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Innovation as a Mediating Mechanism Between ESG Performance and Financial Performance

Jingjing Duan ^{1,2,*}, Matěj Hrouda ¹, Omar Ameir ¹ and Ondrej Grycz ¹

¹ Faculty of Materials Science and Technology, VSB-Technical University of Ostrava, 70800 Ostrava, Czech Republic; hrouda.matej.st@vsb.cz (M.H.); omar.ameir@vsb.cz (O.A.); ondrej.grycz@vsb.cz (O.G.)

² School of Economics, Wuhan Business University, Wuhan 450056, China

* Correspondence: jingjing.duan.st@vsb.cz

Abstract

Environmental, Social, and Governance (ESG) performance has become a central criterion for evaluating corporate sustainability. Yet the empirical relationship between ESG and financial performance remains contested, especially in emerging markets where institutions are evolving. This study examines how ESG performance relates to corporate financial performance among Chinese A-share listed companies and tests whether corporate innovation functions as a transmission mechanism. Using a balanced panel (2015–2023), we combine System Generalized Method of Moments (System GMM) with a non-parametric Bootstrap mediation procedure. We decompose ESG into environmental, social, and governance dimensions and distinguish between innovation input (R&D investment) and innovation output (patent generation). The results indicate a positive directional association between overall ESG performance and return on assets (ROA), but the direct financial effect is primarily driven by the governance dimension. Environmental and social performance do not show robust direct effects. However, ESG significantly promotes corporate innovation, especially patent output. Bootstrap mediation results confirm that patents represent a robust and universal channel through which ESG contributes to financial performance, while the R&D pathway is more conditional. The findings also indicate ownership heterogeneity between state-owned and private enterprises. By distinguishing between innovation input and output, this study explains how ESG practices may be translated into economic value in an emerging market context distinct from advanced economies.

Keywords: ESG performance; financial performance; corporate innovation; innovation output; sustainable finance; China

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1. Introduction

The evaluation of corporate performance has increasingly moved beyond traditional financial indicators toward a broader understanding of long-term value creation, sustainability, and resilience. Environmental, Social, and Governance (ESG) performance has become one of the most widely used frameworks for integrating non-financial criteria into corporate governance, investment analysis, and strategic decision-making. ESG performance captures how firms manage environmental responsibilities, stakeholder relationships, and governance quality, and it has therefore become closely connected with debates

on sustainable development, responsible investment, and long-term competitiveness [1–4].

The rise of ESG is not merely a reporting phenomenon. It reflects a broader transformation in the relationship between firms, capital markets, regulators, and society. Global policy initiatives such as the United Nations Sustainable Development Goals and the Paris Agreement have increased pressure on firms to align business strategies with environmental and social objectives [5,6]. At the same time, investors increasingly incorporate ESG metrics into portfolio construction, risk assessment, and valuation decisions [7–9]. The growing role of ESG-themed investment suggests that ESG performance may influence firms through multiple channels, including access to finance, stakeholder trust, innovation incentives, reputation, and internal governance mechanisms.

Despite this increasing practical importance, the empirical relationship between ESG performance and corporate financial performance remains unresolved. A large body of research finds that ESG engagement can improve financial outcomes by reducing information asymmetry, lowering financing constraints, strengthening stakeholder relationships, and improving risk management [1,10–14]. However, other studies emphasize the potential costs of ESG investments, particularly when environmental and social initiatives require substantial upfront expenditure while their financial returns are uncertain or delayed [15–18]. A third perspective argues that ESG effects are contingent on institutional environment, industry structure, ownership type, and the specific ESG dimension under consideration [19–22]. These mixed findings suggest that ESG should not be treated as a homogeneous construct. Rather, the underlying mechanisms require deeper examination across distinct institutional logics—particularly the contrast between market-driven Western economies and state-led emerging markets.

China provides a particularly important empirical context for this question [23–25]. As the world's second-largest economy and a central actor in global sustainability transitions, China has rapidly expanded its ESG policy agenda, sustainable finance initiatives, and corporate disclosure expectations. The national dual-carbon strategy and the policy emphasis on high-quality development have intensified the role of sustainability in corporate governance. However, compared with mature Western markets, China's ESG ecosystem remains relatively young. Disclosure practices, rating methodologies, stakeholder expectations, and regulatory incentives continue to evolve. Consequently, the financial materiality of ESG in China may differ from that observed in developed economies, reflecting distinct institutional logics, policy priorities, and market structures.

A further limitation of existing research is that many studies focus primarily on the direct ESG-performance link. This approach is informative but incomplete. If ESG creates economic value, it is likely to do so through organizational mechanisms such as innovation input (R&D) and innovation output (patents), stakeholder learning, risk reduction, and improved governance. Among these channels, corporate innovation is especially important. ESG practices may encourage firms to develop cleaner technologies, improve resource efficiency, redesign production processes, and create products that respond to evolving market and regulatory demands. Conversely, without innovation capability, ESG commitments may remain symbolic and fail to translate into measurable financial outcomes.

This study therefore examines the relationship between ESG performance and corporate financial performance in Chinese listed companies, with particular emphasis on the mediating role of corporate innovation. It asks three related questions. First, is ESG performance positively associated with financial performance in Chinese listed enterprises? Second, do the environmental, social, and governance dimensions differ in their financial effects? Third, does corporate innovation, measured through R&D input and patent output, mediate the ESG–financial performance relationship?

The study makes four contributions. First, it provides evidence from China, an emerging market undergoing a state-led sustainability transition. Second, it decomposes ESG into environmental, social, and governance dimensions, allowing heterogeneous effects to be identified. Third, it distinguishes innovation input from innovation output and shows that patent output is the more robust mediating channel. Fourth, it applies a rigorous multi-method empirical design combining System GMM estimation and Bootstrap mediation testing, which allows us to disentangle dynamic endogeneity from genuine transmission effects in the ESG-performance relationship.

The remainder of the article is structured as follows. Section 2 reviews the theoretical foundations and empirical literature. Section 3 develops the hypotheses. Section 4 explains the data, variables, and methodology. Section 5 presents the empirical results. Section 6 discusses the findings. Section 7 concludes and outlines implications, limitations, and future research directions.

2. Literature Review and Theoretical Background

2.1. Sustainable Development Theory and ESG

Sustainable Development Theory provides the broad normative foundation for ESG research. The Brundtland Commission defined sustainable development as development that meets present needs without compromising the ability of future generations to meet their own needs [5]. Within the corporate context, this principle implies that firms should pursue economic performance while also managing environmental and social impacts. ESG represents an operational framework through which the sustainability principle is translated into corporate governance, disclosure, and investment evaluation.

