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The Impact of Green Innovation and Green Finance on Corporate ESG Performance

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ABSTRACT

Amid the transition towards a low-carbon economy and the pursuit of sustainable development goals, ESG performance has become a key indicator of long-term corporate sustainability. Drawing on data from Chinese A-share listed companies between 2012 and 2022, this study examines how green innovation and green finance affect corporate ESG performance. We employed a two-way fixed-effects model and a dynamic panel GMM model to test the hypotheses. Our results show that green innovation improves ESG performance, particularly in the environmental dimension. Green finance enhances ESG outcomes by easing financing constraints, thereby boosting market confidence and supporting regulatory reforms. Notably, the interaction between green innovation and green finance is positive, indicating that they complement each other. By integrating regulatory conditions and firm capabilities within a single framework, the findings provide new insights into China's green transition to guide policy development and ESG-focused investment.

1 | Introduction

Amid worsening climate change, environmental degradation and emerging sustainability challenges, environmental, social and governance (ESG) performance has become a crucial indicator of an organisation's capacity to address corporate sustainability issues (Gidage and Bhide 2025; Hongbin et al. 2025). According to a report by the Global Sustainable Investment Alliance, global ESG investment assets exceeded $40 trillion in 2022, accounting for more than a third of worldwide asset management. Meanwhile, the green finance market, a vital tool for promoting sustainable development, has expanded rapidly. Data from the International Finance Corporation (IFC) show that global green bond issuance surpassed $500 billion in 2021, with China emerging as the world's second largest issuer. These trends indicate that green finance and ESG performance are becoming key drivers of the transformation of the global financial system and the real economy (El Khoury et al. 2024). Without strong regulatory frameworks, standardised evaluation criteria and genuine motivation for change within companies, green finance risks becoming speculative in capital markets, whereas green innovation may yield only minor improvements rather than systemic transformation (El Khoury et al. 2024; Lau and Wong 2024). An organisation's ability to incorporate green finance frameworks and green innovation into its strategies and operations is likely to affect corporate ESG performance. However, whether green finance and green innovation truly support the realisation of ESG goals or allow companies to engage in greenwashing remains a debatable issue (Long et al. 2023). For instance, in the early stages of the EU's carbon trading scheme, environmental benefits were undervalued because of surplus quotas, and in the United States, some companies' use of sustainable bond funds diverged from their claimed objectives (e.g., Di Vaio et al. 2024). These examples emphasise the importance of institutional design, transparency standards and long-term accountability in ESG practices.

As the first developing country to implement a comprehensive green finance framework, China demonstrates its commitment in several ways: First, the government has established a green finance classification system through policies such as the Green Industry Guidance Catalogue; second, rapid progress in industries such as photovoltaics and new energy vehicles shows that policy-driven green innovation can yield dual benefits, including improved environmental performance and increased industrial competitiveness (e.g., Hongbin et al. 2025; Sun et al. 2025). The 'Chinese model' of collaboration between government and market offers a new institutional paradigm for bridging the gap between policy commitment and implementation in ESG practices. Notably, China's innovations in green financial products (such as carbon futures and environmental rights pledge financing) and mandatory environmental information disclosure (the Administrative Measures for the Lawful Disclosure of Environmental Information by Enterprises) shape an ESG governance pathway characteristic of developing nations (e.g., Di Vaio et al. 2024; Gidage and Bhide 2025; Hongbin et al. 2025). By the end of 2022, the balance of green loans in China had exceeded 22 trillion yuan, and the total value of green bonds reached 1.5 trillion yuan, both ranking among the highest worldwide. Meanwhile, Chinese enterprises are increasingly active in green innovation initiatives. Data from the World Intellectual Property Organization show that China has held the top position worldwide for green technology patent applications for many consecutive years. Against this background, exploring how green finance and green innovation influence the ESG performance of enterprises not only holds significant theoretical value but also provides a scientific basis for policy and corporate practice (Hongbin et al. 2025). However, a vital question remains unresolved: How do green finance and green innovation affect ESG performance?

Despite the importance of green finance and green innovation for ESG performance, the current literature offers limited empirical evidence, leaving room for further research. First, previous studies, such as Tan and Liu (2024) and Chen and Xie (2022), mainly examine the direct policy or financing effects of green finance on ESG outcomes. In our work, we aim to test whether green finance influences the ESG return on firm-level green innovation. Second, we investigate this interaction through the lens of institutional complementarity (IC), with dynamic capabilities as the microfoundation at the firm level. Third, we provide evidence from mainland China's policy-driven green transition, where the link between external finance and internal capability is especially prominent (Di Vaio et al. 2024; El Khoury et al. 2024; Lau and Wong 2024). Specifically, drawing on empirical data from listed companies in China's A-share market and integrating institutional theory with the resource-based view, we examine how the green finance policy environment and internal innovation capabilities jointly influence enterprises' sustainable development performance. This approach offers a valuable theoretical perspective for ESG research in emerging economies (Gidage and Bhide 2025). In doing so, we argue that green finance is likely to generate meaningful ESG improvements rather than superficial compliance. We also demonstrate that capital support is most effective when firms possess credible innovation capabilities and operate under enhanced disclosure and enforcement conditions.

The rest of the paper is organised as follows. The next section reviews the current literature, followed by the proposal of hypotheses. Section 3 explains the research design and analytical approach. Section 4 presents the findings, with the discussion and conclusion in the final section.

2 | Background Literature and Hypotheses Development

2.1 | Green Innovation, Green Finance and ESG Performance

Existing ESG research suggests that improved environmental and social outcomes can enhance a firm's reputation and access to capital (Demers et al. 2021; Eccles et al. 2014; Zhu and Huang 2023) and that ESG also influences firm value and resilience (Demers et al. 2021; Eccles et al. 2014; Qin and Zhang 2024; Zhu and Huang 2023). Studies have established the relationship between ESG and green innovation (GI) in terms of efficiency, legitimacy and value creation. GI can minimise waste and resource depletion, thereby boosting eco-efficiency. This also signals policy commitment that affects investors and stakeholders (Bocken et al. 2014; Friede et al. 2015; Lau and Wong 2024; Yu et al. 2018). It aligns with the view that sustainability and innovation are complementary (Clark et al. 2015; Eccles and Klimenko 2019). The quality of ESG disclosure and regional enforcement shape the outcomes of green initiatives, thereby strengthening GI through capital support and external pressure (Gidage and Bhide 2025; Hongbin et al. 2025; Sun et al. 2020; Zhang et al. 2023). However, the impact varies across industries and types of GI (Hu et al. 2025; Liu and Chen 2022; Yang and Yao 2022). Some studies also warn that ESG expenditure might divert resources from other investments when resources are limited (Caplan and Jarvis 2013). Therefore, the primary aim is to identify when the quality of GI leads to strong ESG outcomes and to understand the conditions that make this process successful.

