International Review of Financial Analysis 96 (2024) 103719

Contents lists available at ScienceDirect

International Review of Financial Analysis

journal homepage: www.elsevier.com/locate/irfa

Far-sighted through mitigating risk: Directors and officers liability insurance and corporate ESG performance

Runze Yang [a], Junwei Wu [b], Cunyi Yang [b,*], Khaldoon Albitar [c,*]

[a] *School of Finance, Shanghai University of Finance and Economics, Shanghai, China*
[b] *Lingnan College, Sun Yat-Sen University, Guangzhou, China*
[c] *Adam Smith Business School, University of Glasgow, United Kingdom*

A R T I C L E I N F O

JEL:
G22
G34
Q56

Keywords:
Directors & officers liability insurance
Corporate ESG performance
Corporate governance
Sustainable development

A B S T R A C T

Based on data from China A-share listed companies over the period 2011 to 2021, this paper explores the role of Directors & Officers Liability Insurance (henceforth referred to as D&O insurance) in enhancing the corporate ESG performance. Findings suggest that the procurement of D&O insurance effectively enhances corporate ESG performance, thereby improving societal appraisal of the corporation. Moreover, through employing mediating effect analysis, we find that D&O insurance not only mitigates corporate short-termism but also stimulates governance initiatives, and consequently elevates corporate ESG performance. Additionally, the positive impact of D&O insurance on a company's ESG performance demonstrates significant heterogeneity across different corporate ownership structures and levels of regional marketization. This paper presents compelling evidence supporting the promotion of D&O insurance alongside the progress of ESG frameworks in China. This dual approach significantly contributes to fostering sustainable development within the real economy.

1. Introduction

In the context of a globalized economy, corporate risk management strategies have gradually come under the intense scrutiny of investors, consumers, and regulatory bodies. Directors & Officers Liability Insurance (D&O insurance) serves as a pivotal element within these strategies, designed to shield company decision-makers from potential legal litigation and substantial compensation claims. With societal expectations of corporations intensifying, a company's ESG performance has become a critical metric for the public, shareholders, and other stakeholders to gauge the corporation's social responsibility and commitment (He, Guo, & Yue, 2024; Lian, Ye, Zhang, & Zhang, 2023; Yang, Zhu, & Albitar, 2024). D&O insurance, as a means of transferring the responsibilities for environmental, social, and governance issues from the management, introduces complex governance effects. How does the acquisition of D&O insurance influence a corporation's ESG performance? How should we comprehend the cause-and-effect relationship and the mechanism of influence between D&O insurance and a corporation's ESG performance? How does the effectiveness of D&O insurance vary among different types of corporations? Should publicly-traded companies employ D&O insurance to transfer decision-making risks and enhance stakeholder confidence in ESG investments? These questions form the crux of this paper's in-depth exploration and verification.

Historically, scholars have held varying opinions on the role of D&O insurance, supported by different theoretical underpinnings. Some argue that the introduction of D&O insurance can generate external supervision effects and internal incentive effects, thereby playing a proactive role in corporate governance (Boyer & Stern, 2014; Core, 1997; Core, 2000; Holderness, 1990; Jensen & Meckling, 1976; O'Sullivan, 1997). Others contend that the introduction of such insurance might negatively impact corporate governance, advocating for the opportunistic effect (Bhagat, Brickley, & Coles, 1987; Chalmers, Dann, & Harford, 2002; Gillan & Panasian, 2015; Jia, Mao, & Yuan, 2019; Lin, Officer, Wang, et al., 2013). In the context of ESG and corporate governance, the 2021–2023 strategy survey conducted by the United Nations Global Compact indicates that ESG performance attracts the attention of key stakeholders such as consumers, employees, and governments. Robust ESG advocacy can promote corporate development through aspects like revenue growth, cost reduction, decreased regulatory and legal intervention, increased production investment, and asset optimization (Nofsinger & Varma, 2014; Pástor, Stambaugh, & Taylor, 2021). Negative ESG news and disclosures can evoke pessimistic views

* Corresponding authors.
E-mail addresses: yangrz@163.sufe.edu.cn (R. Yang), wujw79@mail2.sysu.edu.cn (J. Wu), yangcy9@mail2.sysu.edu.cn (C. Yang), Khaldoon.Albitar@glasgow.ac.uk (K. Albitar).

https://doi.org/10.1016/j.irfa.2024.103719
Received 11 September 2023; Received in revised form 27 June 2024; Accepted 26 October 2024
Available online 28 October 2024
1057-5219/

or negative screening from various investment entities (Bolton & Kacperczyk, 2021; Derrien, Krueger, & Landier, 2021; Dilek, 2023; Hong & Kacperczyk, 2009; Hsu, Li, & Tsou, 2023). This suggests a connection between research on D&O insurance, ESG, and corporate governance.

In recent years, research on the influencing factors of ESG has exhibited multifaceted expansion. This includes the attention of sustainable investors (Martin & Moser, 2016), the emphasis of management on legitimacy, and the commitment and efforts of companies to sustainable development (Lee & Raschke, 2023; Saunila, Ukko, & Rantala, 2018). This includes the attention of sustainable investors (Martin and Moser, 2016), the management's emphasis on legitimacy, and corporate commitment and efforts towards sustainable development (Lee & Raschke, 2023; Saunila et al., 2018). Concurrently, the motivations of local government officials advancing to central positions and the environmentally relevant backgrounds of directors and executives have been confirmed to impact ESG (Husted & de Sousa, 2019; Li & Lu, 2020; Lin, Guan, Ho, et al., 2022). Subsequently, more in-depth research topics related to ESG, such as "greenwashing" and excess stock returns, have emerged (Rupamanjari & Sandeep, 2023; Saunila et al., 2018). This series of developments highlights the research value of ESG and its sustained impact in various domains.

To gain a comprehensive understanding of the academic literature on corporate ESG performance, this paper visualizes the temporal distribution and evolving trends of popular research topics in the international and corporate ESG performance fields. Specifically, this paper uses text mining and information visualization software (CiteSpace) to retrieve papers included in the core collection on Web of Science from 2012 to 2022. The main subject words used were "ESG" and "Environmental, Social and Governance," identifying a total of 450 papers. Fig. 1 displays the high-frequency keywords for "ESG" in each time period, demonstrating that ESG has become a hot topic in recent years. Related ESG topics include corporate financial performance, sustainable development, corporate social responsibility, corporate governance, portfolio selection, etc. The main related keywords retrieved have many topics related to corporate governance, which to some extent indicate a potential reliable association between D&O insurance and corporate ESG performance. Through statistical analysis of existing literature, it is evident that research related to the theme of ESG is quite abundant, and literature on factors influencing corporate ESG performance is growing rapidly.

In summary, there is no consensus on how the choices of corporate risk management practices impact corporate performance, and there is limited research on the correlation between D&O insurance and ESG in the academic community. Especially in China, with the rapid development of the ESG assessment system, corporate ESG performance is increasingly important in investment decisions. Understanding how D&O insurance affects corporate ESG performance holds significant value for corporate risk management strategies. Initially, this paper employs a dual fixed effects model regression to test the relationship between D&O insurance and corporate ESG performance. After deriving the basic conclusions, several robustness tests are designed to address endogeneity issues such as sample selection bias and measurement errors. Subsequently, based on theoretical assumptions, this paper conducts a mechanism test to examine how D&O insurance impacts corporate ESG performance. Specifically, it conducts a mediation effect analysis using corporate short-sightedness as a mediating variable. Following that, it conducts a heterogeneity test using corporate ownership property and the level of regional marketization as grouping variables for the heterogeneity analysis. Finally, based on all the theoretical and empirical studies, conclusions are drawn, and recommendations and directions for future research are proposed.

This paper provides two main contributions to the literature. First, by employing a spatiotemporal clustering distribution of literature, we show that there is a lack of research similar to this paper's theme both in China and other countries or regions. Previous research mainly focuses on the governance effect of D&O insurance or corporate governance factors that impact corporate ESG performance. To the best of our knowledge, this may be the first paper that explores the role of D&O Liability Insurance on corporate ESG performance. Secondly, we present a variety of novel and comprehensive impact mechanisms and theoretical frameworks, explaining how D&O insurance's enhancement effect on ESG performance is influenced by shareholder intentions,

