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Directors' and Officers' Liability Insurance and Corporate ESG Performance

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Abstract: ***The Directors' and Officers' Liability Insurance (hereafter D&O insurance) market has shown a rapid development trend. However, it is still niche insurance in China, due to the fact that the theoretical and practical circles have mixed opinions about this insurance and its governance effect. This paper takes the sustainable development perspective as the entry point and selects the observations of A-share listed companies from 2009 to 2022 as the research sample to test the impact of D&O insurance on the ESG performance of enterprises and analyze its path of action. The findings indicate that the introduction of D&O insurance helps to enhance the ESG performance of listed companies, and the conclusions remain robust after mitigating the endogeneity problem using the instrumental variables approach, placebo test, and Heckman's two-stage model. The mechanism of action test finds that D&O insurance can contribute to corporate ESG performance by increasing management optimism and promoting corporate green innovation output. Further analysis shows that the contribution of D&O insurance to ESG performance is more significant in firms with higher institutional investor shareholdings, more media attention, and in heavily polluting industries; the introduction of D&O insurance as an external monitoring mechanism improves the quality of information disclosure, enhances internal control, and reduces operational risk.. The findings enrich the literature on D&O insurance and corporate ESG performance, provide a theoretical basis for constructing a better insurance service system and deepening the governance system of green and low-carbon transformation, and are of great significance to China's achievement of the "dual-carbon" strategic goal.***

Keywords: D&O Insurance, Corporate ESG Performance, Management Optimism, Sustainable Development.

1. Introduction

The full name of ESG is Environmental, Social, and Governance, a sustainable development concept derived from the 1960s and a development approach that integrates environmental performance, social responsibility, and corporate governance. Under the top-level design of China's "dual-carbon" goal, the development concept of ESG resonates with the essential requirements of Chinese-style modernization. Moreover, it is an important institutional tool for the country to promote sustainable development and governance. As a market subject, enterprises practice ESG responsibility, a strategic choice to achieve high-quality development. Therefore, exploring the triggering conditions and conduction mechanisms to enhance corporate ESG governance deserves high attention.

In recent years, due to the complexity of the business environment, the improvement of investors' legal awareness, and the legal system to increase the punishment of directors and executives and other external factors that make directors and executives face more and more high practice risks, D&O insurance, which is regarded as the "bullet-proof vest" for executives of listed companies, came into being. Since the introduction of D&O insurance in China, it has received extensive attention from scholars and its value has been gradually explored. The new Article 193 of the Company Law of the People's Republic of China (hereinafter referred to as the "New Company Law"), which was newly amended in 2023, states that "a company may, during the director's term of office, take out a liability insurance policy for the liabilities assumed by the directors in the course of their duties for the company". The promulgation of the New Company Law has undoubtedly provided a new impetus to the directors. The promulgation of the New Company Law has undoubtedly provided a solid legal guarantee for the orderly development of D&O insurance in China.

Most scholars are optimistic about D&O insurance, and based on the incentive utility hypothesis, they believe that the purchase of D&O insurance can have a positive effect on enterprises. Amore & Bennedsen found that D&O insurance can retain excellent human capital for enterprise innovation and promote the independent innovation behavior of enterprises[1]; Ang et al.(2000) found that the purchase of D&O insurance can significantly reduce the tendency of enterprise's non-compliance and the first type of agency costs of listed companies[2]. However, the voices questioning D&O insurance have also been unceasing. Among the many opponents, the most famous is Warren Buffett, the chairman and CEO of Berkshire Hathaway. In Buffett's view, if directors, supervisors, and executives make mistakes in business management, they should rightly suffer the consequences, instead of shifting the responsibility to the insurance company[3]. A considerable number of research

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results also confirm that D&O insurance weakens the disciplinary effect of lawsuits on directors, supervisors, and executives, reduces the group's sense of responsibility, and is highly susceptible to moral hazard[4].

Promoting ESG governance, companies not only face external risks such as technology choice and market competition but also internal risks such as management, talent, and finance. The reasons why corporate executives do not actively promote corporate ESG governance are as follows: first, ESG governance requires focusing on stakeholders and social sustainability, which requires companies to invest more resources in ESG areas, such as enhancing the intensity of green innovation, reducing carbon emissions, improving energy efficiency, and implementing diversified energy strategies, etc., which may lead to an increase in short-term operating costs and result in short-termism on the part of executives. Second, the promotion of ESG construction by enterprises may also lead to an increase in the risk of the performance of duties by senior management. The promotion of ESG governance involves various aspects of corporate governance such as technology and law and confined to their capacity and energy, senior management will inevitably produce various non-subjective intentional omissions and faults in the process of promoting ESG governance, and these non-subjective intentional omissions and faults will inevitably cause losses to investors or third parties, which increases the risk of senior management being sued and bearing civil compensation. D&O insurance is a more reasonable equity protection tool that increases management's tolerance of ESG governance risks, thus incentivizing them to tilt financial resources towards green technology innovation activities with inherent risks. Currently, there is little domestic literature on the impact of insurance tools on corporate ESG performance. However, listed companies are in dire need of the necessary tools and measures to control the operational and executive performance risks they face in the process of ESG promotion. Insurance is an important tool for modern risk management, and based on this, this paper investigates whether D&O insurance helps listed companies improve their ESG performance.

