

Article

The Effect of ESG Performance on Corporate Innovation in China: The Mediating Role of Financial Constraints and Agency Cost

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Abstract: The effectiveness of environmental, social, and corporate governance (ESG) performance has been widely discussed and is often linked to corporate financial performance or firm value by academics and practitioners. However, a significant research gap remains unexplored; specifically, prior scholars have ignored path research about the effect of ESG performance on corporate innovation, and they have also ignored the impacts of the heterogeneity of stakeholders. Therefore, taking China's A-share listed companies as an example, the research applied linear regressions with panel data, using the ESG rating of SynTao Green Finance Agency as a proxy variable of ESG performance. The results show that ESG performance significantly promotes the quantity and quality of corporate innovation and is mediated by alleviating the financial constraints and agency cost. Internal and external governance plays different roles; the higher institutional investors' attention as an external governance form does not help enterprises improve the quantity and quality of corporate innovation; however, CEO duality as an internal governance form strengthens the effect of ESG performance on corporate innovation. This study provides scientific evidence for the effect and effect path of ESG performance on promoting proactive innovation based on sustainable development in China; furthermore, the study reveals the heterogeneity factors of ESG performance on the innovation effect under stakeholder theory.

Keywords: ESG performance; corporate innovation; sustainable development; financing constraint; agency cost



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1. Introduction

As an important part and implementation subject of economic development, enterprises undertake the important task of improving China's innovation ability and promoting China's economy to achieve high-quality and sustainable development. Therefore, it is very important to explore how to improve enterprise innovation power and study the determinants of enterprise innovation ability [1]. Previous studies have shown that the determinants of enterprise innovation include internal factors and external factors. Among them, the internal factors affecting enterprise innovation include enterprise scale [2–4], enterprise capability [5,6], enterprise financing constraints [7,8], corporate governance [9,10], ownership structure [11–13], etc. The external factors include market structure [14], government support [15–17], industry characteristics [18,19], etc. There are challenges such as "large investment, high risk and long cycle" in enterprise innovation [20]. The enterprises lacking sustainable development ability and long-term stable income have difficulty in implementing innovation strategy. Stakeholder and sustainability management has been rapidly increased by public interest entities (PIEs) since the financial crisis of 2008–2009 and has aimed to increase environmental, social, and governance (ESG) performance [21].

ESG performance represents:

A business organization's configuration of principles of [environmental,] social [and governance] responsibility, processes of [environmental,] social [and governance] respon-

siveness, and politics, programs and observable outcomes as they relate to the firm's societal relationships [22].

Catherine Yeung, director of Fidelity International Limited, an asset management giant, said at an online global media conference in February 2021 that her team was excited by the prospect of innovation in China and would prefer to invest in companies adopting ESG, as firms embracing innovation may become winners in China over the long term. Therefore, the study of ESG performance is of great value to new development and to promoting the healthy development of the capital market [23]. At present, under the guidance of sustainable development, enterprises pay more attention to the values and expectations of stakeholders in the process of innovation, whether this is based on the innovation of technology or the innovation of market-oriented business models [24,25].

With regard to research, a few empirical studies have analyzed the CSR–innovation link. Previous studies have shown that complementary strategic decisions should be made regarding corporate social responsibility and innovation [26]. The newly formed corporate culture of social responsibility can promote corporate innovation [27]. However, some people hold the opposite view: if enterprises invest too much in social responsibility, consumers will think that the enterprises make excessive use of scientific research funds, that product quality cannot be guaranteed, and that enterprise performance will be reduced [28]. Although technological progress can promote green development, technological innovation tending toward green development will lead to higher costs [29]. These heterogeneous results can be mainly explained by heterogeneous theoretical foundations. Moreover, one difference between the two terms (ESG and CSR) is that ESG includes governance explicitly, and CSR includes governance issues indirectly as they relate to environmental and social considerations. Thus, ESG tends to be a more expansive terminology than CSR [30]. There is one study with a direct focus on the ESG rating event and innovation in China [31], but it focuses on the impact before and after the rating events, rather than on the impact of performance level. Prior scholars have ignored path research about effect of ESG performance on corporate innovation, and they have also ignored the impacts of the heterogeneity of stakeholders.

In order to explore the effect of ESG performance on corporate innovation, as well as the path of the effect, and further examine the impacts of the heterogeneity of stakeholders, we use the data on Chinese listed companies from 2015 to 2020 to examine the impact of ESG performance on the quantity and quality of corporate innovation output with panel data, using the ESG rating of the SynTao Green Finance Agency as a proxy variable of ESG performance through the ordinary least squares (OLS) regression analysis method, which is applied to overcome endogenous problems. Subsequent empirical verification demonstrates that the higher the ESG performance, the better it can simultaneously promote the quantity and quality of corporate innovation output. The information asymmetry theory and the sustainable development theory suggest that companies can alleviate financing constraints and agency cost, thereby promoting the quantity and quality of corporate innovation output. Furthermore, internal and external governance play different roles; the institutional investors' attention as an external governance form does not help enterprises improve the quantity and quality of corporate innovation; however, CEO duality as an internal governance form strengthens the association between ESG performance and corporate innovation.

The main contributions of this paper are as follows. (1) It enriches the research on the sustainable development factors affecting enterprise innovation. Studies have confirmed the incentivizing effect of social responsibility on enterprise technological innovation [32] and the innovation effect of environmental information disclosure [33]. Unlike the existing literature, this paper studies the impacts and specific mechanisms of ESG's comprehensive evaluation results in relation to enterprise innovation from the perspective of sustainable development, clarifies the specific impact paths involved, and enriches the research on the influencing factors of enterprise innovation. (2) It reveals the heterogeneity factors of the innovation effect on ESG performance. Institutional investors will pay more attention

to the ESG's rating results to consider whether they own shares; this research shows that the proportion of institutional investors does not affect the innovation effect of ESG, but the management governance will bring the difference and provide direction for regulators seeking to formulate macroeconomic policies in promoting ESG construction. (3) The present work also enriches the relevant literature on the economic consequences of the ESG rating. Unlike the existing literature, which mainly focuses on the economic consequences of enterprise ESG ratings from the perspectives of enterprise performance [34,35] and corporate value [36], this paper provides empirical evidence of the impact of enterprise ESG ratings on the capital market from the perspective of corporate innovation, which helps deepen the theoretical understanding of the economic consequences of the enterprise ESG ratings.

The remainder of this paper is organized as follows. Section 2 provides the literature review and hypotheses; Section 3 presents the research design; Section 4 puts forward the empirical test and result analysis; Section 5 is the robustness test; and Section 6 is the conclusion and the policy recommendations. Section 7 presents the limitations and future research.

2. Theoretical Analysis and Research Hypothesis

2.1. *The Impact of ESG Performance on Corporate Innovation*

ESG performance serves as an evaluation tool that helps investors to pay attention to environmental, social, and corporate governance performance. Studies have discussed the impact on enterprise innovation in three respects: the environment, social responsibility, and corporate governance. For example, an environmental information disclosure policy can significantly promote enterprise innovation [37], and enthusiasm for green innovation in high environmental risk industries is in turn significantly improved [38]. The fulfillment of corporate social responsibility contributes to the improvement of patent quality [39] and the level of green innovation [40]. The piloting of the boards of directors of central enterprises has significantly promoted innovation in state-owned listed companies [41]. Equity checks and balances have a positive effect on innovation investment [42]. Regarding the environment, social responsibility, and corporate governance, this can also improve enterprise innovation. As a result, the impact of ESG performance in enterprise innovation from the perspective of sustainable development is specifically reflected in the following two aspects.

