“Valuation implications of ESG initiatives and technological innovation: A comparative analysis of high-tech and low-tech industries”

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VALUATION IMPLICATIONS OF ESG INITIATIVES AND TECHNOLOGICAL INNOVATION: A COMPARATIVE ANALYSIS OF HIGH-TECH AND LOW-TECH INDUSTRIES[1]

Abstract

The growing emphasis on sustainability and continuous innovation has changed the way firms approach value creation and performance. As firms increasingly adopt ESG initiatives and invest in technological innovation, understanding how these strategies jointly affect financial outcomes across different industry contexts becomes essential. The purpose of this study is to explore the valuation implications of the interplay between ESG initiatives and technological innovation, specifically in terms of accounting, valuation, and growth metrics of corporate operations, with a focus on comparing high-technology and low-technology industries. Utilizing random effects generalized least squares (GLS) regression, this paper examines 4,000 high-technology and 4,739 low-technology firm-year observations from KOSPI and KOSDAQ listed firms in Korea from 2012 to 2022. The results show that while the influence of environmental, social, and governance factors on corporate performance, firm value, and growth show specific implications across the two industries, both ESG adoption (ROA: –0.0025; $p < 0.01$; TQ: –0.0298; $p < 0.05$; SGR: –0.0052; $p < 0.05$) and research and development investments (ROA: –0.0928; $p < 0.01$; SGR: –0.1192; $p < 0.01$) tend to manifest a costly impact on corporate operations. Nevertheless, when these two elements are pursued together, the negative impacts are mitigated, ultimately leading to improvements in corporate performance (ROA: 0.0453; $p < 0.01$; TQ: 0.8902; $p < 0.01$ for high-tech industries; SGR: 0.0920; $p < 0.10$ for low-tech industries). This study provides a comparative analysis of the impact of ESG and innovation on corporate metrics across high- and low-technology industries. The findings show that integrating ESG with technological innovation can promote sustainable corporate operations across varying levels of technological intensity.

Keywords environmental, social, governance, sustainability, research and development, profitability, firm value, growth

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INTRODUCTION

Balancing profit with purpose, the ESG movement urges firms to prioritize sustainability beyond traditional financial metrics (Boufounou et al., 2023), recognizing the broader societal and environmental impact of negative externalities (Dechow, 2023). ESG-focused investment strategies require shifts in business models, as rising expectations around energy, food, climate change, and related issues drive

1 This study constitutes the second component of the author's Ph.D. dissertation, entitled *"Three Accounting Essays on Industry-Level Analyses of the Valuation Implications of Environmental, Social, and Governance (ESG) Sustainability Initiatives,"* which was developed and completed under the close scholarly collaboration, expert mentorship, and direct supervision of Professor Hae-Young Byun, Professor of Accounting at Kangwon National University, South Korea. The version presented herein has been substantially abridged and refined from its original dissertation form for clarity and conciseness.

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corporate innovation (Seebode et al., 2012). Notably, sustainability was already projected as the longest wave of innovation from 2004 onward (Hargroves & Smith, 2005), highlighting its anticipated synergy with innovation.

Sustainable development requires radical, systemic innovations beyond incremental changes (Boons et al., 2013). Technological innovation supports new product development and enhances competitiveness (Huang & Lin, 2006; Doni & Fiameni, 2023). Firms are expected to innovate in ways that align with sustainability goals (Cillo et al., 2019), viewing ESG not as a constraint but as a driver of opportunity, innovation, and competitive advantage. Advancements in technology and ESG initiatives reduce stakeholder information asymmetries, aiding resource acquisition (Wang et al., 2025).

Understanding technological innovation requires distinguishing between high- and low-technology industries, as their technological intensity shapes ESG commitments and innovation strategies. High-tech industries, with greater resources, pursue diverse strategic opportunities, often investing heavily in research and development to drive sustainable growth (McCarthy et al., 1987; Chesbrough & Crowther, 2006). They emphasize innovation, product upgrades, and alternative energy to meet fast-changing market demands (Cui et al., 2019). In contrast, low-tech industries typically pursue incremental innovations (Iddris, 2019). Therefore, how ESG and innovation jointly influence corporate affairs across these two sectors, comparatively, remains an empirical question.

1. LITERATURE REVIEW AND HYPOTHESES

To contextualize the role of ESG and innovation across varying industry types, it is essential to first examine the existing literature on their individual and combined impacts on corporate performance. The primary theoretical foundation of this study is stakeholder theory, which views companies as part of interconnected networks involving stakeholders who affect or are affected by corporate actions. These include customers, employees, suppliers, creditors, and investors. The theory posits that managers should create value for both the firm and its stakeholders by aligning their interests (Freeman, 1984; Freeman et al., 2010). Long-term success, profitability, and survival depend on stakeholder approval and support, requiring management to balance and address their expectations (Herold, 2018; Horisch et al., 2020).

Firms that proactively address stakeholder ESG expectations are viewed as more responsible and gain a competitive edge over less responsive peers. Such proactivity signals a commitment to stakeholder demands, fostering trust and support (Nazir et al., 2024). The resulting reputation and credibility enhance access to financing, essential for R&D and sustained innovation (Lin et al., 2021). These efforts also build networks that facilitate knowledge exchange and innovation. By integrating diverse stakeholder perspectives with firm capabilities, companies can develop effective, innovative solutions (Luo & Du, 2015). Aligning ESG initiatives with stakeholder interests enhances innovation and performance, while ongoing engagement builds social capital, which is a key driver of competitive advantage (Cabaleiro-Cervino & Mendi, 2024).

Studies on sustainability link ESG strategies to firm value and performance, grounded in the "doing well by doing good" principle (Broadstock et al., 2020). ESG has become essential for all firms (Xu et al., 2021), as strong ESG practices are seen to enhance performance and reduce risk (Shaikh, 2022). The impact of ESG initiatives on firm performance and value is widely studied but remains inconclusive. Some studies report positive effects (Li et al., 2018; Aydoğmuş et al., 2022; Tahmid et al., 2022), while others find negative (Byun, 2018) or non-linear, inverted U-shaped relationships (Pu, 2023). Environmental and social efforts may negatively impact performance, whereas governance tends to have a positive effect (Shaikh, 2022; Nazir et al., 2024). Investors often view environmental and social initiatives as burdens rather than value-enhancing (Nazir et al., 2022).

Technological innovation plays a vital role in creating new products and securing competitive advantage (Huang & Lin, 2006; Doni & Fiameni, 2023),

especially in highly competitive markets (Hu et al., 2023). High-technology industries lead in innovation and product enhancements to meet evolving market demands (Cui et al., 2019), thereby demonstrating greater R&D intensity (Barros et al., 2023). Sustainability is a core concern for these firms (Law, 2010; Law & Gunasekaran, 2012), prompting the use of advanced, eco-friendly technologies to meet ESG criteria that can enhance reputation but potentially impact short-term performance. However, neglect of ESG efforts can bring regulatory and competitive risks, while ESG investment may reduce capital costs through shareholder support (Nazir et al., 2024). Given their R&D capabilities and resource advantages, high-tech industries are expected to prioritize both innovation and ESG more than low-tech industries.

Salzmann et al. (2005) highlight the complex relationship between operational performance and sustainable development, shaped by firm- and industry-specific factors. ESG performance, innovation, and sustainable management technologies are key to advancing sustainability and building sustainable communities (Barros et al., 2023; Chen et al., 2024). Technological advancements drive innovation, while ESG efforts reduce information asymmetry and support resource acquisition for progress (Wang et al., 2025).

Innovation supports ESG initiatives that enhance corporate performance. Broadstock et al. (2020) suggest ESG adoption indirectly drives value creation by fostering innovation, which improves operational outcomes. Kluza et al. (2021) found a moderately strong positive link between innovation and the ESG social dimension, highlighting its role in building sustainable business models. Chen et al. (2024) also emphasize that strong ESG performance boosts innovation by expanding resources and reducing agency problems. ESG initiatives help lower the sunk costs and financing constraints associated with high-risk R&D, making innovation more feasible.

It is seen that both ESG and innovation positively influence firm value, indicating that efficient ESG investment can enhance value without hindering innovation (Jung & Kim, 2022). In contrast, Coluccia et al. (2020) suggest a substitution effect, where R&D boosts firm value (via Tobin's Q), but ESG scores show no significant valuation impact.

Research on technology firms highlights the role of ESG and innovation in financial performance. Lawal et al. (2017) found that higher corporate social disclosure, particularly on employee and community initiatives, boosts financial performance in high-tech firms, with a slight positive correlation between social sustainability and financial outcomes. Innovation, measured by R&D intensity, also correlates positively with financial performance. Shaikh (2022) examined ESG, R&D, and firm performance across 17 countries, finding that firms with strong sustainability efforts outperform in profitability and market value. R&D intensity positively impacts firm valuation (Tobin's Q), while sustainability efforts reduce ROA and ROE, with environmental and social factors harming profitability, and governance enhancing efficiency and valuation.

A study found that in the global tech sector, ESG performance is positively linked to both cost of debt and equity, suggesting investors view ESG as a financial burden rather than a value-added factor (Nazir et al., 2022). Similarly, Nazir et al. (2024) found that ESG performance negatively affects financial sustainability in top global high-tech firms. Specifically, environmental and social factors harm financial sustainability, while governance positively impacts it. This implies that high-tech firms should focus more on governance to improve financial sustainability. Meanwhile, Barros et al. (2023) studied US-based high-tech firms and found that while these firms typically do not pay dividends and often have negative earnings and low cash flows, strong ESG scores are linked to a higher likelihood of stable dividend payments, improving shareholder returns. Although high R&D intensity can limit dividends, good ESG scores mitigate this effect, allowing firms to provide higher, more stable returns. This suggests that aligning R&D investment with ESG policies can enhance sustainability and shareholder value.

Research on ESG and innovation has focused mainly on high-tech firms due to their significant innovation investments. However, low-tech firms can also develop substantial innovation capabilities, despite requiring more effort (Hirsch-Kreinsen, 2008). These firms can succeed through sustained incremental innovations (Bay & Cil, 2016) and, as Iddris (2019) highlights, small low-

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tech firms can enhance innovation over time despite limited resources. Frugal innovation, which promotes resource-efficient practices, is particularly relevant in low-tech sectors, encouraging the adoption of energy-efficient technologies and the reuse of materials. This approach reduces waste, integrates human activities with the environment, and supports sustainable production systems (Tanguy et al., 2023).

Building on the insights from the literature, it is evident that both ESG initiatives and innovation play critical roles in shaping corporate performance. This study seeks to elucidate the valuation consequences arising from the dynamic interplay between ESG-oriented strategic initiatives and technological innovation, with a particular emphasis on their impact on profitability, valuation outcomes, and corporate growth trajectories, with a comparative analysis between high-technology and low-technology industry sectors.

The following hypotheses seek to address this by examining how ESG, innovation, and their combined efforts influence corporate affairs in these sectors.

H1: ESG initiatives significantly and positively affect the metrics of corporate affairs of firms in high-technology industries, compared to their low-technology counterparts.

H2: Innovation significantly and positively affects the metrics of corporate affairs of firms in high-technology industries, compared to their low-technology counterparts.

H3: When pursued together, ESG and innovation positively and synergistically affect the metrics of corporate affairs of firms in high-technology industries compared to their low-technology counterparts.