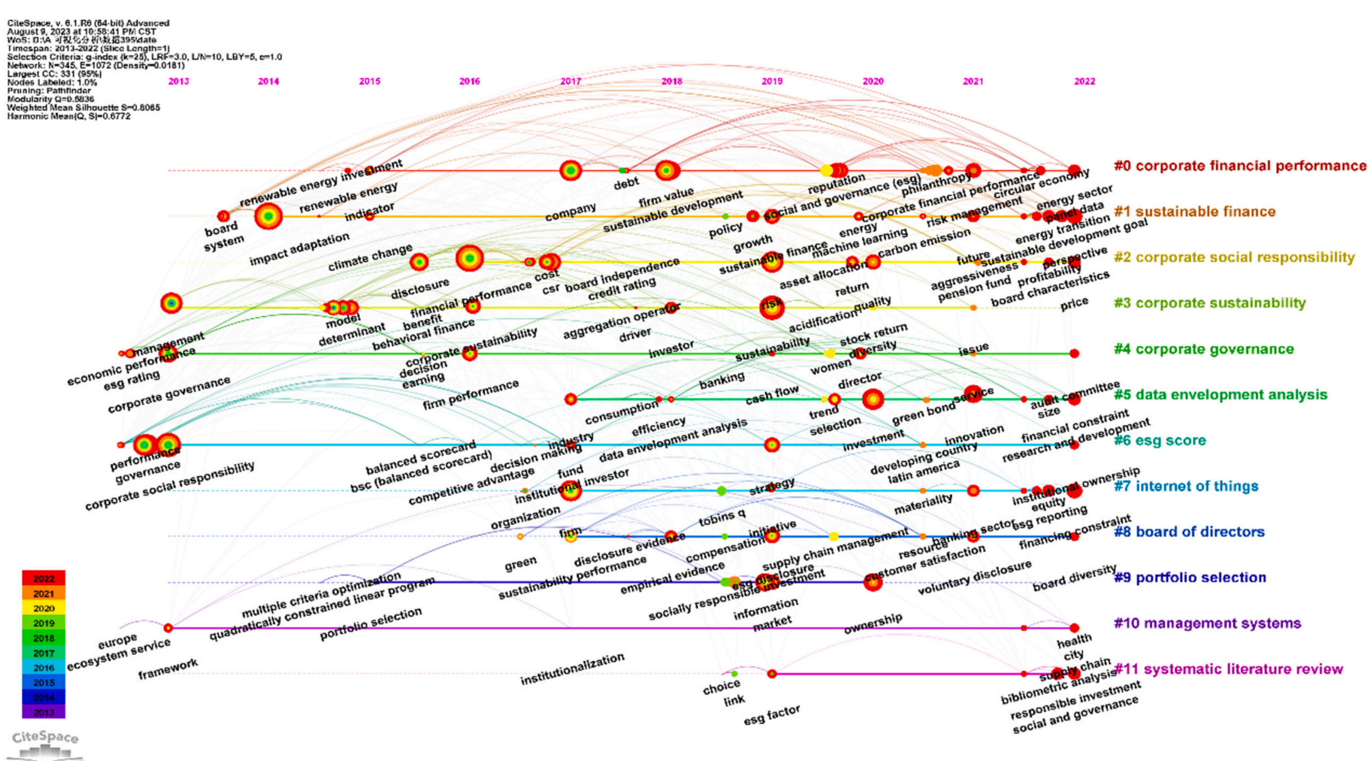

Fig. 1. Spatiotemporal Clustering Distribution of ESG Literature.

compensation of the insured, and corporate expansion strategies. By introducing the impact mechanisms and theoretical frameworks of various stakeholders, including investors, corporate executives and managers, we unveil the concealed connections between D&O insurance and corporate ESG performance. Our conclusion provides an ESG perspective on the choices in corporate risk management practices.

The remaining sections of this paper are arranged as follows: The second section is theoretical analysis and research hypothesis, where empirical hypotheses are proposed through logical inference. The third section is research design, where the sample, variables, and model are examined and expounded. The fourth section is empirical results analysis, where the specific association between D&O insurance and corporate ESG performance is tested, and robustness tests are performed to ensure the reliability of the results and alleviate endogeneity problems. The fifth section involves further research, mainly exploring important channels of influence and the heterogeneity of outcomes for companies. The sixth section primarily summarizes the conclusions of this paper, proposes corresponding policy recommendations, and provides an outlook for subsequent related research.

2. Theoretical analysis and research hypotheses

Over the past two years, with the evolution of sustainability reporting and integrated reporting, an increasing number of entities have recognized the importance of ESG (Environmental, Social, and Governance). Initially, their recognition may have been influenced by regulatory pressure and stakeholder expectations (Mailath & Samuelson, 2001). According to the theory of long-term interests, companies strive to maintain and restore their legitimacy among stakeholders by disclosing ESG performance. This disclosure helps them meet stakeholder expectations and establish robust relationships (DeVilliers, Venter, & Hsiao, 2017). Additionally, ESG disclosure has gained widespread acceptance among companies and is closely linked to a company's institutional background (Nirino, Santoro, Miglietta, et al., 2021). On one hand, companies disclose ESG data to enhance their reputation and counter regulatory threats. On the other hand, companies that disregard social norms and ethical values face severe consequences from socio-political forces and pressure groups. Moreover, according to the Resource-Based View (RBV), environmental and social activities can enhance a company's internal competitive advantage (Hull & Rothenberg, 2008). Therefore, companies are motivated to improve their ESG performance to access resources that influence the company's survival and development.

D&O Insurance can provide a “safety net” effect for management in terms of behavior and personal property (Wang, Zhang, Huang, & Zhang, 2020). However, research results regarding this “safety net” effect are polarized, with both positive and negative outcomes. Positively, D&O Insurance can encourage managers to make responsible decisions and enhance corporate ESG performance. In recent years, improper conduct related to ESG (Environmental, Social, and Governance) by companies has increasingly led to lawsuits or fines (Treepongkaruna, Kyaw, & Jiraporn, 2022). According to risk management theory, Directors and Officers (D&O) insurance, as a risk transfer tool, can mitigate management's concerns regarding potential legal and financial risks. Without insurance, management may hesitate due to personal financial risk (Park, 2023). D&O insurance, on the other hand, reduces the risk borne by management, thereby decreasing their hesitancy in implementing ESG strategies (Guan, Zhang, Zheng, et al., 2021). Furthermore, economic and management studies indicate that decision-makers tend to prioritize long-term outcomes when facing fewer short-term risks (Baron & Kenny, 1986). In modern corporations, management often faces pressure for short-term performance. The safety net provided by D&O insurance encourages management to make long-term and sustainable decisions, including investments in ESG projects. Although these projects may take time to yield benefits, they have a significant impact on the company's long-term sustainability and reputation.

Additionally, according to corporate risk management theory, a transparent governance structure can effectively reduce uncertainty and potential risks in a company's operations (Graham, Harvey & Rajgopal, 2005). D&O insurance, as a component of risk management, encourages management to enhance decision transparency because transparent decision-making processes can reduce misunderstandings and legal risks arising from poor governance. Legal studies indicate that transparency and openness are essential for reducing legal liability and improving corporate governance quality (Chua, Eun, & Lai, 2007). When management is aware that their decision-making processes and outcomes may face stricter scrutiny, they are more likely to ensure the transparency and accountability of these decisions, thereby supporting green technology innovation (Wang, Ma, Dong, & Zhang, 2023; Yang et al., 2024). This is an effective mechanism emphasized by policymakers and scholars for addressing environmental issues and enhancing corporate sustainability (Shi, Sun, & Lyu, 2023). Specifically, before a company purchases D&O insurance, insurance companies typically require the client company to appoint a sufficient number of independent directors to mitigate risks (O'Sullivan, 2002). Independent directors are more inclined to focus on business development and governance efficiency to demonstrate their diligence (Li, Yang, & Zhu, 2022). Moreover, the independence of independent directors enables them to make impartial judgments about the company's decisions and development strategies, prioritizing long-term development over short-term interests (Kallio & Nordberg, 2006).

Finally, when insurance companies provide D&O insurance, they typically evaluate the company's compliance and governance quality. This means that companies with robust compliance monitoring systems may receive more favorable insurance terms (Adams, Lin, & Zou, 2011). This serves as an incentive for companies to strengthen internal controls and compliance monitoring. Additionally, insurance companies, as external third-party regulators, participate in corporate governance, which can reduce information asymmetry and address concerns of external stakeholders about investments, thereby enhancing the availability of external financing.

However, when management knows they are protected by D&O insurance, they may become more complacent about risk. Lin et al. (2013) point out that this reduction in the cost of risk may lead internal oversight bodies to turn a blind eye to or even condone opportunistic behavior by management. In such cases, regulatory failures may result in increased operational and management risks. Jia and Tang (2018) further elaborate on how internal oversight bodies may overlook improper behavior by management due to the presence of D&O insurance, potentially harming corporate culture and governance structures. A strong corporate culture and governance are essential for maintaining sustainable operations and achieving good ESG performance. Furthermore, according to Gillan and Panasian (2015), D&O insurance may lead management to perceive a reduced contractual obligation to shareholders. This perception may motivate them to make riskier decisions without undue concern about potential liability. High-risk decisions may yield short-term benefits but can undermine the company's long-term development and operational stability. This shortsighted behavior can lead to a deterioration in the company's ESG performance, especially when these decisions involve environmental risks, social responsibility, and governance issues.

Hence, we propose the following opposite hypotheses regarding the impact of D&O insurance on corporate ESG performance:

H1a. : Ceteris paribus, the purchase of D&O insurance improves corporate ESG performance.

H1b. : Ceteris paribus, the purchase of D&O insurance reduces corporate ESG performance.