First, according to the theory of information asymmetry, high ESG performance can improve the innovation level of enterprises by alleviating financing constraints. Due to the high uncertainty of the output of enterprise innovation activities, the innovation processes of enterprises are often not disclosed as trade secrets, exposing the external investors in the enterprises to serious information asymmetry and making them often unwilling to bear the high risk of enterprise innovation investment, resulting in strong financing constraints on innovation activities [43]. The performance of enterprises in ESG, as an evaluation of non-financial information disclosure, transmits more of the enterprise's characteristic information to banks and other creditors, reduces information asymmetry, and makes it easy for enterprises to obtain external financing [44,45]. A company with high ESG performance shows that it is willing and that it continues to implement green and innovative development, to guide and encourage enterprises to strengthen R&D and innovation investment, and to adopt energy-saving and environmental protection technologies.

Second, according to stakeholder theory and agency theory, high ESG performance can improve the innovation level of enterprises by reducing agency costs. From the perspective of corporate governance, the modern corporate governance mechanism based on stakeholders requires enterprises to not only protect the interests of shareholders but also to consider multiple external stakeholders. Enterprises that actively practice ESG can obtain the support of various stakeholders for future development, obtain the external resources required for development, improve enterprise efficiency [46], and create conditions to

carry out innovation activities. When enterprises fulfill ESG goals, they can consider the interests of management, improve their ESG rating, and better maintain their interests, which can make managers pay more attention to long-term enterprise development than to the medium- and short-term performance related to their personal interests. Considering the interests of internal and external stakeholders can help enterprises find more partners, share information and resources, and bear costs and risks when carrying out innovation activities. Therefore, fulfilling social responsibility goals and implementing environmental protection and governance can meet the expectations of all stakeholders and strengthen the relationship between enterprises and stakeholders to help enterprises obtain the resources needed for technological innovation and enhance their comprehensive advantages. Regarding company operation, when enterprises want to consider the interests of shareholders and consumers, they need to improve resource utilization efficiency, reduce resource consumption, and improve product effectiveness. This vision of enterprises is inseparable from innovation in production technology and management technology. Therefore, the implementation of ESG can encourage enterprises to carry out innovation activities. Isabel et al. (2018) pointed out that enterprises can reduce energy consumption and provide high-quality services through product and process innovation to meet the demands of stakeholders [47]. Thus, meeting the needs of stakeholders can become the driving force behind innovative practice. Based on the above analysis, this paper proposes Hypothesis 1.

Hypothesis 1 (H1). *ESG performance has a positive effect on corporate innovation output.*

2.2. The Mediating Role of Financing Constraints

Modern corporate finance theory holds that information asymmetry and agency make the cost of external financing higher than that of internal capital, resulting in the problem of financing constraints. Based on signal theory, by disclosing non-financial information to the market, enterprises can reduce the degree of information asymmetry between them and the investors, improve transparency and stakeholder involvement, and reduce the occurrence of enterprise opportunistic behavior [48]. Corporate social responsibility can help them shape a good social image, improve corporate reputation and public awareness, reduce the perceived risk of investors [49], and improve the credit rating and valuation of enterprises, in order to attract more potential investors to invest [50,51], so as to broaden financing channels [52]. ESG practices can release a positive signal to the capital market, help enterprises win the recognition and support of stakeholders, alleviate the market doubts caused by the investors' blocked access to information, and reduce the cost and resistance of enterprises in the financing process [45]. Enterprises with stronger ESG performance are more likely to have fewer equity funds [53], lower equity capital costs, and higher credit ratings [54]; to obtain more external capital; to reduce financing costs; to alleviate financing constraints; and to provide financial guarantees for enterprise R&D and innovation [55]. Hence, it can be inferred that financing constraints have a mediating effect on the relationship between ESG performance and corporate innovation output. The following hypothesis can be postulated:

Hypothesis 2 (H2). *Financing constraints mediate the relationship between ESG performance and corporate innovation output.*

2.3. The Mediating Role of Agency Costs

The return cycle of enterprise innovation activities is relatively long and has high levels of uncertainty. These characteristics make it difficult for management to obtain the personal benefits brought by innovation activities; therefore, they will have concerns when leading enterprises to carry out enterprise innovation activities [56]. According to stakeholder theory, enterprises can take into account the interests of management when engaging in social responsibility. The firms which have the better social responsibility

performance can solve the worries of management. The managers are willing to bear risks of investment to carry out exploratory innovation activities that are relatively risky but actually more important to long-term enterprise development [57]. The study shows that the management will actively carry out innovation activities while actively fulfilling social responsibilities in order to alleviate the agency costs faced by enterprises [58]. In other words, by improving performance in corporate social responsibility, management can alleviate the agency costs of the corporate governance system and better meet the requirements of the shareholders' interests. Consequently, it can be hypothesized that agency costs have a mediating effect on the relationship between ESG performance and corporate innovation output. The following hypothesis can be postulated:

Hypothesis 3 (H3). *Agency costs mediate the relationship between ESG performance and corporate innovation output.*

2.4. The Heterogeneity Role of Internal and External Governance

According to the theoretical analysis above, stakeholders have an impact on the implementation process and product innovation [59,60]. The ESG practice can reduce enterprise risks [61,62] to obtain the support of various stakeholders, especially the governance subject in the future development. As an important internal governance part of China's capital market, institutional investors play an important role in the external supervision of corporate governance [63,64]. Institutional investors have a stronger motivation to pay attention to and obtain the long-term value information of enterprises, rather than relying on short-term performance [65]. The attention of institutional investors will significantly improve a company's innovation performance, which is reflected in the increase in the number of patent authorizations [55], and the shareholding of institutional investors will significantly promote enterprise innovation [13,66]. Therefore, we anticipate that compared with enterprises with a low institutional shareholding ratio, enterprises with a high institutional shareholding ratio play a stronger role in ESG performance and promoting enterprise innovation.

The management is an important internal governance subject of the enterprise [67]. According to the higher-order theory, the heterogeneity between managers will affect the economic consequences of enterprises [68–70]. Scholars gradually pay attention to the impact of the enterprise leadership structure on enterprise innovation and development, especially the impact of the CEO duality on enterprises [71,72]. The CEO duality is conducive to enterprises increasing R&D investment [73] and to helping enterprises increase R&D output [74]. In terms of the impact on innovation decision making, Wu et al. [75] found that the attention of senior management teams to innovation is also positively regulated by the CEO duality. According to the housekeeper's theory, the CEO duality enables the general manager to have greater autonomy in making innovation and organizational change decisions [76], which can improve the general manager's innovation risk-taking ability and then increase the management's approval of innovation decisions [77]. In summary, we posit that compared with enterprises that do not have CEO duality, CEO duality plays a stronger role in ESG performance and promoting enterprise innovation. The following hypotheses can be postulated:

Hypothesis 4 (H4). *Compared with enterprises with a low institutional shareholding ratio, a high institutional shareholding ratio plays a stronger role in ESG performance and enterprise innovation.*

Hypothesis 5 (H5). *Compared with enterprises that do not have CEO duality, CEO duality plays a stronger role in ESG performance and enterprise innovation.*

3. Research Design

3.1. Sample Selection and Data Source

This paper takes the listed companies of the A-share markets achieving the ESG rating of the SynTao Green Finance Company from 2015 to 2020 as its research sample. The rating score is a quantitative evaluation of enterprise ESG performance. The samples were screened according to the following practices. First, we excluded listed companies, such as those involved in finance and insurance; second, we excluded (*) ST listed companies; third, we excluded cases with missing data. The ESG rating data mainly come from the SynTao GF-ESG rating data included in the Wind database. The information on which the rating is based includes ESG reports, social responsibility reports, sustainable development reports, annual reports, official website information, third-party data, etc. Other financial data are drawn from the CSMAR database. Patent data were collected and sorted manually from the China National Intellectual Property Administration (CNIPA). To alleviate the influence of extreme values on the empirical results, the tail of continuous variables was decreased to the 1% level. Finally, a total of 1070 firm-year sample observations were obtained.

