Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 8, 493-504
2025
Publisher: Learning Gate
DOI: 10.55214/2576-8484.v9i8.9326

The impact of environmental, social and governance on firm performance: The mediating role of green innovation

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Abstract: This study aims to investigate the impact of corporate environmental, social and governance (ESG) performance on financial performance (measured by ROA of return on total assets) and to examine the mediating role of green innovation (measured by the number of green patent applications). This paper constructs a research framework based on stakeholder theory and sustainable development theory, selects Chinese A-share listed companies as samples, and constructs a panel regression model for empirical analysis. The results of hypothesis testing show that: good ESG performance significantly enhances corporate ROA; corporate ESG performance positively promotes green innovation; green innovation positively affects ROA; and green innovation plays a partial mediating effect between ESG and ROA. The findings suggest that corporate fulfilment of ESG responsibilities can enhance economic efficiency by promoting green innovation, confirming the expectations of sustainable development and stakeholder theory, and providing empirical evidence for corporate sustainability strategies and government green policies.

Keywords: *ESG, Firm performance, Green innovation, Mediation effect, Return on assets (ROA).*

1. Introduction

As global climate change and resource and environmental issues are becoming more and more prominent, the national strategy represented by 'carbon peak and carbon neutral' has put forward higher requirements for the sustainable development of enterprises [1]. In the context of high-quality development, corporate evaluation indicators have gradually expanded from single financial indicators to comprehensive indicators that take into account environmental and social responsibility. Scholars at home and abroad have found that more and more listed companies have taken the initiative to disclose ESG information, and more than a thousand companies have published ESG reports in China [2]. Excellent ESG performance is regarded as a symbol of responsible management and low-risk characteristics, which usually enhances stakeholders' trust and reduces financing costs, thus contributing to the enhancement of corporate value and financial performance [3]. For example, Tian and Dong [4] empirically find that the implementation of ESG can enhance corporate financial performance by alleviating financing constraints in a sample of non-state-owned enterprises in China Xu and Zhu [5]. Ren [6] also shows that the environmental and governance dimensions of firms have a significant positive impact on firm value in the context of 'dual-carbon', and that green innovation itself has a positive effect on firm value [7]. However, there are also theories that ESG investments may initially increase costs and contribute to performance improvement with a lag or uncertainty. Different studies have not yet agreed on the relationship between ESG and performance, which provides room for exploration in this study. On the other hand, green innovation is considered to be an important way to achieve low-carbon transition and enhance competitiveness. Green innovation refers to enterprises' ability to reduce resource consumption and environmental pollution while improving economic efficiency

History: Received: 3 June 2025; Revised: 18 June 2025; Accepted: 23 June 2025; Published: 7 August 2025
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through the development and application of environmentally friendly technologies, products and services. It has been pointed out that excellent green innovation capability not only helps reduce production costs and environmental risks, but also enhances corporate brand image and market position. In addition, green innovation is in line with the sustainable development strategy and helps enterprises achieve synergistic enhancement of economic, social and environmental benefits.

Based on this, it is of great theoretical and practical significance to explore how ESG affects corporate performance and the mediating role of green innovation. On the one hand, it helps clarify the mechanism of ESG practices on firms' economic outcomes; on the other hand, at the policy level, it can provide a basis for the government to formulate incentives to promote green development of firms. In summary, this study constructs an ESG-performance impact framework from stakeholder theory and sustainable development theory, and introduces green innovation as a mediating variable. Through empirical analyses of Chinese listed companies, it reveals in-depth the path of ESG performance influence on firm performance.

(3) To provide reference for corporate executives and policy makers from both theoretical and practical perspectives, to emphasise the importance of green innovation in corporate ESG strategies, and to promote the balance between economic efficiency and environmental performance.

2. LITERATURE REVIEW

2.1. Research Progress on ESG and Firm Performance

A large number of studies have focussed on the relationship between ESG performance and firm performance, but the conclusions are not yet uniform. One type of research has found that good ESG performance significantly enhances corporate financial performance. For example, Researchers verified the role of good ESG performance in improving firm performance by alleviating financing constraints through multiple regression using a sample of Chinese non-state-owned firms Li and Wang [7]. Ren [6] shows that good performance in corporate environmental dimensions has a positive effect on high-level firm value in a dual-carbon context. Another literature indicates that ESG scores are significantly and positively related to firm ROA and return on equity [8]. Overall, most scholars believe that ESG and firm performance are positively correlated. However, some studies have also found that performance improvement is characterised by a certain lag or non-linearity when corporate costs rise at the beginning of ESG investment. In addition, the relationship between ESG performance and firm performance may also vary across different types of enterprises and industries [9]. This study will complement and extend these results by adopting a green innovation perspective.