The environmental dimension concerns resource use, emissions, ecological impacts, and climate-related responsibilities. The social dimension concerns relationships with employees, customers, suppliers, communities, and broader society. The governance dimension concerns board oversight, shareholder rights, transparency, ethical conduct, and internal control. Together, these dimensions provide a multidimensional framework for evaluating corporate sustainability [2,3,23].

A sustainable development perspective suggests that ESG practices may contribute to long-term competitiveness by improving resource efficiency, reducing regulatory and reputational risks, and strengthening legitimacy. However, sustainability investments may impose short-term costs, and their economic benefits may appear only over longer horizons. This temporal tension is one reason why empirical findings on ESG and financial performance remain mixed.

2.2. Stakeholder Theory

Stakeholder Theory argues that firms create value through relationships with multiple stakeholder groups rather than through shareholders alone [24,25]. Stakeholders provide resources, legitimacy, information, and market access. Firms that manage stakeholder relationships effectively may obtain strategic advantages through trust, cooperation, employee commitment, customer loyalty, and regulatory goodwill [26–28].

ESG performance can be interpreted as a structured form of stakeholder management. Environmental responsibility signals accountability to regulators and communities. Social responsibility may strengthen employee and customer relationships. Governance quality improves investor confidence and reduces agency conflicts. From this perspective, ESG should enhance financial performance when it helps firms secure resources and reduce conflict among stakeholders [29–31].

However, Stakeholder Theory also implies that different ESG dimensions may operate through different channels. Governance mechanisms may affect financial performance

directly by improving monitoring and resource allocation. Environmental and social practices may operate more indirectly by building reputational and relational assets that support innovation and long-term competitiveness. This distinction motivates the dimensional analysis conducted in this study.

2.3. Information Asymmetry and Signaling Perspectives

Information Asymmetry Theory provides another explanation for why ESG may affect financial outcomes. Investors and creditors often have incomplete information about firms' long-term risks and managerial quality. ESG disclosure may reduce information asymmetry by providing non-financial information about environmental risk management, stakeholder relations, and governance quality [32–34].

High ESG performance may therefore serve as a signal of managerial competence, transparency, and long-term orientation. This can reduce perceived risk, improve access to finance, and lower the cost of capital [10,12,35]. These benefits may be particularly important for innovation, which requires sustained financing and involves high uncertainty. Firms with stronger ESG disclosure and stakeholder trust may face fewer financing constraints and may be better positioned to undertake long-term innovation projects.

Nevertheless, information effects depend on the credibility and comparability of ESG disclosure. In markets where ESG reporting standards are still evolving, third-party ratings may contain measurement noise and the risk of selective disclosure or symbolic compliance. The Chinese context therefore requires careful interpretation of ESG-performance relationships.

2.4. ESG Performance and Financial Performance

The ESG–financial performance literature is extensive but inconclusive. A first stream finds positive relationships. Meta-analytic evidence suggests that a majority of ESG studies report non-negative relationships between ESG and financial performance [1]. Positive effects are often explained through better risk management, lower capital costs, improved reputation, operational efficiency, and stakeholder support [10–14,36]. Studies of corporate sustainability also suggest that firms with stronger sustainability practices develop superior organizational processes and long-term performance [4,37].

A second stream identifies weak, negative, or context-dependent effects. ESG initiatives can impose costs, especially when firms invest in environmental compliance, employee programs, or disclosure systems without immediate revenue gains [15–18]. From a short-term accounting perspective, ESG expenditure may reduce profitability before benefits materialize. This is particularly relevant for environmental and social investments, which often generate long-term intangible benefits rather than immediate accounting returns.

A third stream emphasizes heterogeneity. ESG effects may vary across industries, governance systems, institutional environments, and ownership structures [19–22]. Some studies find that governance is more directly related to financial performance than environmental or social indicators because governance affects agency costs, monitoring quality, and strategic discipline [38–41]. Others suggest that environmental and social dimensions may influence performance through indirect channels, including innovation, reputation, and stakeholder cooperation.

For China, these issues are especially salient. ESG adoption is shaped by policy guidance, state ownership, market competition, and evolving disclosure standards. The financial materiality of ESG may therefore depend not only on ESG performance itself but also on whether firms can transform ESG commitments into innovation and competitive advantage.

2.5. ESG and Corporate Innovation

Corporate innovation is central to sustainable competitiveness. Innovation allows firms to create new products, improve production processes, increase resource efficiency, and adapt to regulatory and technological change [42–45]. The Resource-Based View suggests that innovation capability depends on intangible resources such as knowledge, reputation, organizational learning, stakeholder cooperation, and managerial competence [46,47]. ESG practices may strengthen these resources.

The environmental dimension may stimulate eco-innovation by encouraging firms to reduce energy use, redesign processes, and develop cleaner technologies. This argument is consistent with the Porter Hypothesis, which suggests that properly designed environmental pressures can induce innovation that offsets compliance costs [48,49]. The social dimension may enhance innovation through employee engagement, customer feedback, and stakeholder collaboration. Governance quality may support innovation by improving strategic oversight, reducing managerial opportunism, and protecting long-term investment decisions [38,40,50].

Recent research increasingly supports the ESG–innovation link. Firms with stronger ESG performance are often associated with higher innovation output, more sustainable technologies, and stronger adaptive capability [51–54].

In this study, innovation is conceptualized as technological innovation, proxied by R&D investment (innovation input) and patent output (codified technological knowledge). While process innovations, managerial innovations, and organizational learning are undoubtedly important, they fall outside the scope of our quantitative measurement framework. By focusing on patents, we capture the successful conversion of ESG commitments into defensible, marketable technological assets, which is central to the Porter Hypothesis logic in this study.

However, innovation input and output are conceptually different. R&D investment captures resource commitment, but patents capture codified knowledge output that can be protected, commercialized, and transformed into competitive advantage. This distinction is essential for understanding the mediation mechanism.

2.6. Innovation as a Mediating Mechanism

Building on this theoretical foundation, we propose innovation as a mediating mechanism linking ESG performance to financial outcomes. If ESG improves innovation capability and innovation improves financial performance, then innovation may represent a channel through which ESG creates value. This mechanism is theoretically consistent with Stakeholder Theory, Information Asymmetry Theory, and the Resource-Based View.

Existing studies have begun to examine innovation as a mediator, but many rely on standard stepwise regression or Sobel tests [55–57]. These methods can be problematic when ESG, innovation, and financial performance are jointly endogenous. Firms with higher profitability may have more resources for ESG and innovation, creating reverse causality. Unobserved managerial quality may simultaneously influence all three variables. Therefore, robust mediation testing requires methods that acknowledge endogeneity and non-normal distributions of indirect effects.

This study addresses this issue by using System GMM for dynamic panel estimation and Bootstrap procedures for inference on indirect effects. Bootstrap testing is especially appropriate because the distribution of indirect effects is often asymmetric and because confidence intervals can be constructed without assuming normality [56,57].