3.2. Variable Definition

3.2.1. Corporate Innovation

Corporate innovation (Patent). The intangible characteristics of technological innovation complicate quantitative analysis. Patent data provide some of the few quantitative indicators used to study technological innovation [78–80]. This paper measures the innovation ability of enterprises by the number of patent applications. Invention patents promote technological progress and belong to high-tech innovation. The behavior of enterprises applying for “high-quality” invention patents is recognized as innovation quality [80], and the patent application year is used as the company’s innovation output year [81]. We use the natural logarithm of the number of patent applications and one to take the natural logarithm to measure the innovation level (Patent) and use the number of invention patents and one to take the natural logarithm to measure the innovation quality (InoPatent).

3.2.2. ESG Performance

The core explanatory variable of this paper uses the ESG evaluation data developed by the SynTao Green Finance Company (hereinafter referred to as SynTaoGF) to quantitatively evaluate an enterprise’s ESG Performance. In 2021, the ESG rating data were officially logged in the Bloomberg terminal, becoming the first local ESG rating agency data for China to be logged in the Bloomberg terminal; SynTaoGF is the first signatory of the United Nations principle of responsible investment (PRI) and the first evaluation and certification institution recognized by the climate bond standard (CBS) in China. It has obtained minority equity investment from Moody’s and been recognized by international authoritative professional credit rating agencies. It has become an important reference tool and basis for China’s A-share responsible investment institutions. The evaluation indicators of SynTaoGF ESG are divided into three levels, including 127 data items. In the evaluation result link, the SynTaoGF ESG rating is divided into 10 grades, from A+ to D. From high to low, they are A+, A, A−, B+, B, B−, C+, C, and C−. Weighted calculation is carried out according to the substantive factors of ESG in different industries, and finally, the comprehensive ESG score of each listed company is obtained. The sample data used in this paper include the ESG data of CSI 300 for 2015 to 2020. We assign rating grades 9–1, where ESG = 1 when the rating is C−; ESG = 2 when the rating is C; ESG = 3 when the rating is C+; and so on.

3.2.3. Control Variables

We control for factors that explain innovation, to isolate the pure effect related to ESG performance. As mentioned previously, we adopt an evolutionary perspective, in the belief that the probability of innovation depends on a mix of firm-specific characteristics and sector configurations [82,83]. The control variables of this paper refer to a company’s operation

level in terms of development ability (Growth), profitability (Roa), and solvency (Lev) [5,6]. The corporate governance level includes the shareholding ratio of the largest shareholder (TOP1), the proportion of independent directors (IDR), board size (Board), and the CEO duality (DUAL) [9–13] and observing and studying the internal decision-making level of the enterprises (IC) [84], representing external governance (InsHold) [64], representing the business period (AGE), and representing the corporate nature of enterprises (SOE), with the virtual variables set [11] as 1 for state-owned enterprises and 0 for non-state-owned enterprises. In addition, this study also controls the regression's industry fixed effects (IND FE) with the latest edition of the Guidelines for the Classification of Listed Companies in China and year fixed effects (YEAR FE). See Table 1 for specific variable definitions.

Table 1. Variable definition.

Variable	Symbol	Description
Innovation output	Patent	Natural logarithm of the sum of the number of patent applications and 1
Innovation quality	InoPatent	Natural logarithm of the sum of the number of invention patent applications and 1
ESG rating	ESG	The score is assigned as 1~9, from low to high, according to SynTao GF-ESG
Development capacity	Growth	Growth rate of operating income in the current period
Profitability	Roa	Profit margin of total assets in the current period
Solvency	Lev	Ratio of total liabilities to total assets at the end of the year
Ratio of the largest shareholder	TOP1	Ratio of the number of shares held by the largest shareholder to the total number of shares
Board structure	IDR	Ratio of the number of independent directors to directors
Board size	Board	Number of board directors
Company age	AGE	Natural logarithm of the company's listing years
Nature of equity	Soe	Dummy variable, 1 for state-owned enterprises and 0 for non-state-owned enterprises.
CEO duality	DUAL	Dummy variable, 1 for the chairman who serves as the general manager, otherwise it is 0
Shareholding ratio of institutional investors	InsHold	The number of shares held by institutional investors divided by the total number of shares
Risk control capability	IC	Internal control index of the Dibo database
Financing constraints	FC	Calculated by Models (4) and (5)
Agency cost	OER	Operating expense rate = management expense rate + sales expense rate
Industry	IND FE	The industry fixed effects
Year	YEAR FE	The year fixed effects

3.3. Model Setting

In this paper, regression Model (1) is set to test the impact of ESG performance on enterprise innovation, thus testing Hypothesis 1. The specific regression model is as follows:

$$\text{Patent}_{i,t} (\text{InoPatent}_{i,t}) = a_0 + a_1 \text{ESG}_{i,t} + a_i \Sigma \text{Controls}_{i,t} + a_3 \text{YEAR}_{i,t} + a_4 \text{IND}_{i,t} + \varepsilon_{i,t} \quad (1)$$

where $\text{ESG}_{i,t}$ represents the ESG rating obtained by enterprise I in T, and patent represents the enterprise's green patent. $\text{InoPatent}_{i,t}$ represents the enterprise's green innovation patent, a is the coefficient value, Controls is the control variable, and $\varepsilon_{i,t}$ is the residual value. The regression models of this paper control the time fixed effect and industry fixed effect, where the industry is set according to the 2012 industry classification standard of the China Securities Regulatory Commission. To control the influence of the heteroscedasticity of the error term and time-series-related problems on the standard error of the estimation coefficient, this paper adopts robust standard errors and clusters the errors at the company level.