The marginal contributions of this paper are: first, expanding the research on the factors affecting corporate ESG performance. This paper examines the impact of D&O insurance, a financial instrument that can be independently chosen by enterprises, on corporate ESG performance, and proposes a way for enterprises to enhance ESG level by financial instruments, providing a new perspective for enterprises to promote ESG governance. Second, the study of the governance effect of D&O insurance on corporate ESG performance in the context of the new company law enriches the research perspectives in the field of the governance effect of D&O insurance. Third, it provides a theoretical reference for the further promotion of D&O insurance and a comprehensive understanding of the economic utility of D&O insurance. China's D&O insurance market is still incomplete, with the introduction of the New Securities Law and the occurrence of various types of litigation events, the overall litigation risk in China's capital market has increased significantly, which highlights the actual need for D&O insurance. This paper is of practical significance in guiding the financial market regulatory arrangements of China's governmental departments and the decision-making of listed companies in purchasing D&O insurance.

2. Theoretical Analyses and Research Hypotheses

The ESG concept emphasizes that enterprises should pay attention to ecological environmental protection, fulfill social responsibility, and improve governance, which coincides with the theme of high-quality development. However, the long cycle and cost-benefit mismatch of ESG practices constrain the initiative of corporate managers to engage in ESG practices to a certain extent. On the one hand, the uncertainty and long payback period of green innovation, environmental protection projects and socially responsible investment directly affects the market performance of enterprises and increases the risk of shareholder class action and derivative litigation. On the other hand, when corporate ESG practices have positive externalities, they also encounter the thorny problem of “free-riding”. Unlike risk-neutral shareholders, professional managers tend to be risk-averse and prefer to invest in projects with more stable returns for reasons of professional reputation and shareholder litigation risk.

D&O insurance is a kind of occupational insurance purchased by enterprises, whereby the insurance company fulfills the civil liability on behalf of the directors or officers when they are held personally liable for compensation due to their work errors or improper performance of duties. D&O insurance incorporates the insurance company, an external party, into the supervision and governance of listed companies, transfers the practice risk of directors, supervisors, and executives, and incentivizes continuous innovation. The impact of D&O insurance on corporate governance is mainly expressed in the incentive effect hypothesis, the external monitoring hypothesis, and the opportunistic hypothesis.

Firstly, from the perspective of the incentive effect hypothesis, the purchase of D&O insurance by enterprises can improve the motivation and innovation ability of directors and executives. Because of the high uncertainty and high risk of innovation activities, directors and executives are unable to actively face the third-party litigation caused by the failure of innovation activities and their own reputation and social status damage and other adverse consequences, prone to inaction of directors and executives. In addition, the principal-agent theory points out that under the system of separation of management and ownership, the interests of the principal (ownership) and the agent (management) are inconsistent, or even conflicting in some aspects, which will lead to the agent's moral hazard and short-sighted and short-term behaviors, which may constitute a major obstacle to the long-term sustainable development of the enterprise[5]. As the saying goes, “Risks are inevitable, but can only be transferred”, the enterprise purchased D&O insurance to a certain extent can transfer the litigation and compensation risks faced by the directors and officers in the course of practice to the insurance company. This solves the worries of directors and executives, improves their risk-taking level so that they dare to take the initiative, reduces the conflict between principal and agent, inhibits short-sighted and short-term behaviors, motivates executives to invest in ESG activities that have a long lifecycle and are conducive to the long-term development of the enterprise, and promotes the sustainable development of the enterprise.

Based on the external monitoring hypothesis, the insurance company, as a rational and independent individual, has a direct correlation between its compensation cost and the level of corporate governance and litigation risk of the insured enterprise, and out of its interests, it will force the enterprise to improve its corporate governance structure and play the role of external supervision[6].The insurance company has a perfect environmental risk identification mechanism and participates in the supervision of enterprises to improve the ability of environmental risk management and control, and has the advantages of professionalism and operability. Therefore, it can reduce the asymmetry of environmental information and the cost of obtaining external information of enterprises, which provides an important carrier for improving the social supervision mechanism[7]. Compared with Western developed countries such as the United Kingdom and the United States, fewer enterprises in China have taken out D&O insurance, so the insurance company has the actual conditions to carry out all-around supervision of the enterprises. Before both parties sign the insurance contract, the insurance company will conduct an all-around investigation of the insured enterprise's corporate governance, financial status, performance of executives, management ability, risk-taking ability, etc., and in the process of investigation, the insured enterprise will be further required to expand the scope of information disclosure and improve the quality of information disclosure. Improved disclosure quality mitigates the agency's problem of information asymmetry among stakeholders and helps to constrain the opportunistic behavior of executives. In the process of performing the insurance contract, listed companies introduce the external governance mechanism of D&O insurance into the framework of the corporate governance system. To gain profits from underwriting and reduce the risk of huge compensation, insurance companies have a strong incentive to supervise the management throughout the insurance process, and by focusing on the internal control deficiencies that exist in the enterprise, it prompts listed companies to improve their internal control systems and corporate governance mechanisms. When the executives exist or are accused of negligence and misconduct and are pursued civil liability, the insurance company will set up a professional claims team to investigate the directors' and executives' performance of their duties, clarify the liability, and inhibit the executives from using the underwriting effect of the D&O insurance for personal gain and other behaviors. Therefore, as an external governance mechanism, D&O insurance introduces insurance companies into the framework of the corporate governance system, which can proactively monitor whether there are ESG violations in the insured companies and urge the insured companies to improve the quality of ESG information disclosure, to promote the sustainable development of enterprises.