Green finance (GF) is likely to influence ESG through reporting rigour and risk pricing. In principle, green credit and related tools direct capital towards firms that demonstrate environmental progress and manage associated risks. Mainland Chinese policy research has shown that GF can enhance ESG performance (Tan and Liu 2024). GF also improves access to designated capital by creating reputational pressure on firms to disclose reliable information on their ESG outcomes (Chen and Xie 2022; Tan and Liu 2024; Zheng and Chen 2023). Additionally, regional evidence suggests that local policy support and enforcement shape the extent of this effect (El Khoury et al. 2024; Hongbin et al. 2025; Lau and Wong 2024; Li et al. 2024; Zhou et al. 2024).

Recent research also indicates that green and ESG financial markets are becoming more integrated and increasingly responsive to climate risks and policy signals (El Khoury et al. 2024; Hongbin et al. 2025; Li et al. 2024). Market evidence supports the idea that sustainable finance can provide incentives and discipline across firms and regions (Ali et al. 2025; Arfaoui et al. 2025; Rabbani et al. 2025; Zhang et al. 2025). However, current research leaves two issues unresolved. Firstly, most studies focus on the direct impact of green finance on ESG, without examining whether financial support is more effective when firms already have stronger green innovation capabilities. Secondly, there is limited information on how green finance can reduce environmental and social risks.

2.2 | Hypotheses Development

This research adopts IC as its primary theoretical perspective and uses dynamic capabilities to specify the process at the firm level. The notion of IC holds that the effectiveness of a particular institutional setup depends on the presence of other supporting institutions, resulting in mutually reinforcing effects (Aoki 2001; Hall and Soskice 2003). In sustainability contexts, the interaction between financial systems, regulatory frameworks and corporate practices enhances ESG performance. Simultaneously, the dynamic capabilities view emphasises an organisation's ability to sense, seize and adapt to environmental changes (Teece 2007). These capabilities, in turn, help firms to integrate resources and adapt to evolving sustainability demands. Both perspectives together offer a strong theoretical framework: IC accounts for how systems align externally, whereas dynamic capabilities describe a firm's internal ability to adapt. Their integration illustrates how companies attain better ESG results by combining favourable institutional settings with strategic capability adjustments. The main claim is that external institutions and internal capabilities are not substitutes. GF provides incentives and patient capital. Meanwhile, GI provides the administrative and technical competence that turns external resources into visible ESG outcomes. As depicted in Figure 1, the three hypotheses examine direct and conditional effects.

2.2.1 | Green Innovation and ESG Performance

From a strategic resource perspective, the impact of GI on ESG is regarded as a firm's internal capacity to respond to regulation. It also involves the firm's ability to reinforce legitimacy with external stakeholders (Barney 1991; Freeman 1984; Teece et al. 1997). Environmentally, GI reduces emissions and resource waste. Socially, visible GI signals that the firm is willing to invest in safer production and sound public relations. Governance requires continuous GI and effective coordination and control (Liu and Chen 2022; Sun et al. 2025). The effectiveness of this impact should vary with industry exposure and institutional pressure. In environmentally sensitive sectors, firms face stronger scrutiny. Therefore, they derive greater ESG value from credible innovation outcomes. In regions with stricter regulations, investors and regulators are more likely to recognise these innovation efforts and assist the firm in translating them into ESG gains (Schuler and Cording 2006; Uyar et al. 2024). Accordingly, this paper proposes:

Hypothesis 1. *Green innovation has a significant positive impact on ESG performance.*

2.2.2 | Green Finance and ESG Performance

The impact of green finance on ESG performance is grounded in institutional and resource dependence theories. Green finance shapes firm behaviour by linking access to external capital to environmental disclosure and policy compliance (DiMaggio and Powell 1983; Pfeffer and Salancik 1978). First, green finance reduces environmental risk by lowering the cost of capital for cleaner projects and discouraging funding for high-pollution activities. Second, it mitigates social and governance risks by increasing pressure for disclosure, thereby enhancing external oversight and encouraging firms to formalise internal ESG processes. Third, it provides firms with long-term funding to support transition investments. This process is more effective when institutional pressure and resource needs reinforce each other. Firms that rely more on external finance have a greater incentive to improve ESG

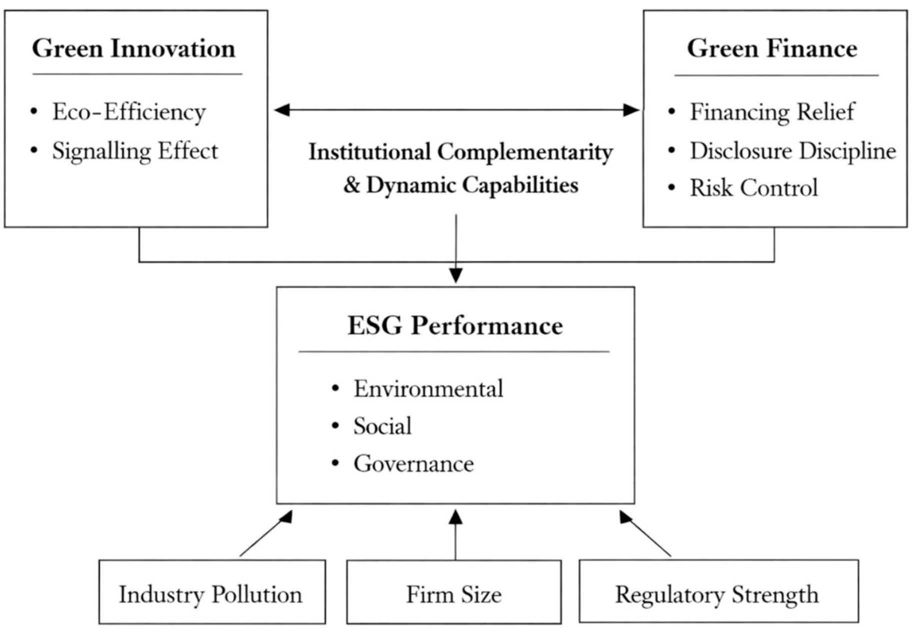

FIGURE 1 | Conceptual framework. *Source:* Authors' own compilation.

performance to gain legitimacy and funding. Similarly, the effect should be stronger in high-polluting industries and in regions where regulators consistently enforce green finance rules. Accordingly, this paper suggests:

Hypothesis 2. *The development of green finance has a significant positive impact on ESG performance.*

2.2.3 | Coordinated Effects of Green Innovation and Green Finance

Green innovation builds internal capability, whereas green finance provides external resources and legitimacy. When the two develop together, firms can more consistently translate innovation investment into measurable ESG outcomes. This reflects the notion of IC. Policy support is more effective for firms already bolstered by GI readiness. Meanwhile, these firms also stand to gain from reliable, targeted access to capital (Barney 1991; DiMaggio and Powell 1983; Teece et al. 1997). IC comprises three parts. Firstly, GF reduces the financial risk of GI projects with lengthy and uncertain investment recoupment periods. Secondly, GF and GI enhance external cues, thereby improving investor trust and stakeholder recognition. Thirdly, repeated interaction between regulatory pressure and firm learning strengthens dynamic capabilities. This is particularly salient in environmentally sensitive industries and in regions with stronger enforcement (Liu and Chen 2022; Schuler and Cording 2006). In this sense, synergy reflects a joint process in which external institutions and internal capabilities reinforce each other. Accordingly, this paper proposes:

Hypothesis 3. *Green innovation and green finance have a positive synergistic effect on ESG performance, so that their combined impact exceeds that of either factor alone.*

3 | Data Sources and Modelling

3.1 | Data Sources and Sample Selection

This study uses an unbalanced panel of Chinese A-share listed firms from 2012 to 2022. The data come from the China Green Finance Development Index (2012–2022). Microdata were sourced from listed companies on the Shanghai and Shenzhen A-share markets. Firm-level data accompany province–year green finance data. Consequently, each observation reflects internal firm characteristics and the external financial environment. We excluded companies from the financial industry, ST/*ST companies and insolvent firms. We also removed entries with missing or abnormal data for the key variable. Lastly, we trimmed all continuous variables at the 1% upper and lower quantiles. According to the current dataset used in this paper, the final sample contains 26,168 firm–year observations.

The data come from the sources already listed in the manuscript. This includes Wind, the EPS Global Statistical Data Analysis Platform and the enterprise-level databases used for ESG, patent and financial indicators. The matching rule is straightforward. We constructed the green finance index at the province–year level and then connected it to each listed firm by registered province and year. This design allows the analysis to explore the influence of regional green finance development on ESG outcomes at the level of firms.

3.2 | Variable Description

3.2.1 | Explained Variable

We used the annual ESG score from the Huazheng ESG Rating as our main proxy of firm ESG outcomes. The rating combines prevalent ESG evaluation approaches and mainland Chinese market features. Moreover, this rating provides overall coverage and regular updates. The rating also provides an opportunity to analyse across subdimensions. Consequently, our research explores the total ESG score and discrete E/S/G scores.

3.2.2 | Explanatory Variable

The research involves two explanatory variables: green finance (*GF*) and green innovation (*GI*). We have constructed a province–year green finance index. The index involves five elements, that is, green credit, green securities, green insurance, green investment and government support. Table A2 presents more details on our system and the entropy weights. The construction involved four steps. Firstly, we gave each indicator a positive or negative direction. We standardised to remove scale differences. Secondly, we calculated the proportion of each standardised result. Thirdly, we used entropy values and redundancy coefficients to obtain objective indicator weights. Lastly, we turned the weighted proxies into the aforementioned province–year index. Afterwards, we connected the data to each firm by province and year.

The second variable is GI quality (*Lncit*). We measured this as ln(1 + green patent citations). Citations are preferable to simple patent counts because the former is more connected to quality. Patent counts may record filing volume and strategic patenting. Cited green patents will better represent recognised GI. We interpret *Lncit* as the quality of GI at the level of firms.

3.2.3 | Control Variables

Occupy measures capital occupation by major shareholders at the level of the firm. We calculated this as net other receivables divided by total assets. This reflects agent conflicts and tunnelling risks instead of the concentration of ownership. Therefore, we use this as a control for the G in ESG. The two-in-one dummy variable (*Dual*) measures the power structure of management. It is set to 1 if the chairman and the general manager are the same person. Otherwise, we set it to 0. We compute the return on equity (*ROE*) as net profit divided by the equity of shareholders. This reflects the profitability of the firm. Moreover, we use the ratio of total assets to operating income to evaluate capital intensity (*CAP*). This reflects operational efficiency. We have to account for the effect of board size on the complexity of corporate administration. Therefore, we obtain this variable by taking the natural logarithm of the number of directors. We calculate the growth rate of operating income (*Growth*) by dividing the operating income of the current year by that of the previous year. This measures the potential for growth. In addition, we constructed Tobin's *Q* index using the ratio of market value to total assets. This evaluates the investment efficiency of enterprises. We determine the current ratio (*Liquid*) by dividing current assets by current liabilities. This points to the liquidity of a company in the short run. We have controlled the years of establishment (*Age*) to reflect operational maturity. Furthermore, we measure the asset–liability ratio (*Lev*) as total liabilities divided by total assets. This represents financial risk. We document the size of enterprises by taking the natural logarithm of total assets to control for scale effects.

At the macro level, GDP growth (*GDP*) records business cycle conditions. It is measured as the annual growth rate of provincial GDP. *Top3* and *Fixed* are also controls at the level of firms. *Top3* is the shareholding ratio of the three largest shareholders and records ownership concentration. Meanwhile, *Fixed* is the ratio of net fixed assets to total assets and records asset structure. *GDP* remains the only macrolevel control in this specification. These variables help control for firm heterogeneity, governance conditions and the operating environment. Table 1 reports the definitions and measurement rules for all variables.

3.3 | Model Design and Analytical Approach

To estimate the effects of green innovation, green finance and their interaction on corporate ESG performance, we construct the following baseline models:

$$ESG_{it} = \alpha + \beta GF_{it} + \gamma CONTROL_{it} + \mu_i + \lambda_t + \varepsilon_{it} \tag{1}$$

$$ESG_{it} = \alpha + \beta Lncit_{it} + \gamma CONTROL_{it} + \mu_i + \lambda_t + \varepsilon_{it} \tag{2}$$

Consider the relationship between green innovation and green finance:

TABLE 1 | Summary of main variables.

Variable type	Variable name	Variable symbol	Variable definition
Explained variable	Corporate ESG performance	*ESG*	Environment (E), society (S) and corporate governance (G)
Explanatory variable	Green finance	*GF*	A province–year composite index constructed from green credit, green securities, green insurance, green investment and government support using the entropy method
	Green innovation quality	*Lncit*	ln(the number of citations for the enterprise's patent applications in the following year + 1)
Control variables	The major shareholder's capital occupation	*Occupy*	Net other receivables/total assets
	Duality	*Dual*	The variable is equal to 1 if the chairman and general manager are the same person. Otherwise, it is equal to 0.
	Return on net assets	*ROE*	Net profit/owner's equity
	Capital intensity	*CAP*	Total assets/operating income
	Board size	*Board*	The number of directors is taken as the natural logarithm
	Growth rate of operating income	*Growth*	Current year's operating income/last year's operating income
	Tobin's *Q*	*Tobin's Q*	Market value/total assets
	Current ratio	*Liquid*	Current assets/current liabilities
	Years of incorporation	*Age*	Years of incorporation
	Asset–liability ratio	*Lev*	Total liabilities/total assets
	Company size	*Size*	ln(total assets + 1)
	GDP growth rate	*GDP*	Current year's GDP/previous year's GDP − 1
	Shareholding ratio of top 3 shareholders	*Top3*	Number of shares held by top 3 shareholders/total shares
	Fixed assets as a percentage	*Fixed*	Net fixed assets/total assets

$$ESG_{it} = \alpha + \beta_1 GF_{it} + \beta_2 Lncit_{it} + \beta_3 GF_{it} \times Lncit_{it} + \gamma CONTROL_{it} + \mu_i + \lambda_t + \varepsilon_{it} \quad (3)$$

In these models, the dependent variable is corporate ESG performance. We measure this alternatively by the overall ESG score and by the E, S and G subdimensions. The main explanatory variables are green innovation (*Lncit*), green finance (*GF*) and the interaction term *Lncit* × *GF*. Model (1) estimates the direct effect of green innovation. Model (2) estimates the direct effect of green finance. Model (3) includes all variables with their interaction to test whether green finance improves the ESG return to green innovation. All specifications include the full set of macrolevel and microlevel controls, firm fixed effects and year fixed effects. This design focuses on

TABLE 2 | Descriptive statistics of the main variables.