The ESG performance is a comprehensive assessment of corporate environmental responsibility, social responsibility, and corporate governance based on the concept of sustainable development. High ESG performance relies on specific paths to play a role in an enterprise's capital and information acquisition and then affects the enterprise's innovation. According to the theoretical analysis of this paper, the following model, (2) and (3), is established to focus on how ESG can improve enterprise innovation by reducing financing constraints and alleviating agency problems. The median is the intermediary variable, and this paper tests the coefficient in turn β_1 and δ_2 .

$$\text{Median}_{i,t} = \beta_0 + \beta_1 \text{ESG}_{i,t} + \sum \beta_j \text{Controls}_{i,t} + \mu \text{YEAR} + \eta \text{ind} + \varepsilon_{i,t} \quad (2)$$

$$\text{Patent}_{i,t} = \delta_0 + \delta_1 \text{ESG}_{i,t} + \delta_2 \text{Median}_{i,t} + \sum \delta_j \text{Controls}_{i,t} + \text{YEAR} + \eta \text{ind} + \varepsilon_{i,t} \quad (3)$$

This paper uses the FC index to measure enterprise financing constraints. We refer to Gu [85] to establish model (4) and (5) to measure the degree of enterprise financing constraints:

$$P(\text{QUFC} = 1 \mid Z_{i,t}) = eZ_{i,t} / (1 + eZ_{i,t}) \quad (4)$$

Of which:

$$Z_{i,t} = \alpha_0 + \alpha_1 \text{size}_{i,t} + \alpha_2 \text{lev}_{i,t} + \alpha_3 (\text{CASHDIV}/\text{ta})_{i,t} + \alpha_4 \text{MB}_{i,t} + \alpha_5 (\text{NWC}/\text{ta})_{i,t} + \alpha_6 (\text{EBIT}/\text{ta})_{i,t} \quad (5)$$

The calculation of the financing constraint variable FC is as follows: (1) standardize the enterprise's size, age, and cash dividend payment rate according to the year and determine financing constraint virtual variable qufc according to the standardized mean value of the variables. Enterprises with an average value higher than the third quantile have fewer financing constraints, and the corresponding qufc is taken as 0. Enterprises below the third quantile have heavy financing constraints, and the corresponding qufc is taken as 1. (2) The logit model is used to fit the occurrence probability of the financing constraints of enterprises every year, and it is defined as the financing constraint index FC (the value is between 0 and 1). The greater the FC is, the more serious the financing constraint problem of the enterprises. Cashdiv in Model (5) represents the cash dividend announced in the current year; Ta represents total assets; NWC represents net working capital; and EBIT represents the EBIT. The second step is to perform a logit regression on Model (1), fit the occurrence probability p of the financing constraints of the enterprises every year, and define it as financing constraint index FC (value between 0 and 1). The larger the FC is, the more serious the financing constraint problem of the enterprises.

4. Analysis of Empirical Results

4.1. Descriptive Statistics

The descriptive statistical results in Table 2 show that the average ESG rating (ESG) of the sampled enterprises is 4.305, and the variance is 1.105, indicating that the average level of ESG ranges from B- ~ B. The ESG rating of the listed companies is uneven, with the lowest performance being grade C and the highest ESG rating reaching grade A-. The mean value of the enterprise innovation output (patent) is 2.166, and the standard deviation is 2.261, indicating that the average number of patents of the sampled companies is 8.72, and the maximum number of patents is 1988. There is great variation in innovation output. The average value of the enterprise innovation output quality (inopatent) is 1.45, indicating that the average number of patents among the sampled companies is 4.26, with great differences in innovation output. It may be that SynTaoGF chooses the CSI 300 index company for rating consideration; so, the company generally has a high shareholding ratio of investment institutions and a high level of risk control. The descriptive statistical results of the other control variables are basically consistent with those of the existing studies.

Table 2. Descriptive statistical results of variables.

Variables	N	Mean	Standard Deviation	Min	Max
ESG	1070	4.305	1.105	2	7
Patent	1070	2.166	2.261	0	7.595
InoPatent	1070	1.450	1.889	0	6.974
IC	1070	680.7	150.8	0	886.5
InsHold	1070	65.34	20.48	11.61	96.11
ROA	1070	0.0647	0.0567	−0.0445	0.238
LEV	1070	0.513	0.192	0.0868	0.895
DUAL	1070	0.212	0.409	0	1
GROWTH	1070	−0.108	0.383	−0.769	1.673
AGE	1070	16.35	6.621	3.052	27.81
SOE	1070	0.508	0.500	0	1

4.2. Analysis of Multiple Regression Results

4.2.1. Test of ESG Performance and Corporate Innovation

Table 3 reports the regression results for the ESG performance and enterprise innovation. To avoid the impact of the heteroscedasticity of disturbance items on the empirical results, this paper uses a firm-level clustering robust standard error. Columns (1) and (4) control the industry fixed effect and time fixed effect, and Columns (2) (3) (5) (6) add other control variables that may affect the innovation level of enterprises. The results show that ESG performance can significantly promote the innovation of enterprises. Taking Column (3) as an example, the coefficient of ESG is 0.3367, which is significantly negative at the level of 1%, indicating that the quantitative application of the ESG performance has significantly increased the number of enterprise patent applications. Column (6) shows that the coefficient of ESG is 0.3062, which is significantly negative at the level of 1%, indicating that the quantitative application of the ESG performance has significantly increased the number of enterprise invention patent applications. In an economic sense, an increase in the ESG performance of an enterprise will increase the natural logarithm of the number of enterprise patent applications by 33.67% and the self-recognized logarithm of the number of invention patent applications by 31%. This result shows that, subject to the needs of the enterprise's own development and the external environment, the enterprise has the motivation to enhance the R&D output and the quality of technological innovation, release the positive signal of practicing sustainable development to the outside world, cater to the values and ethics widely accepted by the public, and win the recognition and support of investors. Hypothesis 1 is verified.

Table 3. Regression results of ESG performance and corporate innovation.

	(1)	(2)	(3)	(4)	(5)	(6)
	Patent	Patent	Patent	InoPatent	InoPatent	InoPatent
ESG	0.3845 *** (6.58)	0.4693 *** (7.70)	0.3367 *** (5.79)	0.3883 *** (7.41)	0.3960 *** (7.59)	0.3062 *** (6.10)
IC		0.0015 *** (3.60)	0.0012 ** (3.20)		0.0011 *** (3.42)	0.0010 ** (3.26)
InsHold		−0.0155 *** (−3.69)	−0.0064 (−1.68)		−0.0146 *** (−4.53)	−0.0077 * (−2.49)
ROA		5.6452 *** (3.52)	5.3896 *** (3.83)		0.7771 (0.60)	0.9865 (0.85)
LEV		0.6434 (1.51)	2.8436 *** (6.20)		0.3939 (1.15)	2.3924 *** (6.30)
DUAL		−0.1123 (−0.71)	−0.0425 (−0.31)		−0.1989 (−1.54)	−0.1422 (−1.23)
GROWTH		0.1463 (0.91)	−0.1653 (−1.08)		−0.0177 (−0.13)	−0.2545 * (−1.98)

Table 3. Cont.

	(1)	(2)	(3)	(4)	(5)	(6)
	Patent	Patent	Patent	InoPatent	InoPatent	InoPatent
AGE		0.0319 ** (3.05)	0.0038 (0.40)		0.0254 ** (2.91)	0.0030 (0.37)
SOE		−0.2949 (−1.75)	−0.3172 * (−2.04)		−0.0258 (−0.18)	−0.0130 (−0.09)
TOP1		0.0034 (0.63)	−0.0026 (−0.53)		−0.0035 (−0.79)	−0.0079 (−1.89)
INDEP		0.0226 (1.83)	0.0396 *** (3.53)		0.0193 (1.90)	0.0306 ** (3.11)
BOARD		0.0742 (1.80)	0.1261 *** (3.53)		0.0584 (1.71)	0.1001 ** (3.19)
Cons	1.6889 *** (3.54)	−2.5598 ** (−3.17)	−3.2666 *** (−3.77)	−0.5232 (−1.19)	−1.8456 ** (−2.72)	−3.4717 *** (−4.42)
YEAR FE	Yes	No	Yes	Yes	No	Yes
IND FE	Yes	No	Yes	Yes	No	Yes
N	1070	1070	1070	1070	1070	1070
r2	0.2802	0.1018	0.3318	0.2319	0.1017	0.3012

Note: *, **, and *** are, respectively, the significant levels at 10%, 5%, and 1%; t statistics in parentheses.

