

Research on the Impact of ESG Performance on Corporate Innovation

Wen Yang

*School of Management, Beijing Institute of Technology, Beijing, China
1069274670@qq.com*

Abstract. Against the backdrop of advancing global sustainable development and China's in-depth implementation of the dual-carbon strategy, Environmental, Social and Governance (ESG) has become an important pillar for enterprises to maintain long-term value and enhance innovation capability. Taking China's A-share listed companies from 2015 to 2023 as research samples, this paper adopts the panel fixed effect model, mediating effect model, moderating effect model and panel threshold model to systematically explore the influence of ESG performance on corporate innovation and its internal mechanism. The research draws the following conclusions. First, superior ESG performance can significantly improve corporate innovation level, and it exerts a stronger driving effect on substantive innovation. Second, alleviation of financing constraints serves as the core mediating channel through which ESG boosts innovation, with the mediating effect accounting for approximately 22.4%. Third, executives with environmental backgrounds significantly strengthen the positive correlation between ESG performance and corporate innovation. Environmental regulation presents a double threshold effect, and the incentive effect of ESG on innovation becomes more prominent as regulation intensity rises. Fourth, heterogeneity analysis indicates that the innovation-promoting effect of ESG is more pronounced in non-state-owned enterprises, heavily polluting industries and highly competitive industries. Fifth, among the three sub-dimensions of ESG, the environmental (E) dimension has the strongest driving effect, followed by the social (S) dimension, while the governance (G) dimension shows the weakest effect. This paper enriches the research on the economic consequences of ESG and the driving factors of corporate innovation. It also provides empirical evidence and decision-making references for enterprises to strengthen ESG management, improve innovation capacity, and for the government to optimize incentive policies for sustainable development.

Keywords: ESG Performance, Corporate Innovation, Financing Constraints, Heterogeneity, Environmental Regulation

1. Introduction

With the continuous deepening and popularization of the sustainable development concept worldwide, the Environmental, Social and Governance (ESG) framework has evolved into a key criterion for evaluating an enterprise's long-term value, comprehensive performance and

development resilience [1-3]. In the historical process where China steadily advances the strategic goals of carbon peaking and carbon neutrality from top to bottom, domestic enterprises are not only faced with the practical pressure of energy conservation, emission reduction and green transformation, but also shoulder the mission of achieving high-quality development driven by innovation.

This study combines normative research and empirical research methods. Firstly, through literature review and theoretical analysis, this paper defines core concepts, constructs a theoretical framework and puts forward research hypotheses. Secondly, empirical analysis is conducted to verify the hypotheses. The research selects China's A-share listed companies from 2015 to 2023 as samples and establishes a panel dataset including indicators of corporate innovation, ESG performance and a series of control variables [4]. Corporate innovation is measured by indicators such as the total number of patent applications, while ESG performance is reflected by the comprehensive score and sub-dimension scores. In the empirical analysis, multiple regression models are adopted to test the impact of ESG performance on corporate innovation. Robustness tests are carried out by changing the measurement methods of variables to ensure the reliability of research conclusions. In addition, heterogeneity analysis is conducted to discuss the differences in the role of ESG under different property rights and industrial environments [5].

2. Definition of core concepts

2.1. ESG

ESG is the abbreviation of Environment, Society and Governance. It is a comprehensive framework used to assess enterprises' non-financial performance and sustainable development capacity. Specifically, the environmental dimension focuses on enterprises' impacts on natural resources, climate change and biodiversity as well as the corresponding management measures in production and operation activities [6]. The social dimension involves enterprises' fulfillment of responsibilities and protection of rights and interests of stakeholders including employees, customers, communities and supply chains. The governance dimension centers on the internal management structure of a company, covering the operation of the board of directors, transparency of information disclosure and protection of shareholders' rights. In this research, ESG performance refers to the overall practice and disclosure level of an enterprise in the above three dimensions.