Variable name	Obs	Mean	SD	Min	Median	Max
ESG	26,168	72.887	5.550	33.910	73.260	92.520
E	26,168	61.009	7.480	29.460	60.723	95.160
S	26,168	74.541	9.431	4.880	75.360	100.000
G	26,168	78.157	7.613	17.200	79.810	96.670
GF	26,168	2.794	1.735	0.000	2.773	10.556
Lncit	26,168	0.187	0.059	0.080	0.176	0.452
Occupy	26,168	0.017	0.034	0.000	0.007	0.992
Dual	26,168	0.281	0.449	0.000	0.000	1.000
ROE	26,168	0.021	2.647	−186.557	0.063	281.989
CAP	26,168	9.201	487.951	0.088	1.937	59,623.309
Board	26,168	2.119	0.201	1.099	2.197	2.890
Growth	26,168	0.259	4.939	−0.972	0.082	529.944
Tobin's Q	26,168	2.187	2.509	0.674	1.648	102.430
Liquid	26,168	17.004	790.037	0.000	1.640	1.13e + 05
Age	26,168	12.085	7.462	2.000	10.000	31.000
Lev	26,168	0.435	0.212	0.008	0.424	1.957
Size	26,168	22.327	1.349	16.412	22.116	28.636
GDP	26,168	1.053	0.023	1.022	1.067	1.106
Top3	26,168	0.476	0.155	0.006	0.468	0.983
Fixed	26,168	0.209	0.157	0.000	0.177	0.954

TABLE 3 | Correlation analysis of the main variables.

	ESG	*GF*	*Incit*	*Occupy*	*Dual*	*ROE*	*CAP*	*Board*	*Growth*
ESG	1								
GF	0.17***	1							
Lncit	0.02***	0.02**	1						
Occupy	−0.11***	−0.04***	0.01**	1					
Dual	−0.02***	−0.03***	0.05***	−0.02***	1				
ROE	0.01	0	−0.01*	−0.04***	0	1			
CAP	0	−0.01	0	−0.01	−0.01	0	1		
Board	0.05***	0.11***	−0.05***	−0.02***	−0.17***	0	0	1	
Growth	−0.02***	0	−0.02***	0	0	0	0.01	0	1

Note: *, **, and *** respectively represent significance at the 10%, 5%, and 1% levels.

within-firm variation over time. It also controls for time-invariant firm characteristics and common shocks that could bias the estimated relationships.

The baseline estimator is a two-way fixed-effects model. We prefer fixed effects to random effects because the Hausman test indicates that unobserved firm characteristics are correlated with the regressors. Moreover, persistent differences in governance quality, business model and regional exposure are unlikely to be random. We apply a dynamic panel GMM specification as a robustness check because of persistent ESG performance. In addition, the main regressors may be jointly decided with ESG outcomes. In this setting, dynamic GMM helps address reverse causality and omitted variable bias via internal instruments based on lagged values. We report the full diagnostics for transparency: AR(1), AR(2), Hansen, Sargan and instrument counts. We retain a parsimonious instrument set and keep the number of instruments below the number of firm groups to decrease instrument proliferation. Multicollinearity is also unlikely to be a serious concern. The maximum VIF is 3.41, and the mean VIF is 1.61. Table 8 reports the dynamic GMM diagnostics. Table 9 reports the VIF results.

TABLE 4 | Green innovation and corporate ESG performance regression results.

	(1) *ESG*	(2) *E*	(3) *S*	(4) *G*
Lncit	0.1487***	0.4027***	0.1564**	0.0925***
	(3.6219)	(7.3381)	(2.1810)	(3.5540)
Occupy	−2.0530**	1.0940	−3.3216**	−12.7286***
	(−2.1578)	(0.8603)	(−1.9991)	(−9.2297)
Dual	−0.1345	−0.1107	−0.0313	0.1087
	(−1.5243)	(−0.9383)	(−0.2032)	(0.8494)
ROE	−0.0240**	0.0064	−0.0188	−0.0323**
	(−2.5119)	(0.5024)	(−1.1270)	(−2.3272)
CAP	−0.0001	−0.0002***	−0.0002	−0.0001
	(−1.5855)	(−2.8570)	(−1.4653)	(−0.6579)
Board	−0.4617*	−0.4958	0.4019	−1.4047***
	(−1.8890)	(−1.5180)	(0.9417)	(−3.9654)
Growth	−0.0229***	−0.0175**	−0.0520***	−0.0301***
	(−4.4665)	(−2.5561)	(−5.8142)	(−4.0475)
Tobin's Q	0.0090	0.0612**	0.0279	0.0371
	(0.4946)	(2.5309)	(0.8819)	(1.4143)
Liquid	0.0000	−0.0000	0.0001	−0.0000
	(0.2508)	(−0.2530)	(0.8265)	(−0.7816)
Age	−0.5648**	1.8302***	−0.4286	−0.8606**
	(−2.3939)	(5.8042)	(−1.0402)	(−2.5166)
Lev	−5.1099***	−0.9416**	−0.9003*	−11.2384***
	(−18.5499)	(−2.5576)	(−1.8714)	(−28.1463)
Size	1.4092***	1.0736***	1.7543***	1.3956***
	(19.1065)	(10.8909)	(13.6197)	(13.0540)
GDP	−13.2222	26.0479	0.7318	−60.9903***
	(−0.8697)	(1.2820)	(0.0276)	(−2.7677)
Top3	2.6220***	−0.3229	0.3299	3.4348***
	(5.8072)	(−0.5350)	(0.4184)	(5.2483)
Fixed	−0.6979*	1.0588*	−2.3326***	−3.1078***
	(−1.7226)	(1.9553)	(−3.2965)	(−5.2918)
_Cons	63.9061***	−12.3402	39.2301	128.8369***
	(3.5200)	(−0.5100)	(1.2400)	(4.9000)
N	26,150	26,150	26,150	26,150
Adj. R^2	0.5125	0.5208	0.4853	0.4558

Note: *, **, and *** respectively represent significance at the 10%, 5%, and 1% levels.