3. Research design

3.1. Sample source

The initial research sample for this study comprises all the China A-share listed companies from 2011 to 2021, organized into enterprise-year panel data. The explained variable, corporate ESG performance data, is derived from the Huazheng ESG database, while the explanatory variable and all other variable data are obtained from the WIND and CSMAR databases. To ensure data reliability, the sample data is processed as follows: (1) Companies in the finance and insurance sectors are excluded; (2) All ST and PT company samples are removed; (3) All samples with missing values are excluded; (4) To avoid sample outlier issues, a 1 % tail-trimming treatment is performed on continuous variables. The industry classification in this paper is based on the classification standard announced by the China Securities Regulatory Commission in 2012, while the codes of excluded finance and insurance companies are according to the 2001 classification standard. Ultimately, a total of 19,870 observations are obtained, and the data processing and empirical regression are performed with Stata17 software.

3.2. Main variable definition and description

The explained variable in this paper is corporate ESG performance. In the existing literature, the majority of scholars directly use the ESG scores from third-party rating agencies. However, some scholars have constructed their ESG evaluation methods, such as Ferriani (2023), who used the principal component analysis method to construct proxy indicators for the E, S, and G dimensions. However, this method, where researchers construct their ESG evaluation system, not only involves some subjectivity but also may result in an inadequate coverage of the evaluation. Therefore, this paper uses the ESG scores of each company derived by third-party rating agencies as the explanatory variable. Foreign third-party agencies have relatively mature ESG rating systems, including ESG ratings from professional data companies such as FTSE Russell, MSCI, and Dow Jones, as well as ESG ratings from NGO background international organizations. However, the construction of ESG ratings in China started late, so there are fewer third-party agencies that have constructed a complete ESG rating system, including the ESG rating constructed by the Green Finance Research Institute of the Central University of Finance and Economics, Zhongchengxin Green Gold's ESG rating, SynTao Green Finance's ESG rating, and Huazheng's ESG rating. Huazheng's ESG evaluation system is divided into nine levels: AAA, AA, A, BBB, BB, B, CCC, CC, and C (from highest to lowest). This paper assigns ESG scores of 9 to 1 according to the rating.

At present, empirical papers on D&O insurance in the academic world mainly use two methods to measure D&O insurance: (1) By manually searching for information about D&O insurance purchase decisions in corporate annual reports, shareholder meeting announcements, etc., and assigning values. If it can be determined that the company has insured D&O insurance, it is assigned a value of 1, otherwise, it is assigned a value of 0. This is the measurement method widely used in previous research; (2) Using the D&O insurance premium disclosed by listed companies in corporate annual reports and shareholder meeting announcements as a measure of director liability risk. Due to the varying quality of information disclosure, the second measurement method has a smaller application range. This paper selects the first D&O insurance measurement method, that is, by searching announcements, manually sorting data, supplemented by the China Research Data Service Platform (CNRDS) database, and verified by the China Securities Information Network to ensure the completeness and reliability of the research data. Further, following the practice of Zou, Wong, Shum, et al. (2008), a 0–1 dummy variable is used to represent whether D&O insurance is purchased. The symbol for the determination of D&O insurance by a listed company is as follows: If it is clearly mentioned in the publicly released board of directors' announcement, shareholder meeting resolution, etc., and the board of directors and the shareholder meeting have voted and passed, then assign a value of 1, otherwise assign a value of 0.

To ensure that the regression results more accurately reflect the impact of D&O insurance on corporate ESG performance, this paper selects the following variables as control variables for research, referring to other empirical literature related to the theme of this paper: debt to assets ratio (LEV), company size (SIZE), cash flow ratio (CASH), total asset net profit rate (ROA), operating income growth rate (GROWTH), company age (AGE), property rights nature (SOE), top ten shareholders' shareholding ratio (TOP10), dual positions (DUAL). For readability and data completeness, this paper conducts standardized treatment of the control variable data by taking logarithms or adjusting the order of magnitude. The specific variable definitions are shown in Table 1 as follows.

3.3. Model construction

The following model was constructed in the benchmark regression of this study, as shown in Eq. (1):

$$ESG_{it} = \alpha_0 + \alpha_1 DO_{it} + \alpha_2 \sum Controls + \sum Industry + \sum Year + \varepsilon_{it} \quad (1)$$

In the above formula, i represents the company, t represents the year, and ε_{it} represents the disturbance term. *Controls* refers to the control variables listed earlier, which have been uniformly abbreviated for simplicity. Moreover, to control the influence of economic cycles and industry differences on regression results, this study has controlled for industry fixed effects (Industry) and yearly fixed effects (Year).

4. Empirical results and discussion

4.1. Descriptive statistics

Table 2 presents the descriptive statistical results of the primary variables utilized in this study. From the data, one can discern that the mean value of corporate ESG performance is 4.156. The highest rating for corporate ESG performance stands at Level 8, and the lowest at Level 1, indicating that no company has reached the AAA rating in all ESG rating samples from 2010 to 2021. A mean value of 4.156 suggests that more than half of the companies in the designed sample did not achieve the BB standard in ESG rating. This reflects a significant disparity in

Table 1
Variable Definition.

Items	Abbr.	Variable Definition
Dependent Variable	*ESG*	ESG rating by Huazheng, with values from 1 to 9. Higher values indicate higher ratings.
Independent Variable	*DO*	Assigned value 1 if insured, otherwise 0. Based on the most recent announcement information that can determine if the company is insured or continues to be insured.
Control Variables	*LEV*	Debt-Asset Ratio = Total Liabilities / Total Assets.
	SIZE	Company Size = Logarithm of Total Assets.
	CASH	Cash Flow Ratio = Net Cash Flow / Total Assets.
	ROA	Net Profit Margin of Total Assets = Net Profit / Average Total Assets, where Average Total Assets = (Total Assets at the Beginning of Year + Total Assets at the End of Year) / 2.
	GROWTH	Growth Rate of Operating Income = (Operating Income in Current Quarter of Current Year - Operating Income in Previous Quarter) / (Operating Income in Previous Quarter).
	AGE	Years Listed.
	SOE	Property Rights, 1 for state-owned, 0 for non-state-owned.
	TOP10	Shareholding ratio of the top ten shareholders.
	DUAL	Dual Positions, assigned value 1 if the Chairman and General Manager are the same person, otherwise 0.

Table 2
Descriptive Statistics of Main Variables.

Variable	Obs	Mean	Std. Dev.	Min	Max
ESG	19,870	4.156	1.051	1	8
DO	19,870	0.065	0.247	0	1
LEV	19,870	0.39	0.204	−0.087	1.021
SIZE	19,870	22.092	1.251	19.973	26.326
CASH	19,870	3.286	28.312	−219.523	1141.76
ROA	19,870	0.029	0.03	−0.061	0.13
GROWTH	19,870	0.202	0.438	−0.514	2.764
AGE	19,870	2.039	0.873	0	3.434
SOE	19,870	0.338	0.473	0	1
TOP10	19,870	58.121	14.653	8.78	97.49
DUAL	19,870	0.283	0.45	0	1

corporate governance levels among various companies, and a consensus has yet to be widely established. There remains a need for improvement in the overall internal governance consciousness. The mean value of the explanatory variable D&O insurance is 0.065, meaning only 1292 samples have purchased D&O insurance. This ratio is vastly different from developed countries, indicating that the promotion of D&O insurance in China is relatively low and there is still a substantial potential for wider dissemination. This phenomenon might be associated with insurance terms design, policy intensity, and societal acceptance levels. Moreover, no outliers were detected in the other variables, which aligns with existing research, demonstrating the reasonableness of the control variables selected for this study. To check for multicollinearity among the variables in the research process, a Variance Inflation Factor (VIF) test was conducted on all variables. The VIF of all inter-variable relations is less than 2.36, affirming that there is no multicollinearity among the main variables in this study.

4.2. Benchmark regression

Table 3 displays the results of the benchmark regression. Columns (1) and (2) represent the regression results between D&O and corporate ESG performance without control variables. Column (2) shows the regression results of the dual fixed effects model, controlling for both year and industry. Columns (3) and (4) reflect the results after the introduction of control variables, with column (4) showing the regression results of the dual fixed effects model, taking both year and industry into account. By comparing models with and without control variables, we can better understand the confounding effects of other variables on the main relationships and figure out whether other potential factors are affecting the regression results. Simultaneously, the two-way fixed effects model helps reduce estimation bias caused by unobserved time and industry-specific factors, thereby enhancing the credibility of causal inferences. The regression results in all groups significantly reject the null hypothesis at the 1 % level, and the goodness of fit progressively improves. This suggests that the benchmark regression results support Hypothesis H1a, i.e., the introduction of D&O insurance can significantly enhance the ESG performance rating of companies.

Table 3
Benchmark Regression Results.

