enterprises, which strengthens the verification of hypothesis H1.

Table 5. Regression Analysis

	(1)	(2)	(3)	(4)
	ESG	ESG	ESG	ESG
EGP	0.0717 ***	0.0269 ***	0.1195 ***	0.0808 ***
	(12.4467)	(4.8731)	(18.3059)	(13.1886)
Age		-0.0872 ***		-0.1082 ***
		(-5.8347)		(-6.4416)
Size		0.2412 ***		0.2637 ***
		(51.3072)		(54.4404)
Lev		-1.0193 ***		-1.1442 ***
		(-37.0010)		(-40.2739)
Board		0.1629 ***		0.2297 ***
		(5.8312)		(8.2544)
Shares		-0.0263 ***		-0.0292 ***
		(-3.2967)		(-3.7520)
Manage		0.0096 ***		0.0095 ***
		(28.1837)		(28.6118)
Indep		0.0119 ***		0.0117 ***
		(13.1712)		(13.3467)
Dual		-0.0062		-0.0125
		(-0.5733)		(-1.1910)
Ins		0.0046 ***		0.0048 ***
		(17.4501)		(18.4716)
_cons	4.0898 ***	1.7825 ***	3.4079 ***	1.1884 ***
	(536.4698)	(23.7845)	(38.9765)	(10.8970)
control	no	yes	no	yes
years	no	no	yes	yes
industry	no	no	yes	yes

N	32758	32758	32758	32758
adj. R^2	0.005	0.136	0.064	0.205

t statistics in parentheses * p < 0.1, ** p < 0.05, *** p < 0.01.

4.4 Robustness Analysis

In order to ensure the reliability and robustness of the sample data results, this paper adopts methods such as replacing variables, lagged explanatory variables, and deleting special years, and uses system GMM to further verify the endogeneity problem. Table 6 Robustness analysis is the result of the robustness analysis of the above method. The original corporate ESG performance was analyzed based on the annual average score of Huazheng Score , which is now replaced by the median. Its executives' green cognition EGP is still significantly effective at the 1% level for the company's ESG performance, which preliminarily verifies the robustness of the sample data. Considering the possible time lag in the impact of executives' green cognition on corporate ESG performance, the specific effect may be in the next period after the executives' green cognition is improved. Therefore, the explanatory variables are lagged for one period for robustness analysis, and its executives' green cognition EGP is still significantly effective at the 1% level for the company's ESG performance, which once again verifies the robustness of the sample data. Since the evaluation of corporate ESG performance may be greatly affected by the financial market, the Chinese stock market suffered a huge impact in 2015, so the sample data of 2015 was deleted for analysis. The result is that the executives' green cognition EGP is still significantly effective at the 1% level for the corporate ESG performance, which further verifies the robustness of the sample data. Finally, the system GMM method is used to verify its endogeneity problem. After analysis, the executives' green cognition EGP is still significantly effective at the 1% level for the corporate ESG performance, which fully demonstrates that the sample data is not affected by the endogeneity problem.

Table 6. Robustness Analysis

	Substituting variables	Lagged explanatory variables	Delete special year	System GMM
	ESG2	ESG	ESG	ESG
EGP	0.0825 ***		0.0787***	0.1425 ***
	(12.8024)		(12.4671)	(7.4004)
L.EGP		0.1018 ***	-0.1054***	
		(15.2765)	(-6.0935)	
L.ESG			0.2627***	0.8868 ***
			(52.5861)	(70.0996)

Age	-0.1093 ***	-0.1009 ***	-1.1312***	0.0069
	(-6.1852)	(-5.3009)	(-38.6799)	(0.6042)
Size	0.2673 ***	0.2755 ***	0.2216***	0.0420 ***
	(52.4723)	(51.9883)	(7.7054)	(8.0425)
Lev	-1.1521 ***	-1.1645 ***	-0.0285***	-0.2811 ***
	(-38.5525)	(-37.4901)	(-3.5546)	(-10.8363)
Board	0.2262 ***	0.2384 ***	0.0096***	0.0102
	(7.7278)	(7.8484)	(28.1821)	(0.4110)
Shares	-0.0242 ***	-0.0268 ***	0.0119***	0.0175 ***
	(-2.9504)	(-3.1546)	(13.1208)	(2.6510)
Manage	0.0093 ***	0.0090 ***	-0.0111	-0.0000
	(26.5792)	(24.4398)	(-1.0235)	(-0.0642)
Indep	0.0118 ***	0.0119 ***	0.0049***	0.0047 ***
	(12.7470)	(12.4636)	(18.3114)	(5.2307)
Dual	-0.0113	-0.0219 *	0.0787***	0.0040
	(-1.0236)	(-1.9138)	(12.4671)	(0.3907)
Ins	0.0048 ***	0.0048 ***	-0.1054***	0.0006 **
	(17.3395)	(16.6621)	(-6.0935)	(2.5604)
_cons	1.2103 ***	0.8948 ***	1.1957 ***	-0.1582 **
	(10.5512)	(7.3954)	(10.6241)	(-2.3408)
control	yes	yes	yes	
years	yes	yes	yes	
industry	yes	yes	yes	
N	32758	28089	30813	28089
adj. R^2	0.191	0.214	0.204	