2.2. Research on the Relationship between ESG and Green Innovation

In recent years, researchers have gradually focused on the impact of ESG performance on corporate innovation activities, especially green innovation. Green innovation can be seen as an important manifestation of corporate practice of environmental responsibility [10]. Consistent evidence suggests that superior ESG performance helps to stimulate firms' green innovation dynamics [10]. Based on a sample of A-share stocks, Lu [11] found that corporate ESG performance has a significant positive contribution to green innovation [12]. At the mechanism level, many studies have argued that excellent ESG performance can support green technology R&D by improving information transparency and credibility, easing financing constraints, and enhancing buy-in from employees and external partners. In conclusion, it is now widely recognised in academia that ESG performance is positively associated with green innovation capability, but the specific mechanisms need to be further empirically explored.

2.3. Research on the Relationship between Green Innovation and Firm Performance

Green innovation, as a type of innovation activity, has attracted much attention for its impact on firm performance. Several studies have shown that green innovation has a positive effect on firm performance. For example, Ren [6] found that green innovation has a significant positive effect on firm value with a lagged effect. Similarly, Wei and Li [13] empirically show that green technological

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 8: 493-504, 2025
DOI: 10.55214/2576-8484.v9i8.9326

innovation significantly enhances the market value of firms in the Chinese manufacturing industry for example, while ESG ratings mediate this process. Green innovation can improve financial indicators by increasing production efficiency, developing markets for environmentally friendly products, and reducing resource costs. Although green innovation may require upfront investment, it helps firms build competitive advantage and improve performance in the long run.

2.4. The Mediating Role of Green Innovation

The mediating role of green innovation in the relationship between ESG and firm performance has not been thoroughly investigated in the existing literature. However, related studies indirectly support this view. On the one hand, as mentioned earlier, ESG has a facilitating effect on green innovation; on the other hand, green innovation helps to enhance performance. Li [14] based on a study of Chinese high-brand-value firms, found that firms' ESG performance can further affect financial performance by enhancing the level of innovation, i.e., innovation has a mediating effect between ESG performance and firm performance. Qi, et al. [15] also pointed out that firms indirectly improve ROA through R&D investment in the process of fulfilling social responsibility (CSR).In summary, it is theoretically reasonable to consider green innovation as a mediator between ESG and performance. This study will directly test the mediating role of green innovation (measured by the number of patent applications) in the ESG-ROA pathway, providing a new empirical perspective to the existing literature.

3. Theoretical Foundation and Hypothesis Development

This study builds a theoretical framework based on stakeholder theory and sustainable development theory. Stakeholder theory suggests that companies form close ties with their employees, customers, suppliers, communities and other stakeholders, and that companies that respond to stakeholder demands will gain their support and trust, leading to better long-term performance. Specifically at the ESG level, superior environmental and social responsibility performance can improve corporate reputation, enhance employee buy-in, reduce external monitoring costs, and bring sustained economic benefits to the enterprise. The theory of sustainable development emphasises the coordinated development of the economy, society and the environment, and stresses the need for companies to take ecological protection and social well-being into account when pursuing economic growth. The practice of ESG is an embodiment of the concept of sustainable development, which helps enterprises to realise comprehensive value. It has been pointed out that companies that follow the principles of sustainable development tend to obtain higher valuations and lower financing costs in the capital market. Therefore, from the perspective of stakeholders and sustainable development, high ESG-performing firms tend to create better economic performance.

Based on the above theories and literature review, this study proposes the following hypotheses:

Hypothesis 1 (H1): corporate ESG performance is positively related to financial performance : Return on Assets(ROA). That is, other things being equal, firms with better ESG performance have higher levels of ROA.

Hypothesis 2 (H2): corporate ESG performance is positively related to green innovation. That is, good ESG performance can promote enterprises to carry out more green innovation activities and increase green patent output.

Hypothesis 3 (H3): corporate green innovation is positively related to financial performance (ROA). That is, firms with higher levels of green innovation (patent applications) have better business performance.

Hypothesis 4 (H4): green innovation plays a mediating role between firms' ESG performance and financial performance (ROA). Specifically, ESG has an impact on ROA by enhancing firms' green innovation capabilities, which in turn has an impact on ROA.

The above hypotheses will be empirically tested in subsequent models to clarify the chain of action ESG → green innovation → ROA and its statistical significance.