2. METHODOLOGY

This study adopts the following research model that will explore the main individual effects and the interplay of *ESG* and *RDI* on the different metrics of corporate affairs for firm *i* at year *t* on both high-technology and low-technology industries:

$$\begin{aligned} CA_{i,t} &= \alpha_{i,t} + \beta_1 ESG\left(E,S,G\right)_{i,t} + \beta_2 RDI_{i,t} \\ &+ \beta_3 ESG\left(E,S,G\right)\cdot RDI_{i,t} + \beta_4 LEV_{i,t} \\ &+ \beta_5 SIZE_{i,t} + \beta_6 ADV_{i,t} + \beta_7 LOSS_{i,t} \\ &+ \beta_8 FO_{i,t} + \beta_9 AGE_{i,t} + \beta_{10} OWNCON_{i,t} \\ &+ \beta_{11} CFO_{i,t} + \beta_{12} FIXED_{i,t} + \beta_{13} BETA_{i,t} \\ &+ \beta_{14} BIG4_{i,t} + \beta_{15} LIST_{i,t} + \delta_1 IDUM \\ &+ \delta_2 YDUM + \varepsilon_{i,t}. \end{aligned} \quad (1)$$

In the proposed model, the dependent variable, corporate affairs (*CA*), represents the accounting, valuation, and growth metrics of corporate affairs, namely Return on Assets (*ROA*), Tobin's Q (*TQ*), and, following Chen et al. (2021), the firm's Sustainable Growth Rate (*SGR*). The primary independent variables of interest in this study are the ESG ratings of Korean listed firms (*ESG*), coupled with a firm's level of technological innovation, proxied by the entity's research and development intensity (*RDI*).

Furthermore, this study integrates a range of control variables to account for various entity characteristics that can affect corporate operational performance. In line with Byun (2018), Rhee et al. (2021), Tang (2022), Kong et al. (2023), and Zhang et al. (2024), the control variables include leverage (*LEV*), size of the firm (*SIZE*), advertising expenditures (*ADV*), net loss indicator (*LOSS*), level of foreign ownership (*FO*), age of the firm from its establishment (*AGE*), level of ownership concentration (*OWNCON*), cash flows from operating activities (*CFO*), fixed assets intensity (*FIXED*), the firm's beta in line with the capital asset pricing model (*BETA*), an indicator of the firm's auditor (*BIG4*), and an indicator on whether the firm is listed in KOSPI or KOSDAQ (*LIST*). This study also accounts for industry-specific variations and temporal changes by the inclusion of dummies of industry categorization (IDUM) and year (YDUM). Each of the variables and their specific calculations are discussed in detail in the appendices.

ESG-related studies in Korea often use the ratings from the Korea Institute of Corporate Governance and Sustainability (KCGS), which has assessed corporate governance since 2003 and added environmental and social factors in 2011. KCGS assigns ratings on a seven-level scale: S, A+, A, B+,

B, C, and D. This study adopts the KCGS ratings as a measure of ESG sustainability, using a point system from Kim et al. (2022) and Kwon and Choi (2024), assigning 1 point for D (lowest) to 7 points for S (highest) across the overall ESG rating and individual dimensions. The details of the scoring levels and proxies used are presented in the appendices.

Research and development (R&D) intensity is commonly used as a proxy for innovation because it quantifies the proportion of resources allocated to the development of new processes, products, or technologies, thereby reflecting an organization's commitment to innovative activities. Following studies such as Falk (2012), Hatzikian (2015), Lawal et al. (2017), and Baek and Lee (2024), this paper utilizes research and development intensity, calculated as the ratio of R&D expenditures to sales, to proxy for firm-level innovation.

This study uses financial data from the Korean databases *TS2000* and *FNDataGuide*. Firms with non-December fiscal year ends and missing data for dependent and control variables were excluded. Banks, insurance companies, capital markets, and diversified financial services firms were also excluded due to their distinct characteristics. After applying these criteria, the final sample includes 8,739 firm-year observations. The summarized selection process and sample distributions by technological intensity, market listing, and year are provided in Table 1.

This study further divided the samples based on their technological intensity, depending on whether a firm belongs to a high-technology industry or a low-technology industry. As a primary basis, the study utilized the International Standard Industrial Classification (ISIC) developed by the Organization for Economic Cooperation and Development (OECD) Directorate for Science, Technology, and Industry (Czarnitzski & Thowarth, 2012; Buenechea-Elberdin et al., 2018; Shin & Kim, 2021; Yoon et al., 2023). The categorizations from the ISIC are divided into four (4) dimensions – high-technology, medium-high-technology, medium-low-technology, and low-

Table 1. Sample selection and other distributions

Panel A. Selection Process		
Total number of companies from KCGS company listing of ESG ratings	10,022	
Less: Banks, Insurance, Capital Markets, and Diversified Financial Services	(951)	
Less: Firms with fiscal years not ending in December	(221)	
Less: Firm-years with missing variables	(111)	
Final sample, firm-years	8,739	
Panel B. Summary of High-Technology and Low-Technology firms		
Firms in high-technology industries	(45.77%)	4,000
Firms in low-technology industries	(54.23%)	4,739
Final sample, firm-years	8,739	
Panel C. Market Listing		
Korea Composite Stock Price Index (KOSPI)	(81.73%)	7,142
Korean Securities Dealers Automated Quotations (KOSDAQ)	(18.27%)	1,597
Total sample, firm-years	8,739	
Panel D. Firm-Year Distribution		
2012	714	
2013	776	
2014	786	
2015	734	
2016	782	
2017	774	
2018	790	
2019	800	
2020	825	
2021	863	
2022	895	
Total sample, firm-years	8,739	

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technology industries. For simplicity, both the high-technology and medium-high-technology industries are categorized as a high-technology industry, while the medium-low-technology and low-technology industries are categorized as a low-technology industry to accommodate creation of a dichotomous indicator during the analysis. Following Lee et al. (2019), the ISIC categorizations are then matched with the Korean Standard Industrial Classification (KSIC), which divides industries based on large, medium, small, very small, and detailed industry categorization levels with respective industry codes. In this study, large and medium code levels were utilized for uniformity, and small code levels were utilized in cases where further analyses of the industry characteristics were needed. As the ISIC emphasizes the classification criteria pertinent to the manufacturing sector, this paper undertakes a detailed analysis of the categorization framework should the firm-year observation belong to a service industry. After applying all categorization criteria, there are exactly 4,000 firm-year observations which were regarded as firms in the high-technology industry (45.77% of the total sample), while there are 4,739 firm-year observations regarded as entities in the low-technology industry (54.23% of the total sample). The classification of technological intensities by industry is provided in the appendices.

All multivariate regression analyses in this study use a random effect generalized least squares (GLS) model, selected based on the Breusch and Pagan Lagrangian Multiplier Test (BP LM Test), which favored random effects over pooled OLS. Variance inflation factor (VIF) tests showed no multicollinearity concerns, with an average VIF of 1.35 (excluding dummies and interactions). Continuous and financial variables were winsorized at the top and bottom 1% to minimize effects of potential outliers.

3. RESULTS

Table 2 summarizes the descriptive statistics of the variables. The mean *ROA*, *TQ*, and *SGR* are 0.0181, 1.2738, and 0.0405, respectively, indicating modest profitability, positive market valuation relative to book value, and an average sustainable growth of 4.05%. The mean total ESG score is 2.8411, which is between "B" and "C," suggesting generally weak sustainability performance. Environmental, social, and governance scores also average between "B" and "C," with ESG ratings ranging from 1 ("D") to 6 ("A+"), showing high variability. Mean R&D intensity is 2.35% of sales, with some firms investing up to 80.15%. Control variables show averages of 45.62% debt ratio, 0.97% advertising

Table 2. Descriptive statistics

Variables	N	Mean	SD	Min	25%Q	Med	75%Q	Max
ROA	8,739	0.0181	0.0844	–0.4379	–0.0018	0.0254	0.0576	0.3264
TQ	8,739	1.2738	1.0530	0.3507	0.7693	0.9535	1.3331	11.1008
SGR	8,739	0.0405	0.1794	–1.1992	–0.0049	0.0516	0.1128	1.0498
ESG_Total	8,739	2.8411	0.9992	1.0000	2.0000	3.0000	3.0000	6.0000
E_Score	8,739	2.6008	1.2275	1.0000	2.0000	3.0000	3.0000	6.0000
S_Score	8,739	2.9963	1.1860	1.0000	2.0000	3.0000	4.0000	6.0000
G_Score	8,739	2.9748	0.9874	1.0000	2.0000	3.0000	4.0000	6.0000
RDI	8,739	0.0235	0.0627	0.0000	0.0000	0.0032	0.0196	0.8015
LEV	8,739	0.4562	0.2060	0.0550	0.2865	0.4602	0.6099	0.9925
SIZE	8,739	20.2053	1.5220	17.0927	19.1401	19.9879	20.9791	24.9424
ADV	8,739	0.0097	0.0211	0.0000	0.0001	0.0009	0.0081	0.1689
LOSS	8,739	0.2576	0.4373	0.0000	0.0000	0.0000	1.0000	1.0000
FO	8,739	0.0995	0.1242	0.0000	0.0164	0.0490	0.1355	0.6360
AGE	8,739	3.4456	0.6910	0.9821	3.0497	3.6728	3.9361	4.4937
OWNCON	8,739	0.4317	0.1646	0.0730	0.3094	0.4350	0.5446	0.8291
CFO	8,739	0.0463	0.0748	–0.2509	0.0082	0.0475	0.0872	0.2878
FIXED	8,739	0.5057	0.5792	0.0048	0.2128	0.3686	0.5990	6.7155
BETA	8,739	0.8416	0.4048	–0.2800	0.5500	0.8300	1.1300	1.9750
BIG4	8,739	0.6230	0.4847	0.0000	0.0000	1.0000	1.0000	1.0000
LIST	8,739	0.8173	0.3865	0.0000	1.0000	1.0000	1.0000	1.0000

Notes: (1) All financial variables are winsorized at 1% and 99% levels. (2) Full variable definitions are provided in Appendix B.

intensity, 9.95% foreign ownership, 43.17% ownership concentration, 4.63% operating cash flow to assets ratio, 50.57% fixed asset intensity, and a beta risk coefficient of 0.84. Additionally, 25.76% of the sample firms reported losses, and 62.30% were audited by Big 4 accounting firms[2].

To examine innovation without regard to industry classification, the sample was split into two groups based on the median R&D intensity (*RDI*). Table 3 presents t-test results comparing firms below and above the median RDI across dependent, independent, and control variables. Among the corporate affairs metrics, only Tobin's Q shows a significant difference. All independent variables differ significantly between groups, while most control variables do, except for net loss and fixed asset intensity. Firms with higher RDI exhibit greater firm valuation, stronger ESG ratings, lower debt, larger size, higher advertising costs and foreign ownership, newer establishment, less concentrated ownership, stronger operating cash flows, greater stock volatility, and better audit quality.

The Pearson correlation among the study variables reveals that overall ESG ratings and their individual components (environmental, social, and governance) show significant positive correlations with return on assets and sustainable growth rate, suggesting ESG efforts may enhance profitability and growth. However, ESG ratings, particularly environmental and social, are negatively correlated with Tobin's Q, implying that the market may view ESG initiatives as burdens rather than value-enhancing. Innovation, measured by R&D intensity, is positively correlated with firm valuation but negatively with profitability and growth, indicating that while innovation is valued by the market, it may come at a cost to short-term performance and sustained internal financing. These correlations, however, are preliminary and do not imply causality, as they do not control for other variables. The succeeding discussions presents the results of the regression analyses for deeper insight into these relationships.

