The Impact of ESG Performance on Collaborative Innovation

Jinfeng Yang[1, *]

[1]School of Economics and Management, Nanjing University of Science and Technology, Nanjing, China

*Corresponding author: Yangjinfeng@njust.edu.cn

Abstract. In recent years, Environmental, Social, and Governance (ESG) factors, serving as crucial non-financial indicators for measuring corporate sustainable development, have garnered increasing attention. Driven by China's new development philosophy, significant progress has been made in ESG-related policies, disclosure, and investment, aiding enterprises in enhancing their governance standards. As stakeholders place growing emphasis on corporate ESG performance, firms are incentivized to strengthen disclosure to improve their ability to acquire resources. Existing research predominantly focuses on the impact of ESG on financial performance and similar outcomes. This study pioneers an investigation from the perspective of collaborative relationships, thereby expanding the field of ESG research with both theoretical and practical significance. Based on reputation theory, information asymmetry theory, and others, this paper utilizes a sample of Chinese A-share listed companies on the Shanghai and Shenzhen stock exchanges from 2011 to 2020. Combining Bloomberg ESG ratings, CNRDS patent data, and CSMAR financial data, a two-way fixed effects model is constructed to empirically analyze the impact of corporate ESG performance on the quantity and quality of collaborative innovation output. Robustness is tested using variable substitution methods. The findings are as follows: (1) Corporate ESG performance significantly enhances both the quantity and quality of collaborative innovation output; (2) This effect is more pronounced in non-high-pollution industries and large enterprises.

Keywords: ESG, Collaborative Innovation, Heterogeneity.

1. Introduction

The Third Plenary Session of the 20th Central Committee of the Communist Party of China emphasized strengthening enterprises' central role in technological innovation and promoting deep integration among industry, universities, and research institutions. Industry–University–Research (IUR) collaborative innovation integrates the comparative advantages of multiple actors to generate synergistic effects [1] and serves as a critical driver of technological progress and industrial upgrading. However, due to the spillover effects inherent in cross-organizational collaboration, IUR cooperation is prone to "market failure" and faces challenges such as complex interest coordination [2], which increase collaboration costs and risks and constrain its potential.

At the same time, ESG has emerged as an important benchmark for evaluating sustainable development. Strong ESG performance not only improves internal efficiency and reduces risk [3], but also conveys positive signals to external stakeholders, thereby enhancing stakeholder recognition. Given that IUR collaboration relies heavily on trust and resource complementarity, examining whether and how corporate ESG performance can alleviate collaboration barriers and promote collaborative innovation is of great significance for building an enterprise-centered technological innovation system.

Stakeholder theory posits that corporate behavior affects multiple stakeholders. Innovation activities are characterized by long cycles, high risks, and substantial costs, which may result in insufficient corporate incentives and limited external support under conditions of information asymmetry. ESG performance helps firms gain trust, mitigate information asymmetry, and address agency and financing problems, thereby promoting innovation investment and innovation quality. However, most existing studies focus on internal R&D activities, providing limited explanations of how ESG affects cross-organizational IUR collaborative innovation.

The performance of collaborative innovation is jointly influenced by macro-level environments and micro-level firm characteristics. While current research largely emphasizes macro perspectives such as government policies and institutional environments, relatively little attention has been paid to how firms' non-financial characteristics—particularly ESG performance reflecting sustainable development practices—affect their willingness and capability to participate in and deepen collaborative innovation. Therefore, whether and how corporate ESG performance drives collaborative innovation remains an important issue warranting further investigation.

2. Theoretical Analysis and Hypotheses

2.1. The Direct Effect of Corporate ESG Performance on IUR Collaborative Innovation

Based on stakeholder theory [4] and signaling theory [5], strong ESG performance enables firms to transmit positive signals to universities and research institutions, thereby enhancing their willingness to collaborate. ESG practices reflect firms' emphasis on long-term value creation and sustainable development[6], and such firms are typically more proactive in R&D investment to maintain competitiveness. IUR collaboration serves as a critical channel for accessing external innovation resources.

High ESG performance not only reflects standardized and efficient internal management [7], but also signals to potential partners that the firm can provide stable support, honor long-term commitments, adhere to high standards of social responsibility, and possess strong risk management capabilities [8]. The trust established through these signals helps alleviate information asymmetry in collaboration, facilitates effective sharing of innovation resources and information [9], and ultimately promotes IUR collaborative innovation.