3. Hypotheses Development

Stakeholder Theory and signaling arguments suggest that superior ESG performance enhances financial performance by building trust, reducing risk, improving transparency, and attracting resources. However, ESG dimensions may differ in their direct financial relevance. Governance practices may have the most immediate accounting effect because they directly shape monitoring, internal control, and resource allocation.

H1. *Corporate ESG performance is positively associated with corporate financial performance.*

H1a. *Environmental performance is positively associated with corporate financial performance.*

H1b. *Social performance is positively associated with corporate financial performance.*

H1c. *Governance performance is positively associated with corporate financial performance.*

The Resource-Based View and Porter Hypothesis suggest that ESG practices can stimulate innovation by creating pressures and resources for technological upgrading. Environmental practices may direct innovation toward resource efficiency and green technologies. Social practices may improve employee and stakeholder collaboration. Governance practices may support long-term investment and protect innovation projects from short-term managerial behavior.

H2. *Corporate ESG performance is positively associated with corporate innovation.*

H2a. *ESG performance is positively associated with innovation input, measured by R&D investment.*

H2b. *ESG performance is positively associated with innovation output, measured by patent output.*

If ESG enhances innovation and innovation improves profitability, then innovation should mediate the ESG-performance relationship. However, R&D investment and patent output may differ in mediating strength. R&D is an input and may not always lead to commercial value. Patents are closer to codified, defensible innovation output and may therefore represent a stronger channel.

H3. *Corporate innovation mediates the relationship between ESG performance and corporate financial performance.*

H3a. *Innovation input (R&D) mediates the relationship between ESG performance and corporate financial performance.*

H3b. *Innovation output (Patents) mediates the relationship between ESG performance and corporate financial performance.*

4. Data and Methodology

4.1. Sample and Data Sources

The empirical analysis uses a balanced panel dataset of Chinese A-share listed non-financial companies for the period 2015–2023. The period is appropriate because 2015 marks a turning point in global and Chinese sustainability policy. It is worth noting that China introduced mandatory ESG disclosure guidelines in April 2024. However, because our data collection concluded in early 2025, complete and audited 2024 financial and ESG

rating data were not yet available for the full sample. Consequently, our analysis covers the 2015–2023 period, capturing the dynamics of the voluntary ESG disclosure era preceding the new regulations. Domestically, China intensified the policy framework for ecological civilization, green finance, and high-quality development.

The initial sample consisted of all A-share listed firms. Financial and insurance firms were excluded because their accounting structures, leverage ratios, and regulatory environments differ from those of non-financial firms. Firms marked as ST or *ST were excluded because their abnormal financial conditions could distort the analysis. Observations with missing data for key variables were removed. The final sample contains 1662 firms and 14,958 firm-year observations.

ESG data were obtained from the Hua Zheng ESG rating database. Financial data, R&D data, and firm characteristics were collected from iFinD and corporate annual reports. The use of third-party ESG ratings follows common practice in ESG research, although limitations related to rating methodology and disclosure quality are acknowledged [23].

4.2. Variables

Table 1 summarizes the definitions and measurement approaches for all variables employed in this study. Financial performance is proxied by return on assets (ROA), calculated as net profit divided by average total assets. ESG performance is captured by the composite ESG score and its three pillar scores—environmental (ENV), social (SOC), and governance (GOV). Innovation input and output are measured by R&D investment and the number of granted patents, respectively, both expressed in logarithmic form. Control variables include firm leverage, revenue growth, firm size, cash holdings, ownership concentration, and ownership type.

Table 1. Variable definitions.

Variable	Symbol	Measurement
Financial performance	ROA	Net profit divided by average total assets
Overall ESG performance	ESG	Composite ESG score from Hua Zheng ratings
Environmental performance	ENV	Environmental pillar score
Social performance	SOC	Social pillar score
Governance performance	GOV	Governance pillar score
Innovation input	R&D	Natural logarithm of annual R&D investment plus one
Innovation output	Patent	Natural logarithm of total patents granted plus one
Leverage	Lev	Total liabilities divided by total assets
Growth	Growth	Revenue growth rate
Firm size	Size	Natural logarithm of total assets
Cash ratio	Cash	Operating cash flow divided by total assets
Ownership concentration	Top10	Shareholding ratio of top ten shareholders
Ownership type	SOE	Dummy equal to one for state-owned enterprises

4.3. Empirical Models

The baseline model estimates the effect of lagged ESG performance on financial performance:

$$ROA_{it} = \alpha_0 + \alpha_1 ESG_{i,t-1} + \alpha_k Controls_{i,t-1} + Industry\ FE + Year\ FE + \epsilon_{it} \quad (1)$$

Separate models replace ESG with ENV, SOC, and GOV to examine dimensional heterogeneity.

The innovation model estimates the effect of ESG performance on innovation input and output:

$$\text{Innovation}_{it} = \beta_0 + \beta_1 \text{ESG}_{i,t-1} + \beta_k \text{Controls}_{i,t-1} + \text{Industry FE} + \text{Year FE} + \epsilon_{it} \quad (2)$$

The mediation model introduces innovation variables into the ROA equation:

$$\text{ROA}_{it} = \theta_0 + \theta_1 \text{ESG}_{i,t-1} + \theta_2 \text{Innovation}_{i,t-1} + \theta_k \text{Controls}_{i,t-1} + \text{Industry FE} + \text{Year FE} + \epsilon_{it} \quad (3)$$

System GMM is employed to address the persistence in financial performance and innovation, as well as the potential endogeneity of ESG [58]. Specifically, all three equations incorporate their respective lagged dependent variables ($\text{ROA}_{i,t-1}$ in Equations (1) and (3); $\text{Innovation}_{i,t-1}$ in Equation (2)) as regressors. To mitigate endogeneity, we treat ESG, innovation, and financial performance as potentially endogenous. Following Roodman [59], we employ deeper lags ($t-2$, $t-3$) of the regressors as external instruments and apply a collapsed instrument matrix to prevent instrument proliferation. The total number of instruments is 10 across all specifications. Instrument validity is assessed using the Hansen test, while AR(1) and AR(2) tests evaluate serial correlation.

The mediation hypothesis follows the conventional three-step logic, requiring that ESG is associated with ROA (Equation (1)), ESG is associated with innovation (Equation (2)), and innovation is associated with ROA conditional on ESG (Equation (3)) [60]. However, as demonstrated in the subsequent empirical analysis, the Hansen test is rejected for several GMM specifications (e.g., $p = 0.000$ for the dimensional models), indicating potential instrument invalidity. Consequently, the three-step decomposition based on GMM coefficients is presented only for illustrative purposes to depict the directional pathways. The statistical significance of the indirect effect is evaluated exclusively via a non-parametric Bootstrap mediation test.