4.2.2. Test of the Mediating Role of Financing Constraints

Columns (1) and (2) of Table 4 report the empirical results of the enterprise financing constraints measured by the FC index as intermediary variables. The results listed in Column (1) show that in the regression of ESG to FC, the ESG coefficient is -0.0075 , which is significantly negative at the 10% level, indicating a significant negative correlation between the ESG rating and the financing constraints and indicating that the good ESG performance of enterprises can reduce financing costs, reduce the degree of information asymmetry and alleviate the financing constraints faced by enterprises. In Column (2), after adding the intermediary variable, the ESG coefficient is 0.287 , which is significant at the 1% level, and the coefficient of FC is significantly negative. After considering the financing constraints, although the impact of the ESG rating on enterprise innovation is still positive, the impact coefficient decreases from 0.3367 in Column (3) of Table 3 to 0.287 in Column (2) of Table 4, and the corresponding t value decreases from 5.79 to 5.00 , which means that the addition of financing constraints reduces the impact of the ESG rating on enterprise innovation. According to the research of Wen et al. [86], the Sobel test is further carried out. The Sobel value is 0.0138 , and the Z value is 1.739 , which is significant at the 5% level. Financing constraints have an intermediary effect on the driving effect of the ESG rating on enterprise innovation; that is, a better ESG rating can result in more investment for enterprises and expand the source of funds for enterprise technological innovation activities by alleviating the financing constraints. The intermediary effect accounts for 21% of the total effect. Financing constraints have some intermediary effects and are economically significant.

Table 4. Results of the mediating role of financial constraints and agency cost.

	(1)	(2)	(3)	(4)
	FC	Patent	OER	Patent
ESG	−0.00724 * (−2.45)	0.287 *** (5.04)	0.0144 * (1.99)	0.309 *** (5.47)
FC		−2.272 *** (−3.37)		
OER				−0.394 * (−1.97)

Table 4. Cont.

	(1)	(2)	(3)	(4)
	FC	Patent	OER	Patent
IC	−0.0000239 (−0.95)	0.000870 * (2.34)	0.00000335 (0.09)	0.000925 * (2.43)
InsHold	−0.000828 *** (−4.06)	−0.00555 (−1.44)	−0.00171 ** (−3.25)	−0.00434 (−1.10)
ROA	0.215 * (2.55)	5.671 *** (4.03)	−0.0125 (−0.11)	5.178 *** (3.71)
LEV	−0.231 *** (−9.21)	2.612 *** (5.58)	−0.0764 (−1.76)	3.106 *** (6.82)
DUAL	0.00401 (0.65)	−0.0228 (−0.17)	0.000118 (0.01)	−0.0318 (−0.23)
GROWTH	−0.0118 (−1.56)	−0.202 (−1.31)	0.0476 ** (3.03)	−0.156 (−1.01)
AGE	−0.00135 ** (−2.85)	−0.00364 (−0.38)	0.00427 * (2.54)	0.00111 (0.11)
SOE	−0.0130 * (−2.11)	−0.450 ** (−2.80)	−0.0655 ** (−3.02)	−0.446 ** (−2.75)
TOP1	0.000378 (1.55)	−0.00229 (−0.48)	0.00106 (1.34)	−0.00273 (−0.56)
INDEP	−0.00117 ** (−2.89)	0.0382 *** (3.46)	−0.00297 ** (−3.23)	0.0397 *** (3.57)
BOARD	−0.00115 (−0.88)	0.134 *** (3.79)	−0.00809 * (−2.50)	0.133 *** (3.71)
_cons	0.347 *** (6.17)	−3.383 *** (−3.57)	0.134 (1.65)	−4.118 *** (−4.35)
YEAR FE	Yes	Yes	Yes	Yes
IND FE	Yes	Yes	Yes	Yes
N	1070	1070	1070	1070
r2	0.443	0.330	0.217	0.324
F	23.47	42.50	39.39	44.59

Note: *, **, and *** are, respectively, the significant levels at 10%, 5%, and 1%; t statistics in parentheses.

4.2.3. Test of the Mediating Role of Agency Costs

At present, two kinds of agency costs are recognized in academia: the agency contradiction between management and shareholders and the contradiction between major and minority shareholders. This paper studies the first kind of agency cost. As the main variable applied to investigate enterprise internal governance, the agency cost represents the absence of enterprise governance. Based on the research of Zhen [87], this paper adopts the operating expense rate (i.e., the sum of the management expense rate and sales expense rate) as the alternative variable of the agency cost. Columns (3) to (4) of Table 4 report the empirical results of taking the enterprise agency cost measured by the operating expense rate (OER) as the intermediary variable. The results listed in Column (3) show that in the regression of ESG to agency costs, the ESG coefficient is 0.0144, which is significantly negative at the 10% level. In Column (4), after adding the intermediary variables, the ESG coefficient is 0.309, which is significantly positive at the 1% level, and the agency cost coefficient is −0.394, which is significantly negative at the 10% level. We further carry out a Sobel test. The Sobel value is −0.0096, and the Z value is −1.366, which is significant at the level of 5%, indicating that agency cost plays an intermediary role in the driving effect of ESG ratings on enterprise innovation, and the intermediary effect accounts for 14.56% of the total effect. The agency cost has a partial intermediary effect that is economically significant.

4.2.4. Test of the Heterogeneous Effect of Internal and External Governance

(a) The Role of External Governance

To test H4, based on the above analysis, we find the 33% and 67% quantiles, take the first and last thirds of the samples, divide the samples into high and low sample groups, and use Model (1) for grouping regression. The results are shown in Columns (1) to (4) of Table 5. Columns (1) and (3) show the regression results of the sample group with a high shareholding ratio of institutional investors, and Columns (2) and (4) show the regression results of the sample group with a low shareholding ratio of institutional investors. A comparison of the regression coefficient and the significance of ESG in the high and low columns shows that both the ESG rating and the enterprise innovation level are significant. In terms of innovation levels, the coefficient of enterprises with a low shareholding ratio of institutional investors is 0.4277, and the enterprise coefficient of the shareholding ratio of institutional investors is 0.2709. The empirical p value of the coefficient difference between groups identified by the Chow test is 0.060, indicating that the ESG rating is indeed different in the groups with high and low shareholding ratios of institutional investors. The innovation effect of the ESG rating is more effective in the group with a low shareholding ratio, which shows that although the increase in the shareholding ratio of institutional investors has strengthened the investors' supervision over enterprises, the ESG rating has not further promoted the improvement of enterprise innovation, which is inconsistent with our expectations. From a review of past work, we find that some research shows that the research behavior of institutional investors below a certain threshold will promote enterprise innovation, but the research behavior of institutional investors above a certain threshold will inhibit enterprise innovation [88]. The above empirical results show that for enterprises with a high institutional shareholding ratio, a good ESG rating is not necessarily more conducive to the improvement of the enterprise innovation level. The higher the shareholding ratio of the institutional investors is, the better the resulting outcome. Beyond a certain limit, the good ESG ratings of enterprises have brought some external resources, but the influx of external resources has not promoted enterprise innovation.