Hypothesis 1 (H1): Firms with better ESG performance significantly promote the level of industry–university–research collaborative innovation.

2.2. Mechanisms through Which ESG Performance Affects IUR Collaborative Innovation

Corporate ESG performance drives IUR collaborative innovation through multiple mechanisms. First, firms with superior ESG performance are more inclined to invest in sustainable and emerging technology fields [10]. Given the high investment intensity, high risk, and long development cycles associated with such technologies, firms are motivated to seek external collaboration. Universities and research institutions possess strong advantages in basic research in these fields[11], making collaboration an effective means for firms to reduce R&D costs and risks and accelerate technology commercialization [12]. ESG performance signals firms' commitment and capability in sustainable development, thereby attracting universities and research institutions to jointly develop new technologies and products [13].

Second, investments in environmental protection and social responsibility enable high-ESG firms to accumulate technological and managerial advantages [14], providing abundant application scenarios and resource support for IUR collaboration. Such firms are also more capable of attracting key resources, including high-end talent and capital [15], and enhancing human capital through sustained investment [6], thereby improving the efficiency of innovation resource integration and sharing.

Finally, the value realization of innovation outcomes depends on effective diffusion and commercialization[1]. Strong ESG performance helps mitigate agency problems, enhances the confidence of universities and research institutions in collaboration, and reduces their perceived risks. Moreover, firms' accumulated experience in environmental and social responsibility provides practical application scenarios and resource support for academic research achievements, effectively promoting knowledge sharing and technology transfer.

Hypothesis 2 (H2): Corporate ESG performance drives industry–university–research collaborative innovation by promoting investment cooperation in sustainable fields, enhancing complementarity

and sharing of innovation resources, and accelerating the diffusion and commercialization of technological achievements.

3. Data Sources and Variable Definitions

To examine the impact of corporate ESG performance on collaborative innovation, this study uses a sample of Chinese A-share listed firms from 2009 to 2023. Firm-level financial data are obtained from the CSMAR and WIND databases. Patent data are sourced from the CNRDS database on patent applications by listed companies, and ESG data are derived from Huazheng ESG ratings. The sample is filtered as follows: (1) ST and *ST firms are excluded; (2) firms in the financial industry are excluded. All continuous variables are winsorized at the 1% and 99% levels.

3.1. Variable Definitions

3.1.1 Dependent Variable (Collaborative Innovation):

Based on patent applicant information from the CNRDS database, patents jointly applied for by firms and institutions containing keywords such as “university,” “research institute,” “college,” “academy,” or “research center” are identified as IUR collaborative patents. The core measures include: (1) a dummy variable indicating whether a firm has IUR collaborative patents in a given year; and (2) the natural logarithm of the number of IUR collaborative patent applications plus one, capturing collaboration intensity.

3.1.2 Core Independent Variable (Corporate ESG Performance):

Corporate ESG performance is measured using Huazheng ESG ratings, which range from C to AAA across nine levels. Ratings are coded from 1 (C) to 9 (AAA), with higher values indicating better ESG performance. Annual average scores are used in regression analyses.

3.1.3 Control Variables:

Control variables include firm size (logarithm of total assets), profitability (return on assets, ROA), leverage (total liabilities divided by total assets), firm growth (revenue growth rate), board size (number of board directors), market-to-book ratio, firm age, shareholding ratio of the largest shareholder, and a dummy variable indicating CEO–chair duality.

3.2. Model Specification

$$patent_{i,t} = \beta_o + \beta_1 ESG_{i,t} + \beta_2 Controls_{i,t} + Year_effects + Firm_effects + \varepsilon_{i,t}$$

Let i denote firms and t denote years. The dependent variable patent represents the level of collaborative innovation, measured by the number of collaborative patent applications. ESG is the core explanatory variable. Firm-level control variables are included. Year fixed effects and firm fixed effects are incorporated to control for time-invariant heterogeneity. Descriptive statistics in Table 1 show that approximately 11% of sample firms participate in IUR collaboration, with an average ESG score of 4.16, indicating substantial variation in ESG performance.