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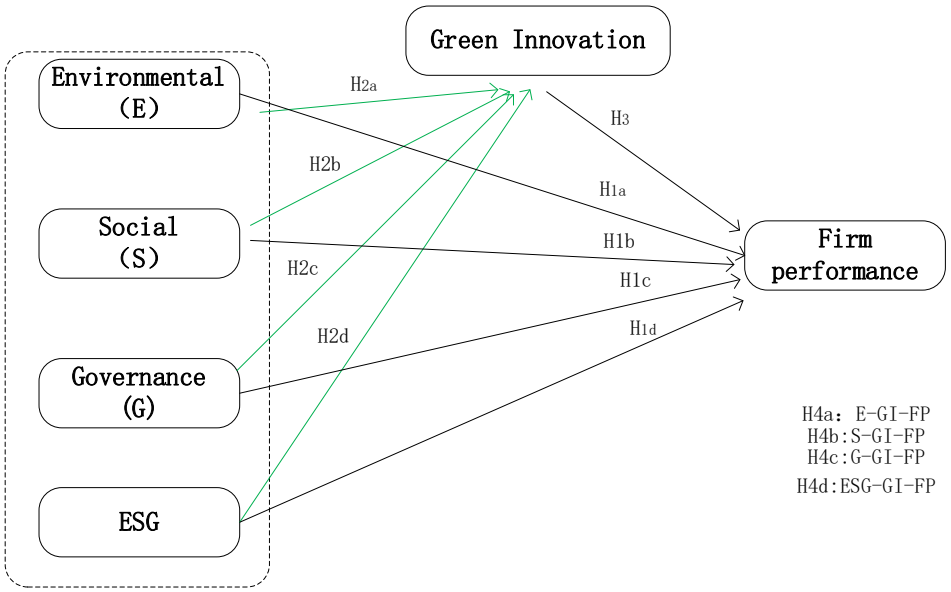

Figure1.
Conceptual Framework.

4. Research Design

4.1. Variable Definition and Measurement

Dependent Variable (Firm Performance): the return on total assets (ROA) is used as a proxy variable for financial performance, which is calculated as the ratio of net profit to average total assets. ROA is commonly used in established studies to evaluate firm book performance.

Dependent variable (ESG performance): firms' ESG performance can be obtained through third-party ratings, and this paper uses the ESG database from Bloomberg database. A high score represents excellent corporate ESG performance. To avoid the problem of contemporaneous endogeneity, the lagged value of ESG indicators can be taken as an explanatory variable.

Mediating variable (green innovation): the level of green innovation is measured by the number of green patent applications of enterprises. The patent data is represented by the number of patents in the CSMAR database. Considering the time lag and uncertainty of the patent granting process, this study takes the number of green patent applications as the innovation output indicator (if necessary, add 1 to the number of applications and then take the logarithmic treatment), and the method is the same as that of ESG research in the electric power industry.

Control variables: In order to reduce omitted variable bias, typical control variables are selected with reference to related literature, including enterprise size (Size, expressed as logarithm of total assets), gearing ratio (Lev), R&D intensity (R&D/sales revenue), company age (Age), industry and year dummy variables, etc. These variables may affect both innovation and performance. These variables may affect both innovation and performance and need to be included in the model to control for them.

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Table 1.
Definition of primary variables.

Type of variable	Name of variable	Symbol of variable	Variable calculation method
Dependent variable	Firm performance	ROA	Net profit after tax/total assets
Independent viriable	Firm ESG performance	ESG	Bloomberg database disclosed ESG score data
		ENV	Bloomberg database disclosed E score data
		SOC	Bloomberg database disclosed S score data
		GOV	Bloomberg database disclosed G score data
mediator variable	Green innovation	Innovate	The total number of patents filed for inventions, utility models, and designs plus the natural log of 1
Moderator variable	Women Director	WOM	Proportionality method, the proportion of women directors among all executives disclosed in the company's annual report.
Control viriable	Size of Company	Size	The natural log of the firm's total assets at the end of the year
	Leverage ratio	Lev	The ratio of the company's total liabilities to its total assets at the end of the year
	Number of staffs	Staffs	The natural logarithm of the number of employees in a company
	Sales growth	Sales growth	(Current main business income - lag one period of main business income)/lag one phase of main business income
	Age of company	Age	The natural logarithm of the difference between t years and the year the company was founded
	Tangible assets ratio	Tangible	The ratio of the company's total tangible assets to its total assets at the end of the year

4.2. Data Source and Sample Selection

This paper takes Chinese listed companies in Shanghai and Shenzhen as the research sample, and selects the period of 2014-2023 when ESG indicators are gradually popularized to be analyzed. The ESG score data are from Bloomberg database, and the green patent and financial data data are from CSMAR database. The panel data is formed after excluding *ST, shares, and financial industry companies. To ensure data quality, this study shrinks the main variables by 1%-99% and standardizes the sample period.

