



ESG Performance and Corporate Innovation: Evidence from A-Share Listed Firms

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Abstract. Using panel data on Shanghai and Shenzhen A-share listed firms from 2009 to 2024, this paper examines the effect of ESG performance on corporate innovation. The results show that ESG significantly promotes innovation output, and this finding remains robust across additional tests. Further analysis indicates that all three ESG dimensions have positive effects, with the social and governance dimensions exerting stronger impacts than the environmental dimension. Overall, the findings suggest that stronger ESG performance enhances firms' innovation capacity and carries important implications for management and policy.

Keywords: ESG performance; corporate innovation; A-share listed firms; sustainability; corporate governance

1 Introduction

In recent years, as sustainable development has gained prominence, investors have increasingly focused on corporate ESG performance, which in turn has begun to exert a growing influence on firms' long-term business activities. Given this trend, it is important to further examine whether ESG performance can promote corporate innovation. Existing research provides several relevant insights. Under conditions of information asymmetry, corporate ESG performance has been shown to help firms gain the trust of stakeholders such as financial institutions, suppliers, and customers, thereby reducing operating costs and improving operational efficiency^[6]. ESG practices can also strengthen corporate governance and mitigate agency conflicts^[2,5], and lower the risk of litigation^[3,8]. While these studies demonstrate ESG's impact on firms' day-to-day operations, they leave open the question of whether ESG performance meaningfully influences corporate innovation, suggesting the need for further investigation. Related research has also explored the drivers of corporate green and technological innovation from the perspective of firm digital transformation, providing empirical evidence for the micro-mechanism of firm operational decisions on innovation output^[1].

Based on these considerations, this paper uses Shanghai and Shenzhen A-share listed firms from 2009 to 2024 as the research sample to examine the impact of ESG performance on corporate innovation. Corporate innovation is measured from the perspective of innovation output, and ESG performance is proxied by the Huazheng ESG rating,

which is widely used in both practice and academic research and covers all A-share listed firms. The empirical results show that ESG performance significantly promotes corporate innovation output, and this conclusion remains robust across multiple tests, including the use of an alternative ESG measure, OLS estimation, double-clustered standard errors, and winsorization. Further analysis reveals that all three ESG dimensions—environmental, social, and governance—exert positive effects on innovation, although the effects are heterogeneous in magnitude. In particular, the social and governance dimensions play a more pronounced role than the environmental dimension. This finding suggests that the innovation effects of ESG are not uniform, but instead operate through different channels with varying strengths.

2 Methodology and Data Source

2.1 Methodology

The following research model is constructed in this paper:

$$Innovation_{i,t} = \alpha + \beta ESG_{i,t} + \sum_{i=1}^n \varphi_{i,t} Control + u_i + \delta_t + \varepsilon_{i,t}$$

Where the subscript i represents the individual firm, t represents the year. Innovation (grp) is measured by R&D investment intensity, the number of patents granted, and patent citations, while ESG captures the firm's ESG performance. To reduce omitted-variable bias, this study further controls for firm-level characteristics, including firm size (size), measured by the natural logarithm of total assets; board independence (board), measured by the number of independent directors; CEO-chairman duality (duality), measured by whether the two positions are held by the same individual; firm growth (growth), proxied by the growth rate of total assets; and equity concentration (top10), measured by the combined shareholding ratio of the top ten shareholders, following Chen Jing (2023)^[7]. In addition, u_i represents firm fixed effect. δ_t represents year fixed effect. $\varepsilon_{i,t}$ represents the random error term.

2.2 Data

Given the availability of ESG and patent data, this study uses Shanghai and Shenzhen A-share listed firms from 2009 to 2024 as the research sample. To ensure data quality, financial firms, ST and *ST firms, firms with insolvency risk, and firms with missing financial data are excluded. Corporate innovation is measured by patent output following Fang and Hu (2023)^[4]. Data on R&D, innovation patents, and patent citations are obtained from CNRDS; firm-level financial data are drawn from CSMAR; and ESG data are collected from the Wind database. Considering the coverage and applicability of available ESG rating systems, this study adopts the Huazheng ESG rating as a proxy for corporate ESG performance. The Huazheng rating covers all A-share listed firms and is widely recognized in both practice and academic research. It comprises nine categories, from C to AAA, which are converted into scores from 1 to 9 for empirical

analysis. Firm-clustered regressions are employed to account for within-firm correlation and heteroskedasticity.