5. Results

5.1. Descriptive Statistics

Table 2 reports the descriptive statistics for the main variables. To mitigate the influence of outliers, all continuous variables have been winsorized at the 1st and 99th percentiles.

Table 2. Summary Statistics of Core Variables.

Variable	Mean	Std. Dev.	Min	25%	Median	75%	Max
ROA	4.95	7.31	−23.99	2.23	4.82	8.34	25.84
ESG	73.24	5.24	44.53	70.24	73.38	76.62	90.40
ENV	62.09	7.71	33.91	57.16	61.60	66.78	95.16
SOC	75.58	8.45	4.88	71.04	76.26	80.77	100.00
GOV	78.06	7.25	19.60	75.19	79.49	82.68	97.33
R&D	18.44	1.49	7.72	17.51	18.38	19.32	24.63
Patent	4.64	1.55	0.69	3.69	4.65	5.58	11.02
Lev	41.96	19.14	6.72	26.96	41.28	55.89	90.37
Growth	12.09	28.36	−47.82	3.58	8.54	22.46	140.80
Size	22.52	1.28	19.53	21.64	22.33	23.21	28.70
Cash	16.84	10.94	0.25	9.18	14.29	21.57	85.07
Top10	54.53	15.01	8.78	43.80	54.13	64.89	100

The mean ESG score is 73.24, indicating a moderate level of ESG performance among Chinese listed firms. Among the three pillars, Governance (GOV) exhibits the highest average score (78.06), whereas the Environmental (ENV) dimension records the lowest (62.09). This divergence suggests that governance structures are relatively well-established, while environmental initiatives remain comparatively underdeveloped in the sample [23,24].

With respect to firm performance, ROA yields a mean of 4.95 with a standard deviation of 7.31. Although extreme values are trimmed, the remaining dispersion reflects substantial heterogeneity in profitability across firms [61,62]. Similarly, firm growth (Growth) displays a wide interquartile range, highlighting divergent expansion trajectories within the Chinese market.

The innovation variables exhibit distinct distribution patterns. R&D intensity is relatively concentrated (Mean = 18.44, SD = 1.49), whereas patent output (Patent) demonstrates greater variability (Mean = 4.64, SD = 1.55). This contrast captures the varying efficiency of firms in transforming R&D inputs into codified knowledge assets [63,64]. Finally, ownership concentration remains high, with the top ten shareholders holding an average of 54.53% of shares, underscoring the highly concentrated ownership structure characteristic of Chinese listed firms.

5.2. Heterogeneous Effects of ESG Dimensions on Financial Performance

Table 3 presents the System GMM estimates of the relationship between ESG performance and ROA. The coefficient on lagged overall ESG performance is positive and statistically significant (1.013, $p < 0.01$), implying an approximate 5.3 percentage point increase in ROA per one-standard-deviation rise in ESG. While this magnitude appears economically sizable relative to the sample mean ROA of 4.95%, it should be interpreted strictly as a directional reference rather than a basis for causal inference, indicating that stronger historical ESG performance is positively associated with higher subsequent financial performance, supporting H1.

Table 3. System GMM results: ESG performance and ROA.

Variable	Model 1	Model 2	Model 3	Model 4
ROA_lag1	0.053 * (0.002)	0.053 * (0.003)	0.053 * (0.002)	0.037 (0.029)
ESG_lag1	1.013 *** (0.000)	-	-	-
ENV_lag1	-	-0.163 (0.185)	-	-
SOC_lag1	-	-	0.024 (0.868)	-
GOV_lag1	-	-	-	0.835 *** (0.000)
Lev_lag1	0.051 *** (0.000)	0.001 (0.876)	0.000 (0.971)	0.097 *** (0.000)
Growth_lag1	0.002 ** (0.013)	0.001 (0.189)	0.001 ** (0.034)	0.001 (0.138)
Size_lag1	-1.447 *** (0.000)	0.206 (0.334)	-0.082 (0.751)	-1.194 *** (0.000)
Cash_lag1	0.011 * (0.199)	0.012 * (0.086)	0.013 * (0.066)	0.001 (0.942)
Top10_lag1	0.012 * (0.097)	0.016 ** (0.016)	0.018 ** (0.013)	0.003 (0.676)
Constant	-39.879 *** (0.000)	8.908 (0.627)	3.353 (0.601)	-37.419 ** (0.034)
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
N	13,296	13,296	13,296	13,296
AR(1) p -value	0.000	0.000	0.000	0.000

Variable	Model 1	Model 2	Model 3	Model 4
AR(2) <i>p</i> -value	0.000	0.016	0.023	0.000
Hansen <i>p</i> -value	0.317	0.000	0.000	0.005
Wald chi2	1838.40 ***	2523.86 ***	2685.32 ***	1875.77 ***

Note: *p*-values are in parentheses. ***, **, and * indicate significance at 1%, 5%, and 10%, respectively.

The dimensional analysis reveals notable heterogeneity. Governance performance exhibits a strong positive association with ROA (0.835, $p < 0.01$), supporting H1c. In contrast, environmental and social performance show no statistically significant association. These patterns suggest that the observed financial linkage is driven primarily by governance quality, aligning with the theoretical expectation that governance mechanisms enhance managerial discipline, disclosure quality, and investor confidence.

We interpret these results with caution regarding causal identification. While the aggregate ESG model satisfies the Hansen test of instrument validity ($p = 0.317$), the dimensional models fail this diagnostic (e.g., $p = 0.000$ for ENV and SOC). Furthermore, the AR(2) statistic is significant in most specifications, suggesting potential serial correlation in the error term. Consequently, although Table 3 identifies economically meaningful associations, it cannot establish definitive causal effects. As noted in Section 4.3, the GMM estimates are presented strictly to illustrate directional relationships, while formal inference on the mediation hypothesis (H3) relies exclusively on a non-parametric Bootstrap procedure that does not depend on these potentially biased coefficients.

5.3. ESG Performance and Innovation

Table 4 summarizes the innovation results. Overall ESG performance is positively associated with both R&D investment and patent output. The effect is substantially stronger for patents than for R&D input, indicating that ESG is not only associated with greater innovation spending but also with more visible innovation output. The coefficient of ESG on patents is 0.9956 and is significant at the 1 percent level. The complete set of estimation results is presented in Appendix A.

Table 4. Summary of ESG effects on innovation.

ESG Dimension	Innovation Measure	Coefficient	Significance	Conclusion
Overall ESG	R&D	0.004 ***	$p < 0.01$	Supported
Overall ESG	Patent	0.996 ***	$p < 0.01$	Supported
Environmental	Patent	0.507 **	$p < 0.05$	Partially supported
Social	Patent	0.446 ***	$p < 0.01$	Partially supported
Governance	R&D	0.003 ***	$p < 0.01$	Supported
Governance	Patent	0.388 ***	$p < 0.01$	Supported

Notes: *** and ** indicate significance at 1% and 5%, respectively.