Based on the opportunistic hypothesis, the underwriting effect of D&O insurance shifts the civil liability to the insurance company and weakens the deterrent effect of the law[8] and the self-restraint of the management[9], which will lead to the opportunistic behavior of the management and moral hazard. The environmental management of enterprises requires continuous efforts, and in the early stage of management, it will cause a "crowding out" effect on the original production and sales planning of the enterprise, resulting in a short-term performance decline. However, the remuneration and equity incentives of executives are usually linked to short-term performance, which will cause executives to neglect the long-term goal of sustainable development. When D&O insurance "covers" the self-interested behavior of executives, executives have more incentives to improve the economic performance of the enterprise and neglect the reputational benefits brought by environmental protection and social responsibility. In addition, D&O insurance reduces the risk of litigation faced by executives, which will weaken the sense of responsibility of executives in performing their duties and make it difficult for them to exercise their initiative, leading to more serious agency problems, which is not conducive to the sustainable development of the enterprise. Therefore, the opportunistic hypothesis suggests that D&O insurance will greatly reduce management's risk appetite and diligence[10], increase the company's agency costs[11], reduce corporate performance[12], and is not conducive to the sustainable development of enterprises. Based on the above analyses, this paper proposes the following competing hypotheses:

H1a: D&O insurance can exert incentive and monitoring effects and improve firms' ESG performance.

H1b: D&O insurance exerts opportunistic effects and inhibits corporate ESG performance.

3. Sample Selection and Research Design

3.1 Research Sample

The Ministry of Finance (MOF) issued a completely new accounting standard for enterprises in February 2006 and implemented it in 2007, which had a great impact on the way business accounting and the evaluation standard of key financial indicators, and the global financial crisis that broke out in 2008 swept across the world. Given this, this paper selects Chinese A-share listed companies in Shanghai and Shenzhen Stock Exchanges from 2009 to 2022 as the initial sample, and adopts the following criteria for screening: (1) excluding samples of financial and insurance industries; (2) excluding samples with missing key data; (3) excluding samples of ST, *ST and PT listed companies. To alleviate the undue influence of outliers, this paper winterizes all continuous variables at the top and bottom 1% percentiles.

3.2 Variables Definition

The dependent variables are corporate ESG performance (ESG). This paper measures the ESG performance of listed companies using the ESG rating data developed by Sino-Securities Index Information Service (Shanghai) Co., Ltd (abbreviated as SSI). As a third-party authoritative rating agency engaged in ESG ratings of listed companies in China, SSI is an official signatory to the United Nations Principles for Responsible Investment (UNPRI). The SSI ESG index system refers to the international mainstream rating system, incorporates evaluation indicators unique to the domestic capital market, and adopts the industry-weighted average method to construct 26 key indicators from top to bottom. In terms of data release, the SSI ESG rating system is updated every quarter, and dynamic tracking is used for regular evaluation and data adjustment, covering all A-share listed companies, which can effectively support the completeness, timeliness, and accuracy of the relevant information required.

The final rating results are divided into nine grades. From best to worst, they are AAA, AA, A, BBB, BB, B, CCC, CC, C. This paper assigns the above ratings from low to high in the order of 1-9.

The independent variable is D&O insurance (Insu). The data on D&O insurance is mainly obtained from the China Stock Market and Accounting Research database. Since listed companies seldom make separate announcements on the purchase of D&O insurance, we manually searched the websites of Juchao Information and other public websites to find out whether the announcements of the board of directors, supervisors, shareholders' meeting, annual report, etc. mention or disclose the D&O insurance. If the relevant information is proposed by the board of directors and voted by the shareholders' representative meeting, the listed company is considered to have purchased D&O insurance. A listed company that resolves to purchase, and then terminates the purchase without an express resolution to do so, is deemed to have continued to purchase D&O insurance. For certain business enterprises that have not issued any announcement mentioning D&O insurance, it is tacitly assumed that they have never purchased D&O insurance. Since there is no mandatory requirement for listed companies to disclose information related to the purchase of D&O insurance in China, this paper adopts a dummy variable to measure D&O insurance by referring to Hu Guoliu[13], and takes the value of 1 if the listed company purchases D&O insurance, and 0 otherwise. To control for heteroskedasticity and bias due to within-group sequences, standard errors are adjusted for clustering at the firm level. The specific definitions of the main variables are shown in Appendix A.