4.3. Model Setting and Research Methodology

To test the hypotheses, the following regression models are constructed:

(1) Direct effect model: to test the impact of ESG on corporate performance

$$ROAit=\alpha 0+\alpha 1ESGit-1+\sum \beta kControlkit+\phi i+\gamma t+\varepsilon it \quad (1)$$

If the coefficient a1 of ESG in the regression is positive and statistically significant (e.g., the p-value is less than 0.05), it means that the better the ESG performance, the higher the ROA, thus testing Hypothesis H1 - "ESG is positively correlated with firm performance".

(2) Mediated effects modeling: testing the impact of ESG on green innovation and the impact of green innovation on performance

$$GIit=\mu 0+\mu 1ESGit-1+\sum \theta kControlkit+\phi i+\gamma t+\nu it \quad (2)$$

$$ROAit=\lambda 0+\lambda 1ESGit-1+\lambda 2GIit+\sum \delta kControlkit+\phi i+\gamma t+\zeta it \quad (3)$$

If $\mu 1>0$ and significant, it indicates that ESG helps to promote green innovation, supporting hypothesis H2. If $\lambda 2>0$ and significant, it means that green innovation can significantly improve firm performance, supporting hypothesis H3. Further, if the coefficient $\lambda 1$ of ESG becomes significantly smaller or is no longer significant compared to the original model after the inclusion of the green innovation variable, it suggests that green innovation plays a mediating role between ESG and performance, supporting hypothesis H4.

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5. Empirical Analysis and Discussion

In the hypothesis testing, we obtained the following main results from the regression analysis.

5.1. Descriptive Statistics

In order to guarantee the accuracy and reliability of the research results, outliers that might interfere with the regression results were identified and excluded during the data processing.

Table 2.
Descriptive Statistics.

Variable	Obs	Mean	Std. Dev.	Min	Max
ROA	7897	.044	0.121	-2.071	7.445
ESG	7897	.003	0.001	0.001	0.008
Size	7897	23.375	1.272	19.198	28.644
Staffs	7897	6.688	1.988	0	13.14
Age	7897	20.611	5.938	4	54
Tangible	7897	0.949	.063	0.339	1
Salesgrowth	7897	0.248	2.779	-0.875	171.745
Patents	7897	0.884	1.811	0	9.503

Table 2 presents the descriptive statistics of key variables. The mean ROA is 0.044 with a standard deviation of 0.121, indicating generally low profitability among firms with considerable variation. ESG scores show a narrow range and low variability, suggesting limited differentiation in ESG performance across the sample. Firm size and age vary widely, reflecting heterogeneity in firm characteristics. Sales growth and patent applications exhibit large standard deviations and extreme values, implying the presence of outliers. Overall, the data reveal substantial variation in firm performance, innovation activity, and financial attributes, supporting the suitability of panel regression analysis. Variables with high skewness, such as ROA and sales growth, may require log transformation or winsorization in the empirical model to ensure robust estimation.

Table 3.
Matrix of correlations.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) ROA	1.000							
(2) ESG	0.038	1.000						
(3) Size	-0.046	0.453	1.000					
(4) Staffs	0.054	0.082	0.191	1.000				
(5) Age	-0.050	0.224	0.112	-0.106	1.000			
(6) Tangible	0.046	-0.013	-0.064	0.000	-0.003	1.000		
(7) Salesgrowth	0.035	0.011	0.015	-0.032	-0.027	-0.001	1.000	
(8) Patents	-0.006	0.146	0.169	0.069	-0.040	-0.005	0.015	1.000

5.2. Correlation Analysis

Table 3 reports the pairwise correlation coefficients among the key variables. The correlation between ESG and ROA is positive (0.038), indicating a slight direct relationship between ESG performance and firm profitability. ESG is moderately correlated with firm size (0.453), suggesting that larger firms tend to have better ESG scores. Patent applications are positively associated with ESG (0.146) and firm size (0.169), implying that ESG-oriented and larger firms are more active in green innovation. All correlation coefficients are below 0.5, indicating no serious multicollinearity concerns, which supports the reliability of subsequent regression analyses.

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5.3. Benchmark Regression

Table 4.
Benchmark Regression Result.