t statistics in parentheses * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

4.5 Mediation Analysis

The above verifies that the green cognition EGP of executives is significantly effective at the 1% level on the ESG performance of enterprises, and tests the robustness of the sample data and its mediating mechanism. Table 7 shows the results of the mediating effect analysis. The second column in Table 7 is the analysis result of model (2), and the third column is the analysis result of model 3. It can be found that after adding green innovation to the model, they are all significant at the 1% level, which verifies that green innovation has a positive mediating mechanism effect on the green cognition EGP of executives on the ESG performance of enterprises, and verifies hypothesis H2.

Table 7. Mediation Analysis

	(1)	(2)	(3)
	ESG	GTI	ESG
EGP	0.0808 ***	0.0327 ***	0.0769 ***
	(13.1886)	(6.3199)	(12.6000)
Age	-0.1082 ***	-0.1292 ***	-0.0926 ***
	(-6.4416)	(-9.0996)	(-5.5322)
Size	0.2637 ***	0.1400 ***	0.2467 ***
	(54.4404)	(34.2086)	(50.3133)
Lev	-1.1442 ***	0.1063 ***	-1.1571 ***
	(-40.2739)	(4.4278)	(-40.9293)
Board	0.2297 ***	0.1579 ***	0.2106 ***
	(8.2544)	(6.7156)	(7.6016)
Shares	-0.0292 ***	-0.0142 **	-0.0275 ***
	(-3.7520)	(-2.1652)	(-3.5487)
Manage	0.0095 ***	0.0014 ***	0.0093 ***
	(28.6118)	(5.1047)	(28.2259)
Indep	0.0117 ***	-0.0013 *	0.0119 ***
	(13.3467)	(-1.7751)	(13.5990)
Dual	-0.0125	0.0214 **	-0.0151
	(-1.1910)	(2.4126)	(-1.4454)
Ins	0.0048 ***	0.0007 ***	0.0047 ***
	(18.4716)	(3.3200)	(18.2242)
GTI			0.1212 ***
			(18.5950)
_cons	1.1884 ***	-1.0145 ***	1.3113 ***
	(10.8970)	(-11.0099)	(12.0649)
control	yes	yes	yes
years	yes	yes	yes
industry	yes	yes	yes
N	32758	32758	32758
adj. R^2	0.205	0.182	0.213

t statistics in parentheses * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

4.6 Heterogeneity Analysis

In order to further analyze the impact of executives' green cognition EGP on corporate ESG

performance, we analyzed whether the executives have a financial background and the heterogeneity of executive compensation. Table 7 Heterogeneity analysis is the results of two heterogeneity analyses. The four results of the two heterogeneities show that the impact of executives' green cognition EGP on corporate ESG performance is significant at the 1% level, but there is a large gap in their regression coefficients. Therefore, the impact of executives' green cognition on corporate ESG performance varies in different situations. The regression coefficient of executives with a financial background is 0.0890, which is greater than the coefficient of 0.0619 for those without a financial background, which shows that executives with a financial background can better improve corporate ESG performance through green cognition. The regression coefficient of high compensation is 0.558, which is lower than the regression coefficient of low compensation of 0.1077. The reason may be that high-paid executives aim to obtain more corporate profits and ignore the improvement of corporate ESG performance. Low-paid executives may increase their compensation levels in order to improve corporate ESG performance.