Table 5. Results of the heterogeneous effect of internal and external governance.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Patent		InoPatent		Patent		InoPatent	
	High InsHold	Low InsHold	High InsHold	Low InsHold	DUAL (Y)	DUAL (N)	DUAL (Y)	DUAL (N)
ESG	0.2709 **	0.4277 ***	0.2062 **	0.4176 ***	0.3971 **	0.2686 ***	0.3703 **	0.2161 ***
InsHold	(3.26)	(3.71)	(2.97)	(3.93)	(2.80)	(4.29)	(3.24)	(4.28)
					0.0048	−0.0059	−0.0054	−0.0049
					(0.51)	(−1.36)	(−0.73)	(−1.40)
IC	0.0016 **	0.0004	0.0012 *	0.0007	0.0007	0.0011 **	0.0008	0.0008 *
	(2.68)	(0.53)	(2.27)	(1.00)	(0.57)	(2.60)	(0.95)	(2.35)
ROA	1.0117	4.9846 *	−6.4773 **	2.8012	2.1036	5.9202 ***	−2.5161	1.5660
LEV	(0.42)	(2.12)	(−3.14)	(1.44)	(0.67)	(3.71)	(−0.92)	(1.20)
	0.3492	5.0012 ***	−0.4010	4.2766 ***	1.9845	3.2488 ***	1.8309 *	2.7993 ***
	(0.40)	(6.10)	(−0.59)	(6.06)	(1.63)	(6.51)	(1.98)	(6.59)
DUAL	−0.0666	−0.1727	−0.3488	−0.0733				
	(−0.26)	(−0.78)	(−1.90)	(−0.37)				
GROWTH	0.2353	−0.8057 *	0.0278	−0.7098 *	−0.0517	−0.2429	−0.1875	−0.2992 *
	(0.89)	(−2.54)	(0.12)	(−2.48)	(−0.14)	(−1.39)	(−0.69)	(−1.97)
AGE	0.0189	−0.0088	0.0125	0.0086	−0.0041	0.0001	−0.0142	0.0025
	(1.08)	(−0.43)	(0.96)	(0.45)	(−0.17)	(0.01)	(−0.72)	(0.27)
SOE	−1.0081 ***	0.5427	−0.3132	0.6386 *	−0.7250 *	−0.3508	−0.3203	−0.0446
	(−4.08)	(1.77)	(−1.50)	(2.21)	(−2.08)	(−1.92)	(−1.06)	(−0.27)
TOP1	0.0397 ***	−0.0209 *	0.0312 ***	−0.0242 **	−0.0132	−0.0003	−0.0157	−0.0065
	(5.35)	(−2.18)	(4.69)	(−2.92)	(−1.08)	(−0.06)	(−1.50)	(−1.40)
INDEP	0.0583 ***	0.0548 **	0.0300 *	0.0586 ***	0.0668 **	0.0325 *	0.0448 *	0.0276 *
	(3.53)	(2.65)	(2.04)	(3.37)	(2.75)	(2.54)	(2.23)	(2.49)

Table 5. Cont.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Patent		InoPatent		Patent		InoPatent	
	High InsHold	Low InsHold	High InsHold	Low InsHold	DUAL (Y)	DUAL (N)	DUAL (Y)	DUAL (N)
BOARD	0.2308 *** (3.78)	0.0003 (0.00)	0.1662 ** (3.21)	−0.0345 (−0.55)	0.2374 ** (3.07)	0.1144 ** (2.78)	0.1671 * (2.45)	0.1015 ** (2.82)
_cons	−5.6959 *** (−4.59)	−2.3321 (−1.40)	−3.5602 ** (−3.08)	−4.1053 ** (−2.96)	−6.0528 ** (−2.81)	−3.5141 *** (−3.41)	−4.9816 ** (−2.93)	−4.1752 *** (−3.99)
YEAR FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
IND FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	356	357	356	357	227	843	227	843
r2	0.4048	0.4702	0.3335	0.4534	0.4147	0.3155	0.3982	0.2775
p value	0.060		0.024		0.041		0.022	

Note: *, **, and *** are, respectively, the significant levels at 10%, 5%, and 1%; t statistics in parentheses.

(b) The Role of Internal Governance

To test H5, taking the unity of these two roles as a dummy variable, the samples are divided into two groups, and the grouping regression is carried out using Model (1). The results are shown in Table 5. In Table 5, Columns (5) and (7) list the regression results for the enterprises combining the two roles into one, and (6) and (8) list the regression results of firms not combining the two roles. A comparison of the ESG regression coefficient and its significance shows that for enterprises with the two functions combined into one role, the coefficient between the ESG rating and the enterprise innovation level is 0.3971. For enterprises without the two roles combined, the coefficient valuation is 0.2686, which is significant at the 10% level. The empirical *p* value of the coefficient difference between the groups identified by the Chow test is 0.041, indicating differences in ESG ratings among enterprises with the two functions performed in one role. The above empirical results show that for enterprises with both roles performed in one position, because managers have a good understanding of the actual state of their enterprises, it is easy for managers to reach a consensus, judge whether enterprise innovation is feasible and operational, and have greater autonomy in making innovation decisions, which is conducive to increasing firm R&D output.

5. Robustness Test

5.1. Measurement Method for Replacing Explanatory Variables

This paper uses the SynTaoGF ESG rating to measure the core explanatory variable in the basic regression. In the robustness test, this paper also assigns the value according to the Huazheng ESG rating to obtain the core explanatory variable ESG rating (ESG2), which also adopts the assignment method. The Huazheng ESG index system is the mainstream ESG evaluation framework employed abroad, combined with the features of China's capital market and the characteristics of various listed companies, and it sets 26 key indicators, using the industry weighted average method for ESG evaluation. The Huazheng ESG rating is divided into nine grades of C, CC, CCC, B, BB, BBB, a, AA, and AAA in ascending order. The explanatory variable (ESG2) is constructed according to the above rating using the assignment method. A total of 9 grades of C ~ AAA are assigned as 1~9, respectively; that is, when the rating is C, ESG2 = 1; when the rating is CC, ESG2 = 2; and when the rating is CCC, ESG2 = 3. Columns (1) and (2) of Table 6 report the empirical results of using ESG2 as the explanatory variable. The coefficients of ESG2 are 0.3304 and 0.2811, respectively, which are significantly positive at the 1% level, indicating that the basic regression result is robust.

Table 6. Results of replacing explanatory variable and explained variable.