The dimensional results are theoretically informative. Environmental and social performance are significant for patent output but not consistently for R&D input, suggesting that these dimensions may improve the productivity and direction of innovation rather than simply increasing innovation expenditure. Governance is significant for both R&D and patents, consistent with the view that governance quality supports resource commitment and the commercialization of innovation.

These results support H2, H2a, and H2b, but they also show that the ESG–innovation relationship is not uniform across dimensions or innovation measures. Patent output appears to be the central innovation channel.

5.4. Mediation Analysis

Although Table 5 presents the System GMM estimates for the full mediation model, the diagnostic tests (Hansen $p = 0.000$; AR(2) significant) indicate that the instruments are invalid. Consequently, these coefficients are interpreted strictly as directional associations and are excluded from formal hypothesis testing. They serve only to satisfy the correlational prerequisites for mediation analysis. While the Bootstrap procedure provides robust inference on the significance of indirect effects, it does not resolve potential endogeneity concerns.

Table 5. System GMM Estimates of the Full Mediation Model.

Variable	ROA (R&D)	ROA (R&D)	ROA (R&D)	ROA (R&D)	ROA (Patent)	ROA (Patent)	ROA (Patent)	ROA (Patent)
ROA_lag1	0.265 *** (0.000)	0.262 *** (0.000)	0.264 *** (0.000)	0.260 *** (0.000)	0.263 *** (0.000)	0.260 *** (0.000)	0.262 *** (0.000)	0.258 *** (0.000)
ESG_lag1	0.085 *** (0.000)	—	—	—	0.087 *** (0.000)	—	—	—
ENV_lag1	—	0.028 ** (0.010)	—	—	—	0.028 ** (0.010)	—	—
SOC_lag1	—	—	0.014 (0.206)	—	—	—	0.015 (0.153)	—
GOV_lag1	—	—	—	0.075 *** (0.000)	—	—	—	0.074 *** (0.000)
R&D_lag1	0.443 *** (0.000)	0.455 *** (0.000)	0.459 *** (0.000)	0.467 *** (0.000)	—	—	—	—
Patent_lag1	—	—	—	—	0.127 * (0.083)	0.154 ** (0.040)	0.164 ** (0.027)	0.154 ** (0.035)
Size_lag1	−0.513 *** (0.002)	−0.433 *** (0.009)	−0.415 ** (0.012)	−0.523 *** (0.002)	−0.1839 (0.174)	−0.099 (0.460)	−0.083 (0.534)	−0.177 (0.192)
Growth_lag1	−0.000 (0.987)	−0.000 (0.981)	−0.000 (0.955)	0.000 (0.983)	0.000 (0.971)	0.000 (0.969)	0.0000 (0.994)	0.000 (0.933)
Lev_lag1	−0.006 (0.608)	−0.011 (0.335)	−0.010 (0.352)	−0.001 (0.911)	−0.008 (0.453)	−0.013 (0.222)	−0.013 (0.236)	−0.004 (0.706)
Cash_lag1	0.027 ** (0.011)	0.028 *** (0.008)	0.028 *** (0.009)	0.027 ** (0.013)	0.029 *** (0.006)	0.030 *** (0.004)	0.030 *** (0.005)	0.029 *** (0.007)
Top10_lag1	0.063 *** (0.000)	0.064 *** (0.000)	0.064 *** (0.000)	0.062 *** (0.000)	0.060 *** (0.000)	0.061 *** (0.000)	0.060 *** (0.000)	0.059 *** (0.000)
N	13,294	13,294	13,294	13,294	13,294	13,294	13,294	13,294
AR(1) p -value	0	0	0	0	0	0	0	0
AR(2) p -value	0.035	0.03	0.03	0.04	0.035	0.03	0.03	0.039
Hansen p -value	0	0	0	0	0	0	0	0
Wald χ^2 (p -value)	3205.31 *** (0.000)	3084.55 *** (0.000)	3111.10 *** (0.000)	3170.21 *** (0.000)	3119.52 *** (0.000)	2990.69 *** (0.000)	3024.04 *** (0.000)	3077.35 *** (0.000)

Note: p -values are in parentheses. ***, **, and * indicate significance at 1%, 5%, and 10%, respectively.

Table 6 provides an illustrative decomposition of the total effects based on the GMM estimates. Although the magnitudes (e.g., the ESG–Patent pathway) are not causally interpretable due to the diagnostic weaknesses noted earlier, the directional patterns are theoretically informative. It is important to note that the coefficient magnitudes in Table 6 differ from those in Table 7. Specifically, the total effect of 1.013 in Table 6 is adopted directly from the System GMM estimates in Table 3 (unstandardized), whereas the total effect of 0.123 in Table 7 is a standardized beta coefficient.

Table 6. Three-step mediation decomposition.

Transmission Path	Total Effect	X -> M	M -> Y	Direct Effect	Indirect Effect	Type
ESG -> R&D -> ROA	1.013 ***	0.0037 ***	0.4430 ***	0.0853 ***	0.00162	Partial mediation
ENV -> R&D -> ROA	−0.163	0.0000208 *	0.4554 ***	0.0279 **	0.00001	No mediation
SOC -> R&D -> ROA	0.024	0.0008437	0.4591 ***	0.0137	0.00039	No mediation
GOV -> R&D -> ROA	0.835 ***	0.00302 ***	0.4672 ***	0.0749 ***	0.00141	Partial mediation
ESG -> Patent -> ROA	1.013 ***	0.9956 ***	0.1274 *	0.0873 ***	0.1268	Partial mediation
ENV -> Patent -> ROA	−0.163	0.5066 ***	0.1535 **	0.0279 **	0.0778	Suppression effect
SOC -> Patent -> ROA	0.024	0.4462 ***	0.1638 **	0.0155	0.0731	Indirect channel
GOV -> Patent -> ROA	0.835 ***	0.3882 ***	0.1541 **	0.0741 ***	0.0598	Partial mediation

Notes: ***, **, and * indicate significance at 1%, 5%, and 10%, respectively. The formal robustness of indirect effects is evaluated using Bootstrap tests.

Table 7. Bootstrap robustness tests of mediation effects.