3 Empirical Research

3.1 Descriptive Statistics

Table 1 reports the descriptive statistics of the main variables and reveals considerable heterogeneity across firms. The mean value of ESG rating (*esg*) is 4.154, with values ranging from 1.000 to 9.000, indicating a moderate overall level of ESG performance among Chinese listed firms and substantial cross-firm variation. The mean value of corporate patent applications (*grp*) is 3.191, suggesting a relatively low level of innovation output overall, while its wide range and large dispersion reflect pronounced differences in firms' innovation capacity. A similar pattern is observed for asset growth (*growth*), whose high variability indicates considerable polarization in firm growth performance. In terms of corporate governance, the mean value of CEO-chairman duality (*duality*) is 0.301, implying that about 30.1% of sample firms adopt a dual leadership structure, whereas board size (*board*) exhibits relatively limited variation, suggesting a generally stable board structure among Chinese listed firms.

Table 1. Descriptive statistics

	N	Mean	Std. Dev.	Min	Max
<i>esg</i>	48811	4.154	1.124	1.000	9.000
<i>grp</i>	50384	3.191	27.435	0.000	1596.000
<i>size</i>	50339	22.278	1.516	11.348	31.519
<i>growth</i>	46815	0.502	29.056	-1.000	4719.612
<i>duality</i>	49064	0.301	0.459	0.000	1.000
<i>board</i>	50292	2.277	0.263	1.386	3.434

3.2 Baseline Regression

To examine the effect of corporate ESG ratings on innovation output, this study employs multiple linear regression models. Table 2 reports the baseline regression results for the core explanatory variable, ESG rating. Columns (1)–(6) follow a stepwise specification in which firm-level controls, including firm size, asset growth, and corporate governance characteristics, are added sequentially to reduce potential omitted-variable bias.

Table 2. Baseline Regression

	(1)	(2)	(3)	(4)	(5)	(6)
<i>esg</i>	0.488*** (0.1585)	0.459*** (0.1626)	0.453*** (0.1688)	0.449*** (0.1679)	0.436*** (0.1658)	0.458*** (0.1721)
<i>size</i>		0.368 (0.2384)	0.322 (0.2356)	0.332 (0.2341)	0.237 (0.2463)	0.257 (0.2498)
<i>growth</i>			0.001***	0.001***	0.001***	0.001***

			(0.0003)	(0.0003)	(0.0003)	(0.0003)
board				-0.455	-0.553	-0.600
				(0.5470)	(0.5524)	(0.5281)
top10					4.002**	4.066**
					(1.7933)	(1.8331)
board						0.250
						(0.4072)
_cons	-2.181*	-9.845**	-8.875*	-8.062	-8.160	-8.778*
	(1.1457)	(4.8521)	(4.8212)	(4.9819)	(5.0160)	(5.1801)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
N	48811	48787	46559	46549	46549	45358

Note: Robust standard errors are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

The regression results show that the coefficients of ESG rating (esg) are consistently positive and significant at the 1% level across all specifications, with estimates ranging from 0.436 to 0.488. This indicates that better ESG performance significantly promotes corporate innovation output, and the result remains stable after the sequential inclusion of control variables. The findings support the core hypothesis of this paper that firms with higher ESG ratings exhibit stronger innovation incentives and greater innovation output. One possible explanation is that high-quality ESG practices send positive signals of sustainable development to the capital market, thereby easing financing constraints and providing stable support for R&D activities. In addition, firm size, asset growth, and the shareholding ratio of the top ten shareholders all have positive effects on innovation, consistent with the existing literature. Overall, the baseline regression provides robust evidence that corporate ESG performance is positively associated with innovation output.

3.3 Regression on ESG Sub-dimensions

To further examine the heterogeneous effects of different ESG dimensions on corporate innovation output, this section separately tests the impacts of the environmental (E_score), social (S_score), and governance (G_score) dimensions. All regressions control for firm and year fixed effects, with standard errors clustered at the firm level. As shown in Table 3, the results show that all three dimensions have positive effects on innovation output, although their magnitudes and significance differ. Specifically, the coefficient on the environmental dimension is 0.056 and significant at the 10% level, indicating a relatively weaker effect. By contrast, the social and governance dimensions are both significantly positive at the 1% level, with coefficients of 0.051 and 0.047, respectively, suggesting stronger contributions to innovation. Overall, the findings indicate that while all ESG dimensions promote corporate innovation, the social and governance dimensions play a more pronounced role.