	(1)	(2)	(3)	(4)	(5)	(6)
	Patent	InoPatent	F.Patent	F2.Patent	F.InoPatent	F2.InoPatent
ESG2	0.3304 *** (5.88)	0.2811 *** (6.27)	0.3935 *** (6.37)	0.4268 *** (6.17)	0.3198 *** (6.25)	0.3443 *** (6.04)
IC	0.0009 * (2.32)	0.0007 * (2.42)	0.0009 * (2.25)	0.0001 (0.20)	0.0010 ** (3.06)	0.0007 (1.83)
InsHold	0.0002 (0.04)	−0.0012 (−0.45)	0.0006 (0.13)	−0.0008 (−0.15)	−0.0022 (−0.68)	−0.0042 (−1.12)
ROA	4.6625 *** (3.45)	0.3079 (0.28)	6.3050 *** (3.86)	9.3880 *** (4.71)	1.6603 (1.21)	4.0860 * (2.42)
LEV	3.3293 *** (7.48)	2.8991 *** (7.83)	3.6166 *** (6.69)	4.2453 *** (6.50)	3.2587 *** (7.19)	3.8337 *** (7.07)
DUAL	−0.0038 (−0.03)	−0.1048 (−0.95)	0.0218 (0.14)	−0.0705 (−0.37)	−0.0483 (−0.36)	−0.0599 (−0.38)
GROWTH	0.0247 (0.15)	−0.0470 (−0.35)	0.0773 (0.43)	0.0073 (0.04)	0.0174 (0.11)	−0.0795 (−0.44)
AGE	0.0137 (1.41)	0.0151 (1.86)	0.0228 (1.94)	0.0413 ** (2.85)	0.0209 * (2.10)	0.0316 * (2.56)
SOE	−0.4628 ** (−2.99)	−0.1309 (−0.96)	−0.4970 ** (−2.70)	−0.5395 * (−2.45)	−0.1533 (−0.93)	−0.2100 (−1.07)
TOP1	0.0014 (0.30)	−0.0033 (−0.82)	0.0022 (0.40)	0.0035 (0.52)	−0.0022 (−0.45)	0.0010 (0.16)
INDEP	0.0405 *** (3.73)	0.0316 *** (3.37)	0.0375 ** (3.04)	0.0246 (1.73)	0.0282 ** (2.60)	0.0210 (1.70)
BOARD	0.1503 *** (4.34)	0.1235 *** (4.13)	0.1410 *** (3.36)	0.0988 (1.95)	0.1227 *** (3.30)	0.1084 * (2.39)
_cons	−4.8988 *** (−5.22)	−4.9411 *** (−6.18)	−5.3043 *** (−5.10)	−4.9968 *** (−3.55)	−5.8042 *** (−6.47)	−6.7070 *** (−6.54)
YEAR FE	Yes	Yes	Yes	Yes	Yes	Yes
IND FE	Yes	Yes	Yes	Yes	Yes	Yes
N	1070	1070	803	589	803	589
r2	0.3570	0.3445	0.3694	0.3801	0.3536	0.3628

Note: *, **, and *** are, respectively, the significant levels at 10%, 5%, and 1%; t statistics in parentheses.

5.2. Replacing the Measurement Method of the Explained Variable

The observation period of the enterprise innovation behavior is defined as the number of patent applications and invention patent applications of the enterprise in the current year. In the robustness test, we express innovation behavior by delaying the number of patent and invention patent applications by one period and two periods, respectively, and substituting them into Model (1). The results given in Columns (3) and (5) of Table 6 show that the coefficient of the number of explained variable patent applications (F.Patent) lagging behind one period is 0.3935, which is significantly positive at the level of 1%, and the coefficient of the number of explained variable invention patents (F.InoPatent) lagging behind one period is 0.3198, which is significantly positive at the level of 1%. The normalization results show that the ESG rating will promote the innovation level of the next year. The results given in Columns (4) and (6) of Table 6 show that the coefficient of the number of explained variable patent applications (F2. Patent) lagging behind two periods is 0.4268, which is significantly positive at the level of 1%, and the coefficient of the number of explained variable invention patents (F.InoPatent) lagging behind two periods is 0.3443, which is significantly positive at the level of 1%. The normalization results show that the ESG rating will promote the innovation level in the next year. Moreover, the coefficient with a lag of two years is higher than that with a lag of one year, indicating that patent application takes time and has a lag, which is also consistent with previous research. It can be concluded that the result of the basic regression is robust.

5.3. Lag Effect of Explanatory Variable

In this paper, the explanatory variable (ESG) lags by one period and two periods to alleviate the two-way causality problem. The results listed in Columns (1) and (3) of Table 7 show that the coefficients of the explanatory variable (ESG_{t-1}) lagging behind one period are 0.3809 and 0.3018, which are significantly positive at the level of 1%, and the result of the basic regression is robust. In this paper, the explanatory variable (ESG) is lagged by two phases to alleviate the two-way causal problem. The results listed in Columns (2) and (4) of Table 7 show that the coefficients of the explanatory variable (ESG_{t-2}) lagged by two phases are 0.3436 and 0.2831, which is significantly positive at the level of 1%, and the result of the basic regression is robust. These results show that the ESG rating will promote the innovation level of the next year, and the coefficients lagging by two years and by one year are significant, indicating that patent application takes time and lags, which is also consistent with previous research. It can be concluded that the result of the basic regression is robust.

Table 7. Results of lag effect of explanatory variable.

	(1)	(2)	(3)	(4)
	Patent	InoPatent	F.Patent	F2.InoPatent
ESG	0.2857 *** 4.07	0.2838 *** 3.38	0.2797 *** 4.58	0.3006 *** 4.14
ESG_{t-1}	0.3809 *** (6.15)		0.3018 *** (5.99)	
ESG_{t-2}		0.3436 *** (4.87)		0.2831 *** (4.93)
IC	0.0018 ** (3.23)	0.0031 *** (4.16)	0.0017 *** (3.87)	0.0024 *** (3.59)
InsHold	0.0010 (0.23)	0.0002 (0.05)	−0.0018 (−0.53)	−0.0027 (−0.67)
ROA	5.2496 *** (3.34)	5.7089 ** (3.15)	0.1424 (0.11)	0.7481 (0.48)
LEV	3.7499 *** (7.49)	3.6703 *** (6.19)	3.2246 *** (7.47)	3.3313 *** (6.43)
DUAL	0.0598 (0.39)	−0.1359 (−0.74)	−0.0595 (−0.46)	−0.2179 (−1.43)
GROWTH	0.0134 (0.07)	−0.1614 (−0.61)	0.0319 (0.18)	−0.0969 (−0.42)
AGE	0.0177 (1.55)	0.0196 (1.39)	0.0181 (1.87)	0.0215 (1.80)
SOE	−0.6093 ** (−3.29)	−0.6844 ** (−3.00)	−0.2205 (−1.36)	−0.2684 (−1.35)
TOP1	0.0022 (0.38)	0.0005 (0.08)	−0.0028 (−0.58)	−0.0039 (−0.65)
INDEP	0.0433 *** (3.54)	0.0557 *** (4.14)	0.0337 ** (3.13)	0.0424 *** (3.56)
BOARD	0.1617 *** (4.08)	0.1641 *** (3.49)	0.1304 *** (3.70)	0.1331 ** (3.16)
_cons	−6.1302 *** (−6.16)	−7.3636 *** (−6.18)	−6.1845 *** (−6.46)	−7.5995 *** (−7.21)
YEAR FE	Yes	Yes	Yes	Yes
IND FE	Yes	Yes	Yes	Yes
N	803	589	803	589
r2	0.3803	0.3979	0.3623	0.3730

Note: ** and *** are, respectively, the significant levels at 5% and 1%; t statistics in parentheses.

5.4. Instrumental Variable Method

Referring to the method of Benlemlih and Bitu [89], the average ESG rating (av_ESG) of all the listed companies in the province where a company is registered in the same year

is selected as the instrumental variable. The ESG rating of each enterprise will be affected by the ESG rating of the other enterprises in the same province, and the ESG rating of the other enterprises is not directly related to the innovation behavior of the enterprise. In this paper, the two-stage least square method (2SLS) is used for instrumental variable regression. Column (2) of Table 8 reports the regression results of the first stage, and Column (3) reports the regression results of the second stage. In the first stage, the F value of Anderson Rubin Wald is 17.9573, passing the weak instrumental variable test. In the second stage, the coefficient of ESG is 0.4025, which is significantly negative at the 10% level, indicating that the conclusion that ESG can promote the innovation of enterprises is robust.