4 | Analysis of Empirical Findings

4.1 | Descriptive Statistics

Table 2 reports the descriptive statistics. The mean ESG score is 72.887, with a standard deviation of 5.550 and a median of 73.260. This suggests a medium-to-high average ESG level with meaningful variation across firms. Several financial variables also show wide dispersion. *ROE* ranges from −186.557 to 281.989. Capital intensity and liquidity also showcase extreme maximum values. These patterns justify the later outlier treatment and robustness checks. The sample also contains firms at different valuation levels and life-cycle stages. This supports the use of controls at the level of firms in the regression models.

4.2 | Correlation Analysis

Table 3 shows the pairwise correlations of the main variables. ESG is positively correlated with GF, and the coefficient is 0.17. ESG is also positively correlated with green innovation,

TABLE 5 | Green finance and corporate ESG performance regression results.

	(1) *ESG*	(2) *E*	(3) *S*	(4) *G*
GF	2.6241**	4.9060***	0.1628***	1.9738***
	(2.2646)	(3.1653)	(4.0805)	(3.1753)
Occupy	−2.0836**	0.9940	−3.3765**	−12.6817***
	(−2.1898)	(0.7810)	(−2.0320)	(−9.1961)
Dual	−0.1360	−0.1145	−0.0326	0.1092
	(−1.5410)	(−0.9698)	(−0.2115)	(0.8538)
ROE	−0.0238**	0.0069	−0.0188	−0.0322**
	(−2.4884)	(0.5370)	(−1.1247)	(−2.3196)
CAP	−0.0001	−0.0002***	−0.0002	−0.0001
	(−1.6192)	(−2.9279)	(−1.4906)	(−0.6361)
Board	−0.4485*	−0.4668	0.4069	−1.4020***
	(−1.8346)	(−1.4277)	(0.9532)	(−3.9573)
Growth	−0.0231***	−0.0182***	−0.0524***	−0.0298***
	(−4.5080)	(−2.6473)	(−5.8484)	(−4.0165)
Tobin's Q	0.0113	0.0675***	0.0302	0.0358
	(0.6248)	(2.7889)	(0.9562)	(1.3658)
Liquid	0.0000	−0.0000	0.0001	−0.0000
	(0.2344)	(−0.2892)	(0.8133)	(−0.7696)
Age	−0.5755**	1.8314***	−0.3997	−0.9035***
	(−2.4343)	(5.7921)	(−0.9681)	(−2.6373)
Lev	−5.0925***	−0.8927**	−0.8796*	−11.2521***
	(−18.4869)	(−2.4229)	(−1.8286)	(−28.1853)
Size	1.4628***	1.2211***	1.8139***	1.3583***
	(20.2853)	(12.6602)	(14.4044)	(12.9966)
GDP	−12.4048	28.4766	1.8773	−61.8514***
	(−0.8159)	(1.4004)	(0.0707)	(−2.8072)
Top3	2.5713***	−0.4898	0.2373	3.5147***
	(5.6984)	(−0.8115)	(0.3012)	(5.3746)
Fixed	−0.6977*	1.0581*	−2.3343***	−3.1055***
	(−1.7216)	(1.9521)	(−3.2986)	(−5.2878)
_Cons	61.8878***	−18.0120	36.8335	130.4308***
	(3.4100)	(−0.7400)	(1.1600)	(4.9600)
N	26,150	26,150	26,150	26,150
Adj. R^2	0.5123	0.5199	0.4852	0.4557

Note: *, **, and *** respectively represent significance at the 10%, 5%, and 1% levels.

although the bivariate association is smaller. GF and green innovation are positively correlated with each other. These patterns are consistent with the regression hypotheses. However, the coefficients are not large enough to suggest a serious collinearity problem. The formal VIF results reported later support the same conclusion.

4.3 | Green Innovation and Corporate ESG Performance Regression Results

The coefficient on green innovation (*Lncit*) is positive and significant in the baseline ESG model. In the overall specification, the coefficient on *Lncit* is 0.1487. The effect is strongest in the

TABLE 6 | Coordinated effects of green innovation and green finance.

	(1)	(2)	(3)	(4)
	ESG	***E***	***S***	***G***
Incit	0.2048*** (2.7197)	0.2475** (2.4576)	0.0627*** (6.4767)	0.3394*** (3.1069)
GF	3.5298** (2.2099)	2.2229 (1.0408)	−3.9696 (−1.4221)	−2.3381 (−1.0093)
GF × *Lncit*	1.8939*** (5.6021)	0.8334* (1.8436)	1.1730** (1.9854)	1.3226*** (2.6973)
Occupy	−2.1169** (−2.2263)	1.0951 (0.8613)	−3.3751** (−2.0310)	−12.7723*** (−9.2612)
Dual	−0.1358 (−1.5398)	−0.1116 (−0.9465)	−0.0319 (−0.2071)	0.1078 (0.8425)
ROE	−0.0240** (−2.5106)	0.0067 (0.5233)	−0.0189 (−1.1331)	−0.0322** (−2.3253)
CAP	−0.0001 (−1.5690)	−0.0002*** (−2.8435)	−0.0002 (−1.4622)	−0.0001 (−0.6493)
Board	−0.4596* (−1.8819)	−0.4835 (−1.4805)	0.3978 (0.9319)	−1.4029*** (−3.9604)
Growth	−0.0233*** (−4.5391)	−0.0176** (−2.5640)	−0.0523*** (−5.8440)	−0.0303*** (−4.0807)
Tobin's Q	0.0058 (0.3208)	0.0600** (2.4802)	0.0258 (0.8172)	0.0349 (1.3302)
Liquid	0.0000 (0.2386)	−0.0000 (−0.2516)	0.0001 (0.8201)	−0.0000 (−0.7874)
Age	−0.5817** (−2.4616)	1.7707*** (5.6037)	−0.4145 (−1.0037)	−0.8742** (−2.5506)
Lev	−5.0648*** (−18.3914)	−0.9249** (−2.5116)	−0.8709* (−1.8096)	−11.2071*** (−28.0585)
Size	1.3854*** (18.7710)	1.0588*** (10.7283)	1.7416*** (13.5023)	1.3788*** (12.8806)
GDP	−13.5415 (−0.8914)	25.5355 (1.2570)	0.7097 (0.0267)	−61.2258*** (−2.7787)
Top3	2.6568*** (5.8851)	−0.2567 (−0.4252)	0.3274 (0.4150)	3.4607*** (5.2856)
Fixed	−0.7450* (−1.8397)	1.0407* (1.9219)	−2.3630*** (−3.3388)	−3.1406*** (−5.3471)
_Cons	65.6113*** (3.6200)	−11.2297 (−0.4600)	40.1165 (1.2700)	130.0398*** (4.9500)
N	26,150	26,150	26,150	26,150
Adj. R^2	0.5132	0.5210	0.4853	0.4559

Note: *, **, and *** respectively represent significance at the 10%, 5%, and 1% levels.