3.3 Empirical Model

To verify the research hypotheses presented in the previous section, this paper constructs the baseline regression model as follows:

$$\mathrm{ESG}_{i,t} = \alpha_0 + \alpha_1 \mathrm{Insu}_{i,t} + \alpha_2 \mathrm{Controls}_{i,t} + \mathrm{Year} + \mathrm{Industry} + \varepsilon_{i,t} \quad (1)$$

In model (1): ESG is the ESG rating of firm i in year t, and D&O insurance (Insu) is the core explanatory variable; Controls is the set of control variables mentioned above; in addition, this paper incorporates time (Year) and industry(Industry) dummies to control for unobservable factors at the time and industry levels.

4. Analysis of Empirical Results

4.1 Descriptive Statistics

Panel A of Table 1 reports the descriptive statistics of the main variables. The mean value of the dependent variable ESG rating is 4.124, with a minimum value of 1 and a maximum value of 8, which is more similar to the results of existing literature. The mean value of D&O insurance Insu is 0.095, indicating that about 9.5% of listed companies take out D&O insurance, which is a large gap in the rate of insurance compared with western countries such as 95% in the United States and 75% in Canada. Panel B in Table 1 is a univariate analysis, the empirical sample is divided into two groups according to whether listed companies take out D&O insurance or not. For the group without D&O insurance, the mean value of corporate ESG performance is 4.098, which is lower than the mean value of the group with D&O insurance, 4.315, and the two have a significant difference. The results of the univariate analysis initially verified hypothesis H1a, but it still needs to be further analyzed in the empirical part. The results of correlation analysis show that Insu and ESG are significantly positively correlated at the 1% level, confirming the previous theoretical analysis and research hypothesis H1a. The correlation coefficients of each variable are almost less than 0.5, and further tests using the variance inflation factor (VIF) method show that, except for the Age variable, which has a VIF value of 1.67, the VIF values of the rest of the control variables are within 1.6, which proves that there is no serious problem of multiple covariances in the baseline regression model. Correlation analysis table is shown in Appendix B.

Table 1: Descriptive Statistics and Univariate Analysis

Panel A：Summary statistics						
Variable	N	Mean	Sd	Min	P50	Max
ESG	36993	4.124	1.078	1.000	4.000	8.000
Insu	36993	0.095	0.294	0.000	0.000	1.000
Size	36993	22.168	1.351	11.348	21.974	28.636
Roa	36993	0.037	0.683	-51.947	0.038	108.366
Board	36993	8.539	1.697	0.000	9.000	18.000
Growth	36993	2.827	310.790	-11.924	0.125	59411.549
Ehold	36993	13.520	19.867	0.000	0.501	235.262
Ind	36993	37.578	5.598	0.000	36.360	100.000
Age	36993	9.964	7.696	0.000	9.000	32.000
Loss	36993	0.111	0.314	0.000	0.000	1.000
Soe	36993	0.359	0.480	0.000	0.000	1.000
Dual	36993	0.286	0.452	0.000	0.000	1.000
Lev	36993	0.441	1.275	-0.195	0.413	178.345
Cash	36993	0.046	0.100	-10.216	0.046	2.222

Panel B：Univariate analysis					
Variable	Not insured		Insured		Difference
ESG	N	Mean	N	Mean	-0.228***
	33469	4.103	3524	4.330	

4.2 Main Results

Table 2 reports the results of the overall test of D&O insurance on the total indicator and each sub-indicator of firms' ESG performance. The regression coefficient of Insu in the regression result in column (1) is 0.1303. In terms of economic significance, the purchase of D&O insurance by firms contributes to the level of ESG performance by an average of 0.1303 units, and the empirical results are consistent with the expectation of hypothesis H1a. Table 2 columns (2)-columns (4) present the regression results of D&O insurance on three different dimensions of environmental, social responsibility, and corporate governance performance, and the coefficients are all significantly positive. In addition, the effects of the remaining control variables on firms' ESG performance are also largely consistent with existing studies.

Table 2: D&O Insurance and Firms' ESG Performance

Variables	(1) ESG	(2) Escore	(3) Sscore	(4) Gscore
Insu	0.130***	0.150***	0.138***	0.098**
	(3.879)	(3.941)	(3.999)	(2.112)
Roa	-0.027***	-0.007	-0.015*	-0.033**
	(-3.295)	(-1.269)	(-1.913)	(-2.268)
Age	-0.027***	0.035***	0.067***	-0.097***
	(-9.77)	(12.271)	(15.488)	(-23.771)
Size	0.192***	0.094***	0.179***	0.083***
	(12.413)	(6.545)	(11.356)	(3.625)