	(1)	(2)	(3)	(4)
	OLS	FE	OLS	FE
DO	0.3245***	0.3049***	0.1311***	0.1202***
	(0.0000)	(0.0000)	(0.0000)	(0.0001)
LEV			−0.5703***	−0.7339***
			(0.0000)	(0.0000)
SIZE			0.2641***	0.2687***
			(0.0000)	(0.0000)
CASH			−0.0001	0.0004*
			(0.5260)	(0.0560)
ROA			5.3947***	5.5119***
			(0.0000)	(0.0000)
GROWTH			−0.0755***	−0.0922***
			(0.0000)	(0.0000)
AGE			−0.2394***	−0.2486***
			(0.0000)	(0.0000)
SOE			0.2325***	0.2629***
			(0.0000)	(0.0000)
TOP10			−0.0031***	−0.0029***
			(0.0000)	(0.0000)
DUAL			−0.0208	−0.0313*
			(0.2108)	(0.0560)
Industry	NO	YES	NO	YES
Year	NO	YES	NO	YES
_cons	4.1350***	3.5595***	−1.0092***	−1.5186***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
N	19,870	19,870	19,870	19,870
adj. R^2	0.0058	0.0555	0.1017	0.1589

Note: Parentheses contain heteroscedasticity robust standard errors. *, **, and *** represent significance levels at 10 %, 5 %, and 1 % respectively.

Upon further observation of the regression results among the control variables, it was found that the regression coefficients of company size, profitability, and property rights are all significantly positive. This aligns with the basic logic of Hypothesis H1a, suggesting that state-owned enterprises with larger scales and stronger profitability, insuring D&O insurance, will produce more pronounced governance effects, thereby enhancing corporate ESG performance. This can also be interpreted as, in practice, large-scale corporate governance actions and profitability situations are more likely to attract market attention and are sensitive to numerical responses, hence the governance effect of D&O insurance will be more pronounced. Therefore, demonstrating good internal governance will become a necessary measure for favorable corporate development. After insuring D&O insurance, its correlation with corporate ESG performance is also significantly positive. Hence, the influence of D&O insurance on corporate ESG performance may show heterogeneity in companies with different property rights, which will need further verification in the subsequent sections.

4.3. Robustness test

4.3.1. Instrumental variables method

We conducted two 2SLS (Two-Stage Least Squares) tests to address estimation biases arising from endogeneity issues. In the first test, we used interest payable (IP) as the instrumental variable, since its relevance to the company's financial condition and the need for personal protection by top management. The increase in interest payable represents higher leverage, good management improves operating performance, but also increases risks. In such situations, acquiring D&O insurance contributes to enhancing the decision-making confidence of the management while protecting individual financial interests. From an exogeneity perspective, the fluctuation of interest payable is related to changes in the macro financial environment such as interest rates and inflation rates, which are generally not direct influencing factors of ESG. On a micro level, interest payable is usually regarded as a short-term financial factor, and its relationship with a company's ESG performance is relatively indirect. Simultaneously, interest payable is only one component of financial indicators, and its impact is relatively limited. The corporate ESG performance is mainly influenced by the corporate long-term strategies and management decisions. Therefore, interest payable alone cannot fully reflect the corporate performance in the ESG domain. Therefore, interest payable is appropriate as an instrumental variable.

The second 2SLS test uses the fluctuation in foreign currency translation differences (FCTD) as the instrumental variable. High exchange rate volatility may suggest that the company has extensive international operations, making it more susceptible to the impact of exchange rate fluctuations. This might motivate the company to actively manage currency risk and acquire D&O insurance to provide protection during unfavorable exchange rate fluctuations. At the same time, global operations bring about extensive management challenges, such as cultural differences, compliance, and political stability. Additionally, in certain countries and regions, purchasing D&O insurance may be a compliance requirement. In terms of exogeneity, the fluctuation in foreign currency translation differences primarily reflects the impact of exchange rate fluctuations on financial statements and generally does not involve specific ESG indicators. Clearly, the relationship between these two is highly independent. Thus, the fluctuation in foreign currency translation differences is a suitable instrumental variable as well.

To facilitate observation, we adjusted the magnitudes of both instrumental variables. Table 4 reports the results of the instrumental variable regressions using two instruments respectively. Columns (1) and (3) present the results of the first-stage regressions. From the table, it can be observed that both IP and FCTD are significantly correlated with D&O insurance at the 1 % level. The F-statistics for the first stage of the two instrumental variables are 71.975 and 354.274, respectively, both exceeding the empirical threshold of 10. This indicates that the chosen instrumental variables in this study pass the weak instrument test. Columns (2) and (4) display the results of the second-stage analysis, consistent with the benchmark regression results.

4.3.2. Heckman two-step method

Considering the endogeneity problem caused by sample self-selection bias, this study employs the Heckman two-step method model for the second robustness check to mitigate the endogeneity problem stemming from self-selection bias. This is specifically divided into two steps. In the first step, the Probit model is used to estimate the Inverse Mills Ratio (IMR) of the sample data. Following the approach of Yuan, Sun, and Cao (2016), considering the company's financial status, governance level, and equity allocation situation, this robustness check additionally includes whether there is a Big Four audit (AUDIT) and the proportion of institutional investor holdings (IHR) as the first stage regression model, as shown in Eq. (2). Table 5 displays the results of the Heckman two-step regression. As can be seen from the results in column (1), the presence of a Big Four audit and the proportion of institutional investor holdings are both significantly positively correlated with D&O insurance, indicating that the chosen variables all have good explanatory power. In the second step, the IMR obtained from the first-stage regression is incorporated into model (2) for regression, as shown in column (2). In a dual fixed effects model, the correlations between the IMR, D&O insurance, and corporate ESG performance are all significantly positive, maintaining a 1 % significance level. This confirms that, after eliminating some interference from endogeneity issues, the company's insurance of D&O insurance would still significantly enhance corporate ESG performance. The test results are consistent with the preceding text, supporting Hypothesis H1a.

Table 4
Instrumental Variables: interest payable and foreign currency translation differences.

	(1)	(2)	(3)	(4)
	DO	ESG	DO	ESG
DO		1.1816**		1.4259***
		(0.0200)		(0.0000)
IP	0.2449***			
	(0.0000)			
FCTD			0.7806***	
			(0.0000)	
LEV	−0.0158	−0.6870***	−0.0393***	−0.7425***
	(0.2010)	(0.0000)	(0.0014)	(0.0000)
SIZE	0.0220***	0.2272***	0.0305***	0.2420***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
CASH	0.0007***	−0.0010*	0.0003***	−0.0007**
	(0.0000)	(0.0987)	(0.0000)	(0.0211)
ROA	0.0587	5.4773***	−0.0511	5.6864***
	(0.4297)	(0.0000)	(0.4728)	(0.0000)
GROWTH	−0.0073*	−0.0898***	−0.0056	−0.0801***
	(0.0913)	(0.0000)	(0.2012)	(0.0000)
AGE	0.0239***	−0.2616***	0.0237***	−0.2582***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
SOE	0.0245***	0.2220***	0.0272***	0.2230***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
TOP10	0.0010***	−0.0046***	0.0010***	−0.0047***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
DUAL	−0.0082*	−0.0174	−0.0104**	−0.0206
	(0.0634)	(0.3714)	(0.0182)	(0.2725)
_cons	−0.5805***	−0.4215	−0.7572***	−0.7490***
	(0.0000)	(0.3154)	(0.0000)	(0.0059)
N	14,490	14,490	17,363	17,363
adj. R^2	0.0911	0.1098	0.1190	0.0800

Note: Parentheses contain heteroscedasticity robust standard errors. *, **, and *** represent significance levels at 10 %, 5 %, and 1 % respectively.

Table 5
Heckman Two-Step Method: Incorporating Audit and Institutional Investor Holding Proportion Variables.

	(1)	(2)
	DO	ESG
DO		0.1383***
		(0.0000)
IMR		0.2766***
		(0.0000)
LEV	−0.1629	−0.7736***
	(0.1391)	(0.0000)
SIZE	0.1788***	0.3200***
	(0.0000)	(0.0000)
CASH	0.0009**	0.0007***
	(0.0458)	(0.0017)
ROA	−0.7165	5.4051***
	(0.2598)	(0.0000)
GROWTH	−0.0024	−0.0957***
	(0.9452)	(0.0000)
AGE	0.2885***	−0.1731***
	(0.0000)	(0.0000)
SOE	0.1202***	0.2977***
	(0.0021)	(0.0000)
TOP10	0.0024	−0.0017***
	(0.1292)	(0.0060)
DUAL	−0.1355***	−0.0659***
	(0.0014)	(0.0003)
AUDIT	0.7230***	
	(0.0000)	
IHR	0.0021*	
	(0.0551)	
Industry	YES	YES
Year	YES	YES
_cons	−7.2788***	−3.6463***
	(0.0000)	(0.0000)
N	19,812	19,812
adj. R^2	0.2158	0.1738

Note: Parentheses contain heteroscedasticity robust standard errors. *, **, and *** represent significance levels at 10 %, 5 %, and 1 % respectively.