With profitability as the dependent variable, proxied by return on assets, ESG initiatives, particularly environmental and social efforts, significantly reduce profitability for all firms (–0.0025; –0.0031; –0.0033; $p<0.01$). This negative effect persists across both high-technology and low-technology firms. This suggests that firms pursuing ESG commitments, particularly environmental and social sustainability undertakings, are more

Table 3. Univariate analysis

Variables	RDI Median Lower Group Means	RDI Median Upper Group Means	Difference	t-value		p-value
ROA	0.017	0.019	–0.002	–1.008		0.313
TQ	1.136	1.412	–0.276	–12.346	***	0.000
SGR	0.038	0.043	–0.005	–1.217		0.224
ESG_Total	2.729	2.954	–0.225	–10.589	***	0.000
E_Score	2.494	2.708	–0.214	–8.175	***	0.000
S_Score	2.848	3.145	–0.297	–11.800	***	0.000
G_Score	2.883	3.067	–0.184	–8.748	***	0.000
RDI	0.000	0.047	–0.046	–36.949	***	0.000
LEV	0.467	0.446	0.021	4.697	***	0.000
SIZE	20.011	20.399	–0.388	–12.005	***	0.000
ADV	0.008	0.012	–0.004	–9.571	***	0.000
LOSS	0.254	0.261	–0.007	–0.716		0.474
FO	0.078	0.121	–0.043	–16.545	***	0.000
AGE	3.520	3.371	0.150	10.176	***	0.000
OWNCON	0.455	0.408	0.048	13.631	***	0.000
CFO	0.043	0.050	–0.007	–4.138	***	0.000
FIXED	0.508	0.504	0.004	0.344		0.731
BETA	0.775	0.909	–0.134	–15.697	***	0.000
BIG4	0.607	0.639	–0.032	–3.105	***	0.002
LIST	0.872	0.762	0.110	13.455	***	0.000

Notes: (1) All financial variables are winsorized at 1% and 99% levels. (2) Full variable definitions are provided in Appendix B.

2 The Big 4 accounting firms in Korea include Samil PwC, Samjong KPMG, EY Hanyoung, and Deloitte Anjin.

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of a cost burden for firms that affect their profitability, contradicting Hypothesis 1 for ROA. Meanwhile, it was also revealed that R&D intensity also significantly reduces ROA for all firms (–0.0928; p<0.01), with negative effects in both high-technology (–0.0769; p<0.01) and low-technology (–0.1073; p<0.10) sectors. These results suggest that activities involving innovation detrimentally affect an entity's profitability and is a financial burden for both types of firms due to the costs of sustaining research and development, contradicting Hypothesis 2 for ROA. However, the interaction between ESG and innovation significantly offsets these negative effects. For all firms, combined ESG and innovation efforts improve profitability (0.0453; p<0.01), with significant positive interactions also observed for environmental (0.0341), social (0.0350), and governance (0.0325) dimensions. These interaction effects are stronger in low-technology firms (0.0789; 0.0850; 0.0685; 0.0698; p<0.01) than in high-technology firms (0.0274; p<0.10), suggesting that innovation enhances the value of ESG more meaningfully in industries where such initiatives exceed stakeholder expectations. In sum, while ESG and innovation independently burden profitability, their combined implementation mitigates this effect, especially in low-technology sectors, contradicting Hypothesis 3 for ROA.

Using Tobin's Q to represent firm valuation, it can be seen that ESG initiatives, particularly environmental ones, significantly reduce firm valuation for all firms (–0.0298; –0.0392; p<0.05). This negative effect is more pronounced in low-technology firms, where overall ESG, environmental, and social responsibility efforts are viewed by investors as burdens rather than value-adding initiatives, contradicting Hypothesis 1 for TQ. Meanwhile, there is no significant relationship between R&D intensity and firm valuation across all firms and subgroups, suggesting the market does not directly reward innovation efforts unless they lead to successful outcomes, contradicting Hypothesis 2 for TQ. Interestingly, the negative impact of ESG on valuation is mitigated when combined with innovation, especially in high-technology firms. Notably, interactions between innovation and governance (1.0239; p<0.01), social responsibility (0.5983; p<0.01), and overall ESG (0.8902; p<0.01) improve valuation. However, for low-technology firms, environmental initiatives combined with innovation have a synergistically negative effect on valuation (–1.0551; p<0.10), indicating market skepticism toward such efforts in these industries. In summary, innovation enhances the valuation impact of ESG, particularly in high-tech industries, supporting Hypothesis 3 for TQ.

In terms of sustainable growth, the analysis4 reveals that ESG initiatives significantly hinder firms to achieve sustainable growth opportunities (–0.0052; p<0.05), especially through environmental (–0.0040; p<0.05) and social (–0.0070; p<0.01) efforts. This effect is stronger in high-technology firms (–0.0082; p<0.05), where ESG appears to divert resources from growth. Social responsibility negatively affects both high- and low-technology industries (HT: –0.0062; p<0.05; LT: –0.0074; p<0.01), while corporate governance positively impacts SGR only in low-technology firms (0.0051; p<0.10). These findings contradict Hypothesis 1 for SGR. It can also be seen that R&D intensity significantly reduces SGR across all groups (overall: –0.1192; HT: –0.1085; LT: –0.1509), indicating that innovation investments strain internal resources and hinder sustainable self-financing, contradicting Hypothesis 2 for SGR. Meanwhile, there is no significant overall interaction between ESG and innovation for all firms. However, for low-technology firms, ESG-innovation interactions improve SGR (0.0920; p<0.10), especially environmental efforts with innovation (0.3611; p<0.01), indicating improved efficiency and internal financing. In contrast, for high-technology firms, ESG-innovation combinations further harm SGR (E: –0.0540; G: –0.0374; p<0.10), suggesting compounding financial burdens. In summary, ESG and innovation individually hinder sustainable growth, but their combination can promote growth in low-tech industries. These results contradict Hypothesis 3 for SGR.

Due to the size and complexity of the comparative regression analysis results, all corresponding tables have been included in the appendices for ease of reference and readability. These tables contain detailed outputs that are essential for transparency and replication but are too extensive to be presented within the main text. These tables are likewise made publicly available through an open-access repository (see Chua & Byun, 2025).

4. DISCUSSION

This study explores the impact of ESG initiatives and corporate innovation on key corporate metrics, examining how these dynamics influence profitability, valuation, and sustainable growth across high- and low-technology industries, thereby addressing a research gap and providing novel insights into ESG's effects on the underexplored literature on low-tech sectors. The findings suggest that ESG commitments negatively impact key corporate metrics, including short-term profitability, firm valuation, and sustainable growth. Resource allocation to ESG and sustainability efforts imposes financial strain, diminishing profitability and leading investors to view ESG as a deviation from core objectives. This diversion of resources also hampers a firm's ability to achieve financial self-sufficiency and sustainable growth.

ESG initiatives negatively affect short-term profitability, as measured by return on assets, particularly in environmental and social responsibility efforts, across both high- and low-technology industries. These initiatives impose costs that hinder profitability, irrespective of industry. Furthermore, ESG efforts are associated with reduced firm valuation, as investors view them as a financial burden rather than value-enhancing, aligning with Nazir et al. (2022). This effect is more pronounced in low-technology industries, where environmental and social initiatives are seen as cost burdens, conflicting with the cost-efficiency strategies these firms rely on. Regarding sustainable growth, ESG initiatives, especially in environmental and social areas, limit firms' internal financing and growth opportunities, with the impact more pronounced in high-tech industries. Social responsibility efforts also reduce internal funding leverage in both sectors. However, strong corporate governance notably enhances sustainable growth in low-tech industries, emphasizing the importance of effective management and resource optimization for stability and reduced reliance on external funding. Overall, the findings show that ESG initiatives, particularly in environmental and social aspects, detrimentally affect corporate performance metrics, in line with Byun (2018), Shaikh (2022), Nazir et al. (2022), and Nazir et al. (2024). Meanwhile, robust corporate governance can foster sustainable growth, particularly in low-technology industries, supporting findings by Shaikh (2022) and Nazir et al. (2024).

The study finds that innovation negatively impacts corporate operational metrics, including short-term profitability and sustainable growth, contrary to Lawal et al. (2017) and Shaikh (2022). R&D expenditures are viewed as a financial burden, reducing profitability and limiting internal funding utilization across both high- and low-technology sectors. However, innovation does not significantly affect firm valuation. High-tech firms are expected to innovate as a baseline, leading investors to view it as a standard rather than a value driver. In contrast, low-tech firms prioritize operational efficiency over breakthrough innovations, with innovations often being incremental rather than radical (Iddris, 2019).

Interestingly, the interplay between ESG and innovation mitigates the negative impact of ESG on corporate performance metrics. When firms pursue both ESG and innovation, the negative effect on profitability is buffered, highlighting the importance of innovation, in line with Broadstock et al. (2020), Kluza et al. (2021), Jung and Kim (2022), and Chen et al. (2024). This effect is more pronounced in low-tech industries, where innovation through energy-efficient technologies and resource repurposing can enhance competitive positioning (Tanguy et al., 2023). Innovation, even with limited resources, is valued by stakeholders in low-tech firms pursuing ESG (Iddris, 2019). In high-tech industries, innovation combined with ESG initiatives, particularly in social responsibility and governance, mitigates the financial burden of ESG on firm valuation, leading to positive investor perception and market value (Lawal et al., 2017; Barros et al., 2023). However, in low-tech industries, environmental and innovation efforts together negatively impact firm value, as they are seen as burdens. Regarding sustainable growth, ESG and innovation generally have no significant effect on growth opportunities, except in low-tech firms, where they enhance sustainability, operational efficiency, and internal financing, fostering sustainable growth.

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From all these narratives, we can understand that the dual, simultaneous commitment to ESG and innovation serves as a catalyst in long-term value creation by fostering a more resilient and adaptable business environment. It not only allows companies to mitigate the immediate financial drawbacks associated with ESG and innovation initiatives but also unlocks new potential opportunities that lead to improved financial performance, valuation, and sustained growth.

CONCLUSION

This study seeks to elucidate the valuation implications of the dynamic interplay between ESG strategic initiatives and technological innovation, with a particular emphasis on their impact on profitability, valuation outcomes, and corporate growth trajectories, with a comparative analysis between high-technology and low-technology industry sectors. The findings indicate that although environmental, social, and governance (ESG) factors exhibit distinct effects on corporate performance, firm value, and growth across high- and low-technology industries, both ESG adoption and research and development expenditures individually impose financial burdens on firms. However, when implemented concurrently, these elements demonstrate a complementary effect that offsets their standalone costs, ultimately enhancing firm performance across different industry contexts. This study underscores the growing importance of sustainability initiatives and innovation as drivers of competitive advantage and corporate performance. By comparing high- and low-technology industries, particularly the underexplored low-tech sector, it contributes to the ESG and innovation literature. Using three key corporate metrics, it offers a robust framework for assessing the impact of ESG and innovation on firm operations. This study emphasizes the need for tailored ESG and innovation strategies for high and low-tech industries, showing how these approaches impact financial performance, valuation, and growth. It suggests that sector-specific strategies are essential for effectively integrating ESG principles, driving technological advancements, and adding value for firms and stakeholders. By expanding stakeholder theory, the study highlights the importance of aligning ESG and innovation with industry-specific goals to meet both operational and sustainability objectives.