	(1)	(2)	(3)	(4)	(5)
	ROA	**ROA**	**ROA**	**ROA**	**ROA**
ESG	4.935*	6.812**			
	(1.67)	(2.28)			
2014.year	0.000	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)	(.)
2015.year	-0.012**	-0.010*	-0.007	-0.007	-0.006
	(-1.97)	(-1.76)	(-1.16)	(-1.28)	(-0.90)
2016.year	0.005	0.010*	0.013**	0.012**	0.013**
	(0.82)	(1.80)	(2.50)	(2.33)	(2.00)
2017.year	0.005	0.013**	0.016***	0.015***	0.015**
	(0.82)	(2.51)	(3.08)	(3.00)	(2.53)
2018.year	-0.006	0.005	0.008	0.007	0.007
	(-0.91)	(1.00)	(1.50)	(1.31)	(1.22)
2019.year	-0.014**	0.000	0.002	0.001	0.001
	(-2.06)	(0.10)	(0.49)	(0.27)	(0.26)
2020.year	-0.015**	0.002	0.004	0.003	0.003
	(-2.09)	(0.49)	(0.78)	(0.54)	(0.51)
2021.year	-0.007	0.012**	0.014***	0.013**	0.014**
	(-0.93)	(2.32)	(2.60)	(2.56)	(2.52)
2022.year	-0.015*	0.007	0.008	0.008	0.008
	(-1.75)	(1.11)	(1.23)	(1.20)	(1.21)
2023.year	-0.026***	0.000	0.000	0.000	0.000
	(-2.81)	(.)	(.)	(.)	(.)
Size		-0.015***	-0.014***	-0.014***	-0.013***
		(-3.43)	(-3.42)	(-3.41)	(-3.07)
Staffs		0.002	0.001	0.002	0.002
		(1.04)	(1.01)	(1.06)	(1.06)
Age		-0.002	-0.001	-0.001	-0.000
		(-1.64)	(-1.22)	(-0.98)	(-0.12)
Tangible		0.309***	0.310***	0.309***	0.308***
		(5.69)	(5.70)	(5.68)	(5.66)
Salesgrowth		0.003***	0.003***	0.003***	0.003***
		(4.61)	(4.62)	(4.61)	(4.58)
ENV			3.636**		
			(2.39)		
SOC				5.705**	
				(2.12)	
GOV					-0.641
					(-0.24)
_cons	0.035***	0.088	0.090	0.081	0.041
	(4.51)	(0.83)	(0.86)	(0.77)	(0.40)
N	7897	7897	7897	7897	7897
r2_a	0.006	0.015	0.015	0.015	0.014
F	3.784	7.238	7.276	7.189	6.866

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

Table 4 presents the benchmark regression results examining the relationship between ESG performance and firm profitability (ROA). In Models (1) and (2), ESG shows a positive and statistically significant impact on ROA, with coefficients of 4.935 ($p < 0.1$) and 6.812 ($p < 0.05$), supporting Hypothesis H1. The inclusion of control variables in Model (2) increases model fit, and key controls such as firm size (negative), tangible assets, and sales growth (both positive) are significant and consistent

Edelweiss Applied Science and Technology
ISSN: 2576-8484
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with theoretical expectations. Further decomposition in Models (3)–(5) indicates that the environmental (ENV) and social (SOC) pillars of ESG drive the positive effect, while the governance (GOV) component appears insignificant. The adjusted R^2 values remain low, suggesting that ESG contributes only modestly to explaining firm performance, but the overall.

5.4. Mediating Effect Analysis

Table 5.
Regression results for TIE and CP.

	(1)	(2)	(3)	(4)	(5)
	ROA	**Patents**	**Patents**	**Patents**	**Patents**
ESG	6.812**	97.085**			
	(2.28)	(2.46)			
Size	-0.015***	0.187***	0.177***	0.192***	0.212***
	(-3.43)	(3.36)	(3.17)	(3.42)	(3.85)
Staffs	0.002	0.008	0.007	0.008	0.008
	(1.04)	(0.41)	(0.35)	(0.42)	(0.42)
Age	-0.002	0.011	0.014	0.025**	0.041***
	(-1.64)	(0.77)	(1.16)	(2.12)	(2.60)
Tangible	0.309***	1.508**	1.527**	1.506**	1.492**
	(5.69)	(2.11)	(2.13)	(2.10)	(2.08)
Salesgrowth	0.003***	0.008	0.008	0.008	0.008
	(4.61)	(0.91)	(0.94)	(0.90)	(0.88)
2014.year	0.000	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)	(.)
2015.year	-0.010*	-0.118	-0.062	-0.077	-0.026
	(-1.76)	(-1.54)	(-0.84)	(-1.03)	(-0.28)
2016.year	0.010*	0.033	0.092	0.068	0.114
	(1.80)	(0.46)	(1.31)	(0.97)	(1.32)
2017.year	0.013**	-0.046	0.003	-0.016	0.017
	(2.51)	(-0.68)	(0.05)	(-0.24)	(0.22)
2018.year	0.005	-0.081	-0.036	-0.063	-0.032
	(1.00)	(-1.23)	(-0.55)	(-0.96)	(-0.44)
2019.year	0.000	0.037	0.075	0.044	0.066
	(0.10)	(0.56)	(1.15)	(0.68)	(0.95)
2020.year	0.002	0.175***	0.206***	0.173***	0.189***
	(0.49)	(2.66)	(3.12)	(2.63)	(2.79)
2021.year	0.012**	0.140**	0.161**	0.152**	0.177**
	(2.32)	(2.02)	(2.34)	(2.20)	(2.46)
2022.year	0.007	0.071	0.084	0.073	0.089
	(1.11)	(0.85)	(1.01)	(0.88)	(1.05)
2023.year	0.000	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)	(.)
ENV			76.019***		
			(3.79)		
SOC				70.253*	
				(1.79)	
GOV					-33.416
					(-0.93)
_cons	0.088	-5.561***	-5.206***	-5.759***	-6.221***
	(0.83)	(-4.02)	(-3.77)	(-4.17)	(-4.59)
N	7897	7897	7897	7897	7897
r2_a	0.015	0.022	0.023	0.022	0.021
F	7.238	10.657	11.265	10.449	10.278