Table 1. Descriptive Statistics

VARIABLES	N	Mean	SD	Min	Max
patent1	43357	.8596	14.9918	0	1070
ESG	43357	3.6973	1.6049	0	8
AGE1	43357	18.4269	6.1925	1	64
BOARD	43357	2.1237	.2018	1.0986	2.8904
GROWTH	43357	3.9948	650.6308	-2.7335	135000
INDBOA	43357	.375	.055	0	.8
LEV	43357	.4559	1.1294	-.1947	178.3455
ROA	43357	.0291	.6383	-48.3159	108.3657
TobinQ1	43357	2.1818	3.6854	.6085	393.0135
TOP1	43357	33.8305	15.0588	.29	89.99
DUAL	43357	.282	.45	0	1

4. Empirical Results

4.1. Baseline Regression Results

Table 2 presents the baseline regression results examining the impact of ESG performance on firms' IUR collaboration. The ESG coefficient is positive and statistically significant at the 1% level in both specifications. In Column (1), the ESG coefficient is 0.139, indicating that a one-unit increase in ESG score significantly increases the probability of collaborative innovation. Column (2), which includes control variables, yields an ESG coefficient of 0.1324, further confirming that ESG performance significantly enhances firms' collaborative innovation. Overall, the baseline results support the research hypothesis that higher ESG performance promotes collaborative innovation.

Table 2. Baseline Regression

VARIABLES	(1) patent1	(2) patent1
ESG	0.1390***	0.1324***
	(0.0408)	(0.0409)
AGE1		0.0356*
		(0.0199)
BOARD		0.4797
		(0.4015)
GROWTH		0.0000
		(0.0001)
INDBOARD		2.2391*
		(1.2018)
LEV		-0.0003
		(0.0404)
ROA		-0.0319
		(0.0657)
TobinQ1		-0.0051
		(0.0129)
TOP1		0.0071
		(0.0058)
DUAL		0.0036
		(0.1294)
Constant	-0.3204	-2.7621**
	(0.2050)	(1.2352)
Observations	43,357	43,357
Number of scode	5,097	5,097
Firm FE	Yes	Yes
Year FE	Yes	Yes

4.2. Multicollinearity Test

The variance inflation factor (VIF) results in Table 3 show that all VIF values are close to 1 and well below the threshold of 5, indicating that multicollinearity is not a concern in the regression models.

Table 3. VIF Test

VARIABLES	VIF	1/VIF
BOARD	1.410	0.710
INDBOARD	1.380	0.727
LEV	1.310	0.761
TobinQ1	1.200	0.834
ROA	1.200	0.836
DUAL	1.050	0.953
TOP1	1.040	0.963
ESG	1.030	0.974
AGE1	1.020	0.976
GROWTH	1	1.000
Mean	VIF	1.160

4.3. Robustness Tests

Several robustness checks are conducted to validate the baseline results.

First, an alternative estimation method is employed. In the baseline analysis, a two-way fixed effects model is used to control for firm-specific and time-specific heterogeneity. To further improve model fit and account for potential multiple high-dimensional fixed effects, the *reghdfe* estimator is adopted in the robustness analysis, allowing for more comprehensive control of unobservable heterogeneity. The results reported in Column (1) of Table 4 remain statistically significant, indicating that corporate ESG performance continues to promote collaborative innovation even under more stringent fixed-effects specifications.

Second, additional potential omitted variables are included. Specifically, firm size and managerial ownership are incorporated, as both are important factors that may influence firms' collaborative innovation behavior. Firm size is commonly regarded as a proxy for resource availability and risk-bearing capacity; larger firms are generally better positioned to undertake long-term, high-investment, and high-risk innovation projects. Managerial ownership reflects the degree of alignment between management incentives and firms' collaborative innovation strategies and is theoretically expected to exert a positive effect on collaborative innovation. The regression results in Column (2) of Table 4 remain significant, suggesting that the inclusion of these omitted variables does not materially affect the significance of the core explanatory variable, thereby supporting the robustness of the main findings.

Third, standard errors are clustered at the firm level. In panel data settings, error terms may exhibit firm-level autocorrelation or heteroskedasticity. Clustering standard errors at the firm level enhances the reliability of statistical inference. As shown in Column (3) of Table 4, the ESG coefficient remains statistically significant after accounting for firm-level error correlations, confirming the robustness of the results.

Fourth, observations from the COVID-19 pandemic period are excluded. As an exogenous shock, the COVID-19 pandemic may have influenced firms' collaborative innovation behavior through supply chain disruptions, financial constraints, and policy adjustments, potentially dampening innovation investment and collaboration incentives in the short term. To eliminate the confounding effects of this exceptional period, pandemic-year observations are removed in the robustness analysis. The results reported in Column (4) of Table 4 remain robust, indicating that the baseline conclusions are not driven by the pandemic shock.