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Growth	-0.000***	-0.000	-0.000***	-0.000***
	(-7.570)	(-1.331)	(-8.001)	(-11.463)
Soe	0.051	0.029	0.099**	0.067
	(1.207)	(0.698)	(2.199)	(1.021)
Dual	-0.018	-0.012	-0.017	0.013
	(-0.903)	(-0.629)	(-0.815)	(0.468)
Ehold	0.009***	0.001	0.008***	0.017***
	(10.969)	(1.587)	(9.119)	(13.605)
Board	0.007	-0.011	0.002	0.008
	(0.916)	(-1.374)	(0.177)	(0.790)
Ind	0.012***	-0.002	0.009***	0.022***
	(6.328)	(-1.056)	(5.062)	(8.872)
Loss	-0.176***	0.008	-0.179***	-0.312***
	(-9.417)	(0.463)	(-9.137)	(-11.246)
Lev	-0.015**	0.005***	-0.017**	-0.023**
	(-2.263)	(2.897)	(-2.502)	(-2.271)
Cash	-0.192***	-0.011	-0.085	-0.252**
	(-2.873)	(-0.202)	(-1.218)	(-2.415)
Intercept	-0.429	0.041	-0.963*	2.961***
	(-0.960)	(0.113)	(-1.938)	(5.158)
Industry	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
N	36993	36993	36993	36993
Adj. R^2	0.044	0.068	0.104	0.160

4.3 Robustness Checks

4.3.1 Heckman's Two-stage Model

Given that listed companies have multiple motives for purchasing D&O insurance, in order to alleviate the bias of the empirical results caused by the sample self-selection problem, this paper adopts Heckman's two-stage regression for the robustness of the model.According to Heckman[14], firm size (Size), profitability (Roa), firm growth (Growth), firm age (Age), board size (Board), proportion of independent directors (Ind), proportion of executive shareholding (Ehold), whether cross-listed or not (BH), Tobin's Q (Tuobin's Q), expense ratio (Feerate) and other variables that have a potential impact on the purchase of D&O insurance by listed companies were subjected to Probit regression. The inverse Mills coefficient (imr) derived from the regression is substituted as a control variable in the second stage. According to the regression results in Table 3, the Insu is significantly correlated with the three introduced variables, which justifies the introduction of the variables. After adding the inverse Mills coefficient (imr) in the second stage, the Insu is significantly and positively associated with firms' ESG performance, and the inverse Mills coefficient (imr) is significant. After correcting for sample selection bias using the inverse Mills ratio, the findings remain unchanged.

Table 3: Heckman's Two-stage Regression Results

Variables	(1) first-stage Insu	(2) second-stage ESG
BH	0.875***	
	(8.840)	
Feerate	0.001*	
	(1.928)	
TobinQ	-0.0006**	
	(-2.326)	
Insu		0.052***
		(3.399)
imr		0.270***
		(2.742)
Controls	Yes	Yes
Intercept	-5.431***	-2.124***
	(-8.149)	(-3.689)
Industry	Yes	Yes
Year	Yes	Yes
N	36685	36685
Adj. R^2		0.026

4.3.2 Instrumental Variable

To solve the endogeneity problem caused by omitted variables and variable measurement errors, this paper adopts the instrumental variable method to test the original model. Referring to Tang Songlian[15], the overseas background (Overseas) of the board of directors, supervisory board, and executives is selected as an instrumental variable. If the current directors, supervisors, and executives have an overseas background (overseas background includes previous and current education and employment background), the indicator overseas will be 1, otherwise, it will be 0. The instrumental variables are selected for the following reasons: Based on the branding theory, the environmental characteristics and experiences at a particular stage will leave a historical "brand" on the organization and individuals in terms of cognition, experience, and knowledge. These imprints will have an important and lasting impact on the behavior of organizations and individuals[16]. Overseas learning or working experience is a process of being "branded", shaping the characteristics of directors, supervisors, and executives in terms of cognition, ability, and other aspects to match the overseas working environment. When directors and supervisors cross the organizational boundaries, the branding effect will also be transferred[17], which will have a profound impact on their subsequent personal careers. D&O insurance has a higher coverage rate in overseas mature capital markets. When directors and supervisors have an overseas study or work background, they can have a more comprehensive understanding of the mechanism of D&O insurance and tend to introduce D&O insurance to reduce their litigation risks in the course of performing their duties. The instrumental variable 2SLS regression results are shown in Table 4. In the first-stage regression, the coefficient of directors' and supervisors'overseas background (Overseas) is significantly positive, as expected, and the F-statistic value of 55.48 is greater than 10, which passes the weak instrumental variable test. In the second-stage regression, the positive correlation between D&O insurance and firms' ESG performance at the 1% significance level suggests that the empirical findings remain valid and robust after mitigating potential endogeneity problems.