The findings provide valuable insights into integrating ESG into corporate strategy. While both ESG and innovation are crucial for sustainable development, firms must balance the potential trade-offs to avoid negative impacts on performance. These insights can help managers make informed decisions to optimize ESG and innovation initiatives, driving sustainability in both high and low-tech industries. This study provides valuable insights into the effects of ESG and innovation on corporate affairs in Korean listed firms, filling a gap in low-technology industries. Future research could explore diverse industry contexts outside Korea, considering varying regulatory, cultural, and economic environments. A qualitative study on investor perceptions of ESG and innovation could further contribute to the emerging literature of qualitative studies in accounting. Through providing an understanding of ESG, innovation, and financial outcomes, this study offers information to entities instrumental in balancing corporate success with sustainable development that fosters innovation in the years to come.

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APPENDIX A

Table A1. Classification of technological intensity of Korean listed firms

Industry Categorization	KSIC Code	Firm-years
Panel A. High-Technology Industries		
Aircrafts / Spacecrafts / Parts	313	22
Architectural, Engineering, and other Scientific Technical Services	72	78
Broadcasting Activities	60	63
Chemicals	20	797
Computer Programming, Consultancy, and Related Activities	62	92
Electrical Equipment	28	219
Electronics, Computer / Radio / Television, Communication Equipment	26	617
Information Service Activities	63	122
Motor Vehicles and Trailers	30	462
Other Machinery and Equipment	29	471
Other Professional, Scientific and Technical Services	73	6
Pharmaceuticals	21	631
Postal Activities and Telecommunications	61	60
Printing and Reproduction of Recorded Media	18	5
Publishing Activities (Books, E-Books, Game, and Software)	58	212
Research and Development	70	41
Watches / Medical / Precision / Optical Instruments	27	102
Total number of firm-years in the high-technology industry		**4,000**
Panel B. Low-Technology Industries		
Accommodation	55	22
Agriculture	1	6
Air Transport	51	46
Apparels / Accessories / Fur	14	158
Basic Metal Products	24	526
Business Support Services	75	63
Cokes / Briquettes / Refined Petroleum	19	55
Education	85	38
Electricity, Gas, Steam and Air Conditioning Supply	35	115
Fabricated Metal	25	134
Fishing and Aquaculture	3	33
Food and Beverage, F&B Service Activities	10, 11, 56	434
Furniture	32	62
General Construction	41	283
Land Transport and Transport via Pipelines	49	98
Leathers / Luggage / Footwears	15	43
Motion Picture, Video and Television, Sound Recording, and Music	59	78
Non-metallic Minerals	7, 23	239
Other Manufacturing	33	34
Other Personal Services Activities	96	11
Other Transport Equipment	319	22
Professional Services	71	651
Pulps and Papers	17	177
Real Estate Activities	68	22
Rental and leasing activities; except real estate	76	19
Retail trade, except motor vehicles and motorcycles	47	206
Rubber and Plastics	22	275
Sale of motor vehicles and parts	45	12
Ships and Boats	311	42
Specialized Construction Activities	42	50
Sports Activities and Amusement Activities	91	41
Textiles	13	69
Tobacco Products	12	11
Warehousing and support activities for transportation	52	44
Waste Collection, Treatment and Disposal Activities; Materials Recovery	38	10
Water Transport	50	55
Wholesale Trade on Own Account or on a Fee or Contract Basis	46	509
Woods	16	46
Total number of firm-years in the low-technology industry		**4,739**

APPENDIX B

Table B1. Study variables

Variables	Definitions
	Dependent Variables: Corporate Affairs
ROA	***Return on Assets.*** An accounting-based metric of corporate affairs, calculated as the ratio of Net Income to Average Total Assets.
TQ	***Tobin's Q.*** A valuation metric of corporate affairs, calculated as the ratio of the market value of a company plus the book value of total liabilities relative to the book value of its total assets.
SGR	***Sustainable Growth.*** A metric to represent a firm's growth opportunity, calculated as the ratio of a firm's net income to average total shareholders' equity, using the method used by Chen et al. (2021). $$SGR_{i,t} = \frac{ROE_{i,t}}{1 - ROE_{i,t}}$$
	Independent Variables: ESG and Innovation
ESG_Total	***Overall ESG Rating.*** The overall ESG rating as provided by KCGS.
E_Score	***Environmental Rating.*** The "E" dimension of ESG and its rating as provided by KCGS.
S_Score	***Social Rating.*** The "S" dimension of ESG and its rating as provided by KCGS.
G_Score	***Corporate Governance Rating.*** The "G" dimension of ESG and its rating as provided by KCGS.
RDI	***R&D Intensity.*** A proxy for innovation calculated as the ratio of R&D expenditures to sales.
ESG • RDI	An interaction term representing the total ESG rating and R&D Intensity.
E • RDI	An interaction term representing the environmental score and R&D Intensity.
S • RDI	An interaction term representing the social score and R&D Intensity.
G • RDI	An interaction term representing the governance score and R&D Intensity.
	Control Variables
LEV	***Leverage.*** Ratio of total liabilities to total assets.
SIZE	***Firm Size.*** Natural logarithm of the total assets of the firm.
ADV	***Advertising Expenditures.*** Advertising expense divided by total sales.
LOSS	***Net Loss Indicator.*** A dichotomous variable set to 1 if the firm suffered net loss during the year and 0 otherwise.
FO	***Foreign Ownership.*** Ratio of foreign ownership.
AGE	***Firm Age.*** Natural logarithm of the firm's age from the date of establishment.
OWNCON	***Ownership Concentration.*** Percentage of shares that the largest shareholder owns as a proportion of all outstanding shares.
CFO	***Cash Flow from Operating Activities.*** Cash flow from operating activities divided by total assets.
FIXED	***Fixed Assets Intensity.*** Ratio of Fixed Assets to Total Sales.
BETA	***Beta.*** An entity's beta coefficient under the Capital Asset Pricing Model (CAPM).
BIG4	***Audit by Big 4 Firms.*** A dichotomous variable set to 1 if the firm has been audited by one of the big four accounting firms in Korea (Samil-PwC, Anjin-Deloitte, Hanyoung-EY and Samjong-KPMG) and 0 otherwise to represent audit quality.
LIST	***Market Listing.*** A dichotomous variable set to 1 if the firm is listed in the Korea Composite Stock Price Index (KOSPI) and 0 if the firm is listed in the Korean Securities Dealers Automated Quotations (KOSDAQ).
IDUM	***Industry Dummy.*** Control variable for industry categorization to account for industry-specific variations.
YDUM	***Year Dummy.*** Control variable for year representation to account for temporal changes in between years of the study.

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APPENDIX C

Table C1. Descriptions of ESG ratings and numerical proxies

Ratings	Descriptions (translated from original Korean)	Numerical Proxies
S (Excellent)	Establishing an excellent sustainable management system, serving as a role model for other companies in all aspects of sustainable management.	7
A+ (Very Satisfactory)	Building a very satisfactory sustainable management system and consistently demonstrating excellent performance.	6
A (Satisfactory)	Building a relatively satisfactory sustainable management system, with efforts needed for system enhancement.	5
B+ (Fair)	Having a fair, sustainable management system with continuous efforts required for system improvement.	4
B (Average)	Having a somewhat weak sustainable management system, with continuous efforts needed for improvement.	3
C (Weak)	Having a weak sustainable management system, requiring considerable effort for improvement.	2
D (Very Weak)	Having a very weak sustainable management system, requiring significant effort for improvement.	1

Note: The above numerical proxies are not provided by the Korea Institute of Corporate Governance and Sustainability (KCGS). Rather, these are quantitative proxies following Kim et al. (2022) and Kwon and Choi (2024) for utilization in all regression analyses.

APPENDIX D

Table D1. Pearson correlation

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
(1) ROA	1.0000																			
(2) TQ	–0.0431	1.0000																		
	0.0001																			
(3) SGR	0.8473	0.0138	1.0000																	
	0.0000	0.1970																		
(4) ESG_Total	0.1106	–0.0746	0.0832	1.0000																
	0.0000	0.0000	0.0000																	
(5) E_Score	0.0535	–0.1571	0.0327	0.7212	1.0000															
	0.0000	0.0000	0.0022	0.0000																
(6) S_Score	0.1017	–0.0578	0.0847	0.8098	0.5807	1.0000														
	0.0000	0.0000	0.0000	0.0000	0.0000															
(7) G_Score	0.1391	–0.0117	0.1143	0.7678	0.3413	0.5455	1.0000													
	0.0000	0.2752	0.0000	0.0000	0.0000	0.0000														
(8) RDI	–0.1183	0.3845	–0.0817	–0.0056	–0.0967	0.0129	0.0338	1.0000												
	0.0000	0.0000	0.0000	0.6001	0.0000	0.2287	0.0016													
(9) LEV	–0.3445	–0.1032	–0.2756	0.1417	0.1866	0.1560	0.0249	–0.1399	1.0000											
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0200	0.0000												
(10) SIZE	0.1693	–0.2029	0.1377	0.5838	0.4874	0.6214	0.4348	–0.0397	0.2589	1.0000										
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0002	0.0000											
(11) ADV	–0.0011	0.1642	–0.0034	0.0462	–0.1270	0.0883	0.0904	0.2077	–0.1477	0.0503	1.0000									
	0.9159	0.0000	0.7491	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000										
(12) LOSS	–0.6879	0.0764	–0.6422	–0.1077	–0.0651	–0.1078	–0.1220	0.1022	0.2772	–0.1697	0.0086	1.0000								
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.4189									
(13) FO	0.2609	0.0959	0.2186	0.3377	0.2569	0.3322	0.2869	0.0871	–0.1387	0.4420	0.1632	–0.2078	1.0000							
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000								
(14) AGE	–0.0291	–0.1725	–0.0446	–0.0611	0.0379	–0.0439	–0.0905	–0.1308	0.0344	0.0278	–0.0691	0.0186	–0.0526	1.0000						
	0.0066	0.0000	0.0000	0.0000	0.0004	0.0000	0.0000	0.0000	0.0013	0.0094	0.0000	0.0826	0.0000							
(15) OWNCON	0.1605	–0.2211	0.1166	–0.0027	–0.0147	0.0157	0.0008	–0.2165	–0.0544	0.0592	–0.0500	–0.1602	–0.1694	–0.0105	1.0000					
	0.0000	0.0000	0.0000	0.7991	0.1684	0.1420	0.9402	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.3244						
(16) CFO	0.5399	–0.0184	0.4388	0.1544	0.1221	0.1407	0.1251	–0.1075	–0.1902	0.1455	0.0276	–0.3848	0.2718	–0.0587	0.1021	1.0000				
	0.0000	0.0851	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0099	0.0000	0.0000	0.0000	0.0000					
(17) FIXED	–0.1581	0.0498	–0.1535	–0.0200	–0.0087	–0.0183	–0.0329	0.2071	0.0748	0.0605	0.0511	0.1646	–0.0493	0.0281	–0.0283	–0.1119	1.0000			
	0.0000	0.0000	0.0000	0.0621	0.4147	0.0873	0.0021	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0087	0.0081	0.0000				
(18) BETA	–0.0786	0.1558	–0.0465	0.0109	0.0125	0.0620	–0.0084	0.1430	0.1054	0.0870	–0.0298	0.1111	–0.0168	–0.0489	–0.2194	–0.0478	0.0249	1.0000		
	0.0000	0.0000	0.0000	0.3068	0.2423	0.0000	0.4326	0.0000	0.0000	0.0000	0.0054	0.0000	0.1171	0.0000	0.0000	0.0000	0.0197			
(19) BIG4	0.1160	–0.0915	0.0737	0.3687	0.2736	0.3681	0.2693	–0.0209	0.0787	0.4173	0.0614	–0.1249	0.2388	–0.0960	0.1177	0.1505	–0.0803	–0.0444	1.0000	
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0503	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		
(20) LIST	–0.0446	–0.3360	–0.0581	0.1459	0.2288	0.1381	0.0845	–0.2834	0.1553	0.1678	–0.1125	–0.0119	–0.0207	0.2647	0.1236	–0.0584	–0.0721	–0.1487	0.0347	1.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.2641	0.0531	0.0000	0.0000	0.0000	0.0000	0.0000	0.0012	

Notes: (1) All financial variables are winsorized at 1% and 99% levels. (2) The numbers below the coefficients indicate the p-values. (3) Full variable definitions are provided in Appendix B.