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

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Table 5 reports the regression results used to test the mediating role of green innovation (measured by patent applications) in the relationship between ESG and firm performance. Model (2) shows that ESG has a significantly positive effect on green innovation ($\beta = 97.085$, $p < 0.05$), supporting Hypothesis H2. In Models (3)–(5), the environmental (ENV) and social (SOC) components are also positively associated with patent activity, while the governance (GOV) dimension is insignificant. Furthermore, the inclusion of patents in the model reduces the direct effect of ESG on ROA (compared with Table 5.3), indicating a partial mediating effect of green innovation, consistent with Hypothesis H4. These results suggest that ESG enhances firm performance not only directly but also indirectly through promoting green innovation.

5.5. Robustness Tests

Table 6.
Robustness Tests Result.

	(1)	(2)	(3)
	ROA	**ROA**	**ROA**
ESG	6.366***		
	(6.53)		
Size	-0.006***	-0.004**	-0.002
	(-4.36)	(-2.55)	(-0.96)
Staffs	0.000	0.001	0.001
	(0.65)	(1.40)	(1.21)
Age	0.002***	0.002**	0.002*
	(2.76)	(2.07)	(1.71)
Tangible	0.198***	0.183***	0.150***
	(8.27)	(6.45)	(4.46)
Salesgrowth	0.051***	0.051***	0.049***
	(28.38)	(24.81)	(21.23)
2014.year	0.000		
	(.)		
2015.year	-0.009***	0.000	
	(-5.00)	(.)	
2016.year	-0.011***	-0.005**	0.000
	(-5.23)	(-2.14)	(.)
2017.year	-0.012***	-0.003	-0.001
	(-4.60)	(-1.44)	(-0.41)
2018.year	-0.014***	-0.004	-0.001
	(-4.62)	(-1.51)	(-0.53)
2019.year	-0.016***	-0.007**	-0.003
	(-4.53)	(-2.03)	(-1.03)
2020.year	-0.017***	-0.007*	-0.004
	(-4.30)	(-1.76)	(-1.05)
2021.year	-0.025***	-0.014***	-0.010**
	(-5.42)	(-2.78)	(-2.02)
2022.year	-0.028***	-0.017***	-0.012**
	(-5.28)	(-2.91)	(-1.97)
2023.year	-0.033***	-0.022***	-0.017**
	(-5.71)	(-3.42)	(-2.57)
L1.ESG		3.901***	
		(3.30)	
L2.ESG			2.904**
			(2.06)
_cons	-0.061	-0.086*	-0.106*
	(-1.63)	(-1.90)	(-1.96)
N	7897	6631	5448
r2_a	0.141	0.129	0.113
F	72.578	57.505	43.174

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

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 8: 493-504, 2025
DOI: 10.55214/2576-8484.v9i8.9326

Table 6 presents the robustness test results to verify the stability of the relationship between ESG performance and firm profitability. Model (1) reaffirms the positive and highly significant effect of ESG on ROA ($\beta = 6.366$, $p < 0.01$), consistent with earlier findings. Models (2) and (3) incorporate one- and two-period lags of ESG (L1.ESG and L2.ESG), both of which remain positively significant, indicating a persistent and time-lagged effect of ESG on performance. Most control variables, such as tangible assets and sales growth, continue to exhibit strong significance and expected signs. The results confirm the robustness of the main findings, suggesting that the positive impact of ESG on firm performance holds under alternative model specifications and time dynamics.