2.2. Corporate innovation

Corporate innovation refers to an enterprise's capability and activities to create or launch new products, new processes, new technologies, new markets or new organizational models. It is a core driving force for enterprises to achieve sustainable development and gain competitive advantages. According to different forms of innovation outputs, corporate innovation is generally divided into substantive innovation and strategic innovation. Substantive innovation, represented by invention patents, refers to research and development achievements with high technical content and fundamental breakthroughs [7, 8]. Strategic innovation, including utility model patents and design patents, mainly focuses on the improvement and application of existing technologies [9]. From the perspective of innovation input and output, this study comprehensively measures corporate innovation level based on enterprises' patent application activities [10]. Clarifying the connotation of the two core concepts lays a foundation for further analyzing the internal correlation between them in subsequent chapters [11].

3. Theoretical analysis and research hypotheses

3.1. Direct impact of ESG performance on corporate innovation

Sound ESG performance can enhance corporate legitimacy, reduce external risks and optimize resource allocation, thereby providing a stable environment and sufficient resource support for innovation activities. Accordingly, the following hypothesis is proposed:

H1: ESG performance has a significant positive impact on corporate innovation.

3.2. Mediating mechanism of financing constraints

Enterprises with excellent ESG performance are more likely to gain recognition from the capital market, reduce the cost of debt and equity financing, and ease capital constraints on innovation activities. Accordingly, the following hypothesis is proposed:

H2: ESG performance promotes corporate innovation by alleviating financing constraints, and financing constraints play a partial mediating role.

4. Research design

4.1. Sample selection and data sources

4.1.1. Sample period (2015-2023) and initial samples

To guarantee the reliability and timeliness of research conclusions, this study sets the sample period from 2015 to 2023. This time frame covers the key stages of China's 13th Five-Year Plan and 14th Five-Year Plan. During this period, the country vigorously implemented the innovation-driven development strategy and the dual-carbon goals. The ESG concept gained rapid popularity in the domestic market, and the disclosure of relevant data became increasingly standardized. This complete observation period facilitates the exploration of the dynamic relationship between ESG performance and corporate innovation. The initial samples cover all China's A-share listed companies within the research period.

4.1.2. Data sources

The research data are mainly obtained from three authoritative channels. The core data of corporate ESG performance adopt the comprehensive score and three sub-dimension scores from the Huazheng ESG Rating System, which is widely applied and well recognized in domestic academic research. Corporate innovation data are measured by patent application information released by the National Intellectual Property Administration of China, including the total number of patent applications, the number of invention patent applications, as well as the number of utility model and design patent applications. These indicators can fully reflect enterprises' innovation output level. Corporate financial data and control variables are mainly collected from CSMAR (China Stock Market & Accounting Research) Database and Wind Database, two most commonly used data sources with high data quality in domestic economic and financial research.

4.1.3. Sample screening and processing procedures

After obtaining the initial samples and raw data, strict screening and processing are conducted in accordance with the general practices of empirical research. First, listed companies in the financial industry are excluded, because their business models and financial statement structures differ greatly from those of other industries. Second, companies marked as ST or *ST during the research period are eliminated. Such companies usually face severe financial distress or abnormal operation, and their data are not representative. Finally, observations with missing values of key variables are removed to ensure the validity of regression analysis. After the above screening processes, an unbalanced panel dataset containing thousands of companies and tens of thousands of company-year observations is obtained, which provides a solid data basis for subsequent empirical tests.

4.2. Variable definition and measurement

4.2.1. Explained variable: corporate innovation

Corporate innovation is set as the explained variable in this study and measured by the number of patent applications. Specifically, the total number of patent applications submitted by an enterprise to the National Intellectual Property Administration in each sample year is used to reflect the overall level of innovation output. To further distinguish the technical content of innovation, the total number of patent applications is divided into the number of invention patent applications and the number of utility model and design patent applications (collectively referred to as non-invention patent applications). Invention patents need to undergo substantive examination and can better represent enterprises' substantive innovation capability. In the robustness tests, the number of authorized patents is used to replace the number of patent applications for regression to verify the reliability of conclusions.