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APPENDIX E

Table E1. Panel regression results: Main effects of ESG on Return on Assets (ROA)

	Dependent Variable: Return on Assets (ROA)									
	(1) ESG		(2) E		(3) S		(4) G		(5) Full	
(A) All Observations										
ESG_Total	−0.0025	***								
	(−2.80)									
E_Score			−0.0031	***					−0.0022	**
			(−3.82)						(−2.44)	
S_Score					−0.0033	***			−0.0026	***
					(−4.30)				(−3.01)	
G_Score							−0.0001		0.0011	
							(−0.12)		(1.24)	
LEV	−0.1085	***	−0.1083	***	−0.1083	***	−0.1086	***	−0.1079	***
	(−15.62)		(−15.64)		(−15.59)		(−15.61)		(−15.57)	
SIZE	0.0103	***	0.0106	***	0.0108	***	0.0095	***	0.0111	***
	(8.33)		(8.73)		(8.80)		(7.94)		(8.75)	
ADV	−0.3159	***	−0.3203	***	−0.3143	***	−0.3195	***	−0.3171	***
	(−4.28)		(−4.34)		(−4.24)		(−4.35)		(−4.28)	
LOSS	−0.0857	***	−0.0857	***	−0.0856	***	−0.0859	***	−0.0856	***
	(−34.72)		(−34.84)		(−34.77)		(−34.80)		(−34.84)	
FO	0.0384	***	0.0382	***	0.0385	***	0.0379	***	0.0384	***
	(3.58)		(3.58)		(3.57)		(3.53)		(3.58)	
AGE	−0.0027	*	−0.0025	*	−0.0027	*	−0.0025	*	−0.0025	*
	(−1.88)		(−1.77)		(−1.91)		(−1.73)		(−1.78)	
OWNCON	0.0363	***	0.0354	***	0.0366	***	0.0361	***	0.0359	***
	(3.70)		(3.62)		(3.74)		(3.69)		(3.67)	
CFO	0.2590	***	0.2590	***	0.2594	***	0.2583	***	0.2594	***
	(16.90)		(16.89)		(16.94)		(16.82)		(16.93)	
FIXED	−0.0068	***	−0.0069	***	−0.0070	***	−0.0067	***	−0.0070	***
	(−2.69)		(−2.71)		(−2.74)		(−2.63)		(−2.75)	
BETA	0.0002		0.0002		0.0001		0.0002		0.0001	
	(0.08)		(0.10)		(0.07)		(0.12)		(0.07)	
BIG4	−0.0036	*	−0.0035	*	−0.0034		−0.0041	*	−0.0033	
	(−1.74)		(−1.71)		(−1.62)		(−1.95)		(−1.58)	
LIST	−0.0062	**	−0.0055	*	−0.0060	*	−0.0067	**	−0.0054	*
	(−2.00)		(−1.78)		(−1.94)		(−2.19)		(−1.77)	
Intercept	−0.1078	***	−0.1135	***	−0.1150	***	−0.0973	***	−0.1211	***
	(−4.22)		(−4.48)		(−4.53)		(−3.91)		(−4.73)	
Indicator	None		None		None		None		None	
Industry/Year	Included		Included		Included		Included		Included	
Observations	8,739		8,739		8,739		8,739		8,739	
Adj-R^2	0.5924		0.5934		0.5925		0.5921		0.5935	
(B) High-Technology Industries										
ESG_Total	−0.0026	**								
	(−2.00)									
E_Score			−0.0031	**					−0.0022	*
			(−2.58)						(−1.72)	
S_Score					−0.0032	***			−0.0026	*
					(−2.71)				(−1.92)	
G_Score							−0.0001		0.0012	
							(−0.07)		(0.88)	
Intercept	−0.1032	***	−0.1115	***	−0.1111	***	−0.1351	***	−0.1598	***
	(−3.23)		(−3.49)		(−3.46)		(−3.85)		(−4.44)	
Control Variables	Included		Included		Included		Included		Included	
Indicator	ISC = 1		ISC = 1		ISC = 1		ISC = 1		ISC = 1	
Industry/Year	Included		Included		Included		Included		Included	
Observations	4,000		4,000		4,000		4,000		4,000	
Adj−R^2	0.6391		0.6399		0.6390		0.6389		0.6400	

Table E1 (cont.). Panel regression results: Main effects of ESG on Return on Assets (ROA)

	Dependent Variable: Return on Assets (ROA)									
	(1) ESG		(2) E		(3) S		(4) G		(5) Full	
	(C) Low-Technology Industries									
ESG_Total	−0.0021	*								
	(−1.76)									
E_Score			−0.0028	**					−0.0020	
			(−2.54)						(−1.62)	
S_Score					−0.0030	***			−0.0024	**
					(−3.10)				(−2.18)	
G_Score							0.0002		0.0012	
							(0.21)		(1.14)	
Intercept	−0.0634	*	−0.0697	**	−0.0699	**	−0.0541		−0.0754	**
	(−1.87)		(−2.04)		(−2.06)		(−1.64)		(−2.20)	
Control Variables	Included		Included		Included		Included		Included	
Indicator	ISC = 0		ISC = 0		ISC = 0		ISC = 0		ISC = 0	
Industry/Year	Included		Included		Included		Included		Included	
Observations	4,739		4,739		4,739		4,739		4,739	
Adj−R^2	0.5534		0.5545		0.5538		0.5534		0.5549	

Notes: (1) Numbers in parentheses represent z-values. (2) ***, **, and * represent significance at the 1, 5, and 10% levels, respectively. (3) All financial variables are winsorized at 1% and 99% levels. (4) Full variable definitions are provided in Appendix B.

Table E2. Panel regression results: Main effects of R&D intensity on Return on Assets (ROA)

	Dependent Variable: Return on Assets (ROA)					
	(A)		(B)		(C)	
	All Observations		High-Technology		Low-Technology	
RDI	−0.0928	***	−0.0769	***	−0.1073	*
	(−4.10)		(−3.28)		(−1.93)	
LEV	−0.1095	***	−0.1018	***	−0.1122	***
	(−15.97)		(−11.11)		(−11.36)	
SIZE	0.0094	***	0.0117	***	0.0063	***
	(8.32)		(7.18)		(4.25)	
ADV	−0.2903	***	−0.3352	***	−0.1738	
	(−4.07)		(−3.98)		(−1.39)	
LOSS	−0.0857	***	−0.0906	***	−0.0814	***
	(−34.85)		(−25.47)		(−24.32)	
FO	0.0403	***	0.0259	*	0.0500	***
	(3.79)		(1.81)		(3.22)	
AGE	−0.0030	**	−0.0041	**	−0.0015	
	(−2.16)		(−2.13)		(−0.82)	
OWNCON	0.0324	***	0.0238	*	0.0406	***
	(3.36)		(1.84)		(3.11)	
CFO	0.2546	***	0.3138	***	0.1965	***
	(16.64)		(14.15)		(9.84)	
FIXED	−0.0043	*	−0.0109	***	−0.0002	
	(−1.71)		(−2.87)		(−0.07)	
BETA	0.0001		−0.0012		0.0023	
	(0.05)		(−0.43)		(0.81)	
BIG4	−0.0039	*	−0.0054	*	−0.0027	
	(−1.89)		(−1.70)		(−1.02)	
LIST	−0.0086	***	−0.0115	***	−0.0040	
	(−2.80)		(−3.14)		(−0.75)	
Intercept	−0.0900	***	−0.1248	***	−0.0468	
	(−3.71)		(−3.91)		(−1.48)	
Indicator	None		ISC = 1		ISC = 0	
Industry/Year	Included		Included		Included	
Observations	8,739		4,000		4,739	
Adj-R^2	0.5961		0.6420		0.5572	

Notes: (1) Numbers in parentheses represent z-values. (2) ***, **, and * represent significance at the 1, 5, and 10% levels, respectively. (3) All financial variables are winsorized at 1% and 99% levels. (4) Full variable definitions are provided in Appendix B.

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Table E3. Panel regression results: ESG, innovation, and Return on Assets (ROA)

Dependent Variable: Return on Assets (ROA)										
	(1) ESG		(2) E		(3) S		(4) G		(5) Full	
(A) All Observations										
ESG_Total	−0.0035	***								
	(−3.87)									
E_Score			−0.0038	***					−0.0025	**
			(−4.53)						(−2.53)	
S_Score					−0.0040	***			−0.0030	***
					(−5.21)				(−3.27)	
G_Score							−0.0008		0.0007	
							(−0.98)		(0.81)	
RDI	−0.2054	***	−0.1511	***	−0.1870	***	−0.1875	***	−0.2095	***
	(−4.77)		(−4.17)		(−4.89)		(−3.58)		(−4.24)	
ESG • RDI	0.0453	***								
	(3.78)									
E • RDI			0.0341	***					0.0100	
			(2.65)						(0.56)	
S • RDI					0.0350	***			0.0222	
					(3.54)				(1.20)	
G • RDI							0.0325	**	0.0139	
							(2.27)		(0.76)	
LEV	−0.1093	***	−0.1084	***	−0.1089	***	−0.1099	***	−0.1085	***
	(−15.95)		(−15.93)		(−15.91)		(−16.03)		(−15.90)	
SIZE	0.0100	***	0.0103	***	0.0105	***	0.0094	***	0.0108	***
	(8.32)		(8.69)		(8.77)		(7.99)		(8.74)	
ADV	−0.2922	***	−0.2910	***	−0.2872	***	−0.2887	***	−0.2887	***
	(−4.10)		(−4.10)		(−4.01)		(−4.07)		(−4.04)	
LOSS	−0.0854	***	−0.0855	***	−0.0854	***	−0.0856	***	−0.0853	***
	(−34.78)		(−34.91)		(−34.91)		(−34.86)		(−34.96)	
FO	0.0402	***	0.0397	***	0.0402	***	0.0401	***	0.0400	***
	(3.81)		(3.79)		(3.80)		(3.78)		(3.80)	
AGE	−0.0033	**	−0.0031	**	−0.0034	**	−0.0030	**	−0.0031	**
	(−2.34)		(−2.21)		(−2.42)		(−2.13)		(−2.24)	
OWNCON	0.0321	***	0.0315	***	0.0323	***	0.0321	***	0.0316	***
	(3.31)		(3.27)		(3.34)		(3.32)		(3.28)	
CFO	0.2545	***	0.2555	***	0.2553	***	0.2532	***	0.2550	***
	(16.60)		(16.64)		(16.63)		(16.56)		(16.65)	
FIXED	−0.0045	*	−0.0045	*	−0.0046	*	−0.0043	*	−0.0047	*
	(−1.87)		(−1.85)		(−1.90)		(−1.77)		(−1.93)	
BETA	0.0000		0.0000		0.0000		0.0001		0.0000	
	(−0.02)		(−0.02)		(0.01)		(0.04)		(−0.01)	
BIG4	−0.0035	*	−0.0034	*	−0.0032		−0.0040	*	−0.0031	
	(−1.69)		(−1.65)		(−1.55)		(−1.92)		(−1.52)	
LIST	−0.0090	***	−0.0079	**	−0.0086	***	−0.0092	***	−0.0082	***
	(−2.94)		(−2.59)		(−2.81)		(−3.02)		(−2.69)	
Intercept	−0.0942	***	−0.1011	***	−0.1011	***	−0.0865	***	−0.1066	***
	(−3.73)		(−4.05)		(−4.05)		(−3.52)		(−4.23)	
Indicator	None		None		None		None		None	
Industry/Year	Included		Included		Included		Included		Included	
Observations	8,739		8,739		8,739		8,739		8,739	
Adj-R^2	0.5983		0.5989		0.5981		0.5971		0.5994	