Table 4. Robustness Tests

VARIABLES	(1) patent1	(2) patent1	(3) patent1	(4) patent1
ESG	0.1324***	0.1200***	0.1324**	0.1264***
	(0.0409)	(0.0413)	(0.0563)	(0.0471)
AGE1		0.0164		0.0347*
		(0.0216)		(0.0211)
BOARD	0.4797	0.3753	0.4797	0.9086**
	(0.4015)	(0.4042)	(0.5243)	(0.4382)
GROWTH	0.0000	0.0000	0.0000*	0.0000
	(0.0001)	(0.0001)	(0.0000)	(0.0001)
INDBOARD	2.2391*	2.1800*	2.2391	3.3657**
	(1.2018)	(1.2021)	(1.6756)	(1.3127)
LEV	-0.0003	-0.0030	-0.0003	0.0099
	(0.0404)	(0.0404)	(0.0098)	(0.0661)
ROA	-0.0319	-0.0373	-0.0319*	-0.0364
	(0.0657)	(0.0658)	(0.0173)	(0.0700)
TobinQ1	-0.0051	0.0028	-0.0051	-0.0061
	(0.0129)	(0.0134)	(0.0067)	(0.0140)
TOP1	0.0071	0.0064	0.0071	0.0075
	(0.0058)	(0.0059)	(0.0100)	(0.0064)
DUAL	0.0036	0.0050	0.0036	0.0293
	(0.1294)	(0.1294)	(0.1012)	(0.1435)
SIZE		0.1876**		
		(0.0811)		
MFEE		-0.0000		
		(0.0017)		
Constant	-1.7122	-6.2584***	-1.7122	-4.0577***
	(1.1632)	(1.9514)	(1.8625)	(1.3377)
Observations	42,915	43,353	42,915	36,424
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes

4.4. Heterogeneity Analysis

To examine the heterogeneous effects of corporate ESG performance on collaborative innovation, this study employs a grouped regression approach and conducts heterogeneity analyses along three dimensions: ownership structure, regional location, and high-tech firm classification.

The regression results reported in Columns (1) and (2) of Table 5 indicate that the promoting effect of ESG performance on collaborative innovation is more pronounced for state-owned enterprises (SOEs) than for non–state-owned enterprises. This difference may stem from the unique institutional environment and resource access enjoyed by SOEs. State-owned enterprises typically benefit from stronger policy support and resource endowments, and ESG performance—serving as an important manifestation of their fulfillment of social responsibilities and policy responsiveness—can further enhance their credibility with government authorities and the public. As a result, SOEs are more likely to receive preferential policies and resource allocations in collaborative innovation activities. Moreover, SOEs often play a leading role in collaborative innovation networks. Their ESG performance not only reflects a commitment to sustainable development but also exerts a demonstration effect, facilitating consensus formation among partners and improving coordination efficiency. In addition, SOEs generally face lower financing constraints and higher social

expectations, making ESG practices more likely to be incorporated into corporate strategic decision-making and to serve as a key driver of collaborative innovation.

The regression results in Columns (3) and (4) of Table 5 show that the impact of ESG performance on collaborative innovation is significant for firms located in western regions, but insignificant for those in eastern regions. This finding is closely related to differences in regional economic structures, policy orientations, and firms' stages of development. Eastern regions are relatively more economically developed, with more mature market mechanisms, and firms typically possess stronger independent innovation capabilities. Consequently, collaborative innovation in these regions relies more heavily on market-based resource allocation and specialized division of labor, which weakens the marginal effect of ESG performance on collaborative innovation. In contrast, western regions are relatively less developed, and governments play a more prominent role in promoting regional coordination and sustainable development. Under such circumstances, ESG principles are more readily integrated into regional development strategies and policy support systems. By improving ESG performance, firms in western regions can more effectively obtain policy preferences, fiscal support, and collaborative resources, thereby strengthening their willingness to cooperate with research institutions, government agencies, and other firms and enhancing their collaborative innovation capacity.