Table 4: 2SLS Regression Results

Variables	(1) IV-first stage Insu	(2) IV-second stage ESG
Overseas	0.046***	
	(15.322)	
Insu		0.702***
		(2.992)
Controls	Yes	Yes
Constant	-0.824***	-1.514***
	(-22.53)	(-6.19)

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F	54.48	
Wald chi2		8462.89
Wald P-Value	0.000	0.000
Observations	36993	36993
R-squared	0.132	0.164

4.3.3 Propensity Score Matching Test

The empirical results in this paper suffer from the problem of sample selection bias. To mitigate this potential endogeneity problem, this paper uses 1:1 nearest neighbor matching with a caliper range of 0.05 for PSM-OLS processing.The results of the balance test show that relative to the pre-matching period, the standardized deviations of the matched covariates are substantially reduced, with all absolute values below 10%, satisfying the common support assumption and the parallel assumption. The OLS regression of the matched samples is calculated, and the results are shown in column (1) of Table 5, the coefficient of D&O insurance (Insu) is significantly positive, and the research conclusion still holds.PSM first stage regression results are shown in Appendix C

4.3.4 Placebo Test

The baseline regression in this paper finds that D&O insurance is correlated with firms' ESG performance, controlling for the estimation bias that may be caused by the sample self-selection problem and the omitted variable problem. However, theoretically, the correlation in this paper's baseline regression may also be just a placebo effect, i.e., due to unobserved limitations in the research design process. To ensure the robustness of the findings, this paper utilizes a placebo test to rule out this possibility. Drawing on Pan Yue[18], the sample values of D&O insurance are first extracted from all samples, then randomly assigned to firm-year observations, and finally, the model (1) is re-regressed. If the placebo effect does exist, then the treated Insu should still be positively associated with firms' ESG performance, driven by unobserved study design limitations. Specific regression results are presented in column (2) of Table 5.The coefficient of Insu is 0.0027, which is close to 0 in absolute value and insignificant. The distinct difference from the baseline regression results implies that the placebo effect is not present, again validating the robustness of the conclusions.

Table 5: Robustness Checks

Variables	(1) ESG	(2) ESG
Insu	0.088***	0.003
	(3.558)	(0.159)
Controls	Yes	Yes
Intercept	-3.598***	-2.1320***
	(-13.725)	(-7.807)
Industry	Yes	Yes
Year	Yes	Yes
N	7012	36993
Adj. R^2	0.283	0.184

In addition to the above tests, this paper also conducts the following analyses, including but not limited to ① Alternative measure for ESG rating: the dependent variable adopts the Bloomberg ESG ratings to avoid differences in measurement standards among different institutions. ② Entropy balancing: to further control the sample self-selection problem. ③Lagging the dependent variable ESG rating by one period. The above empirical results remain consistent with the empirical conclusions of this paper. The test results are shown in Appendix D and E.

5. Mechanism of Action Tests

As mentioned above, D&O insurance, as a "talisman" for management, increases their willingness to take risks in the course of performing their duties and transfers the liability for negligence and misconduct to the insurance company. To a certain extent, it eases the mental pressure of management, enables them to focus more on the daily operation and strategic planning of the enterprise, and positively and optimistically responds to the resistance of the enterprise's emerging product research and development and green innovation in the process of green economic transformation. Behavioral finance suggests that optimistic managers have better expectations of corporate and personal prospects, and higher tolerance for corporate risks and decision failures[19]. Optimistic managers have better expectations of corporate profitability and higher motivation to fulfill corporate social responsibilities. Therefore, D&O insurance may act on corporate ESG performance by increasing management optimism.

As the ultimate decision-makers and implementers of innovative activities, managers tend to avoid risky innovative activities due to career planning, acquisition threats, and the pursuit of short-term stock performance[20], resulting in the "short-sightedness profit-seeking effect". D&O insurance can cover the property losses that may be incurred by managers' decision-making behaviors, which not only helps enterprises to attract and retain excellent managers[21], but also effectively mitigates managers' risk aversion and other agency problems, improves the level of corporate risk-taking, increase tolerance for the risk of innovation failures, and promotes independent innovation. Green innovation may provide another path for D&O insurance to promote corporate ESG performance.

To test the above two paths, drawing on the methodology of existing studies[22], we used path analysis to carry out the test. The structural equation model used is shown below:

$$\mathrm{Med}_{i,t} = \beta_0 + \beta_1 \mathrm{Insu}_{i,t} + \beta_2 \mathrm{Controls}_{i,t} + \mathrm{Year} + \mathrm{Industry} + \varepsilon_{i,t} \quad (2)$$

$$\mathrm{ESG}_{i,t} = \gamma_0 + \gamma_1 \mathrm{Insu}_{i,t} + \gamma_2 \mathrm{Med}_{i,t} + \gamma_3 \mathrm{Controls}_{i,t} + \mathrm{Year} + \mathrm{Industry} + \varepsilon_{i,t} \quad (3)$$

The mechanism variables (Med) are management optimism (Tone1 and Tone2) and green technology innovation (lnpatent), respectively. Drawing on Tang Songlian's approach (2023), management optimism is measured by the tone of management's annual report disclosure, Tone1 = (optimistic vocabulary - pessimistic vocabulary) / (optimistic vocabulary + pessimistic vocabulary); Tone2 = (optimistic vocabulary - pessimistic vocabulary) / number of vocabulary in the annual report; the greater Tone1 and Tone2, the higher the optimism of the management. Green technological innovation adopts the natural logarithm of the sum of the number of green inventions and green utility patent applications filed independently and jointly by enterprises plus one. The empirical results are shown in Table 6.