Table 7. Heterogeneity Analysis

	Do the executives have a financial background?		Executive Compensation Heterogeneity	
	yes	no	High salary	Low pay
	ESG	ESG	ESG	ESG
EGP	0.0890 ***	0.0619 ***	0.0558 ***	0.1077 ***
	(12.1200)	(5.5579)	(6.5618)	(12.1542)
Age	-0.1112 ***	-0.0923 ***	-0.0340	-0.1771 ***
	(-5.5810)	(-2.9320)	(-1.4381)	(-7.4399)
Size	0.2707 ***	0.2381 ***	0.2560 ***	0.2074 ***
	(47.5987)	(25.0130)	(37.0320)	(26.2010)
Lev	-1.1053 ***	-1.2304 ***	-1.1269 ***	-1.0730 ***
	(-32.3527)	(-23.8268)	(-26.4077)	(-27.8980)
Board	0.2257 ***	0.2424 ***	0.2015 ***	0.2468 ***
	(6.9224)	(4.4628)	(5.3716)	(5.9626)
Shares	-0.0355 ***	0.0011	-0.0296 ***	-0.0517 ***
	(-3.8390)	(0.0775)	(-2.7897)	(-4.4917)
Manage	0.0102 ***	0.0075 ***	0.0076 ***	0.0105 ***
	(25.2290)	(12.7884)	(15.4730)	(23.0054)
Indep	0.0107 ***	0.0137 ***	0.0136 ***	0.0111 ***
	(10.1550)	(8.4938)	(10.8580)	(9.0400)
Dual	-0.0068	-0.0265	-0.0109	-0.0070
	(-0.5354)	(-1.4326)	(-0.7279)	(-0.4763)

Ins	0.0051 ***	0.0043 ***	0.0049 ***	0.0044 ***
	(16.0501)	(9.1157)	(13.5315)	(11.5805)
_cons	1.1993 ***	1.2049 ***	0.8698 ***	1.8858 ***
	(9.2428)	(5.9260)	(4.8576)	(12.7934)
control	yes	yes	yes	yes
years	yes	yes	yes	yes
industry	yes	yes	yes	yes
N	23274	9484	16399	16359
adj. R^2	0.218	0.181	0.187	0.191

t statistics in parentheses * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

5. Conclusions and Suggestions

This paper selects Shenzhen and Shanghai A-share listed companies from 2009 to 2023 as sample data to study the impact of executives' green cognition EGP on corporate ESG performance. The study found that executives' green cognition EGP and corporate ESG performance showed a significant positive correlation, that is, executives' green cognition can significantly promote the improvement of corporate ESG performance, and the results still hold after a series of stability tests; green innovation plays a mediating role in the process of executives' green cognition promoting the improvement of corporate ESG performance, that is, executives' green cognition can promote companies to carry out green innovation, and then green innovation greatly improves the company's ESG performance; further research found that the green cognition of executives in different situations has different degrees of influence on corporate ESG performance, specifically, the cognition of executives with financial backgrounds and low-paid executives is more obvious in promoting corporate ESG performance. By improving the green cognition level of executives, strengthening green innovation investment and practice, and optimizing the structure of the executive team, companies can more effectively improve their ESG performance and achieve sustainable development goals. Three specific suggestions are put forward:

First, improve the green cognition level of senior executives. Enterprises should attach importance to and improve the green cognition level of senior executives, and increase their in-depth understanding of ESG-related issues such as environmental protection, social responsibility and corporate governance through organizing training, seminars, external learning exchanges, etc.; encourage senior executives to participate in ESG-related decision-making processes, so that they can deepen their understanding and recognition of ESG concepts in practice, and thus pay more attention to the sustainable development of enterprises in daily operations. Secondly, strengthen green innovation investment and practice. Enterprises should increase investment in green innovation, including R&D funds, technology introduction and talent training, to support the transformation of senior executives' green cognition into practical actions; establish a green innovation incentive mechanism to encourage employees to propose

and implement green innovation projects, such as energy saving and consumption reduction, resource recycling, and environmentally friendly product development, so as to improve the company's ESG performance through green innovation; regularly evaluate and feedback on green innovation results, and adjust innovation strategies and directions in a timely manner to ensure that green innovation activities can continuously and effectively promote the sustainable development of enterprises. Finally, optimize the structure of the senior management team. When forming an executive team, priority can be given to executives with a financial background, as their knowledge may have a more significant effect on improving the company's ESG performance. When designing the compensation system, the fixed salary ratio of executives can be moderately reduced, and an incentive mechanism linked to ESG performance can be increased to stimulate executives' enthusiasm and creativity in ESG. Diverse backgrounds and perspectives can be encouraged within the executive team to jointly promote continuous improvement and innovation in the company's ESG through cross-field cooperation and exchanges.

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