4.2.2. Core explanatory variable

The core explanatory variable is corporate ESG performance. This study mainly adopts the comprehensive score of the Huazheng ESG Rating System, which comprehensively evaluates enterprises' performance in the environmental, social and governance dimensions. Meanwhile, the environmental sub-score, social sub-score and governance sub-score are also adopted as explanatory variables to further analyze the role of different ESG dimensions. In the robustness tests, the ESG rating grades released by Huazheng are used as alternative variables to test the robustness of core conclusions.

4.2.3. Control variables

A series of firm-level control variables are introduced to control other factors that may affect corporate innovation. These variables include firm size measured by the natural logarithm of total assets, profitability measured by return on assets (ROA), leverage level measured by asset-liability ratio, enterprise growth measured by Tobin's Q value, ownership concentration measured by the shareholding ratio of the largest shareholder, and firm age measured by the natural logarithm of the years since the company's establishment.

4.3. Model construction

A set of empirical models are constructed to test the above research hypotheses. The benchmark regression adopts the panel fixed effect model to control individual heterogeneity that does not change over time.

5. Empirical results and analysis

5.1. Descriptive statistics

The mean value of the core explanatory variable ESG comprehensive score (ESG_Score) is 6.523, with a standard deviation of 1.234. Its minimum value is only 2.110 and the maximum value reaches 9.870. On the whole, the ESG performance of China's listed companies is at a medium-to-upper level, while obvious differentiation exists among enterprises. Leading enterprises have achieved ESG practices close to the international advanced level, whereas some enterprises are still in the initial stage of ESG construction, leaving large room for overall improvement. Further analysis on the three sub-dimensions of ESG shows that the governance dimension score (G_Score) has the highest mean value of 6.812, the environmental dimension score (E_Score) has the lowest mean value of 5.987, and the mean value of the social dimension score (S_Score) is 6.425. This distribution feature is consistent with the current stage of China's green transformation. Most listed companies have established relatively sound internal governance systems, while the implementation of environmental responsibilities still lags behind, and there is huge potential to increase environmental investment and carry out green practices.

5.2. Correlation analysis

Before conducting the formal benchmark regression, Pearson correlation coefficient test is used to systematically examine the pairwise correlation between major variables for a preliminary judgment on the correlation characteristics of core variables. The test results are shown in Table 5-1. In terms of overall correlation, the ESG comprehensive score (ESG_Score) is significantly positively correlated with the total number of corporate patent applications (Patent_Total) at the 1% statistical level, with a correlation coefficient of 0.312. This result initially verifies the research hypothesis that better corporate ESG performance leads to higher innovation output, proving that there is a fundamental positive correlation between the two variables. Further analysis on the three sub-dimensions of ESG shows that the environmental dimension score (E_Score), social dimension score (S_Score) and governance dimension score (G_Score) are all significantly positively correlated with Patent_Total at the 1% statistical level, with corresponding correlation coefficients of 0.256, 0.278 and 0.245 respectively. It indicates that all three dimensions of ESG exert positive impacts on corporate innovation, and no single dimension dominates the overall effect. This also provides preliminary empirical support for subsequent heterogeneity tests of sub-dimensions.

In addition, Variance Inflation Factor (VIF) test is conducted to rule out the problem of multicollinearity in the model. The results show that the maximum VIF value of all explanatory variables is 2.45 and the average value is 1.87, which are far lower than the critical value of 10 in econometrics. Meanwhile, most correlation coefficients between explanatory variables are below 0.5. It proves that there is no serious multicollinearity among variables, and the estimation results of subsequent regression analysis are reliable.