Variable	Mediator	Effect	Coefficient	95% CI	Robustness
ESG	R&D	Indirect	0.0051727 *	[−0.0000292, 0.0103745]	Marginally robust
ESG	R&D	Direct	0.1180035 ***	[0.0745961, 0.161411]	Highly robust
ESG	R&D	Total	0.1231762 ***	[0.0797994, 0.166553]	Highly robust
ENV	R&D	Indirect	0.0025039 **	[0.0001618, 0.0048459]	Highly robust
SOC	R&D	Indirect	0.0030434 **	[0.0000968, 0.005990]	Highly robust
GOV	R&D	Indirect	0.0013485	[−0.0003226, 0.0030195]	Not robust
ESG	Patent	Total	0.117 ***	[0.056, 0.178]	Highly robust
ENV	Patent	Indirect	0.028 ***	[0.009, 0.047]	Highly robust
ENV	Patent	Direct	−0.015	[−0.039, 0.009]	Not robust
SOC	Patent	Indirect	0.042 ***	[0.023, 0.061]	Highly robust
SOC	Patent	Total	0.045 ***	[0.018, 0.072]	Highly robust
GOV	Patent	Indirect	0.031 **	[0.006, 0.056]	Highly robust
GOV	Patent	Direct	0.059 ***	[0.020, 0.098]	Highly robust
GOV	Patent	Total	0.090 ***	[0.039, 0.141]	Highly robust

Notes: Bootstrap tests use 2000 replications. ***, **, and * indicate significance at 1%, 5%, and 10%, respectively.

Table 6 reports unstandardized GMM coefficients, whereas Table 7 reports standardized Bootstrap effects. The decomposition suggests that patent output, representing codified knowledge, carries a larger share of the transmission compared to R&D input. Governance appears to create value through both direct channels and innovation commercialization, whereas environmental and social dimensions appear to lack robust direct financial payoffs, operating primarily through these indirect innovation pathways.

Table 7 provides the primary evidence for the mediation hypothesis using a non-parametric Bootstrap procedure, which does not rely on the potentially invalid instruments of the GMM model. The results confirm that patent output is a robust and universal mediator across all ESG dimensions. Specifically, the indirect effects of ESG (0.028), SOC (0.042), and GOV (0.031) through patents are statistically significant, with 95% confidence intervals that exclude zero. In contrast, the R&D pathway is highly conditional. While the overall ESG → R&D → ROA pathway is only marginally robust, the governance-R&D indirect effect fails to reach significance in the Bootstrap analysis. Given the failure of the GMM diagnostics, we formally conclude that H3b is strongly supported, while H3a receives only partial and conditional support. These findings demonstrate that patents constitute the dominant transmission mechanism.

5.5. Robustness Checks and Ownership Heterogeneity

Several robustness checks support the main conclusions. First, alternative performance measures were examined, including Return on Equity (ROE). Second, Driscoll-Kraay (DK) standard errors were used in pooled OLS models to address cross-sectional dependence, serial correlation, and heteroskedasticity [65]. ESG data were obtained from the Hua Zheng ESG rating database [66]. The use of third-party ESG ratings follows common practice in ESG research, although limitations related to rating methodology and disclosure quality are acknowledged [25]. This reinforces the conclusion that governance is the most direct financial channel [61,67]. Third, to ensure robustness, we employ alternative innovation measures, specifically R&D intensity (R&D/Sales) and invention patent applications [62,63]. Appendix B reports the detailed estimation results using these proxies. Fourth, subgroup analyses by ownership type were performed.

The DK results provide a complementary static perspective. Consistent with the dynamic GMM findings, overall ESG and governance remain positively associated with ROA, whereas environmental and social dimensions exhibit weaker direct effects. This reinforces the conclusion that governance is the most direct financial channel [61,67]. Regarding innovation, alternative specifications confirm the positive ESG–innovation linkage. Although patent data are often over-dispersed and zero-inflated, the Bootstrap results demonstrate that the patent-mediated pathway remains highly robust across all ESG dimensions.

Ownership heterogeneity analysis reveals systematic differences between state-owned enterprises (SOEs) and private enterprises. As summarized in Table 8, the ESG–innovation link is statistically significant in both ownership types; however, the economic magnitudes and diagnostic profiles differ meaningfully.

For private enterprises, the System GMM diagnostic tests are robust, with AR(2) *p*-values ranging from 0.792 to 0.838 and Hansen *p*-values between 0.902 and 0.921. Overall ESG performance increases patent output by 0.062 ($p < 0.001$) and R&D input by 0.035 ($p < 0.001$).

For SOEs, the diagnostic tests are similarly robust (AR(2): 0.165–0.743; Hansen: 0.261–0.890). The coefficients indicate that ESG increases patent output by 0.056 ($p < 0.001$) and R&D input by 0.031 ($p < 0.001$). Notably, the ESG–ROA relationship appears stronger in SOEs (ESG: 0.351, $p < 0.1$) than in private enterprises (ESG: 0.171, $p < 0.1$), whereas the ESG–innovation effects are slightly larger in private firms.

These patterns suggest that institutional context moderates ESG value creation. SOEs, which are more directly aligned with policy mandates and national green development objectives, tend to pursue ESG-driven innovation as a strategic compliance behavior. In contrast, private enterprises, operating under stronger market competition and tighter financing constraints, appear to leverage ESG more instrumentally, aiming to build organizational legitimacy, ease external financing constraints, and enhance innovation efficiency. Table 8 illustrates these ownership-specific pathways.

Table 8. Ownership Heterogeneity.

Outcome	SOE	Private
ESG → ROA		
ESG	0.351 * (0.081)	0.171 * (0.080)
GOV	0.224 * (0.051)	0.148 * (0.059)
ESG → Patent		
ESG	0.056 *** (0.000)	0.062 *** (0.000)
ENV	0.043 *** (0.000)	0.038 *** (0.000)
SOC	0.031 *** (0.000)	0.045 *** (0.000)
GOV	0.029 *** (0.000)	0.032 *** (0.000)
ESG → R&D		

ESG	0.031 *** (0.001)	0.035 *** (0.001)
ENV	0.014 *** (0.002)	0.012 *** (0.002)
SOC	0.018 *** (0.003)	0.025 *** (0.003)
GOV	0.019 *** (0.003)	0.021 *** (0.003)
AR(2) <i>p</i> -value	0.165–0.743	0.792–0.838
Hansen <i>p</i> -value	0.261–0.890	0.902–0.935

Note: *p*-values are in parentheses. *** and * indicate significance at 1% and 10%, respectively.

5.6. Summary of Hypothesis Testing

Table 9 provides a systematic summary of our main findings, offering a clear synthesis of the empirical evidence presented in the previous sections. It delineates the validation status of each proposition, explicitly indicating whether Hypotheses H1, H2, and H3—along with their sub-hypotheses—are supported or rejected based on the estimation results.

Table 9. Inventory of hypothesis testing results..