A comparison across the three dimensions shows that the social and governance dimensions are significant at the 1% level and constitute the main drivers of corporate innovation within the ESG framework, whereas the environmental dimension is only significant at the 10% level and exhibits a relatively weaker effect. Among the control

variables, asset growth and the shareholding ratio of the top ten shareholders remain significantly positive, consistent with the baseline regression results. Overall, although all three ESG dimensions promote innovation output, their effects differ markedly in strength, providing further evidence of the structural heterogeneity in the relationship between ESG performance and corporate innovation.

Table 3. ESG Sub-dimensions and Corporate Innovation

	(1)	(2)	(3)
E_score	0.056* (0.0289)		
S_score		0.051*** (0.0188)	
G_score			0.047*** (0.0175)
size	0.313 (0.2428)	0.299 (0.2412)	0.345 (0.2431)
growth	0.001*** (0.0002)	0.001*** (0.0002)	0.001*** (0.0002)
board	-0.675 (0.5339)	-0.671 (0.5371)	-0.605 (0.5364)
top10	4.212** (1.8565)	4.199** (1.8556)	4.024** (1.8597)
duality	0.253 (0.4079)	0.241 (0.4075)	0.239 (0.4086)
_cons	-11.167** (5.2979)	-11.311** (5.3433)	-12.636** (5.2069)
Firm FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
N	45358	45358	45358

Note: Robust standard errors are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

3.4 Robustness Tests

To verify the robustness of the baseline findings, a series of additional robustness checks are conducted in this study, as reported in Table 4. First, to address potential bias arising from a single ESG rating methodology, an alternative ESG score (esg_score) is employed. As reported in columns (1) and (2), after controlling for firm and year fixed effects, the coefficients on esg_score are 0.102 and 0.096, respectively, both significant at the 1% level, thereby supporting the hypothesis. Second, the baseline model is re-estimated using ordinary least squares (OLS). In column (3), the univariate OLS regression including only esg yields a coefficient of 0.488, significant at the 1% level; after adding the full set of firm-level control variables in column (4), the coefficient declines to 0.049 but remains significant at the 1% level. Third, to account for potential cross-sectional and serial correlation in firm-level panel data, standard errors are double-clustered at the firm and year levels. The result in column (5) shows that the coefficient on esg remains significantly positive, consistent with the baseline findings. Finally, to mitigate the influence of extreme observations, all continuous variables are

winsorized at the 1st and 99th percentiles. The result in column (6) continues to show a significantly positive ESG coefficient at the 1% level. Overall, these results confirm the robustness of the baseline conclusions.

Table 4. Robust Tests

	(1)	(2)	(3)	(4)	(5)	(6)
	grp	grp	grp	grp	grp	grp_w
esg_score	0.102*** (0.0315)	0.096*** (0.0343)				
esg			0.488*** (0.1585)	0.049*** (0.0101)	0.453* (0.2465)	
esg_w						0.047*** (0.0098)
size		0.249 (0.2480)		0.097*** (0.0190)	0.322 (0.2753)	0.103*** (0.0185)
growth		0.001*** (0.0003)		0.000*** (0.0000)		
board		-0.592 (0.5290)		-0.024 (0.0369)	-0.702 (0.4747)	-0.026 (0.0364)
top10		4.062** (1.8318)		-0.307*** (0.1053)	4.145* (2.0226)	-0.293*** (0.1012)
duality		0.249 (0.4073)		-0.007 (0.0271)	0.263 (0.3931)	-0.009 (0.0261)
_cons	-7.645*** (2.6705)	-13.757** (5.4285)	1.248* (0.6584)	-1.432*** (0.4121)	-6.735 (6.3482)	-1.832*** (0.3862)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
N	48811	45358	48763	41348	47507	43747

Note: Robust standard errors are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

4 Conclusion

Using data on Shanghai and Shenzhen A-share listed firms from 2009 to 2024, this paper examines the effect of corporate ESG performance on innovation output. The baseline results, together with a series of robustness tests, show that stronger ESG performance significantly enhances firms' innovation capacity. Further analysis indicates that all three ESG dimensions exert positive effects, although the social and governance dimensions play a stronger role than the environmental dimension. These findings provide empirical support for the view that ESG performance can serve as an important driver of corporate innovation and offer useful implications for firms, investors, and policymakers in promoting the coordinated development of economic, social, and environmental objectives. Nevertheless, this study has several limitations: the sample is limited to Chinese A-share listed firms, the measurement of ESG performance can be

further enriched by incorporating additional rating agencies, and the underlying mechanisms through which ESG affects innovation warrant deeper investigation in future research.

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