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Table 6: Mechanism of Action Test Results

	(1) Tone1 Coefficient	(2) Tone2 Coefficient	(3) Lnpatent Coefficient
Direct Path			
P(Insu,ESG)=γ_1	0.068 (3.672***)	0.067 (3.621***)	0.110 (5.903***)
PercentAge	60.00%	59.24%	97.14%
Mediated path			
P(Insu,Med)=β_1	0.003 (15.721***)	0.019 (16.412***)	0.062 (3.213***)
P(Med,ESG)=γ_2	18.119 (30.034***)	2.45 (29.292***)	0.053 (10.413***)
Total mediated path(=$\beta_1 * \gamma_2$)	0.045	0.046	0.03
PercentAge	40.00%	40.76%	2.86%
Control variables	Yes	Yes	Yes
Industry	Yes	Yes	Yes
Year	Yes	Yes	Yes
N	36993	36993	36993

The direction of the coefficients of the empirical results in Table 6 is consistent with the expectation of the previous hypothesis. Further, by comparing the effects of the direct and indirect paths of different action mechanisms, it can be found that the indirect effect of management optimism in the action path is about 40%, and the effect of the indirect path of green innovation only accounts for 2.86%. In conclusion, the empirical results confirm that ‘increasing management optimism’ and ‘promoting corporate green innovation’ are the channels through which D&O insurance promotes corporate ESG governance.

6. Further analysis

6.1 Heterogeneity Analysis

6.1.1 Heavily Polluting Industry

Heavily polluting enterprises, represented by thermal power, energy, and chemical industries, have provided strong support and guarantee for China's stable economic and social development. However, their crude development mode of “high pollution” and “high emission” also poses a serious threat to the environment. It is the social responsibility and legal obligation of heavily polluting enterprises to publish regular environmental reports and disclose environmental information in detail. When a heavily polluted listed company purchases D&O insurance, the insurance company, out of its interests, has a strong incentive to require the management of the heavily polluted company to further expand the scope of environmental information disclosure and improve the quality of information disclosure, to prevent it from being penalized by the government regulatory authorities for failing to disclose environmental information in a truthful, accurate and comprehensive manner. On the other hand, the introduction of D&O insurance provides a good risk-transfer mechanism for the uncertainty of returns on environmental R&D investment of heavily polluting enterprises, stimulates the enthusiasm of executives for green innovation, and thus promotes the sustainable development of enterprises. Therefore, this paper expects that the marginal effect of D&O insurance on corporate ESG performance is more significant in the heavy pollution industry.

Therefore, this paper divides the sample into heavy-polluting industry group and non-heavy-polluting industry group for testing concerning the SEC 2012 industry classification standard, and the test results are reported in Table 7, column (1) and column (2). Compared with the non-heavy polluting industry group, the regression coefficient of the heavy-polluting industry group is larger in absolute value and higher in significance level. There is a significant difference in the coefficients between the different groups (p=0.012), which suggests that D&O insurance has a stronger promotional utility on ESG level of heavy polluting industry.

6.1.2 Media Attention

Media reporting is an important component of external corporate governance. Media reports can not only inhibit the occurrence of corporate irregularities and reduce the probability of corporate financial fraud but also help firms improve the quality of internal controls and thus improve their innovative performance. Media coverage promotes the active performance of corporate management and reduces the occurrence of opportunistic behavior by providing incremental information and public opinion pressure. When listed companies purchase D&O insurance: on the one hand, media reports can play its role as an information intermediary to alleviate the information asymmetry between the insurance company and the enterprise. On the other hand, with the increase of media attention, the reports of negative news such as untreated pollutant emissions exceeding the standard and product quality and safety not meeting the standard of the enterprise will create a greater reputational threat to the management of the enterprise. Both will increase management's willingness to improve corporate governance mechanisms and internal controls. Media attention and D&O insurance play a joint governance effect, enhancing the enthusiasm of enterprises to protect the environment, fulfill their social responsibilities and improve corporate governance.

In this paper, we use the natural logarithm of the total number of newspaper media headline reports to measure media attention, and divide the study sample into two groups according to the industry-year median for testing. The test results, as shown in columns (3) and (4) of Table 7, indicate that the contribution of D&O insurance to corporate ESG performance is more significant for firms with higher media attention. There is a significant difference in the coefficients between the different groups (p=0.001), indicating a complementary effect between media attention and D&O insurance.

6.1.3 Institutional Investor Shareholdings

Institutional investors, whose investment behavior tends to be long-term, are important investment subjects in China's capital market and actively participate in corporate governance by voting with their hands. Institutional investors have richer professional knowledge, wider network resources, and information advantages. They can use their strong information interpretation ability to identify the information that the management intentionally hides and play the role of information transfer, to effectively alleviate the information asymmetry between the management and external investors. Institutional investors make full use of their talent, professional, and information advantages to play their governance role, inhibit aggressive surplus manipulation, and

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promote the enhancement of the quality of information disclosure. The synergistic governance effect of institutional investors and D&O insurance can further enhance corporate ESG ratings.