Table E3 (cont.). Panel regression results: ESG, innovation, and Return on Assets (ROA)

Dependent Variable: Return on Assets (ROA)										
	(1) ESG		(2) E		(3) S		(4) G		(5) Full	
(B) High–Technology Industries										
ESG_Total	–0.0035	**								
	(–2.49)									
E_Score			–0.0032	**					–0.0020	
			(–2.42)						(–1.33)	
S_Score					–0.0037	***			–0.0031	**
					(–2.95)				(–2.05)	
G_Score							–0.0006		0.0011	
							(–0.40)		(0.68)	
RDI	–0.1385	***	–0.0844	**	–0.1202	***	–0.1150	**	–0.1269	**
	(–3.03)		(–2.22)		(–2.94)		(–2.08)		(–2.23)	
ESG • RDI	0.0274	*								
	(1.77)									
E • RDI			0.0055						–0.0073	
			(0.32)						(–0.36)	
S • RDI					0.0181				0.0187	
					(1.43)				(0.97)	
G • RDI							0.0136		0.0057	
							(0.87)		(0.30)	
Intercept	–0.0908	***	–0.1397	***	–0.0995	***	–0.0836	***	–0.1078	***
	(–2.85)		(–4.19)		(–3.11)		(–2.70)		(–3.32)	
Control Variables	Included		Included		Included		Included		Included	
Indicator	ISC = 1		ISC = 1		ISC = 1		ISC = 1		ISC = 1	
Industry/Year	Included		Included		Included		Included		Included	
Observations	4,000		4,000		4,000		4,000		4,000	
Adj–R^2	0.6432		0.6434		0.6429		0.6423		0.6440	
(C) Low-Technology Industries										
ESG_Total	–0.0027	**								
	(–2.38)									
E_Score			–0.0036	***					–0.0025	*
			(–3.24)						(–1.95)	
S_Score					–0.0035	***			–0.0027	**
					(–3.71)				(–2.39)	
G_Score							–0.0004		0.0013	
							(–0.36)		(1.24)	
RDI	–0.3613	***	–0.3252	***	–0.3478	***	–0.3359	***	–0.3313	***
	(–3.77)		(–4.17)		(–4.13)		(–3.27)		(–3.56)	
ESG • RDI	0.0789	***								
	(3.68)									
E • RDI			0.0850	***					0.0507	
			(3.87)						(0.93)	
S • RDI					0.0685	***			0.0486	
					(3.47)				(0.92)	
G • RDI							0.0698	***	–0.0234	
							(3.01)		(–0.46)	
Intercept	–0.0483		–0.0547	*	–0.0549	*	–0.0406		–0.0600	*
	(–1.51)		(–1.69)		(–1.71)		(–1.30)		(–1.84)	
Control Variables	Included		Included		Included		Included		Included	
Indicator	ISC = 0		ISC = 0		ISC = 0		ISC = 0		ISC = 0	
Industry/Year	Included		Included		Included		Included		Included	
Observations	4,739		4,739		4,739		4,739		4,739	
Adj–R^2	0.5611		0.5622		0.5609		0.5599		0.5625	

Notes: (1) Numbers in parentheses represent z-values. (2) ***, **, and * represent significance at the 1, 5, and 10% levels, respectively. (3) All financial variables are winsorized at 1% and 99% levels. (4) Full variable definitions are provided in Appendix B.

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APPENDIX F

Table F1. Panel regression results: Main effects of ESG on Tobin's Q (TQ)

Dependent Variable: Tobin's Q (TQ)										
	(1) ESG		(2) E		(3) S		(4) G		(5) Full	
(A) All Observations										
ESG_Total	−0.0298	**								
	(−2.39)									
E_Score			−0.0392	***					−0.0397	***
			(−3.47)						(−3.23)	
S_Score					−0.0132				0.0036	
					(−1.25)				(0.31)	
G_Score							−0.0117		−0.0052	
							(−1.08)		(−0.47)	
LEV	0.4550	***	0.4597	***	0.4547	***	0.4511	***	0.4582	***
	(3.13)		(3.18)		(3.12)		(3.10)		(3.18)	
SIZE	−0.2220	***	−0.2186	***	−0.2255	***	−0.2281	***	−0.2187	***
	(−7.80)		(−7.70)		(−7.93)		(−8.15)		(−7.60)	
ADV	−3.0138	**	−3.0054	**	−3.0540	**	−3.0764	**	−3.0032	**
	(−2.14)		(−2.13)		(−2.17)		(−2.18)		(−2.13)	
LOSS	−0.0587	***	−0.0591	***	−0.0598	***	−0.0606	***	−0.0592	***
	(−2.63)		(−2.67)		(−2.70)		(−2.73)		(−2.68)	
FO	1.6014	***	1.6001	***	1.6015	***	1.6004	***	1.5999	***
	(5.77)		(5.77)		(5.78)		(5.77)		(5.77)	
AGE	−0.1967	***	−0.1949	***	−0.1963	***	−0.1972	***	−0.1951	***
	(−5.66)		(−5.61)		(−5.64)		(−5.67)		(−5.63)	
OWNCON	−0.3709	**	−0.3794	**	−0.3741	**	−0.3761	**	−0.3797	**
	(−2.32)		(−2.38)		(−2.35)		(−2.36)		(−2.38)	
CFO	0.2584		0.2584		0.2553		0.2534		0.2580	
	(1.51)		(1.52)		(1.49)		(1.48)		(1.51)	
FIXED	−0.1110	***	−0.1121	***	−0.1101	***	−0.1097	***	−0.1121	***
	(−3.22)		(−3.26)		(−3.19)		(−3.17)		(−3.25)	
BETA	0.1076	***	0.1078	***	0.1082	***	0.1090	***	0.1081	***
	(3.70)		(3.70)		(3.70)		(3.74)		(3.70)	
BIG4	−0.0210		−0.0195		−0.0229		−0.0242		−0.0197	
	(−0.85)		(−0.79)		(−0.93)		(−0.99)		(−0.79)	
LIST	−0.3182	***	−0.3078	***	−0.3224	***	−0.3232	***	−0.3081	***
	(−2.96)		(−2.86)		(−2.99)		(−3.00)		(−2.86)	
Intercept	5.9383	***	5.8710	***	5.9837	***	6.0334	***	5.8768	***
	(10.29)		(10.19)		(10.40)		(10.58)		(10.15)	
Indicator	None		None		None		None		None	
Industry/Year	Included		Included		Included		Included		Included	
Observations	8,739		8,739		8,739		8,739		8,739	
Adj−R^2	0.3403		0.3391		0.3408		0.3414		0.3393	
(B) High-Technology Industries										
ESG_Total	−0.0284									
	(−1.34)									
E_Score			−0.0568	***					−0.0656	***
			(−2.60)						(−2.63)	
S_Score					−0.0037				0.0208	
					(−0.19)				(0.93)	
G_Score							−0.0055		0.0024	
							(−0.30)		(0.12)	
Intercept	9.4518	***	9.9341	***	9.5326	***	10.2575	***	9.9827	***
	(6.11)		(9.92)		(6.15)		(10.49)		(9.96)	
Control Variables	Included		Included		Included		Included		Included	
Indicator	ISC = 1		ISC = 1		ISC = 1		ISC = 1		ISC = 1	
Industry/Year	Included		Included		Included		Included		Included	
Observations	4,000		4,000		4,000		4,000		4,000	
Adj−R^2	0.3391		0.3374		0.3402		0.3404		0.3384	

Table F1 (cont.). Panel regression results: Main effects of ESG on Tobin's Q (TQ)

Dependent Variable: Tobin's Q (TQ)										
	(1) ESG		(2) E		(3) S		(4) G		(5) Full	
(C) Low-Technology Industries										
ESG_Total	−0.0297	**								
	(−2.26)									
E_Score			−0.0292	***					−0.0204	**
			(−3.12)						(−2.28)	
S_Score					−0.0291	***			−0.0206	**
					(−3.04)				(−2.32)	
G_Score							−0.0104		−0.0021	
							(−0.85)		(−0.18)	
Intercept	5.2624	***	5.2444	***	5.2386	***	5.3690	***	5.1819	***
	(9.72)		(9.83)		(9.76)		(10.03)		(9.63)	
Control Variables	Included		Included		Included		Included		Included	
Indicator	ISC = 0		ISC = 0		ISC = 0		ISC = 0		ISC = 0	
Industry/Year	Included		Included		Included		Included		Included	
Observations	4,739		4,739		4,739		4,739		4,739	
Adj−R^2	0.2508		0.2492		0.2491		0.2529		0.2473	

Notes: (1) Numbers in parentheses represent z-values. (2) ***, **, and * represent significance at the 1, 5, and 10% levels, respectively. (3) All financial variables are winsorized at 1% and 99% levels. (4) Full variable definitions are provided in Appendix B.

Table F2. Panel regression results: Main effects of R&D intensity on Tobin's Q (TQ)

Dependent Variable: Tobin's Q (TQ)						
	(A)		(B)		(C)	
	All Observations		High-Technology		Low-Technology	
RDI	0.3321		0.2608		1.3412	
	(0.54)		(0.35)		(1.48)	
LEV	0.4543	***	0.2957		0.5952	***
	(3.17)		(1.50)		(2.97)	
SIZE	−0.2272	***	−0.2681	***	−0.2048	***
	(−8.41)		(−5.65)		(−8.37)	
ADV	−3.0547	**	−3.8444	**	−0.2745	
	(−2.26)		(−2.35)		(−0.21)	
LOSS	−0.0601	***	−0.0874	**	−0.0508	***
	(−2.71)		(−2.02)		(−3.01)	
FO	1.5972	***	2.2584	***	0.7292	***
	(5.82)		(5.48)		(3.11)	
AGE	−0.1907	***	−0.2878	***	−0.1137	***
	(−5.60)		(−4.81)		(−3.63)	
OWNCON	−0.3720	**	−0.4578	*	−0.2829	
	(−2.41)		(−1.72)		(−1.60)	
CFO	0.2558		0.3698		0.0944	
	(1.50)		(1.24)		(0.59)	
FIXED	−0.1167	***	−0.2569	***	−0.0366	
	(−3.20)		(−3.10)		(−1.19)	
BETA	0.1112	***	0.2022	***	0.0507	*
	(3.86)		(4.01)		(1.86)	
BIG4	−0.0261		−0.0920	**	0.0128	
	(−1.07)		(−2.05)		(0.59)	
LIST	−0.3350	***	−0.2693	*	−0.3993	***
	(−3.26)		(−1.88)		(−4.27)	
Intercept	5.9670	***	10.1532	***	5.2161	***
	(10.84)		(10.71)		(10.56)	
Indicator	None		ISC = 1		ISC = 0	
Industry/Year	Included		Included		Included	
Observations	8,739		4,000		4,739	
Adj−R^2	0.3476		0.3458		0.2707	

Notes: (1) Numbers in parentheses represent z-values. (2) ***, **, and * represent significance at the 1, 5, and 10% levels, respectively. (3) All financial variables are winsorized at 1% and 99% levels. (4) Full variable definitions are provided in Appendix B.