4.3.3. Substitution of dependent variable

Considering the discrepancies in ESG evaluations by different institutions, we employed multiple Chinese and international ESG assessments as alternative dependent variables in regression for robustness testing. Specifically, the indicators we employed are Bloomberg ESG scores, SynTao Green Finance ESG rating (SDRL), MSCI ESG scores, and ASSET4 ESG scores. The last three supplementary ESG indicator data come from the CSI 300 Index, which reflects the overall performance of securities listed on the Shanghai and Shenzhen markets. Consequently, although this results in a reduction in sample size, combining these results can provides considerable persuasion. Additionally, we also selected corporate social responsibility (CSR) assessments aligned with ESG evaluation values as alternative variables. The CSR scores were derived from Hexun.com according to Hexun CSR reports. The regression results are shown in Table 6, where columns (1), (2), (3), (4) and (5) respectively present the regression results with Bloomberg ESG scores, SynTao Green Finance ESG rating, MSCI ESG scores, ASSET4 ESG scores, and CSR scores as dependent variables. The results demonstrate that the

Table 6
Results of Substitution of Dependent Variable.

	(1)	(2)	(3)	(4)	(5)
	Bloomberg	SDRL	MSCI	ASSET4	CSR
DO	3.6383***	3.7769***	0.3213***	8.2827***	1.3833***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0010)
LEV	−1.3696***	0.6792	−0.1279	−0.1759	−3.5514***
	(0.0036)	(0.5539)	(0.5157)	(0.9564)	(0.0000)
SIZE	1.6739***	0.5910**	−0.0425	4.8241***	3.5107***
	(0.0000)	(0.0130)	(0.1510)	(0.0000)	(0.0000)
CASH	0.0110***	−0.0031	−0.0001	0.0036	−0.0109***
	(0.0000)	(0.1426)	(0.6829)	(0.4456)	(0.0093)
ROA	6.5968***	−12.6066***	0.1799	−16.8080	199.4719***
	(0.0072)	(0.0099)	(0.8448)	(0.2447)	(0.0000)
GROWTH	−0.4405***	−0.3033	0.0331	−0.1522	−0.3514*
	(0.0058)	(0.3517)	(0.6640)	(0.8857)	(0.0784)
AGE	0.4210***	−0.8635**	−0.0119	−1.8747**	0.4453***
	(0.0027)	(0.0125)	(0.8479)	(0.0262)	(0.0014)
SOE	0.0149	0.2698	−0.2062***	−1.0317	1.8093***
	(0.9254)	(0.4576)	(0.0007)	(0.2730)	(0.0000)
TOP10	0.0122**	0.0137	0.0009	−0.0297	0.0094
	(0.0147)	(0.2271)	(0.6595)	(0.3093)	(0.2020)
DUAL	0.4860***	−1.6361***	0.1611**	−0.4313	−0.0585
	(0.0042)	(0.0000)	(0.0150)	(0.6569)	(0.7549)
Industry	YES	YES	YES	YES	YES
Year	YES	YES	YES	YES	YES
_cons	−19.0086***	36.4449***	3.3383***	−94.4275***	−57.1941***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
N	6711	1043	1199	1138	19,870
adj. R^2	0.5821	0.3113	0.1333	0.2538	0.3591

Note: Parentheses contain heteroscedasticity robust standard errors. *, **, and *** represent significance levels at 10 %, 5 %, and 1 % respectively.

coefficient of D&O insurance remains significantly positive at the 1 % level, providing further validation for hypothesis H1a.

5. Further research

5.1. Mechanism analysis

In order to ensure the practical significance of our research findings, we intentionally avoided using ESG's main factors as the starting point for mechanism testing to prevent falling into the trap of purely statistical significance without substantive meaning. Our empirical tests concentrate on three crucial mechanisms: shareholder intentions, compensation of the insured, and the emphasis of corporate strategy.

5.1.1. Shareholder intentions

Shareholders' intentions for participating in general meetings plays an important role in corporate governance and decision-making processes. We chose the number of shares attended (NSA) and the number of attendees (NA) at the shareholders' meeting as alternative indicators for the degree of shareholder participation in corporate decision-making. Simultaneously, the total number of shareholders (NS) was selected as an alternative indicator for investor participation and attention. Mechanism tests were conducted separately. The results of the mechanism tests are presented in Table 8, shows that the regression coefficients of D&O insurance and interaction terms in the three moderating effect regressions are all positive, that is, their moderating effects are all significantly positive.

The explanation for this phenomenon may lie in the fact that D&O insurance, as a tool of corporate governance, has diverse motivations for its introduction in various companies, given the coexistence of governance objectives and opportunism. A favorable attendance at shareholder meetings, signaling increased shareholder participation in corporate governance and a wider spectrum of attention, could create a conducive environment for the corporate long-term sustainability. In such situations, beneficiaries of D&O insurance may be more inclined to implement decisions that contribute to enhancing the corporate social reputation, meeting stakeholder expectations, rather than pursuing self-interest to the detriment of corporate development. This, in turn, contributes to the company fulfilling a better ESG performance and generates a positive and profound impact on its sustainability.

Table 8
Mechanism Analysis: Shareholder Intentions.

	(1)	(2)	(3)
	ESG		
DO	0.1276***	0.1281***	0.0927**
	(0.0001)	(0.0001)	(0.0166)
DO_NSA	0.0000**		
	(0.0208)		
NSA	−0.0000*		
	(0.0966)		
DO_NA		0.0003*	
		(0.0667)	
NA		0.0000	
		(0.6554)	
DO_NS			0.0000**
			(0.0144)
NS			0.0000
			(0.2638)
Controls	YES	YES	YES
Industry	YES	YES	YES
Year	YES	YES	YES
_cons	−2.0987***	−1.9743***	−1.8388***
	(0.0000)	(0.0000)	(0.0000)
N	15,578	15,578	15,599
adj. R^2	0.1642	0.1642	0.1647

Note: Parentheses contain heteroscedasticity robust standard errors. *, **, and *** represent significance levels at 10 %, 5 %, and 1 % respectively.

5.1.2. Compensation of the insured

The compensation levels of directors and officers are closely linked to their behavior and decisions, influencing the overall performance of the company when facing risks. We selected the compensation of the insured individuals under D&O insurance as the second mechanism perspective. Considering the comprehensiveness and imbalance of director and officers' compensation, we chose the total compensation of all directors

(CD), the total compensation of the top 3 directors (CTTD), and the total compensation of the top 3 directors, supervisors, and senior management (CTT) as alternative indicators for the moderating effect tests. The results are shown in Table 9. In the regression results of the three moderating effects, the regression coefficients of D&O insurance and the interaction terms are all significantly positive, indicating that their moderating effects are positive.

This result is highly consistent with the logic of behavioral science and game theory. Initially, the incorporation of long-term incentive mechanisms in compensation design, such as stock awards and options, facilitates the redirection of directors' and officers' focus from short-term returns to the long-term sustainability of the company. Protected by D&O insurance, they may be more inclined to invest efforts and resources in implementing long-term strategies, ultimately enhancing the corporate ESG performance. Secondly, in a sense, D&O insurance increases the motivation for directors or officers to gain improper profits and escape compensation, as long as the individual benefits from a single improper act exceed the future comprehensive penalties (such as reputational damage, dismissal, etc.). High compensation can reduce this risk, as they have already received substantial remuneration. This contributes to building trust and transparency in corporate governance, facilitating the company's ability to attract support from investors and stakeholders, thereby fostering enhancements in ESG. Furthermore, competitive compensation levels and the protection afforded by D&O insurance contribute to the attraction and retention of high-caliber management talent. In an era where ESG becomes a focal point for investors and society, having a management team equipped with the skills and experience necessary to propel the ESG agenda is pivotal for the company's long-term sustainable development.

5.1.3. Corporate expansion strategies

D&O insurance facilitates directors and officers in advancing expansion plans more effectively within a complex legal and risk environment. We selected the tangible asset ratio (TAR) and research and development expenditure (R&D) as alternative variables for corporate expansion. On the one hand, the increase in the tangible asset ratio may reflect the company's capital expenditure plan, aimed at improving infrastructure, increasing inventory, and updating equipment to enhance production capacity. On the other hand, the increase in research and development expenditure contributes to maintaining the competitiveness of the enterprise. The increase in tangible asset ratio and research and development expenditure is generally regarded as a positive signal, indicating the company's confidence in future development and commitment to maintaining competitiveness and innovation capability. However, it also implies higher liquidity, environmental, and regulatory risks. The results of our mechanism tests, as shown in Table 10, indicate that in the regressions of both moderating effects, the interaction terms are significantly negative, suggesting that the expansion strategies have suppressive effects.

This indicates that under corporate strategies emphasizing expansion, the governance effects brought about by D&O insurance may be restrained. Expansion plans usually demand substantial resources, encompassing financial, human, and technological components. While the governance and supervisory effects of D&O insurance encourage management to make decisions beneficial for the long-term development of the company, in situations of limited resources, professional managers may struggle to fully consider the opinions and decision risks of the insurance company due to strong pressures from short-term performance evaluations and market expectations. This manifests as their inclination to prioritize limited resources for expansion to meet market expectations, thereby overlooking some ESG responsibilities, ultimately restraining the comprehensive improvement of ESG. Meanwhile, expansion involves legal and compliance requirements in different regions and countries, and D&O insurance contracts may conceal some decision consequences. Despite professional managers potentially having greater confidence in their professional competence when achieving the company's expansion goals, this may result in more regulatory penalties and legal risks, ultimately restricting the overall enhancement of ESG performance.