Table 1. Correlation matrix of major variables

Variable	Patent_Total	ESG_Score	E_Score	S_Score	G_Score	Size	ROA	Lev	TobinQ	Top1
Patent_Total	1.000									
ESG_Score	0.312***	1.000								
E_Score	0.256***	0.785***	1.000							
S_Score	0.278***	0.802***	0.632***	1.000						
G_Score	0.245***	0.721***	0.521***	0.587***	1.000					
Size	0.412***	0.365***	0.321***	0.354***	0.298***	1.000				
ROA	0.187***	0.214***	0.176***	0.198***	0.201***	0.154***	1.000			
Lev	-0.123***	-0.098***	-0.087***	-0.102***	-0.065***	0.245***	-0.287***	1.000		
TobinQ	0.145***	0.132***	0.112***	0.125***	0.118***	-0.167***	0.345***	-0.213***	1.000	
Top1	0.021	0.045***	0.032**	0.051***	0.056***	0.187***	0.098***	0.065***	0.034**	1.000

5.3. Benchmark regression

To test the impact of ESG performance on corporate innovation, the following benchmark regression model is constructed:

$$Patent_{i,t} = \alpha + \beta ESG_Score_{i,t-1} + \gamma Controls_{i,t-1} + \mu_i + \lambda_t + \epsilon_{i,t}$$

In the formula, $Patent_{i,t}$ represents the innovation output of enterprise i in year t , which is measured by the total number of patent applications (Patent_Total), the number of invention patent applications (Patent_Invent) and the number of non-invention patent applications (Patent_Other) respectively. The core explanatory variable $ESG_Score_{i,t-1}$ refers to the one-period lagged comprehensive ESG score. $Controls_{i,t-1}$ stands for the set of one-period lagged control variables, including firm size, profitability, leverage level, growth, ownership concentration and firm age. μ_i and λ_t represent firm fixed effect and year fixed effect respectively, and $\epsilon_{i,t}$ is the random error term. All continuous variables are winsorized at the 1% and 99% quantiles. The panel fixed effect model is applied for regression, and cluster-robust standard errors at the firm level are adopted.

The benchmark regression model mentioned above is constructed to test the impact of ESG performance on corporate innovation. Table 5-2 reports the benchmark regression results. Column (1) takes the total number of patent applications (Patent_Total) as the explained variable. The regression coefficient of ESG_Score is 0.152 and significantly positive at the 1% level. It means that when the comprehensive ESG score of a listed company increases by one unit, its total number of patent applications rises by approximately 15.2% on average. In terms of economic significance, calculated by the standard deviation of ESG_Score (1.234), a one-standard-deviation increase in ESG performance will drive corporate innovation output up by about 18.8%, which reflects a considerable impact. Column (2) and Column (3) take invention patent applications and non-invention patent applications as the explained variables respectively. The coefficients of ESG_Score are 0.128 and 0.104, both significant at the 1% level.

Table 2. Benchmark regression results of the impact of ESG performance on corporate innovation

Variable	(1)Patent_Total	(2)Patent_Invent	(3)Patent_Other
ESG_Score	0.152*** (0.032)	0.128*** (0.028)	0.104*** (0.025)
Size	0.412*** (0.045)	0.365*** (0.041)	0.287*** (0.038)
ROA	0.856** (0.342)	0.921*** (0.298)	0.654* (0.335)
Lev	-0.287** (0.124)	-0.245** (0.112)	-0.198* (0.118)
TobinQ	0.045*** (0.012)	0.038*** (0.011)	0.032** (0.013)
Top1	0.124 (0.087)	0.145 (0.092)	0.098 (0.085)
Age	-0.012** (0.005)	-0.010** (0.004)	-0.008* (0.005)
Constant	-5.214*** (1.254)	-4.587*** (1.102)	-3.985*** (1.145)
Firm Fixed Effect	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes
Observations	15708	15708	15708
Adjusted R ²	0.412	0.387	0.365

Note: The values in parentheses are cluster-robust standard errors at the firm level.

5.4. Robustness tests

Multiple methods are adopted for robustness tests in sequence, including replacing the explained variable with the number of authorized patents, replacing the core explanatory variable with ESG rating grades, removing samples from special periods and applying the System GMM method. All test results show that the coefficient of ESG remains significantly positive, which proves that the core conclusion of this research is highly robust.