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Table F3. Panel regression results: ESG, innovation, and Tobin's Q (TQ)

	Dependent Variable: Tobin's Q (TQ)									
	(1) ESG		(2) E		(3) S		(4) G		(5) Full	
	(A) All Observations									
ESG_Total	–0.0401	***								
	(–3.16)									
E_Score			–0.0364	***					–0.0245	**
			(–3.25)						(–2.01)	
S_Score					–0.0213	**			–0.0030	
					(–1.97)				(–0.26)	
G_Score							–0.0285	***	–0.0238	**
							(–2.64)		(–2.16)	
RDI	–0.6510		0.5378		–0.5018		–1.7259	*	–1.5546	
	(–0.56)		(0.50)		(–0.48)		(–1.71)		(–1.44)	
ESG • RDI	0.3871									
	(1.34)									
E • RDI			–0.1016						–0.7224	*
			(–0.34)						(–1.73)	
S • RDI					0.2956				0.2512	
					(1.37)				(0.85)	
G • RDI							0.7010	***	0.8530	***
							(3.05)		(2.78)	
LEV	0.4550	***	0.4595	***	0.4553	***	0.4416	***	0.4404	***
	(3.17)		(3.24)		(3.18)		(3.06)		(3.09)	
SIZE	–0.2193	***	–0.2151	***	–0.2230	***	–0.2258	***	–0.2148	***
	(–7.91)		(–7.81)		(–8.04)		(–8.30)		(–7.70)	
ADV	–3.0132	**	–2.9855	**	–3.0096	**	–2.9497	**	–2.8701	**
	(–2.26)		(–2.19)		(–2.27)		(–2.27)		(–2.17)	
LOSS	–0.0566	**	–0.0585	***	–0.0584	***	–0.0574	**	–0.0553	**
	(–2.53)		(–2.64)		(–2.64)		(–2.58)		(–2.51)	
FO	1.5954	***	1.5984	***	1.5919	***	1.5979	***	1.6040	***
	(5.82)		(5.81)		(5.84)		(5.84)		(5.86)	
AGE	–0.1922	***	–0.1890	***	–0.1928	***	–0.1912	***	–0.1885	***
	(–5.64)		(–5.55)		(–5.64)		(–5.65)		(–5.55)	
OWNCON	–0.3697	**	–0.3721	**	–0.3730	**	–0.3772	**	–0.3813	**
	(–2.38)		(–2.41)		(–2.42)		(–2.42)		(–2.46)	
CFO	0.2588		0.2637		0.2573		0.2316		0.2299	
	(1.52)		(1.55)		(1.52)		(1.36)		(1.34)	
FIXED	–0.1197	***	–0.1204	***	–0.1179	***	–0.1195	***	–0.1219	***
	(–3.26)		(–3.31)		(–3.19)		(–3.22)		(–3.36)	
BETA	0.1092	***	0.1107	***	0.1103	***	0.1106	***	0.1123	***
	(3.80)		(3.86)		(3.82)		(3.84)		(3.92)	
BIG4	–0.0216		–0.0207		–0.0234		–0.026		–0.0218	
	(–0.88)		(–0.84)		(–0.95)		(–1.07)		(–0.89)	
LIST	–0.3371	***	–0.3159	***	–0.3398	***	–0.3486	***	–0.3293	***
	(–3.31)		(–3.09)		(–3.32)		(–3.43)		(–3.28)	
Intercept	5.9059	***	5.7728	***	5.9539	***	6.0377	***	5.8374	***
	(10.50)		(10.39)		(10.63)		(10.91)		(10.40)	
Indicator	None		None		None		None		None	
Industry/Year	Included		Included		Included		Included		Included	
Observations	8,739		8,739		8,739		8,739		8,739	
Adj-R^2	0.3449		0.3458		0.3445		0.3476		0.3469	

Table F3 (cont.). Panel regression results: ESG, innovation, and Tobin's Q (TQ)

Dependent Variable: Tobin's Q (TQ)										
	(1) ESG		(2) E		(3) S		(4) G		(5) Full	
(B) High-Technology Industries										
ESG_Total	−0.0673	***								
	(−3.15)									
E_Score			−0.0627	***					−0.0508	**
			(−2.83)						(−2.06)	
S_Score					−0.0326				0.0056	
					(−1.58)				(0.23)	
G_Score							−0.0492	***	−0.0367	*
							(−2.77)		(−1.91)	
RDI	−1.7824		0.0350		−1.2669		−2.5918	***	−2.6218	**
	(−1.49)		(0.03)		(−1.27)		(−2.65)		(−2.34)	
ESG • RDI	0.8902	***								
	(2.85)									
E • RDI			0.1650						−0.3030	
			(0.39)						(−0.61)	
S • RDI					0.5983	***			0.2934	
					(2.93)				(0.97)	
G • RDI							1.0239	***	0.9305	***
							(4.81)		(3.18)	
Intercept	10.2545	***	9.8381	***	9.5354	***	9.5733	***	10.0765	***
	(10.50)		(10.13)		(6.39)		(6.44)		(10.29)	
Control Variables	Included		Included		Included		Included		Included	
Indicator	ISC = 1		ISC = 1		ISC = 1		ISC = 1		ISC = 1	
Industry/Year	Included		Included		Included		Included		Included	
Observations	4,000		4,000		4,000		4,000		4,000	
Adj-R^2	0.3454		0.3437		0.3432		0.3493		0.3457	
(C) Low-Technology Industries										
ESG_Total	−0.0218									
	(−1.56)									
E_Score			−0.0170	*					−0.0025	
			(−1.76)						(−0.26)	
S_Score					−0.0225	**			−0.0189	**
					(−2.22)				(−2.01)	
G_Score							−0.0064		−0.0119	
							(−0.50)		(−0.92)	
RDI	3.9422		4.3550	*	3.7162		2.8542		2.9262	
	(1.36)		(1.66)		(1.39)		(1.19)		(1.30)	
ESG • RDI	−0.7458									
	(−1.23)									
E • RDI			−1.0551	*					−2.0670	***
			(−1.66)						(−2.73)	
S • RDI					−0.6157				−0.1838	
					(−1.25)				(−0.45)	
G • RDI							−0.4405		1.4681	*
							(−0.84)		(1.96)	
Intercept	5.0128	***	4.9575	***	5.0004	***	5.1533	***	4.8767	***
	(10.36)		(10.60)		(10.38)		(10.65)		(10.35)	
Control Variables	Included		Included		Included		Included		Included	
Indicator	ISC = 0		ISC = 0		ISC = 0		ISC = 0		ISC = 0	
Industry/Year	Included		Included		Included		Included		Included	
Observations	4,739		4,739		4,739		4,739		4,739	
Adj-R^2	0.2809		0.2882		0.2783		0.2752		0.2942	

Notes: (1) Numbers in parentheses represent z-values. (2) ***, **, and * represent significance at the 1, 5, and 10% levels, respectively. (3) All financial variables are winsorized at 1% and 99% levels. (4) Full variable definitions are provided in Appendix B.

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APPENDIX G

Table G1. Panel regression results: Main effects of ESG on Sustainable Growth Rate (SGR)

Dependent Variable: Sustainable Growth Rate (SGR)										
	(1) ESG		(2) E		(3) S		(4) G		(5) Full	
(A) All Observations										
ESG_Total	−0.0052	**								
	(−2.19)									
E_Score			−0.0040	**					−0.0013	
			(−2.08)						(−0.64)	
S_Score					−0.0070	***			−0.0068	***
					(−3.64)				(−3.10)	
G_Score							−0.0009		0.0013	
							(−0.42)		(0.61)	
LEV	−0.1877	***	−0.1875	***	−0.1872	***	−0.1880	***	−0.1869	***
	(−9.08)		(−9.07)		(−9.07)		(−9.09)		(−9.06)	
SIZE	0.0173	***	0.0170	***	0.0185	***	0.0158	***	0.0186	***
	(5.92)		(6.02)		(6.35)		(5.66)		(6.25)	
ADV	−0.5692	***	−0.5789	***	−0.5651	***	−0.5755	***	−0.5680	***
	(−4.16)		(−4.23)		(−4.12)		(−4.19)		(−4.13)	
LOSS	−0.1941	***	−0.1941	***	−0.1939	***	−0.1944	***	−0.1939	***
	(−33.99)		(−33.99)		(−34.02)		(−34.10)		(−33.97)	
FO	0.0498	*	0.0491	*	0.0502	*	0.0489	*	0.0500	*
	(1.90)		(1.87)		(1.90)		(1.86)		(1.89)	
AGE	−0.0111	***	−0.0107	***	−0.0112	***	−0.0108	***	−0.0111	***
	(−3.17)		(−3.10)		(−3.20)		(−3.08)		(−3.13)	
OWNCON	0.0565	**	0.0554	**	0.0573	**	0.0564	**	0.0569	**
	(2.38)		(2.33)		(2.42)		(2.38)		(2.39)	
CFO	0.4243	***	0.4235	***	0.4252	***	0.4229	***	0.4250	***
	(10.85)		(10.80)		(10.89)		(10.79)		(10.88)	
FIXED	−0.0156	***	−0.0155	***	−0.0159	***	−0.0153	***	−0.0159	***
	(−3.60)		(−3.60)		(−3.69)		(−3.54)		(−3.67)	
BETA	0.0032		0.0034		0.0032		0.0034		0.0032	
	(0.62)		(0.65)		(0.62)		(0.66)		(0.62)	
BIG4	−0.0166	***	−0.0169	***	−0.0160	***	−0.0175	***	−0.0160	***
	(−3.37)		(−3.45)		(−3.25)		(−3.55)		(−3.25)	
LIST	−0.0177	***	−0.0173	***	−0.0173	***	−0.0188	***	−0.0171	**
	(−2.70)		(−2.63)		(−2.64)		(−2.85)		(−2.59)	
Intercept	−0.0978	*	−0.0970	*	−0.1145	**	−0.0771		−0.1181	**
	(−1.79)		(−1.80)		(−2.10)		(−1.46)		(−2.15)	
Indicator	None		None		None		None		None	
Industry/Year	Included		Included		Included		Included		Included	
Observations	8,739		8,739		8,739		8,739		8,739	
Adj-R^2	0.4759		0.4761		0.4758		0.4757		0.4759	
(B) High-Technology Industries										
ESG_Total	−0.0082	**								
	(−2.48)									
E_Score			−0.0052	**					-0.0028	
			(−2.00)						(-1.00)	
S_Score					−0.0062	**			-0.0044	
					(−2.15)				(-1.42)	
G_Score							-0.0044		-0.0024	
							(-1.43)		(-0.76)	
Intercept	−0.1900	**	−0.2841	***	−0.2897	***	-0.1603	**	-0.2024	**
	(−2.43)		(−2.97)		(−2.97)		(-2.13)		(-2.56)	
Control Variables	Included		Included		Included		Included		Included	
Indicator	ISC = 1		ISC = 1		ISC = 1		ISC = 1		ISC = 1	
Industry/Year	Included		Included		Included		Included		Included	
Observations	4,000		4,000		4,000		4,000		4,000	
Adj-R^2	0.5235		0.5233		0.5229		0.5229		0.5233	