5.2. Additional analysis

In this part, we employed decomposition analysis to conduct a detailed study on the impact of D&O insurance on environmental, social, and corporate governance aspects. The more the objectives, the smaller the chance of accurately hitting any specific target. Hence, by delineating the research emphases, we have the opportunity to formulate more comprehensive and specific research conclusions, elevating the depth, precision, and applicability of the study. Practically, this approach helps companies gain a clearer understanding of the specific ESG domain where D&O insurance has the most notable enhancement effect, facilitating improved risk management. The three columns in Table 11 represent the regression results for the environmental, social,

Table 9
Mechanism Analysis: Compensation of the Insured.

	(1)	(2)	(3)
	ESG		
DO	0.0804**	0.0740**	0.0837**
	(0.0273)	(0.0412)	(0.0492)
DO_CD	0.0000**		
	(0.0284)		
CD	−0.0000**		
	(0.0280)		
DO_CTTD		0.0000**	
		(0.0157)	
CTTD		−0.0000	
		(0.1320)	
DO_CTT			0.0000**
			(0.0103)
CTT			−0.0000
			(0.1643)
Controls	YES	YES	YES
Industry	YES	YES	YES
Year	YES	YES	YES
_cons	−1.5964***	−1.5575***	−2.0436***
	(0.0000)	(0.0000)	(0.0000)
N	19,860	19,860	15,590
adj. R^2	0.1576	0.1576	0.1645

Note: Parentheses contain heteroscedasticity robust standard errors. *, **, and *** represent significance levels at 10 %, 5 %, and 1 % respectively.

Table 10
Mechanism Analysis: Corporate Expansion Strategies.

	(1)	(2)
	ESG	
DO	1.2640***	0.3627***
	(0.0000)	(0.0000)
DO_TAR	−1.2454***	
	(0.0000)	
TAR	0.8470***	
	(0.0000)	
DO_R&D		−0.0000**
		(0.0377)
R&D		0.0000**
		(0.0189)
Controls	YES	YES
Industry	YES	YES
Year	YES	YES
_cons	−2.4860***	−1.8177***
	(0.0000)	(0.0000)
N	19,870	3522
adj. R^2	0.1620	0.2108

Note: Parentheses contain heteroscedasticity robust standard errors. *, **, and *** represent significance levels at 10 %, 5 %, and 1 % respectively.

Table 11
Separate examination of ESG.

	(1)	(2)	(3)
	E	S	G
DO	0.1959***	0.0996**	0.0387
	(0.0000)	(0.0209)	(0.2229)
LEV	0.0836*	0.1524**	−1.9153***
	(0.0833)	(0.0293)	(0.0000)
SIZE	0.2216***	0.3188***	0.1497***
	(0.0000)	(0.0000)	(0.0000)
CASH	0.0002	−0.0003	0.0004
	(0.4070)	(0.3584)	(0.1438)
ROA	0.3540	5.5374***	5.1240***
	(0.1927)	(0.0000)	(0.0000)
GROWTH	−0.0826***	0.0604**	−0.1343***
	(0.0000)	(0.0130)	(0.0000)
AGE	−0.0522***	−0.2427***	−0.1711***
	(0.0001)	(0.0000)	(0.0000)
SOE	−0.0066	−0.0798***	0.4363***
	(0.7218)	(0.0029)	(0.0000)
TOP10	−0.0016***	−0.0060***	−0.0002
	(0.0044)	(0.0000)	(0.8003)
DUAL	−0.0486***	−0.0503**	0.0442**
	(0.0037)	(0.0377)	(0.0132)
_cons	−2.5887***	−4.2017***	4.1698***
	(0.0000)	(0.0000)	(0.0000)
N	19,196	19,196	19,196
adj. R^2	0.0909	0.2865	0.2323

Note: Parentheses contain heteroscedasticity robust standard errors. *, **, and *** represent significance levels at 10 %, 5 %, and 1 % respectively.

and corporate governance dimensions, respectively. It can be observed that D&O insurance does improve the ratings of companies in the environmental and social dimensions, but the improvement in the governance dimension is not significant.

Initially, this may seem counterintuitive as the most direct impact of D&O insurance should theoretically be evident in corporate governance. However, after a thorough analysis, we believe this result actually reveals the advantage of risk transfer as a decision in corporate risk management. Firstly, to provide protection when directors and executives face legal responsibilities, insurance companies require companies to meet various policy standards, including local government's environmental and social responsibility policies, before underwriting. This helps attract and retain leadership talents with environmental expertise and experience while prompting corresponding financial investments. Secondly, opportunism triggered by D&O insurance may be less, or even not reflected in environmental compliance or social responsibility metrics. Instead, the short-term consequences of opportunistic behavior may be more reflected in governance metrics, intertwining with the beneficial internal governance effects of D&O insurance. Lastly, various effects are manifest in disclosure metrics, explaining why the ratings of E and S significantly improve while there is no notable improvement in G. This suggests that the benefits of companies utilizing D&O insurance to transfer risk outweigh the drawbacks.

5.3. Heterogeneity analysis

According to previous regression results and analysis, a firm's purchase of D&O insurance enhances its ESG performance rating. However, this result does not analyze different characteristics of firms, such as property rights, regional marketization level, and other inherent factors that impact a firm's development mode and shareholder decisions. Will this heterogeneity influence the empirical result that D&O insurance can enhance a firm's ESG performance? To further answer these questions, this section carries out group regression according to these two firm characteristics to further verify and deepen the conclusions of this study.

To ensure the sufficiency of the premise for heterogeneity analysis, this subsection first conducts a *t*-test on the mean ESG for different property rights and regions. The results are shown in Table 12. The study

Table 12
T-Test of Mean ESG Performance for Enterprises.

Property Rights	Mean ESG	Region	Mean ESG
State-Owned Enterprises	4.094912	Eastern Region	4.056477
Non-State-Owned Enterprises	4.276149	Central and Western Region	4.196001
Difference in Mean ESG	−0.1812372 *** (*t* = −11.5438)	Difference in Mean ESG	−0.1395239 *** (*t* = −12.4676)

Note: *** represent significance levels at 1 %.

finds that compared to non-state-owned enterprises and the central-western region, state-owned enterprises and the eastern region bear more ESG governance responsibilities, indicating that the empirical samples have heterogeneity in terms of property rights and regional marketization level.

5.3.1. Property heterogeneity

Table 13 shows the regression results after grouping the sample according to property rights. Based on the stock equity data organized from the CSMAR database, the ownership of listed companies is divided into two categories. The regression sample in this section has nearly half the number of state-owned enterprise samples as non-state-owned enterprise samples. From the results, it can be seen that under the dual fixed effects model, the regression grouping results for state-owned enterprises are significantly positively correlated at the 1 % level, while the correlation coefficient for non-state-owned enterprises is not significant, indicating that there is no statistical correlation. This suggests that property rights play an important distinguishing role. State-owned enterprises that insure D&O insurance will significantly enhance corporate ESG performance, which is consistent with previous theoretical analysis results. State-owned enterprises inherently possess scale advantages, their operational goals are not simply profit-oriented, and they bear higher internal governance and social economic stability maintenance obligations, so their operational efficiency may not be very prominent. However, after the introduction of D&O insurance, state-owned enterprises will further accept external supervision, which will

Table 13
Heterogeneity Analysis: Property Rights.

	(1)	(2)
	State-Owned Enterprises	Non-State-Owned Enterprises
DO	0.1617***	0.0035
	(0.0000)	(0.9452)
LEV	−0.8209***	−0.6834***
	(0.0000)	(0.0000)
SIZE	0.2792***	0.2645***
	(0.0000)	(0.0000)
CASH	0.0003	0.0004
	(0.1107)	(0.6585)
ROA	4.2588***	5.9587***
	(0.0000)	(0.0000)
GROWTH	−0.0798***	−0.0945***
	(0.0028)	(0.0000)
AGE	−0.0694***	−0.2881***
	(0.0021)	(0.0000)
TOP10	−0.0033***	−0.0037***
	(0.0002)	(0.0000)
DUAL	−0.1451***	−0.0181
	(0.0003)	(0.3145)
Industry	YES	YES
Year	YES	YES
_cons	−2.1137***	−1.1976***
	(0.0000)	(0.0000)
N	6721	13,149
adj. R^2	0.2080	0.1408

Note: Parentheses contain heteroscedasticity robust standard errors. *, **, and *** represent significance levels at 10 %, 5 %, and 1 % respectively.

enhance operational efficiency to a certain extent, thereby improving governance levels and obtaining higher ESG evaluations. This suggests that in China's market economic system, to accelerate the realization of socialist modernization goals, the active promotion of D&O insurance should perhaps be seen as one of the ways for government departments to manage the market, rather than simply allowing the free market to determine its development speed. In actively promoting D&O insurance, state-owned enterprises may need to take the lead, which requires more favorable policies and actively leveraging the advantages of socialist market economy in China.