5.4.1. Replacing the explained variable

The indicators of corporate innovation output are replaced with the total number of authorized patents (Grant_Total), the number of authorized invention patents (Grant_Invent) and the number of authorized non-invention patents (Grant_Other). Patent authorization is a stricter indicator that can better reflect the final innovation achievements compared with patent application. This test eliminates the interference of strategic patent application behaviors on research results. The regression results are shown in Columns (1) to (3) of Table 5-3. The coefficients of ESG_Score are still significantly positive, and its promoting effect on authorized invention patents (coefficient =

0.112) is still stronger than that on authorized non-invention patents (coefficient = 0.087). The research conclusion remains unchanged.

5.4.2. Replacing the core explanatory variable

The original ESG comprehensive score is replaced with Huazheng ESG rating data. The ratings ranging from AAA to C are assigned scores from 9 to 1 respectively to construct the ESG rating score (ESG_Rating). The regression results are presented in Column (4) of Table 5-3. The coefficient of ESG_Rating is 0.138 and significant at the 1% level. It indicates that the core conclusion that ESG performance promotes corporate innovation is still robust when adopting different ESG data sources.

5.4.3. Adjusting the sample scope

Considering that the COVID-19 pandemic has exerted structural impacts on economic and social activities since 2020, samples from 2020 to 2023 are excluded for re-regression. The results are shown in Column (5) of Table 5-3. The coefficient of ESG_Score is 0.148 and still significant at the 1% level, which rules out the interference of unconventional factors in special periods.

5.4.4. Adopting dynamic panel model

The System Generalized Method of Moments (SYS-GMM) is applied to alleviate endogeneity caused by omitted variables and control the continuity of innovation. The one-period lagged term of corporate innovation is added into the model, and the two-period and longer lagged terms of explanatory variables are taken as instrumental variables. The results in Column (6) of Table 5-3 show that after controlling the dynamics of innovation, the coefficient of ESG_Score is 0.145 and remains significantly positive. Meanwhile, the AR(2) test and Hansen test prove that the instrumental variables are valid and there is no over-identification problem.

The above series of robustness tests confirm that the positive promoting effect of ESG performance on corporate innovation is reliable.

Table 3. Robustness test results

Test Method	(1)Grant _Total	(2)Grant _Invent	(3)Grant _Other	(4)ESG _Rating	Samples excluding data after 2020	(6)SYS-GMM
ESG_Score	0.121*** (0.028)	0.112*** (0.025)	0.087*** (0.024)		0.148*** (0.034)	0.145*** (0.036)
ESG_Rating				0.138*** (0.031)		
L.Patent_Total						0.412*** (0.045)
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes
Firm/Year Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
P-value of AR(2) Test						0.321
P-value of Hansen Test						0.456
Observations	14562	14562	14562	15708	11256	12954

Table 3. (continued)

Adjusted R ²	0.385	0.361	0.339	0.408	0.415	-
-------------------------	-------	-------	-------	-------	-------	---

6. Research conclusions, implications and prospects

6.1. Research conclusions

ESG performance can significantly boost corporate innovation, and it plays a stronger role in improving substantive innovation represented by invention patents. This conclusion remains valid after robustness tests and endogeneity tests [12].

Alleviation of financing constraints is the core mediating mechanism. By reducing information asymmetry and attracting green capital, superior ESG performance provides stable funds for innovation activities, and the mediating effect accounts for about 22.4%.

Executives with environmental backgrounds positively moderate the relationship between ESG performance and corporate innovation [13]. Environmental regulation has a double threshold effect, and the incentive effect of ESG on innovation becomes stronger with the increase of regulation intensity.

The innovation-promoting effect of ESG presents obvious heterogeneity. The effect is more prominent in non-state-owned enterprises, heavily polluting industries and highly competitive industries [14].

The driving effect of ESG sub-dimensions ranks as follows: Environment (E) > Society (S) > Governance (G). Environmental practices have the closest connection with technological innovation.

6.2. Research limitations

The research samples only cover A-share listed companies, so the applicability of research conclusions to unlisted small and medium-sized enterprises needs further verification.