Table 5. Heterogeneity Analysis

VARIABLES	(1) patent1	(2) patent1	(3) patent1	(4) patent1	(5) patent1	(6) patent1
ESG	0.0616**	0.2163**	0.0868**	0.1200	0.0045	0.1738***
	(0.0314)	(0.0970)	(0.0348)	(0.0739)	(0.0985)	(0.0595)
AGE1	0.0147	0.0046	0.0406***	0.0951***	0.0141	0.1288***
	(0.0168)	(0.0450)	(0.0117)	(0.0278)	(0.0341)	(0.0228)
BOARD	1.0727***	-0.4690	0.2042	0.1224	-1.72**	1.6205***
	(0.3128)	(0.9469)	(0.2774)	(0.6375)	(0.8099)	(0.5124)
GROWTH	0.0000	0.0000	0.0000	-0.0001	0.0000	-0.0003
	(0.0003)	(0.0001)	(0.0000)	(0.0042)	(0.0001)	(0.0064)
INDBOARD	3.9444***	-0.7885	-1.1707	2.5540	-1.5540	4.1995***
	(0.9627)	(2.6332)	(0.8335)	(1.8830)	(2.3625)	(1.5442)
LEV	-0.0086	-0.2816	-0.2864	-0.5886	-0.2577	-0.7046
	(0.0258)	(0.7464)	(0.2582)	(0.5665)	(0.7450)	(0.4687)
ROA	-0.0451	-0.3822	-0.3514	-0.0974	-0.0310	-0.4223
	(0.0396)	(1.0236)	(0.4487)	(0.8242)	(1.1576)	(0.7086)
TobinQ1	-0.0004	-0.0978	0.0015	-0.0552	-0.0375	-0.0147
	(0.0080)	(0.0742)	(0.0092)	(0.0434)	(0.0720)	(0.0223)
TOP1	-0.0015	0.0120	0.0184***	0.0103	-0.0096	0.0381***
	(0.0047)	(0.0142)	(0.0041)	(0.0096)	(0.0124)	(0.0080)
DUAL	-0.0916	0.1917	0.0997	-0.0468	-0.0213	0.0264
	(0.0892)	(0.3890)	(0.0986)	(0.1915)	(0.2757)	(0.1533)
Constant	-3.7854***	1.1482	-1.3963	-3.0937	4.7893*	-8.6021***
	(0.9730)	(2.9180)	(0.8713)	(1.9910)	(2.5357)	(1.6101)
Observations	27,916	15,441	11,291	27,337	15,613	23,015
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes

The regression results in Columns (5) and (6) of Table 5 indicate that the effect of ESG performance on collaborative innovation is significant for high-tech firms but insignificant for non–high-tech firms. This heterogeneity may be attributed to differences in industry characteristics, innovation modes, and sensitivity to ESG practices. High-tech firms typically exhibit higher R&D

intensity and greater dependence on external knowledge resources. Their innovation activities often require deep collaboration with universities, research institutions, and upstream and downstream firms within the industrial chain. As an important indicator of corporate social responsibility and sustainable development capability, ESG performance enhances firms' credibility and attractiveness within collaborative networks, thereby facilitating industry–university–research collaborative innovation. Furthermore, high-tech industries generally impose stricter requirements regarding environmental protection and social responsibility, making ESG performance more aligned with industry norms and more likely to be incorporated into corporate strategies and collaboration standards. In contrast, non–high-tech firms are primarily engaged in manufacturing or traditional service industries, where innovation activities rely more on internal resources and incremental improvements, and dependence on external collaboration is relatively limited. As a result, ESG performance does not exert a significant influence on their collaborative innovation.

5. Conclusions and Policy Implications

Using a sample of Chinese A-share listed firms from 2009 to 2023, this study systematically investigates the impact of corporate ESG performance on collaborative innovation. The empirical results reveal a significant positive relationship between ESG performance and industry–university–research (IUR) collaborative innovation, and this finding remains robust after a series of robustness checks. Further mechanism analysis indicates that ESG performance promotes collaborative innovation primarily by encouraging investment in sustainable and emerging fields, facilitating complementarity and sharing of innovation resources, and accelerating the diffusion and commercialization of technological outcomes. Heterogeneity analysis shows that the positive effect of ESG performance on IUR collaborative innovation is more pronounced among state-owned enterprises, firms located in western regions, and non–high-tech firms. This study not only extends the theoretical boundaries of the economic consequences of ESG but also provides new insights into how firms can enhance innovation performance through ESG practices.