5.3.2. Regional heterogeneity

The level of regional marketization greatly influences the development mode of enterprises. Firstly, the level of marketization in different regions of China is quite distinct, and it is generally believed that the higher the degree of market development, the broader corporate managers' knowledge base and the more scientific their decision-making becomes. They may accept new types of risks such as D&O insurance faster. In regions with a high level of marketization, purchasing such insurance may become a way for enterprises to gain competitive advantages within the industry. Secondly, the level of marketization is also an important factor encouraging enterprises to actively engage in internal governance. Therefore, studying the impact of marketization level on the purchase of D&O insurance by enterprises and ESG performance is of significant importance. Table 14 shows the regression results after regional differentiation. It can be seen that the impact of D&O insurance on corporate ESG performance is significantly positively correlated in the eastern region, while it does not pass the statistical test in the central and western regions. Hence, with different levels of regional marketization, the impact of D&O insurance on corporate ESG performance will present heterogeneity. In regions with a high degree of marketization, companies might improve ESG performance as a strategic approach to instill investor confidence in the company's long-term stability. This may be influenced by factors such as a higher capital turnover rate and increased financial leverage, which can facilitate better financing opportunities. The introduction of D&O insurance could play a regulatory role in risk management and is more likely to be integrated into corporate internal governance decisions, potentially contributing to the enhancement of corporate ESG performance.

Table 14
Heterogeneity Analysis: Degree of Regional Marketization.

	(1)	(2)
	Eastern Region Enterprises' ESG	Central and Western Region Enterprises' ESG
DO	0.1422***	−0.1330
	(0.0000)	(0.1797)
LEV	−0.6718***	−0.8944***
	(0.0000)	(0.0000)
SIZE	0.2566***	0.2903***
	(0.0000)	(0.0000)
CASH	0.0004	0.0013
	(0.1043)	(0.2434)
ROA	5.9064***	4.6610***
	(0.0000)	(0.0000)
GROWTH	−0.1025***	−0.0610**
	(0.0000)	(0.0377)
AGE	−0.2238***	−0.2920***
	(0.0000)	(0.0000)
SOE	0.2667***	0.2930***
	(0.0000)	(0.0000)
TOP10	−0.0009	−0.0082***
	(0.1536)	(0.0000)
DUAL	−0.0488***	0.0182
	(0.0093)	(0.5937)
Industry	YES	YES
Year	YES	YES
_cons	−1.4413***	−1.5255***
	(0.0000)	(0.0000)
N	14,204	5666
adj. R^2	0.1683	0.1508

Note: Parentheses contain heteroscedasticity robust standard errors. *, **, and *** represent significance levels at 10 %, 5 %, and 1 % respectively.

6. Conclusions and recommendations

Presently, with the steady improvement of the social credit system and the further development of the capital market, the ESG concept is increasingly accepted by more countries and regions, and the application of related field ratings is also gradually widespread. After the implementation of the new Securities Law, there appeared a "collective litigation system with Chinese characteristics," and the trend of transferring management risks of listed companies and senior managers through D&O insurance is becoming increasingly apparent. Therefore, it is particularly important to study the impact of D&O insurance on corporate ESG performance. However, since the concept of D&O insurance was formally introduced to China in 2002, several major property insurance companies have successively designed related products, but the development of these products has been lukewarm over the years, and the coverage is not high. Academic circles have not reached a unified conclusion on the role of D&O insurance in corporate internal governance. Therefore, this paper first summarizes and organizes domestic and foreign literature and selects A-share listed companies' data from 2010 to 2021 as the sample according to the background of D&O insurance development in China. It then analyzes the impact of D&O insurance on corporate ESG ratings from both theoretical and empirical perspectives. After using multiple robustness tests to verify the reliability of empirical results and research conclusions, this paper further studies the mechanism analysis and heterogeneity analysis. Finally, this paper arrives at the following conclusions:

(1) D&O insurance significantly enhances corporate ESG performance. To address possible endogeneity problems, this paper uses the instrumental variable method, Heckman's two-step method, and the substitution of the main variable method for robustness testing, and the test results are consistent with the benchmark regression.
(2) Shareholder intentions and compensation of the insured play a moderating role in promoting the enhancement of corporate ESG performance by D&O insurance, while corporate expansion strategies play a moderating role in inhibiting the enhancement of corporate ESG performance by D&O insurance.
(3) The impact of D&O insurance on ESG has significant heterogeneity in different regions with different marketization levels and different property rights of enterprises. Specifically, D&O insurance has a significant impact on the ESG performance of companies in the more marketized eastern regions, but it is not significant in the central and western regions; D&O insurance has a significant impact on the ESG performance rating of state-owned enterprises, but the impact on non-state-owned enterprises is not significant. Therefore, the introduction of D&O insurance by companies improves the sustainability of corporate operations and the impact on social values, and provides more long-term investment references for investors.

The research in this paper may have the following directions worth further research: (1) "Greenwashing" effect research. Since the introduction of D&O insurance in China is relatively late and the formulation of related laws and regulations is not perfect, the China Securities Regulatory Commission has not yet mandated companies to disclose information related to D&O insurance, which may make the D&O insurance data obtained different from the actual data, and the detailed data on D&O insurance premiums and insurance amounts cannot be obtained. This makes companies have the operational space for "greenwashing". (2) Expansion of the viewpoint of the impact mechanism. This paper studies the impact mechanism of D&O insurance on corporate ESG performance, mainly from the perspective of Shareholder, D&O insurance insured compensation, corporate strategies, but investor characteristics and behavior and corporate ESG performance may have a higher goodness of fit causal relationship. In the future, with the increase in the coverage rate of D&O insurance and the continuous improvement of the financial market, investor characteristics and behavior can be used as new mechanisms for research. (3) Enriching theoretical research. At present, the empirical papers on D&O insurance in academia have a poor model fit, most of the goodness of fit is less than 0.1, which is related to the disclosure situation of D&O insurance. On the other hand, it also shows that the current empirical research on D&O insurance still lacks in-depth discussion of basic theory, and the promotion value of D&O insurance needs more detailed theoretical explanation and strong empirical support.

The present discourse beseeches the rendering of several recommendations to enhance the development and profound research pertaining to D&O insurance and corporate ESG performance.

(1) It is prudent to institute policies that augment the purchase rate of D&O insurance among publicly listed companies. In contrast to the developed nations, such as Europe and America, where the coverage rate of listed companies reaches an astonishing 95 %, the purchase rate in China is still relatively low and its growth rate languid. It is incumbent upon relevant departments to aptly exploit the 'invisible hand' of the market, vigorously promoting D&O insurance, thereby providing investors with an abundance of governance information. By adopting a multifaceted approach and promoting through various channels, we can encourage listed companies to purchase D&O insurance, thereby amplifying its influence in China's capital market, which will in turn benefit a broader spectrum of investors from the governance advantages brought forth by D&O insurance.
(2) It is of paramount importance to refine the regulatory stipulations associated with D&O insurance. Chinese legal and regulatory systems for the economic market are still undergoing rapid amelioration. The regulations for some small-scale types of insurance remain somewhat nebulous, and the supervision of D&O insurance is nearly non-existent. Over the past two decades since D&O insurance was introduced into China's capital market, it has not been accorded the same level of attention as automobile and critical illness insurance, which to a certain extent has curtailed the opportunities for it to be publicized and promoted. The regulations for D&O insurance in China currently number less than a dozen, and the specifics lack practical operability. This inevitably causes hesitancy in decision-making among some interested enterprises. Regulatory bodies such as the Banking and Insurance Regulatory Commission and the Securities Regulatory Commission should formulate detailed regulations in accordance with the specific circumstances of local listed companies, thereby elevating the confidence of enterprises in insurance, urging insurance companies to enhance the specificity and operability of D&O insurance clauses, and providing assistance for the promotion of D&O insurance.
(3) Governmental departments should intervene in the formulation of the ESG evaluation system. According to the final research results of this paper, there is a certain positive correlation between D&O insurance and the ESG performance of enterprises. Therefore, when the coverage rate of D&O insurance increases, it can improve the macro market environment to a certain extent. However, how to make the ESG performance of enterprises concrete, data-driven, and visualized is a subject that warrants further exploration. At present, the ESG performance of enterprises in China mainly relies on data provided by third-party evaluation institutions. However, all these ESG governance evaluation indicators have a common problem, that is, their measurement subjects are relatively singular and are formulated by the research team or institution themselves, without reliable papers for reference. Moreover, there are clear boundaries between each subject due to conflicts of interest, and there is very little public communication and discussion about the scientific nature of their data. This leads to a large deviation in the market perception of each ESG evaluation system, and due to the lack of government endorsement, there is a lack of fairness and comprehensiveness. Therefore, the market department should formulate the general direction and promote the iterative improvement of the ESG evaluation system of various institutions.

Data availability

Data will be made available on request.

Acknowledgements

The authors acknowledge support from the National Natural Science Foundation of China (72371256); the Excellent Young Team Project Natural Science Foundation of Guangdong Province of China (2023B1515040001).