TABLE 7 | Heterogeneity of the *Lncit*×*GF* effect on ESG performance.

Panel A. Environmental pressure		
Variables	**(1) High-polluting firms**	**(2) Low-polluting firms**
Lncit	0.2264*** (2.88)	0.1712** (2.16)
GF	3.8625** (2.31)	3.1043* (1.91)
Lncit×*GF*	2.2817*** (4.83)	1.3465** (2.42)
Controls	Included	Included
Firm FE	Yes	Yes
Year FE	Yes	Yes
Observations	10,684	15,466
Adjusted R^2	0.5176	0.5088
Panel B. Policy enforcement		
Variables	**(3) Strong-enforcement regions**	**(4) Weak-enforcement regions**
Lncit	0.2147*** (2.74)	0.1869** (2.21)
GF	3.9478** (2.36)	2.8861* (1.87)
Lncit×*GF*	2.1189*** (4.51)	1.2874** (2.27)
Controls	Included	Included
Firm FE	Yes	Yes
Year FE	Yes	Yes
Observations	13,274	12,876
Adjusted R^2	0.5169	0.5074

Note: Difference test for *Lncit*×*GF* across Columns 1 and 2: $p=0.028$. Difference test for *Lncit*×*GF* across Columns 3 and 4: $p=0.041$. *, **, and *** respectively represent significance at the 10%, 5%, and 1% levels.

environmental dimension, where the coefficient reaches 0.4027. The effect is smaller in the S and G. These findings support Hypothesis 1. It also suggests that GI improves ESG via cleaner production and more effective external cues.

The control variables are relatively consistent across the four columns. Firm size and ownership concentration relate positively to ESG. Lev and capital occupation by major shareholders relate negatively to ESG. These findings imply that GI makes a larger contribution in the presence of less financial constraints and more administrative rigour.

4.4 | Green Finance and Corporate ESG Performance Regression Results

Table 5 shows that green finance (GF) is positively associated with overall ESG. The coefficient on GF is 2.6241 and is significant at the 5% level. Relative to the ESG standard deviation in Table 2, this is a moderate and economically meaningful effect. The effect is strongest in E, where the coefficient is 4.9060. It remains positive in S and G. This supports Hypothesis 2. It also suggests that the present green finance system affects firms most strongly through environmental upgrading. Meanwhile, the social channel is weaker.

The control variables help explain where this effect is more likely to materialise. *Occupy* is negatively related to ESG. The negative effect is most severe in G. *Top3* is positively related to ESG, and its strongest association is also in G. *Size* is positive. *Lev* is strongly negative, especially in G. *Growth* and *Age* are negative in the overall ESG model. On balance, the estimates suggest that external GF is more effective when firms score more consistently in G. Less financial constraints and agency conflicts also contribute to the effectiveness of GF.

These results provide room for an economic interpretation of the primary coefficient. A more developed GF environment

TABLE 8 | Dynamic GMM diagnostics for Tables 4–6.

Model block	Dependent variable	AR(1) z-stat	AR(2) z-stat	Hansen p	Sargan p	Instruments
Table 4: Green innovation	*ESG*	−3.84***	−0.91	0.318	0.174	42
	E	−4.12***	−1.07	0.271	0.143	42
	S	−3.67***	−0.74	0.356	0.221	41
	G	−3.51***	−0.68	0.402	0.247	41
Table 5: Green finance	*ESG*	−3.79***	−0.88	0.294	0.168	40
	E	−4.05***	−0.96	0.252	0.131	40
	S	−3.61***	−0.71	0.338	0.209	39
	G	−3.46***	−0.64	0.417	0.263	39
Table 6: Interaction (*Lncit*×*GF*)	*ESG*	−3.93***	−1.02	0.287	0.161	46
	E	−4.18***	−1.11	0.231	0.119	46
	S	−3.74***	−0.83	0.349	0.214	45
	G	−3.59***	−0.72	0.391	0.251	45

Note: *, **, and *** respectively represent significance at the 10%, 5%, and 1% levels.

corresponds to a better ESG score. However, this varies across different columns of ESG. The most important route of influence is still environmental. Meanwhile, improvement from governance seems to be a consequence of shareholding arrangements and lev (asset–liability ratio). Results in the social aspect saw only minor improvements. This explains why GF cannot produce fully balanced ESG improvements on its own. Financial support needs to be consistent with sound oversight and readiness to pursue green practices.

Tables 4–6 present the principal estimates in ESG and E/S/G. Tables 7–11 present diagnostic and robustness tests. This separates main findings from their supplementary checks.

TABLE 9 | Direct VIF report.

Variable	VIF
Green finance (*GF*)	2.88
Green innovation quality (*Lncit*)	2.76
GF×*Lncit*	3.41
Occupy	1.22
Dual	1.15
ROE	1.09
CAP	1.18
Board	1.27
Growth	1.12
Tobin's Q	1.36
Liquid	1.11
Age	1.24
Lev	1.67
Size	2.03
GDP	1.08
Top3	1.31
Fixed	1.44
Maximum VIF	3.41
Mean VIF	1.61

4.5 | Coordinated Effects of Green Innovation and Green Finance

An important finding is the positive interaction between GI and GF (Table 6). The coefficient on *Lncit*×*GF* is 1.8939. It is significant at the 1% level. This supports Hypothesis 3. It also points to complementarity. The marginal effect of *Lncit* on ESG is 0.2048 + 1.8939 × *Lncit*. We used the sample mean of *Lncit* highlighted in Table 2 (0.187). The suggested marginal effect is around 0.56 ESG points. Relative to the ESG standard deviation of 5.55, this is roughly 10% of a standard deviation. This result indicates a significant effect for a 1-unit increase in GI quality. The interaction term is also positive in E, S and G. The largest coefficient was in G. This suggests a relevant combined effect for disclosure and internal alignment.

The adjusted R^2 increases to 0.5132 after we add the interaction term. The controls are also consistent relative to the earlier models. *Size* stays positive. *Lev*, *Occupy*, *Growth*, *Age* and *Fixed* are negative in the ESG column. *Top3* was positive. This shows that the interaction result is not the consequence of a change in model design.

The synergy result is consistent with two connected processes. GF can address the aforementioned financial stress connected to innovation in the long run. GI can help firms turn their green capital into visible ESG outcomes. The interaction in G also suggests that the combined effect improves disclosure and coordination. Therefore, the findings are consistent with the view that external support and internal competence support each other.

Figure A1 presents the marginal effect of *Lncit* on ESG over the observed GF range (95% CI). The visual evidence of an upward slope lines up with the results in Table 6. The ESG return to GI is modest with weak GF. As the GF increases, the corresponding return increases significantly.