To fully leverage the positive role of ESG in promoting IUR collaborative innovation, this study proposes several policy implications. First, ESG information disclosure systems and incentive mechanisms should be strengthened. Governments should integrate international experience with domestic realities to establish standardized and scientifically grounded ESG evaluation frameworks and disclosure standards, thereby improving information transparency and comparability and incorporating ESG performance into corporate credit assessment systems. In addition, ESG-based fiscal subsidies, tax incentives, and green financing policies should be explored to encourage firms to deepen ESG practices and engage in substantive collaboration with universities and research institutions, thereby preventing ESG initiatives from becoming merely symbolic.

Second, mechanisms for industry–university–research collaboration should be further optimized. Given that ESG performance facilitates the complementarity and sharing of innovation resources, governments and relevant institutions should promote the development of collaborative platforms and encourage firms with strong ESG performance to establish joint laboratories or innovation alliances with universities and research institutions. For private enterprises, targeted policy support—such as simplifying collaboration approval procedures and establishing dedicated funds—should be provided to alleviate resource constraints and enhance the practical effectiveness of ESG in IUR collaboration.

Finally, greater emphasis should be placed on technology commercialization and ESG-coordinated governance. Governments should improve intellectual property protection and technology transfer mechanisms and support large enterprises with strong ESG performance in playing a demonstrative role in the industrialization of technological outcomes. At the same time, ESG-oriented innovation funds or guarantee mechanisms should be established to address financing constraints faced by small and medium-sized enterprises, reduce collaboration risks, and enhance knowledge spillovers and innovation efficiency, thereby fostering the sustainable development of industry–university–research collaborative innovation.

References

[1] Hong Yinxing. Economic Analysis of Collaborative Innovation among Industry, Academia and Research. Economic Science, 2014, 1: 56–64.

[2] Bai Junhong, Bian Yuanchao. Does Government Support Promote IUR Synergy Innovation. Statistical Research, 2015, 11: 43–50.

[3] Boulhaga, M., Bouri, A., Elamer, A. A., et al. Environmental, Social and Governance Ratings and Firm Performance: The Moderating Role of Internal Control Quality. Corporate Social Responsibility and Environmental Management, 2023, 30(1): 134–145.

[4] Freeman, R. E. Strategic Management: A Stakeholder Approach. Boston: Pitman Press, 1984.

[5] Spence, M. Market Signaling: Informational Transfer in Hiring and Related Screening Processes. Cambridge, MA: Harvard University Press, 1974.

[6] Chen Xiaoshan, Li Hanfei, Chen Simin. ESG Performance of Listed Companies: Literature Review and Future Outlook. Communication of Finance and Accounting, 2024, 23: 16–22.

[7] Yan Bing, Cheng Min, Wang Naihe. ESG Green Spillover, Supply Chain Transmission and Corporate Green Innovation. Economic Research Journal, 2024, 7: 72–91.

[8] Huang, D. Z. Environmental, Social and Governance Factors and Assessing Firm Value: Valuation, Signaling and Stakeholder Perspectives. Accounting & Finance, 2022, 62(S1): 1983–2010.

[9] Yu Guifang, Hu Beibei, Wang Haiyun. Research on the Realization Mechanism of Functional Positioning of New Research and Development Institutions: Take Beijing as an example. Studies in Science of Science, 2024, 3: 563–570.

[10] Yuan, B., Cao, X. Do Corporate Social Responsibility Practices Contribute to Green Innovation? The Mediating Role of Green Dynamic Capability. Technology in Society, 2022, 68(2): 101868.

[11] Akcigit, U., Hanley, D., Serrano-Velarde, N. Back to Basics: Basic Research Spillovers, Innovation Policy, and Growth. The Review of Economic Studies, 2021, 88(1): 1–43.

[12] Liu Feiran, Hu Lijun, Fan Xiaoqun. Research on the Influence of Industry-University-Research Cooperation on Enterprise Innovation Quality. Business and Management Journal, 2020, 10: 120–136.

[13] Xiao Zhenhong, Li Yan. The Impact of Social Network Embeddedness on Collaborative Innovation of High-end Equipment Manufacturing Enterprises: Based on the Role of Industrial Alliance Relationship. Management Review, 2023, 6: 72–81.

[14] Chen Ruohong, Zhao Xueyan, Jin Hua. The Impact of ESG Indices on the Cost of Capital. Scientific Decision Making, 2022, 11: 24–40.

[15] Fang Xianming, Hu Ding. Corporate ESG Performance and Innovation: Empirical Evidence from A-share Listed Companies. Economic Research Journal, 2023, 2: 91–106.