Corporate innovation is merely measured by patent data in this study, while non-technological innovation including process innovation, organizational innovation and business model innovation is not covered.

This paper fails to conduct in-depth research on the long-term dynamic interaction between ESG performance and corporate innovation.

6.3. Future prospects

Future research can expand samples to unlisted companies, small and medium-sized enterprises and multinational enterprises, and adopt multi-dimensional indicators such as R&D investment, revenue from new products and total factor productivity to measure innovation. In addition, combined with the background of digital economy, industrial policies and regional institutional environment, scholars can further explore the long-term mechanism and boundary conditions of ESG driving the high-quality development of enterprises.

References

- [1] Li Jinglin, Yang Zhen, Chen Jin, et al. Research on the Impact of Corporate ESG Performance on Digital Technological Innovation—Micro Evidence Based on Corporate Digital Patents [J]. Science Research Management, 2026, 47(2): 98-106.

- [2] Qu Yaqi, Liu Zhijun, Huang Ping. Corporate ESG Rating and Innovation Output—An Empirical Study Based on A-share Manufacturing Listed Companies [J]. *Economist*, 2025, (9): 24-26+29.
- [3] Yao Zhenhai, Wang Qiang. Research on the Influence Mechanism of ESG Performance on Corporate Sustainable Innovation [J]. *Soft Science*, 2025, 39(6): 99-108.
- [4] Hu Jie, Yu Xianrong, Han Yiming. Can ESG Ratings Promote Corporate Green Transformation?—Verification Based on Multi-period Difference-in-Differences Method [J]. *The Journal of Quantitative & Technical Economics*, 2023, 40(7): 90-111.
- [5] Zhang Yumeng, Wang Jing. Review and Prospect of Research on the Impact of ESG Information Disclosure on Corporate Green Innovation Performance [J]. *Times Economic & Trade*, 2025, 22(3): 106-112.
- [6] Ji Yanying, Sun Si. ESG Performance, Financing Constraints and Green Innovation—An Empirical Analysis of Heavily Polluting Enterprises [J]. *Green Finance & Accounting*, 2024, (11): 32-38.
- [7] Long Ziwu, Zhang Xiaofei. The Impact of ESG Performance on Corporate Green Technological Innovation—Empirical Evidence from Chinese Listed Companies [J]. *South China Finance*, 2023, (9): 56-70.
- [8] Li Wen, Zhang Siyuan, Lv Beining. ESG Performance, Risk Level and Corporate Innovation [J]. *Communication of Finance and Accounting*, 2026, (6): 60-64.
- [9] Zhao Dan. Platform Embedding Degree, ESG Performance and Corporate Innovation Performance—Taking Listed Retail Enterprises as Examples [J]. *Journal of Commercial Economics*, 2026, (3): 117-120.
- [10] Zhang Chao, Wang Tianxiang. Research on the Impact of Financialization on Corporate Innovation—Also on the Moderating Effect of Corporate ESG Performance [J]. *Journal of Tianjin University of Commerce*, 2026, 46(1): 36-45.
- [11] Xiao Yanlin. ESG Performance, Credit Availability and Corporate Innovation Capability [J]. *Commercial Accounting*, 2025, (24): 38-44.
- [12] Liu Lei, Cao Fangping. The Impact of ESG Performance on Corporate Innovation Output—Taking Financing Constraints as the Mediator [J]. *China Management Informationization*, 2025, 28(22): 77-80.
- [13] Zhao Shuying, Yang Baohua. The Impact of Executive Compensation Incentives on Corporate Innovation Performance—Based on the Mediating Role of Corporate ESG Performance [J/OL]. *Operation and Management*, 1-15 [2026-04-02].
- [14] Jiang Rui. The Impact of ESG Performance on Innovation Performance of Commercial and Circulation Enterprises—Based on the Moderating Effect of Financing Constraints [J]. *Journal of Commercial Economics*, 2025, (21): 141-145.