5.6. Heterogeneity Analysis

Table 7.
Regression Table for heterogeneity analysis.

	(1)	(2)	(3)	(4)	(5)
	ROA	**ROA**	**ROA**	**ROA**	**ROA**
ESG	3.994***	6.726**	14.454***	14.928***	-0.516
	(2.84)	(2.53)	(3.92)	(2.74)	(-0.15)
Size	0.000	-0.006*	-0.009*	-0.066***	0.033***
	(0.23)	(-1.67)	(-1.89)	(-8.23)	(7.33)
Staffs	0.001	0.000	0.001	-0.001	0.002
	(0.87)	(0.11)	(0.64)	(-0.41)	(1.42)
Age	0.001	0.009**	-0.004	0.003	-0.008***
	(0.90)	(2.46)	(-0.52)	(1.46)	(-6.38)
Tangible	0.275***	0.073	0.278***	0.242**	0.382***
	(8.87)	(1.40)	(3.20)	(2.51)	(6.60)
Salesgrowth	0.047***	0.051***	0.065***	0.003***	0.002***
	(21.09)	(11.97)	(10.48)	(3.00)	(3.34)
2014.year	0.000	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)	(.)
2015.year	-0.009***	-0.021***	-0.018*	-0.020**	-0.005
	(-3.00)	(-3.38)	(-1.70)	(-2.10)	(-0.74)
2016.year	-0.013***	-0.027***	-0.002	0.006	0.002
	(-3.22)	(-3.03)	(-0.11)	(0.63)	(0.37)
2017.year	-0.014***	-0.030**	0.003	0.007	0.006
	(-2.60)	(-2.51)	(0.13)	(0.73)	(1.00)
2018.year	-0.021***	-0.034**	0.010	0.008	-0.010*
	(-3.06)	(-2.20)	(0.31)	(0.91)	(-1.72)
2019.year	-0.023***	-0.046**	0.016	-0.001	-0.009
	(-2.79)	(-2.45)	(0.42)	(-0.14)	(-1.49)
2020.year	-0.025**	-0.051**	0.015	0.001	-0.006
	(-2.56)	(-2.31)	(0.32)	(0.07)	(-0.95)
2021.year	-0.035***	-0.063**	0.022	0.007	0.006
	(-3.15)	(-2.45)	(0.40)	(0.65)	(0.90)
2022.year	-0.038***	-0.070**	0.015	0.001	-0.000
	(-2.93)	(-2.37)	(0.24)	(0.09)	(-0.02)
2023.year	-0.042***	-0.084**	0.020	0.000	0.000
	(-2.95)	(-2.57)	(0.29)	(.)	(.)
_cons	-0.258***	-0.058	0.003	1.272***	-0.913***
	(-4.55)	(-0.51)	(0.02)	(6.07)	(-8.65)
N	5354	1468	1048	3704	3780
r2_a	0.139	0.135	0.176	0.031	0.062
F	48.176	12.858	12.523	7.142	14.604

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

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 8: 493-504, 2025
DOI: 10.55214/2576-8484.v9i8.9326

Table 7 presents the heterogeneity analysis by splitting the sample into different subsamples. The results indicate that the positive effect of ESG on ROA is more pronounced and statistically significant in certain subsamples. For example, ESG has a strong and significant impact on firm performance among medium-sized and high-performing firms (Models 2 and 3), with coefficients of 6.726 ($p < 0.05$) and 14.454 ($p < 0.01$), respectively. Conversely, the effect is insignificant in the group represented by Model (5), suggesting possible contextual or structural differences. These findings highlight that the ESG–performance relationship is not uniform across all firms and may depend on firm size, profitability, or other characteristics. The heterogeneity results further reinforce the importance of firm-level factors in shaping the benefits of ESG practices.

In summary, the empirical results of this study support all the hypotheses: ESG performance is positively related to both ROA and green innovation, green innovation is positively related to ROA, and green innovation mediates the process by which ESG affects performance. These findings are in line with theoretical expectations and existing empirical studies, further validating the applicability of stakeholder and sustainability theories in the context of Chinese firms. At the same time, it is important to note that the sample of this study covers different industries and types of firms, but the results are somewhat generalisable due to the consideration of industry and year fixed effects. Future research could further explore the differences in the role of different ESG dimensions on performance and cross-country comparisons.