Table 8. Results of instrumental variable method.

	(1)	(2)	(3)
	OLS	First Stage	Second Stage
ESG	0.3367 *** (5.79)		0.4025 * (2.46)
AV_ESG	0.0012 ** (3.20)	0.9218 *** (14.05)	
IC	−0.0064 (−1.68)	0.0010 *** (5.61)	0.0008 (1.75)
InsHold	5.3896 *** (3.83)	−0.0058 *** (−3.38)	−0.0031 (−0.78)
ROA	2.8436 *** (6.20)	−1.5079 * (−2.41)	5.3055 *** (3.65)
LEV	−0.0425 (−0.31)	−0.2577 (−1.27)	3.1577 *** (6.76)
DUAL	−0.1653 (−1.08)	−0.0336 (−0.54)	−0.0253 (−0.18)
GROWTH	0.0038 (0.40)	0.0064 (0.09)	−0.1688 (−1.01)
AGE	−0.3172 * (−2.04)	0.0184 *** (4.16)	−0.0021 (−0.20)
SOE	−0.0026 (−0.53)	0.4178 *** (6.39)	−0.4711 ** (−2.75)
TOP1	0.0396 *** (3.53)	0.0018 (0.86)	−0.0030 (−0.64)
INDEP	0.1261 *** (3.53)	0.0155 *** (3.45)	0.0395 *** (3.75)
BOARD	0.3367 *** (5.79)	0.0183 (1.26)	0.1360 *** (4.08)
_cons	−3.2666 *** (−3.77)	−0.3527 (−0.51)	−4.8474 ** (−3.13)
YEAR FE	Yes	Yes	Yes
IND FE	Yes	Yes	Yes
N	1070	1070	1070
r2	0.3318	0.3491	0.3215
F	41.3670	17.9573	

Note: *, **, and *** are, respectively, the significant levels at 10%, 5%, and 1%; t statistics in parentheses.

6. Conclusions and Policy Recommendations

6.1. Conclusions

With the rapid growth of global ESG investment, regulators, investors, and enterprises have paid more attention to ESG. An increasing number of enterprises have begun to apply ESG practices in important decision making. ESG performance can be used to measure the performance of enterprises in sustainable development. However, the validity of ESG performance remains controversial in existing studies, with most studies focusing on the impact of ESG performance in developed countries. However, there is a lack of research exploring the role of ESG performance and its relationship with corporate

innovation in developing countries. This research contributes to the existing literature on sustainable development and corporate innovation behavior. Moreover, it provides further theoretical and empirical support for the previous study on the effectiveness of ESG practices and innovation in a framework that proposes ways in which ESG performance can promote corporate innovation through the use of internal and external resources and governance forms.

Specifically, taking China's A-share listed companies as an example, the research applied linear regressions with panel data, using the ESG rating of SynTao Green Finance Agency as a proxy variable of ESG performance. The results show that ESG performance significantly promotes the quantity and quality of corporate innovation and is mediated by alleviating financial constraints and agency cost. In this context, the higher the ESG performance, the more apparent is the promotion effect. Furthermore, institutional investors' attention does not help enterprises improve the quantity and quality of corporate innovation, and CEO duality strengthens the association between ESG performance and corporate innovation.

6.2. Theoretical Implications

This paper examines the mediating role and the determinants of the ESG–innovation link in the emerging markets. It provides evidence on the role played by the ESG–innovation link in alleviating financial constraints and reducing agency costs. The ESG–innovation link could be influenced by internal and external governance subjects. It enriches the research in the studies that has confirmed the incentivizing effect of CSR on enterprise technological innovation [32]. However, one difference between the two terms (ESG and CSR) is that ESG includes governance explicitly and CSR includes governance issues indirectly as they relate to environmental and social considerations. Thus, ESG tends to be a more expansive terminology than CSR [30].

Under stakeholder theory, the study reveals the heterogeneity factors of ESG performance on the innovation effect. We contribute to the prior literature by revealing different sides of the institutional investors in the ESG–innovation link. The prior literature shows that the shareholding of institutional investors will significantly promote enterprise innovation [65,66]. In line with a review of past work, we confirm the research of Peng (2021) that the behavior of institutional investors below a certain threshold will promote enterprise innovation, but the research behavior of institutional investors above a certain threshold will inhibit enterprise innovation [31].

Scholars believe that the CEO chair duality has different roles in the impact of innovation, and some studies show that CEO duality increases the positive effect between the processes of innovation [90,91]. In some, there is only weak evidence that duality status affects long-term performance [92]. This study clarifies that CEO duality is significantly promoted in the relationship between ESG and innovation. It provides evidence support for the positive regulation effect of CEO duality on the logical chain of innovation.

6.3. Managerial Implications

We put forward the following management and policy implications:

First, enterprises should strengthen their ESG practices and improve their ESG ratings. Enterprises should actively improve the disclosure and use of ESG-related information and actively increase capital investment in the field of ESG to improve enterprise ESG performance, enhance enterprise reputation, achieve higher market evaluation, effectively reduce agency costs, alleviate financing constraints, and then improve enterprise investment efficiency. Enterprises should embrace the ESG concept in product development, employee training, and project investment; cultivate environmental awareness; actively assume social responsibility; strengthen internal governance; improve investment efficiency; and realize their high-quality development. To obtain a higher return on ESG investment, enterprises should also increase their information disclosure so that investors, creditors, and other stakeholders can grasp the enterprise ESG rating in a more timely and accurate manner

to further support their development. This approach can jointly promote the building of enterprise core competitiveness and the promotion of long-term value.

Second, regulatory authorities should improve relevant systems and help enterprises practice ESG. As the Chinese market is in an emerging and transition stage, the external system still needs to be further improved. Regulatory and policy-making departments should strengthen and improve the ESG information disclosure system of listed companies and study and build a clear and feasible green financial standard system with domestic units, international standards, ESG ratings, and relevant information disclosure standards. Third, the capital market system must be improved to promote the effective transmission of information between the capital market and the enterprises; facilitate the effective and comprehensive transmission of the enterprise environment, social responsibility, and corporate governance information to the capital market; reduce frictions in capital allocation; alleviate internal and external information asymmetry; solve the financing problems of enterprises; and fundamentally promote the technological innovation of enterprises. These actions can stimulate the innovation vitality of enterprises and activate the microscale foundations of high-quality economic development.

7. Limitations and Future Research

This study has some limitations, which will require further research in the future.

First, this study used a single dimension of ESG measurement. However, some studies have shown that ESG has multiple dimensions for the E (environmental), S (social), and G (corporate governance) aspects of ESG for this rating method. This study chooses China's authoritative SynTao Green Finance rating method for the ESG rating. However, we did not obtain separate scores. This study faces certain challenges in evaluating the specific ESG aspects of listed companies and can only look at their effect on innovation from the overall level. Therefore, this study is not the final conclusion of the ESG performance for corporate innovation behavior. Hence, for a complete and detailed investigation, future researchers are advised to use a multi-dimensional ESG performance in future potential research. Secondly, the subject of this research was mainly China. Future research may select a wide range of subjects from other areas for research. Furthermore, China is an emerging country; therefore, future researchers can target developed countries and compare the results. Lastly, future researchers can modify the model to incorporate the current pandemic situation and empirically examine the impact of COVID-19 on ESG performance and innovation.

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