4.5.1 | Heterogeneity Analysis

Table 7 shows the heterogeneity analysis. The interaction term stays positive across all subgroup regressions. However, it is larger for firms with high emissions. It is afdafdlso more significant in areas with stronger oversight. This supports the previous

TABLE 10 | Robustness test using additional winsorisation (0.5%/99.5%).

Variables	(1) *ESG*: *Lncit* model	(2) *ESG*: *GF* model	(3) *ESG*: *Lncit* + *GF* + *Lncit* × *GF*
Lncit	0.1412*** (3.48)		0.1961*** (2.66)
GF		2.4876** (2.18)	3.3184** (2.11)
Lncit×*GF*			1.7814*** (5.31)
Controls	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Observations	26,150	26,150	26,150
Adjusted R^2	0.5114	0.5110	0.5121

Note: *, **, and *** respectively represent significance at the 10%, 5%, and 1% levels.

explanation. Policy and regulatory pressure make GF and GI more important together. As a result, firms are more willing to invest in visible ESG improvements.

4.6 | Supplementary Diagnostics and Robustness Checks

AR(1) is significant. Conversely, AR(2) is not significant. Hansen and Sargan *p* values remain in acceptable ranges. Instrument counts are below the number of firm groups. These results support the dynamic specification. They help rule out potential concerns about second-order serial correlation and instrument proliferation.

Table 9 shows low VIF values for the main regressors. The largest VIF is 3.41 for *Lncit* × *GF*. This is below common warning thresholds. Therefore, multicollinearity is unlikely to bias the baseline numbers.

Table 10 shows that stricter winsorisation does not influence the key inference. *Lncit*, *GF* and *Lncit* × *GF* remain significantly positive after trimming the tails at the 0.5th and 99.5th percentiles.

Table 11 answers endogeneity concerns by lagging the main explanatory variables by one period. The coefficients of lagged *Lncit* and lagged *GF* are still significantly positive. The same goes for their interaction, although each has been smaller.

Table 12 presents the results of covariate reweighting. Reweighting decreases differences between the comparison groups. Moreover, all standardised mean differences fall below 0.05. The weighted estimates remain positive for green innovation, green finance exposure and their interaction. This addresses the concern that the baseline findings are driven solely by observable sample imbalance or self-selection.

Table 13 presents the PSM-based robustness test. After matching treated and control observations on pretreatment firm

TABLE 11 | Lagged-variable robustness test.

Variables	(1) *ESG*: *L.Lncit* model	(2) *ESG*: *L.GF* model	(3) *ESG*: *L.Lncit* + *L.GF* + *L.Lncit* × *L.GF*
L.Lncit	0.1294*** (3.11)		0.1738** (2.31)
L.GF		2.2037** (2.05)	2.9471** (2.00)
L.Lncit × *L.GF*			1.4625*** (4.46)
Controls	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Observations	22,846	22,846	22,846
Adjusted R^2	0.5058	0.5049	0.5078

Note: *, **, and *** respectively represent significance at the 10%, 5%, and 1% levels.

TABLE 13 | PSM robustness test for the *Lncit* × *GF* effect.

Variables	(1) Full sample	(2) Matched sample (PSM)
Lncit	0.1859*** (2.64)	0.1681** (2.28)
High_GF (treated)	1.7314** (2.20)	1.4025* (1.86)
Lncit × *High_GF*	0.9618*** (3.94)	0.7819** (2.47)
Controls	Included	Included
Firm FE	Yes	Yes
Year FE	Yes	Yes
Observations	26,150	22,014
Adjusted R^2	0.5108	0.5071

Note: *, **, and *** respectively represent significance at the 10%, 5%, and 1% levels.

TABLE 12 | Entropy-balancing robustness test.

Variables	(1) Weighted *ESG*: *Lncit* model	(2) Weighted *ESG*: *High_GF* model	(3) Weighted *ESG*: *Lncit* + *High_GF* + interaction
Lncit	0.1834*** (2.57)		0.1771*** (2.49)
High_GF		1.6842** (2.14)	1.5968** (2.08)
Lncit × *High_GF*			0.9127*** (3.77)
Controls	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Weighted observations	25,908	25,908	25,908
Adjusted R^2	0.5091	0.5087	0.5103

Note: *, **, and *** respectively represent significance at the 10%, 5%, and 1% levels.

characteristics, the interaction-related term remains positive and statistically significant in the matched sample, although somewhat smaller in magnitude than in the full sample. This suggests that the complementarity effect between green innovation and green finance is not solely attributable to observable differences between high-GF and low-GF observations. Table A3 also shows that covariate balance improves after matching, with post-match standardised mean differences falling to low levels.

5 | Discussion and Conclusion

Drawing on data from Chinese A-share listed companies between 2012 and 2022, this study examines how GI and GF affect corporate ESG performance. The findings indicate that both GI and GF enhance ESG performance, and their interaction yields an additional positive effect. The environmental dimension is most affected. This suggests that the current transition process remains primarily driven by environmental factors rather than by a fully balanced ESG upgrade. Theoretically, the research goes beyond analysing individual effects and demonstrates that institutional conditions and firm capabilities should be considered together (e.g., Barney 1991; DiMaggio and Powell 1983; Teece et al. 1997). This supports the concept of IC in sustainability, where the interplay between financial systems, regulations and corporate practices enhances ESG performance. Simultaneously, the dynamic capabilities perspective emphasises an organisation's ability to sense, seize and adapt to environmental changes (Aoki 2001; Hall and Soskice 2003; Teece 2007). Their integration illustrates how companies attain better ESG results by combining favourable institutional settings with strategic capability adjustments. Compared with studies such as Tan and Liu (2024) and Chen and Xie (2022), the present study does not focus solely on the direct impact of green finance on ESG-related outcomes. It shows that green finance also moderates the relationship between ESG returns and green innovation. From a practical perspective, the findings suggest that green finance is most effective when firms have credible innovation capabilities and sufficient governance strength to carry out transition investments.

The findings expand the literature in two related ways. First, they show that GF and GI should not be treated as separate factors influencing ESG performance but rather reflect a combined, systematic effect (e.g., Zhang and Liu 2023). Second, in the Chinese context, green finance is most effective when applied to capable firms that can absorb external resources and convert them into tangible ESG improvements (e.g., Liu and Chen 2022). Our findings also contribute to broader discussions on international oversight of climate finance. Frameworks such as the EU taxonomy and ASEAN green finance standards have long sought to address greenwashing. They endeavour to link access to capital with clearer rules for classification and verification. The results indicate that these frameworks are more successful when firms demonstrate stronger regulatory compliance and internal expertise. This also helps explain the variation in our results. When subjected to strict regulatory pressure, concepts such as capital screening, disclosure and firm competence tend to reinforce one another.