Hypothesis	Proposition	Conclusion	Core Evidence
H1	ESG performance is positively associated with ROA	Supported	ESG_lag1 = 1.013, $p < 0.01$
H1a	Environmental performance is positively associated with ROA	Not supported	ENV_lag1 = −0.163, $p > 0.1$
H1b	Social performance is positively associated with ROA	Not supported	SOC_lag1 = 0.024, $p > 0.1$
H1c	Governance performance is positively associated with ROA	Strongly supported	GOV_lag1 = 0.835, $p < 0.01$
H2	ESG performance is positively associated with innovation	Supported	Significant for R&D and Patent
H2a	ESG performance is positively associated with innovation input, measured by R&D investment	Partially supported	Overall ESG (0.004, $p < 0.001$) and Governance (0.003, $p < 0.001$) significant; Environmental and Social dimensions not statistically significant
H2b	ESG performance is positively associated with innovation output, measured by Patent	Supported	Overall ESG (0.996, $p < 0.001$), Environmental (0.507, $p < 0.05$), Social (0.446, $p < 0.001$), and Governance (0.388, $p < 0.001$) all significant
H3	Innovation mediates the ESG-ROA link	Partially and robustly supported	Bootstrap confirms heterogeneous indirect effects
H3a	R&D mediates ESG-ROA	Partially supported	Significant for E and S dimensions; weaker for overall ESG and G
H3b	Patent mediates ESG-ROA	Strongly supported	Significant for overall ESG and all ESG dimensions

6. Discussion

The results provide several important insights into the ESG-performance relationship in emerging markets. First, the findings show that ESG performance is positively associated with financial performance, but the direct effect is driven mainly by governance. This aligns with agency theory and corporate governance literature, which emphasize the importance of monitoring, transparency, and managerial discipline for firm performance [38–41]. In the Chinese context, where ownership structures are concentrated and state involvement remains important, governance quality may be especially financially material.

Second, the lack of direct effects for environmental and social performance does not imply that these dimensions are irrelevant. Rather, their value appears to be indirect and

innovation-based. Environmental practices may encourage firms to develop cleaner processes and products, while social practices may strengthen employee commitment, stakeholder collaboration, and organizational learning. These benefits may not immediately appear in ROA but may be visible through patent output and longer-term competitiveness.

Third, innovation is a key mechanism. The dominance of the patent pathway is one of the central findings. R&D investment captures resource allocation, but patents capture codified output. Patents may be protected, licensed, commercialized, or used to strengthen competitive positioning. This explains why patents mediate the ESG-performance relationship more robustly than R&D expenditure.

Fourth, the findings refine the Porter Hypothesis in the Chinese ESG context. Environmental performance does not directly increase ROA, but it contributes to patent-mediated value creation. This suggests that environmental responsibility may create value when it stimulates compensatory innovation rather than when it is considered only as a compliance cost.

Fifth, the ownership results show that ESG value creation is institutionally embedded. SOEs and private enterprises face different incentives. SOEs may pursue ESG partly because of policy mandates, while private firms may use ESG to improve legitimacy and obtain market resources. Therefore, ESG strategies should not be evaluated without considering ownership context [64]. Methodologically, the study highlights the importance of robust mediation testing. Some GMM specifications face instrument validity concerns, particularly in models involving patents, and potential common-method concerns should also be considered when interpreting ESG-related organizational data. Instead of ignoring these concerns, the analysis relies exclusively on non-parametric Bootstrap procedures for inference on indirect effects. While this approach provides robust statistical evidence for mediation, it does not fully resolve potential endogeneity arising from omitted variables or reverse causality. Nevertheless, the consistency of the patent pathway across specifications strengthens confidence in its role as a mediating channel.

7. Contributions and Implications

7.1. Theoretical Contributions

This study contributes to the literature in three ways. First, it advances ESG research by shifting the focus from whether ESG affects financial performance to how ESG creates value. The results show that innovation, especially patent output, is a key mechanism.

Second, the study decomposes ESG into environmental, social, and governance dimensions. This reveals that governance has the strongest direct effect on ROA, while environmental and social dimensions operate mainly through innovation. Treating ESG as a single index would obscure these differences.

Third, the study contributes to emerging market ESG research. The Chinese institutional context differs from developed markets because ESG adoption is shaped by policy, ownership structures, evolving disclosure standards, and broader institutional legitimacy pressures [64,68]. Firms may adopt ESG practices not only for efficiency but also to conform to institutional expectations and gain legitimacy [69]. The findings therefore extend stakeholder and agency theories to a state-led sustainability transition context.

7.2. Practical Implications

For managers, the findings imply that ESG should be integrated into innovation strategy rather than treated only as compliance reporting. Governance improvements can provide direct financial benefits, while environmental and social practices should be connected to product development, process innovation, and patent strategy.

For investors, the results suggest that ESG analysis should be granular. A high composite ESG score is informative, but governance quality and patent output are especially important for assessing financial materiality in the Chinese market.

For policymakers, the results support policies that connect ESG regulation with innovation incentives. Disclosure requirements alone may not generate performance benefits unless firms are encouraged to translate ESG commitments into technological upgrading. Green finance, R&D subsidies, carbon-market mechanisms, and intellectual property protection can support this transformation.

8. Limitations and Future Research

Several limitations should be acknowledged. First, ESG ratings may contain measurement error because disclosure standards and rating methodologies differ across providers. The absence of a fully unified ESG disclosure framework in China may create noise in ESG measurement.

Second, innovation is measured through R&D investment and patents. These measures capture formal and codified innovation but may not capture process improvements, trade secrets, managerial innovation, or informal technological learning.

Third, although System GMM and Bootstrap testing reduce endogeneity concerns, causal identification remains challenging in observational ESG research. Time-varying omitted variables such as managerial quality, strategic change, or market opportunities may still influence ESG, innovation, and performance.

Fourth, the sample is limited to Chinese A-share listed non-financial firms. The findings may not fully generalize to SMEs, private unlisted firms, financial institutions, or developed markets.

Future research could compare Chinese firms with firms in other emerging economies, examine nonlinear ESG effects, study industry-specific mechanisms, or distinguish green patents from general patents. Future work could also examine digital transformation, human capital development, and supply-chain resilience as additional mediating mechanisms [70].

9. Conclusions

This study investigates the relationship between ESG performance, corporate innovation, and financial performance among Chinese A-share listed companies from 2015 to 2023. The findings show that overall ESG performance is directionally associated with ROA, but the direct effect is primarily driven by the governance dimension. Environmental and social dimensions do not show robust direct effects on ROA in the core models.

ESG performance significantly promotes corporate innovation, particularly patent output. Bootstrap mediation tests confirm that patent output is a robust and universal mediating channel linking ESG to financial performance. R&D input plays a more conditional role. These results demonstrate that ESG creates value not simply through disclosure or reputation, but through innovation capability and the conversion of sustainability-related resources into defensible knowledge assets.

The study therefore concludes that ESG strategies in emerging markets should be evaluated not only by their direct financial effects but also by their capacity to generate innovation. Firms, investors, and policymakers should pay special attention to the ESG–innovation–performance chain, especially the role of patents as a bridge between sustainability engagement and financial value.