References

Adams, M., Lin, C., & Zou, H. (2011). Chief executive officer incentives, monitoring, and corporate risk management: Evidence from insurance use. *Journal of Risk and Insurance, 78*, 551–582.
Baron, R. M., & Kenny, D. A. (1986). The moderator–mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology, 51*(6), 1173.
Bhagat, S., Brickley, J. A., & Coles, J. L. (1987). Managerial indemnification and liability insurance: The effect on shareholder wealth. *The Journal of Risk and Insurance, 54*, 721–736.
Bolton, P., & Kacperczyk, M. (2021). Do investors care about carbon risk? *Journal of Financial Economics, 142*, 517–549.
Boyer, M. M., & Stern, L. H. (2014). D&O insurance and IPO performance: What can we learn from insurers? *Journal of Financial Intermediation, 23*, 504–540.
Chalmers, J. M., Dann, L. Y., & Harford, J. (2002). Managerial opportunism? Evidence from directors' and officers' insurance purchases. *The Journal of Finance, 57*, 609–636.
Chua, C. T., Eun, C. S., & Lai, S. (2007). Corporate valuation around the world: The effects of governance, growth, and openness. *Journal of Banking & Finance, 31*(1), 35–56.
Core, J. (2000). The directors' and officers' insurance premium: An outside assessment of the quality of corporate governance. *The Journal of Law, Economics, and Organization, 16*, 449–477.
Core, J. E. (1997). On the corporate demand for Directors' and Officers' Insurance. *The Journal of Risk and Insurance, 64*, 63–87.
Derrien, F., Krueger, P., Landier, A., et al. (2021). *ESG news, future cash flows, and firm value*. Swiss Finance Institute Research Paper.
DeVilliers, C., Venter, E. R., & Hsiao, P.-C. K. (2017). Integrated reporting: Background, measurement issues, approaches and an agenda for future research. *Accounting & Finance, 57*, 937–959.
Dilek, D. (2023). ESG-focused hedge fund activism. *Economic Analysis Letters, 2*(4), 35.
Ferriani, F. (2023). Issuing bonds during the Covid-19 pandemic: Was there an ESG premium? *International Review of Financial Analysis, 88*, Article 102653.
Gillan, S. L., & Panasian, C. A. (2015). On lawsuits, corporate governance, and Directors' and Officers' liability insurance. *Journal of Risk and Insurance, 82*, 793–822.
Graham, J. R., Harvey, C. R., & Rajgopal, S. (2005). The economic implications of corporate financial reporting. *Journal of Accounting and Economics, 40*(1–3), 3–73.
Guan, Y., Zhang, L., Zheng, L., et al. (2021). Managerial liability and corporate innovation: Evidence from a legal shock. *Journal of Corporate Finance, 69*, Article 102022.
He, F., Guo, X., & Yue, P. (2024). Media coverage and corporate ESG performance: Evidence from China. *International Review of Financial Analysis, 91*, Article 103003.
Holderness, C. G. (1990). Liability insurers as corporate monitors. *International Review of Law and Economics, 10*, 115–129.
Hong, H., & Kacperczyk, M. (2009). The price of sin: The effects of social norms on markets. *Journal of Financial Economics, 93*(1), 15–36.
Hsu, P.-H., Li, K., & Tsou, C.-Y. (2023). The pollution premium. *The Journal of Finance, 78*, 1343–1392.
Hull, C. E., & Rothenberg, S. (2008). Firm performance: The interactions of corporate social performance with innovation and industry differentiation. *Strategic Management Journal, 29*, 781–799.
Husted, B. W., & de Sousa, J. M. (2019). Board structure and environmental, social, and governance disclosure in Latin America. *Journal of Business Research, 102*, 220–225.

Jensen, M. C., & Meckling, W. H. (1976). Theory of the firm: Managerial behavior, agency costs and ownership structure. *Journal of Financial Economics, 3*, 305–360.
Jia, N., Mao, X., & Yuan, R. (2019). Political connections and directors' and officers' liability insurance: Evidence from China. *Journal of Corporate Finance, 58*, 353–372.
Jia, N., & Tang, X. (2018). Directors' and officers' liability insurance, independent director behavior, and governance effect. *Journal of Risk and Insurance, 85*, 101103–101124.
Kallio, T. J., & Nordberg, P. (2006). The evolution of organizations and natural environment discourse: Some critical remarks. *Organization & Environment, 19*, 439–457.
Lee, M. T., & Raschke, R. L. (2023). Stakeholder legitimacy in firm greening and financial performance: What about greenwashing temptations? *Journal of Business Research, 155*.
Li, S., & Lu, J. W. (2020). A dual-agency model of firm CSR in response to institutional pressure: Evidence from Chinese publicly listed firms. *Academy of Management Journal, 63*, 2004–2032.
Li, T., Yang, T., & Zhu, J. (2022). Directors' and officers' liability insurance: Evidence from independent directors' voting. *Journal of Banking & Finance, 138*, Article 106425.
Lian, Y., Ye, T., Zhang, Y., & Zhang, L. (2023). How does corporate ESG performance affect bond credit spreads: Empirical evidence from China. *International Review of Economics & Finance, 85*, 352–371.
Lin, C., Officer, M. S., Wang, R., et al. (2013). Directors' and officers' liability insurance and loan spreads. *Journal of Financial Economics, 110*, 37–60.
Lin, F.-Y., Guan, L., Ho, C.-L., et al. (2022). Examining the D&O insurance effect on managerial ability. *Finance Research Letters, 46*, Article 102297.
Mailath, G. J., & Samuelson, L. (2001). Who wants a good reputation? *The Review of Economic Studies, 68*, 415–441.
Martin, P. R., & Moser, D. V. (2016). Managers' green investment disclosures and investors' reaction. *Journal of Accounting and Economics, 61*(1), 239–254.
Nirino, N., Santoro, G., Miglietta, N., et al. (2021). Corporate controversies and company's financial performance: Exploring the moderating role of ESG practices. *Technological Forecasting and Social Change, 162*, Article 120341.
Nofsinger, J., & Varma, A. (2014). Socially responsible funds and market crises. *Journal of Banking & Finance, 48*, 180–193.
O'Sullivan, N. (1997). Insuring the agents: The role of directors' and officers' Insurance in corporate governance. *The Journal of Risk and Insurance, 64*, 545–566.
O'Sullivan, N. (2002). The demand for directors' and officers' insurance by large UK companies. *European Management Journal, 20*, 574–583.
Park, S. (2023). Bank runs and design flaws of deposit insurance. *Economic Analysis Letters, 2*(3), 29.
Pástor, Ľ., Stambaugh, R. F., & Taylor, L. A. (2021). Sustainable investing in equilibrium. *Journal of Financial Economics, 142*, 550–571.
Rupamanjari, S. R., & Sandeep, G. (2023). Impact of ESG score on financial performance of Indian firms: Static and dynamic panel regression analyses. *Applied Economics, 55*.
Saunila, M., Ukko, J., & Rantala, T. (2018). Sustainability as a driver of green innovation investment and exploitation. *Journal of Cleaner Production, 179*, 631–641.
Shi, C., Sun, Y., & Lyu, J. (2023). D&O insurance, technology independent directors, and R&D investment. *International Review of Financial Analysis, 89*, Article 102868.
Treepongkaruna, S., Kyaw, K., & Jiraporn, P. (2022). Shareholder litigation rights and ESG controversies: A quasi-natural experiment. *International Review of Financial Analysis, 84*, Article 102396.
Wang, J., Ma, M., Dong, T., & Zhang, Z. (2023). Do ESG ratings promote corporate green innovation? A quasi-natural experiment based on SynTao green Finance's ESG ratings. *International Review of Financial Analysis, 87*, Article 102623.
Wang, J., Zhang, J., Huang, H., & Zhang, F. (2020). Directors' and officers' liability insurance and firm innovation. *Economic Modelling, 89*, 414–426.
Yang, C., Zhu, C., & Albitar, K. (2024). *ESG ratings and green innovation: A U-shaped journey towards sustainable development*. Business Strategy and the Environment. Online Version of Record.
Yuan, R., Sun, J., & Cao, F. (2016). Directors' and officers' liability insurance and stock price crash risk. *Journal of Corporate Finance, 37*, 173–192.
Zou, H., Wong, S., Shum, C., et al. (2008). Controlling-minority shareholder incentive conflicts and directors' and officers' liability insurance: Evidence from China. *Journal of Banking & Finance, 32*, 2636–2645.

Cunyi Yang is an active scholar at the Lingnan College of Sun Yat-sen University, with his main research areas being digitization, financial risk, and green finance.

Khaldoon Albitar is currently a Senior Lecturer at the Adam Smith Business School, University of Glasgow. He has published more than 60 papers in various journals including *Research Policy*, *International Journal of Finance & Economics*, *Business Strategy and the Environment*, *International Journal of Accounting & Information Management*, *Technological Forecasting and Social Change*, *Review of Quantitative Finance and Accounting*, and *Journal of Applied Accounting Research*.