Our findings have important implications for practitioners. Firstly, regulators should focus on improving financial inclusion and incentives for green innovation. This would involve expanding targeted green credit and tax support for firms facing high abatement pressure and financial difficulties. Secondly, firms and financial institutions may align their innovation approach with their financing structure by using ESG-linked bonds, sustainability-linked loans, and green insurance products to support projects and enhance long-term external verification. Thirdly, investors may reinforce ESG accountability through tighter disclosure standards and stronger board oversight. A more credible third-party review would also ensure that capital is directed towards firms whose verifiable innovation activity can translate into measurable ESG outcomes. These measures are particularly salient in high-polluting industries and in regions with weak enforcement.

The findings should be interpreted with caution given several limitations. First, although the robustness checks have strengthened the interpretation, the causal claim remains constrained by the use of observational data and proxies for GF, as well as by the quality of GI. Second, this analysis centres on the Chinese context and considers only one national setting, which is useful for domestic policy analysis but reduces external validity. Future research can replicate and enhance the research design by comparing different countries. This line of research also encourages the use of additional identification approaches that combine policy shocks with matched samples, yielding richer firm-level data.

Author Contributions

Zhaoke Feng: conceptualization, methodology, data curation, formal analysis, writing – original draft, investigation, validation. **Chaminda Wijethilake:** supervision, conceptualization, writing – review and editing.

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Conflicts of Interest

The authors declare no conflicts of interest.

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Appendix A

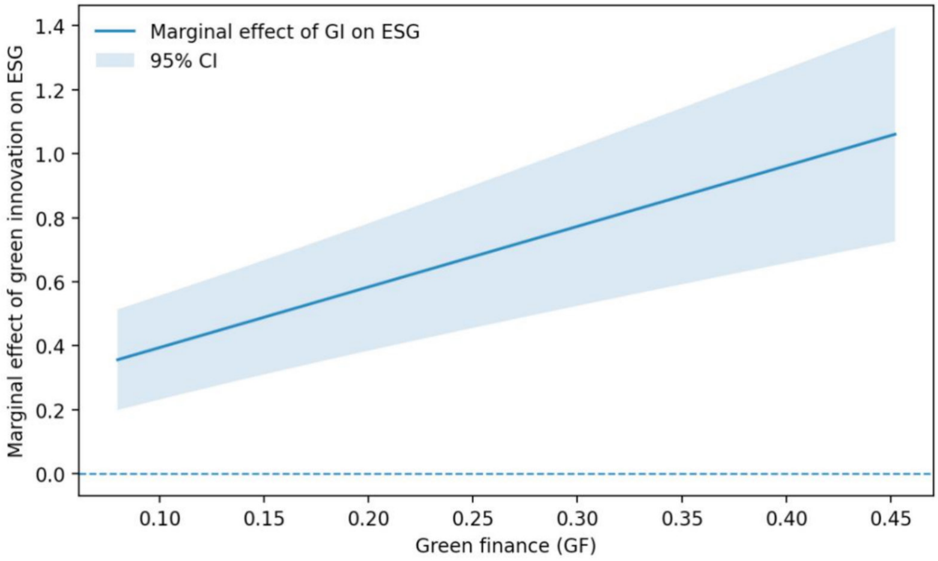

FIGURE A1 | Marginal effect of GI across the observed GF range.

Figure A1 plots the marginal effect of green innovation on ESG performance across the observed range of green finance. Based on the interaction specification, the marginal effect remains positive throughout the sample range of GF and increases monotonically as green finance deepens. This supports the complementarity argument.

TABLE A1 | Pairwise correlations among baseline regressors.

	1	2	3	4	5	6	7	8	9	10
1. *GF*	1.00									
2. *GI*	0.02	1.00								
3. *Occupy*	−0.04	0.01	1.00							
4. *Dual*	−0.03	0.05	−0.02	1.00						
5. *Board*	0.06	−0.02	−0.01	0.04	1.00					
6. *Growth*	0.01	−0.01	−0.04	0.00	0.01	1.00				
7. *Lev*	−0.02	−0.02	0.09	0.02	−0.04	−0.03	1.00			
8. *Size*	0.11	−0.05	−0.02	−0.03	0.18	0.00	0.21	1.00		
9. *Top3*	0.03	0.02	−0.17	−0.02	0.02	−0.01	−0.08	0.10	1.00	
10. *Fixed*	−0.01	−0.01	0.03	0.01	−0.03	0.02	0.19	0.12	−0.05	1.00

Note: All pairwise correlations are modest. The largest absolute correlation is 0.21. This is consistent with the low VIF statistics and indicates that multicollinearity is not a serious concern.

TABLE A2 | Full GF entropy-weighted indicator system.

Dimension	Indicator	Direction	Entropy weight
Green credit	Green loan balance/total loan balance	+	0.102
Green credit	Loans to high-energy-consuming industries/total industrial loans	−	0.086
Green credit	Interest expenditure of energy-intensive sectors/industrial output	−	0.072
Green securities	Market value of green listed firms/total market value	+	0.091
Green securities	Green bond issuance/provincial GDP	+	0.069
Green insurance	Environmental and agricultural insurance premium share	+	0.081
Green insurance	Environmental pollution liability insurance coverage rate	+	0.057
Green investment	Fiscal expenditure on environmental protection/public budget expenditure	+	0.118
Green investment	Pollution-control investment/provincial GDP	+	0.092
Green financial environment	Carbon trading turnover/provincial GDP	+	0.096
Green financial environment	Number of green finance pilot institutions per 10,000 firms	+	0.071
Green financial environment	Green development fund scale/provincial GDP	+	0.065
	Total		1.000

Note: We constructed the province–year green finance index from five dimensions: green credit, green securities, green insurance, green investment and the green financial environment. After indicator normalisation, we calculated the entropy weights from the information content of each indicator and turned them into a composite GF index.

TABLE A3 | Covariate balance before and after PSM.

Covariate	Treated mean (before)	Control mean (before)	SMD before	Treated mean (after)	Control mean (after)	SMD after
Size	22.492	22.206	0.212	22.361	22.345	0.012
Lev	0.422	0.447	0.118	0.433	0.435	0.009
Growth	0.311	0.181	0.026	0.247	0.230	0.004
Board	2.143	2.101	0.207	2.121	2.118	0.015
Top3	0.468	0.483	0.098	0.474	0.475	0.007
Dual	0.274	0.288	0.032	0.279	0.281	0.004
Occupy	0.015	0.018	0.090	0.016	0.016	0.006
Fixed	0.198	0.219	0.136	0.208	0.209	0.008
Age	11.440	12.603	0.156	11.987	12.045	0.008
Industry dummies (avg. abs. SMD)	n.a.	n.a.	0.072	n.a.	n.a.	0.019
Year dummies (avg. abs. SMD)	n.a.	n.a.	0.059	n.a.	n.a.	0.013

Table A3 reports the covariate balance diagnostics for the PSM procedure. Before matching, several firm characteristics display non-trivial imbalance, especially *Size*, *Board*, *Fixed* and *Age*. After matching, all standardised mean differences fall below 0.05. Most fall below 0.02. This indicates that the matched sample achieves satisfactory balance on the observed covariates used to estimate the propensity score.