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Conflicts of Interest: The authors declare no conflicts of interest.

Abbreviations

ESG	Environmental, Social, and Governance
GMM	Generalized Method of Moments
ST/*ST	Special Treatment and *Special Treatment

Appendix A

Table A1. ESG and Corporate Innovation—R&D & Patent Results.

Indicator	R&D (5)	R&D (6)	R&D (7)	R&D (8)	Patent (5)	Patent (6)	Patent (7)	Patent (8)
ESG_lag1	0.00366 *** (0.001)	-	-	-	0.9956 *** (0.001)	-	-	-
ENV_lag1	-	0.0000208 (0.973)	-	-	-	0.5066 ** (0.038)	-	-
SOC_lag1	-	-	0.0008437 (0.213)	-	-	-	0.4462 *** (0.001)	-
GOV_lag1	-	-	-	0.0030216 *** (0.000)	-	-	-	0.3882 *** (0.007)
Lev_lag1	0.0000971 (0.782)	-0.0000886 (0.806)	-0.0000945 (0.794)	0.0002670 (0.459)	0.1370 (0.088)	0.0759 (0.333)	0.0849 (0.279)	0.1296 (0.103)
Growth_lag1	0.0001675 ** (0.035)	0.0001586 ** (0.042)	0.0001631 ** (0.037)	0.0001612 ** (0.039)	0.0019 (0.794)	0.0021 (0.768)	0.0009 (0.894)	0.0007 (0.924)
Size_lag1	0.1053432 *** (0.002)	0.1086162 *** (0.001)	0.1114014 *** (0.001)	0.1040864 *** (0.002)	2.2315 (0.517)	2.7567 (0.425)	3.1870 (0.381)	3.0619 (0.388)
Cash_lag1	-0.0001046 (0.847)	0.0000029 (0.996)	0.000022 (0.967)	-0.0001970 (0.717)	-0.0057 (0.962)	0.0228 (0.850)	0.0236 (0.844)	-0.0015 (0.990)
Top10_lag1	0.0008408 ** (0.034)	0.0008453 ** (0.032)	0.0008309 ** (0.038)	0.0008429 ** (0.033)	0.0207 (0.913)	0.0156 (0.934)	0.0164 (0.931)	0.0197 (0.917)
_cons	-0.5688 *** (0.004)	-0.4293 ** (0.016)	-0.4775 ** (0.014)	-0.5625 *** (0.002)	-129.9321 (0.156)	-101.8461 (0.240)	-110.8891 (0.197)	-109.2290 (0.219)
Year FE	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled
Industry FE	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled
N	11,634	11,634	11,634	11,634	11,634	11,634	11,634	11,634
AR(1) <i>p</i> -value	0.021	0.021	0.021	0.021	0.054	0.054	0.054	0.053
AR(2) <i>p</i> -value	0.362	0.349	0.354	0.361	0.157	0.157	0.157	0.157

Hansen p -value	0.094	0.089	0.094	0.080	0.038	0.031	0.035	0.036
Wald χ^2	1.42×10^7	1.53×10^7 ***	1.38×10^7 ***	1.36×10^7 ***	98,225.51 ***	100,719.98	95,958.84 ***	96,523.18 ***
(p -value)	*** (0.000)	(0.000)	(0.000)	(0.000)	(0.000)	*** (0.000)	(0.000)	(0.000)

Note: p -values are in parentheses. *** and ** indicate significance at 1% and 5%, respectively.

Appendix B

We replace R&D investment (log form) with R&D intensity (R&D/Sales) to mitigate size effects, and total granted patents with invention patent applications to capture high-quality innovation. Table A2 presents the System GMM estimates. The results confirm that ESG continues to drive both R&D intensity and invention patent output, supporting the main conclusions.

Table A2. Alternative Measures of Innovation: R&D Intensity and Invention Patents.

Variable	R&D_Sales (5)	R&D_Sales (6)	R&D_Sales (7)	R&D_Sales (8)	Patent-In-vention (5)	Patent-In-vention (6)	Patent-In-vention (7)	Patent-In-vention (8)
ESG_lag1	0.036 *** (0.001)	-	-	-	6.064 ** (0.042)	-	-	-
ENV_lag1	-	0.004 (0.575)	-	-	-	-1.404 (0.734)	-	-
SOC_lag1	-	-	0.025 *** (0.000)	-	-	-	-5.102 (0.373)	-
GOV_lag1	-	-	-	0.015 ** (0.020)	-	-	-	9.331 (0.204)
Size_lag1	-0.009 ** (0.031)	-0.012 *** (0.003)	-0.011 *** (0.008)	-0.010 ** (0.017)	-1.171 (0.653)	-1.669 (0.509)	-2.285 (0.327)	-0.346 (0.810)
Growth_lag1	0.000 (0.549)	0.000 (0.653)	0.000 (0.589)	0.000 (0.668)	0.058 (0.726)	0.028 (0.857)	0.074 (0.497)	-0.017 (0.928)
Lev_lag1	0.148 *** (0.001)	0.257 *** (0.000)	0.181 *** (0.000)	0.213 *** (0.000)	-10.920 (0.139)	12.446 (0.529)	27.883 (0.337)	-25.300 (0.171)
Cash_lag1	0.029 *** (0.000)	0.030 *** (0.000)	0.030 *** (0.000)	0.030 *** (0.000)	0.410 (0.659)	0.686 (0.497)	0.709 (0.490)	0.075 (0.936)
Top10_lag1	-0.030 *** (0.000)	-0.030 *** (0.000)	-0.030 *** (0.000)	-0.030 *** (0.000)	5.439 (0.204)	5.675 (0.171)	5.831 (0.162)	5.806 (0.159)
_cons	2.0231 *** (0.000)	2.1018 *** (0.000)	2.0172 *** (0.000)	2.0057 *** (0.000)	-0.0376 (0.764)	-0.0422 (0.733)	-0.0535 (0.667)	-0.0346 (0.782)
N	12,070	12,070	12,070	12,070	12,070	12,070	12,070	12,070
Year FE	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled
Industry FE	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled
AR (1) p -value	0.077	0.074	0.072	0.076	0.636	0.542	0.561	0.598
AR (2) p -value	0.097	0.105	0.099	0.097	0.915	0.956	0.937	0.973
Hansen p -value	0.253220	0.260371	0.241766	0.258699	0.031053	0.029045	0.030234	0.031133
Wald χ^2 (p -value)	2624.848 *** (0.000)	2617.73 *** (0.000)	2615.17 *** (0.000)	2582.86 *** (0.000)	116.82 *** (0.000)	123.65 *** (0.000)	93.83 *** (0.000)	92.56 *** (0.000)

Notes: *** and ** are significant at the 1% and 5% levels, respectively. Robust p -statistics are reported in parentheses.

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