Dependent Variable: Sustainable Growth Rate (SGR)										
	(1) ESG		(2) E		(3) S		(4) G		(5) Full	
(C) Low-Technology Industries										
ESG_Total	−0.0019									
	(−0.59)									
E_Score			-0.0026						0.0003	
			(-1.00)						(0.08)	
S_Score					-0.0074	***			-0.0087	***
					(-2.96)				(-2.90)	
G_Score							0.0028		0.0051	*
							(0.99)		(1.79)	
Intercept	0.0468		0.0404		0.0162		0.0599		0.0199	
	(0.73)		(0.63)		(0.25)		(0.96)		(0.31)	
Control Variables	Included		Included		Included		Included		Included	
Indicator	ISC = 0		ISC = 0		ISC = 0		ISC = 0		ISC = 0	
Industry/Year	Included		Included		Included		Included		Included	
Observations	4,739		4,739		4,739		4,739		4,739	
Adj-R^2	0.4429		0.4431		0.4431		0.4432		0.4437	

Notes: (1) Numbers in parentheses represent z-values. (2) ***, **, and * represent significance at the 1, 5, and 10% levels, respectively. (3) All financial variables are winsorized at 1% and 99% levels. (4) Full variable definitions are provided in Appendix B.

Table G2. Panel regression results: Main effects of R&D intensity on Sustainable Growth Rate (SGR)

Dependent Variable: Sustainable Growth Rate (SGR)						
	(A)		(B)		(C)	
	All Observations		High-Technology		Low-Technology	
RDI	−0.1192	***	−0.1085	***	−0.1509	**
	(−3.88)		(−3.15)		(−2.07)	
LEV	−0.1896	***	−0.1869	***	−0.1716	***
	(−9.15)		(−7.34)		(−5.81)	
SIZE	0.0156	***	0.0253	***	0.0064	**
	(5.78)		(5.86)		(2.03)	
ADV	−0.5434	***	−0.5797	***	−0.4733	*
	(−3.96)		(−3.52)		(−1.87)	
LOSS	−0.1940	***	−0.1840	***	−0.2025	***
	(−34.06)		(−25.19)		(−24.30)	
FO	0.0521	**	0.0383		0.0611	*
	(2.00)		(1.02)		(1.77)	
AGE	−0.0114	***	−0.0177	***	−0.0048	
	(−3.29)		(−3.33)		(−1.15)	
OWNCON	0.0516	**	0.0375		0.0568	*
	(2.18)		(1.12)		(1.93)	
CFO	0.4160	***	0.5020	***	0.3355	***
	(10.58)		(9.46)		(5.91)	
FIXED	−0.0123	***	−0.0226	***	−0.0058	
	(−2.78)		(−3.15)		(−1.15)	
BETA	0.0032		0.0106		−0.0023	
	(0.63)		(1.41)		(−0.32)	
BIG4	−0.0174	***	−0.0235	***	−0.0092	
	(−3.54)		(−3.29)		(−1.38)	
LIST	−0.0213	***	−0.0364	***	−0.0003	
	(−3.21)		(−4.23)		(−0.03)	
Intercept	−0.0686		−0.2431	***	0.0630	
	(−1.30)		(−2.75)		(1.02)	
Indicator	None		ISC = 1		ISC = 0	
Industry/Year	Included		Included		Included	
Observations	8,739		4,000		4,739	
Adj-R^2	0.4470		0.5242		0.4444	

Notes: (1) Numbers in parentheses represent z-values. (2) ***, **, and * represent significance at the 1, 5, and 10% levels, respectively. (3) All financial variables are winsorized at 1% and 99% levels. (4) Full variable definitions are provided in Appendix B.

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Table G3. Panel regression results: ESG, innovation, and Sustainable Growth Rate (SGR)

Dependent Variable: Sustainable Growth Rate (SGR)										
	(1) ESG		(2) E		(3) S		(4) G		(5) Full	
(A) All Observations										
ESG_Total	−0.0052	**								
	(−2.14)									
E_Score			−0.0044	**					−0.0019	
			(−2.18)						(−0.84)	
S_Score					−0.0072	***			−0.0070	***
					(−3.65)				(−3.06)	
G_Score							−0.0007		0.0019	
							(−0.29)		(0.86)	
RDI	−0.1442	**	−0.1575	***	−0.1611	***	−0.1015		−0.1254	*
	(−1.97)		(−3.04)		(−2.65)		(−1.36)		(−1.69)	
ESG • RDI	0.0110									
	(0.40)									
E • RDI			0.0229						0.0251	
			(0.96)						(0.89)	
S • RDI					0.0171				0.0164	
					(0.89)				(0.60)	
G • RDI							−0.0060		−0.0265	
							(−0.26)		(−1.01)	
LEV	−0.1894	***	−0.1890	***	−0.1889	***	−0.1898	***	−0.1881	***
	(−9.15)		(−9.13)		(−9.13)		(−9.18)		(−9.11)	
SIZE	0.0171	***	0.0169	***	0.0183	***	0.0158	***	0.0183	***
	(5.90)		(5.99)		(6.32)		(5.67)		(6.21)	
ADV	−0.5385	***	−0.5465	***	−0.5348	***	−0.5429	***	−0.5393	***
	(−3.96)		(−3.99)		(−3.90)		(−3.96)		(−3.94)	
LOSS	−0.1936	***	−0.1937	***	−0.1935	***	−0.1940	***	−0.1935	***
	(−33.93)		(−33.94)		(−33.97)		(−34.04)		(−33.92)	
FO	0.0530	**	0.0519	**	0.0531	**	0.0523	**	0.0525	**
	(2.04)		(2.00)		(2.03)		(2.01)		(2.01)	
AGE	−0.0119	***	−0.0115	***	−0.0120	***	−0.0115	***	−0.0119	***
	(−3.37)		(−3.31)		(−3.41)		(−3.29)		(−3.35)	
OWNCON	0.0518	**	0.0506	**	0.0525	**	0.0518	**	0.0522	**
	(2.18)		(2.13)		(2.21)		(2.18)		(2.19)	
CFO	0.4175	***	0.4167	***	0.4184	***	0.4165	***	0.4190	***
	(10.65)		(10.59)		(10.68)		(10.58)		(10.68)	
FIXED	−0.0126	***	−0.0125	***	−0.0130	***	−0.0123	***	−0.0130	***
	(−2.87)		(−2.86)		(−2.96)		(−2.78)		(−2.95)	
BETA	0.0031		0.0031		0.0031		0.0032		0.0030	
	(0.59)		(0.61)		(0.59)		(0.62)		(0.58)	
BIG4	−0.0164	***	−0.0167	***	−0.0158	***	−0.0172	***	−0.0157	***
	(−3.34)		(−3.42)		(−3.22)		(−3.51)		(−3.22)	
LIST	−0.0203	***	−0.0201	***	−0.0200	***	−0.0211	***	−0.0196	***
	(−3.07)		(−3.03)		(−3.02)		(−3.18)		(−2.96)	
Intercept	−0.0884		−0.0867		−0.1037	*	−0.0707		−0.1074	*
	(−1.61)		(−1.61)		(−1.89)		(−1.33)		(−1.95)	
Indicator	None		None		None		None		None	
Industry/Year	Included		Included		Included		Included		Included	
Observations	8,739		8,739		8,739		8,739		8,739	
Adj-R^2	0.4771		0.4775		0.4770		0.4770		0.4774	

Table G3 (cont.). Panel regression results: ESG, innovation, and Sustainable Growth Rate (SGR)

Dependent Variable: Sustainable Growth Rate (SGR)										
	(1) ESG		(2) E		(3) S		(4) G		(5) Full	
(B) High-Technology Industries										
ESG_Total	–0.0059	*								
	(–1.72)									
E_Score			–0.0029						–0.0008	
			(–1.02)						(–0.25)	
S_Score					–0.0053	*			–0.0051	
					(–1.71)				(–1.50)	
G_Score							–0.0026		–0.0005	
							(–0.76)		(–0.14)	
RDI	–0.0038		–0.0268		–0.0745		–0.0025		0.0158	
	(–0.04)		(–0.49)		(–0.99)		(–0.04)		(0.19)	
ESG • RDI	–0.0437									
	(–1.16)									
E • RDI			–0.0540	*					–0.0574	*
			(–1.70)						(–1.84)	
S • RDI					–0.0119				0.0299	
					(–0.44)				(0.94)	
G • RDI							–0.0374	*	–0.0391	
							(–1.76)		(–1.58)	
Intercept	–0.1918	**	–0.2799	***	–0.2774	***	–0.1606	**	–0.2031	**
	(–2.44)		(–3.07)		(–3.00)		(–2.12)		(–2.56)	
Control Variables	Included		Included		Included		Included		Included	
Indicator	ISC = 1		ISC = 1		ISC = 1		ISC = 1		ISC = 1	
Industry/Year	Included		Included		Included		Included		Included	
Observations	4,000		4,000		4,000		4,000		4,000	
Adj-R^2	0.5252		0.5251		0.5245		0.5249		0.5252	
(C) Low-Technology Industries										
ESG_Total	–0.0026									
	(–0.80)									
E_Score			–0.0038						–0.0026	
			(–1.41)						(–0.84)	
S_Score					–0.0076	***			–0.0069	**
					(–3.05)				(–2.25)	
G_Score							0.0022		0.0049	*
							(0.77)		(1.71)	
RDI	–0.4443	*	–0.4952	***	–0.3318	**	–0.3829		–0.3153	*
	(–1.96)		(–2.74)		(–1.98)		(–1.51)		(–1.77)	
ESG • RDI	0.0920	*								
	(1.68)									
E • RDI			0.1357	**					0.3611	***
			(2.43)						(3.93)	
S • RDI					0.0541				–0.1924	*
					(1.48)				(–1.94)	
G • RDI							0.0712		–0.0223	
							(1.13)		(–0.23)	
Intercept	0.0632		0.0597		0.0306		0.0737		0.0382	
	(1.00)		(0.93)		(0.48)		(1.19)		(0.60)	
Control Variables	Included		Included		Included		Included		Included	
Indicator	ISC = 0		ISC = 0		ISC = 0		ISC = 0		ISC = 0	
Industry/Year	Included		Included		Included		Included		Included	
Observations	4,739		4,739		4,739		4,739		4,739	
Adj-R^2	0.4458		0.4470		0.4453		0.4457		0.4487	

Notes: (1) Numbers in parentheses represent z-values. (2) ***, **, and * represent significance at the 1, 5, and 10% levels, respectively. (3) All financial variables are winsorized at 1% and 99% levels. (4) Full variable definitions are provided in Appendix B.

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