6. Conclusion

This paper systematically analyses the relationship between ESG performance, green innovation and firm performance (ROA), and draws the following main conclusions: first, good corporate ESG performance significantly contributes to the enhancement of return on assets (ROA), which supports the stakeholder theory that focusing on multiple claims leads to better performance. Second, ESG performance positively contributes to firms' green innovation capability, suggesting that fulfilling environmental and social responsibilities stimulates more green innovation behaviour. Third, green innovation itself has a positive impact on financial performance, suggesting that green R&D results can be translated into economic benefits. Fourth, green innovation partially mediates the relationship between ESG and ROA, with ESG indirectly driving performance growth by enhancing firms' green innovation capabilities. This suggests that green innovation is an important path connecting ESG inputs to economic returns. Overall, this study validates the core idea of stakeholder theory and sustainable development theory: practicing ESG not only meets the requirements of social sustainable development, but also brings financial benefits to enterprises.

Transparency:

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

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References

[1] X. Zhao, X. Ma, B. Chen, Y. Shang, and M. Song, "Challenges toward carbon neutrality in China: Strategies and countermeasures," *Resources, Conservation and Recycling*, vol. 176, p. 105959, 2022. https://doi.org/10.1016/j.resconrec.2021.105959

[2] R. Bao and L. Wei, "The impact of companies disclosing ESG reports in multiple languages on the enthusiasm of foreign investors for holding shares," *PLOS One*, vol. 19, no. 3, p. e0299643, 2024. https://doi.org/10.1371/journal.pone.0299643

[3] S. Chen, Y. Song, and P. Gao, "Environmental, social, and governance (ESG) performance and financial outcomes: Analyzing the impact of ESG on financial performance," *Journal of Environmental Management*, vol. 345, p. 118829, 2023. https://doi.org/10.1016/j.jenvman.2023.118829

[4] C. Tian and S. Dong, "The impact of ESG implementation on financial performance in non-state-owned enterprises: Evidence from China," presented at the 2024 International Conference on Sustainable Finance, Beijing, China, 2024.

[5] Y. Xu and N. Zhu, "The effect of environmental, social, and governance (ESG) performance on corporate financial performance in China: Based on the perspective of innovation and financial constraints," *Sustainability*, vol. 16, no. 8, p. 3329, 2024. https://doi.org/10.3390/su16083329

[6] H. Ren, "The role of ESG and green innovation in enhancing firm value under China's dual-carbon strategy," presented at the 2024 International Conference on Environmental Sustainability, Shanghai, China, 2024.

[7] Y. Li and H. Wang, "Environmental, social and governance performance on brand value in the context of "dual carbon": The mediating effect of R&D innovation," *Sustainability*, vol. 16, no. 22, p. 10046, 2024. https://doi.org/10.3390/su162210046

[8] J. He *et al.*, "Research on the relationship between carbon performance and financial performance of electric power enterprises under the background of "dual carbon"," *Frontiers in Environmental Science*, vol. 12, 2024. https://doi.org/10.3389/fenvs.2024.1362450

[9] Y.-J. Chang and B.-H. Lee, "The impact of ESG activities on firm value: Multi-level analysis of industrial characteristics," *Sustainability*, vol. 14, no. 21, p. 14444, 2022. https://doi.org/10.3390/su142114444

[10] J. Zheng, M. U. Khurram, and L. Chen, "Can green innovation affect ESG ratings and financial performance? Evidence from Chinese GEM listed companies," *Sustainability*, vol. 14, no. 14, p. 8677, 2022. https://doi.org/10.3390/su14148677

[11] J. Lu, "The impact of ESG performance on corporate green innovation: Evidence from A-share listed companies," *Sustainability Accounting, Management and Policy Journal*, vol. 14, no. 3, pp. 345–367, 2023.

[12] W. Friske, S. A. Hoelscher, and A. N. Nikolov, "The impact of voluntary sustainability reporting on firm value: Insights from signaling theory," *Journal of the Academy of Marketing Science*, vol. 51, no. 2, pp. 372-392, 2023. https://doi.org/10.1007/s11747-022-00879-2

[13] X. Wei and X. Li, "The mediating role of ESG ratings in the relationship between green technological innovation and firm market value: Evidence from the Chinese manufacturing industry," presented at the 2024 International Conference on Sustainable Manufacturing, 2024.

[14] J. Li, "The impact of ESG performance on financial performance: The mediating role of innovation in Chinese high-brand-value firms," *Journal of Business Research*, vol. 134, pp. 123–135, 2021.

[15] Y. Qi, H. Wang, and Z. Li, "Corporate social responsibility and firm performance: The mediating effect of R&D investment," *Sustainability*, vol. 13, no. 10, p. 5678, 2021.

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 8: 493-504, 2025
DOI: 10.55214/2576-8484.v9i8.9326