The grouping test of the model (1) is performed by dividing the sample into a high institutional investor shareholding group and a low institutional investor shareholding group based on the industry-year median of institutional investor shareholding. The institutional investor shareholding ratio is equal to the ratio of institutional investor shareholding to the total number of shares at the end of the year. Columns (5) and (6) of Table 7 report the regression results of the group test for institutional investor shareholding. In the high institutional investor shareholding group, the regression coefficient of Insu is 0.1809 and significant at a 1% level, while in the low institutional investor shareholding group, the regression coefficient of Insu is 0.0464 but not significant. The coefficient difference test shows that the variable Insu is significantly different in different groups (p=0.092), which verifies the complementary effect of institutional investors and D&O insurance.

Table 7: Heterogeneity Analysis Results

Variables	(1)	(2)	(3)	(4)	(5)	(6)
	Heavily polluting industry		Media attention		Institutional investor shareholdings	
	No	Yes	lower	higher	lower	higher
	ESG	ESG	ESG	ESG	ESG	ESG
Insu	0.092**	0.160***	0.065	0.161***	0.046	0.181***
	(2.257)	(2.783)	(1.498)	(3.143)	(0.865)	(4.199)
Intercept	-0.546	-1.044	-0.263	-1.641**	-0.191	-0.760
	(-1.101)	(-1.159)	(-0.517)	(-2.286)	(-0.291)	(-1.107)
P Value	0.012**		0.001***		0.092*	
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes
N	26230	10763	20969	16024	18483	18510
Adj. R^2	0.049	0.046	0.051	0.040	0.056	0.041

6.2 Analysis of the governance Effects of D&O Insurance

6.2.1 Improving the Quality of Information Disclosure

As an independent individual, the insurance company will continue to evaluate the insured company to protect its interests, and this powerful external supervisory body can effectively reduce the moral hazard of directors and executives and the problem of adverse selection, which can reduce the accounting information distortion phenomenon[23]. In this paper, the disclosure assessment results of listed companies are chosen as the proxy variables for the quality of information disclosure. The annual report assessment results are divided into excellent, good, qualified, and unqualified. In this paper, the company with an excellent rating is set as high quality of disclosure (Dis=1), and the rest is set as low quality of disclosure (Dis=0), and the regression test is carried out using the logit model.

According to the regression results of further research shown in column (1) of Table 8, The effect of D&O insurance on improving the quality of information disclosure remains significant at the level of 1%. D&O insurance gives full play to its external supervisory role, improves the quality of information disclosure, and mitigates information asymmetry among stakeholders. Thus, it effectively suppresses management's opportunistic behavior, protects the interests of multiple stakeholders, and improves the sustainable development of the enterprise.

6.2.2 Strengthening Corporate Internal Controls

In this section, a dummy variable for internal control effectiveness is selected to measure internal control quality, and a Probit model is used to conduct a regression to test whether the introduction of D&O insurance can strengthen the firm's internal control.

The regression results are shown in column (2) of Table 8, and the regression coefficient between D&O insurance and internal control effectiveness is significantly positive at the 1% level. The external supervisory effect of D&O insurance can urge enterprises to improve their internal control system and realize sustainable development by improving their internal environment and restraining the self-interested behavior of executives.

6.2.3 Reducing Operational Risk

To test the actual supervisory effect of D&O insurance on corporate management, this paper further investigates the impact of the external governance effect of D&O insurance on corporate operational risk. Referring to the approach of Li Baixing, this paper adopts the Z-index proposed by Altman as a measure of corporate business operational risk, which is calculated as follows:

$$Zscore=0.012X1+0.014X2+0.033X3+0.006X4+0.999X5$$

Where X1 = net working capital/total assets, X2 = retained earnings/total assets, X3 = EBITDA/total assets, X4 = stock market capitalization/total liabilities, and X5 = operating income/total assets. This indicator reflects the comprehensive status of the enterprise's operating conditions, earnings level, and other aspects, representing the level of business operational risk faced by the enterprise. The larger the value of this indicator, the lower the level of business risk and the level of bankruptcy risk faced by the enterprise.

According to the regression results shown in column (3) of Table 8, the regression coefficients of D&O insurance and corporate business risk (Zscore) are positive and significant at the 1% level. It shows that the purchase of D&O insurance effectively reduces the business risk of the enterprise, achieves the improvement of corporate governance efficiency, and promotes the sustainable development of the enterprise.

Table 8: Governance Effect Regression Results

Variables	(1) Dis	（2） Ic	(3) Zscore
Insu	0.286***	0.162***	0.032***
	(3.328)	(2.739)	(3.510)
Controls	Yes	Yes	Yes
Intercept	-21.763***	-0.564	0.772***
	(-26.211)	(-1.519)	(12.102)
Industry	Yes	Yes	Yes
Year	Yes	Yes	Yes
N	28022	36263	36800

7. Conclusions

This study systematically explores the far-reaching impact of D&O insurance on corporate environmental, social, and governance (ESG) performance using a sample of Chinese A-share listed companies from 2009 to 2022. The core findings of the study point out that the introduction of D&O insurance significantly optimizes corporate ESG performance and lays a solid cornerstone on the path to sustainable development, and the results also highlight the key role of

D&O insurance in building effective corporate monitoring and incentive mechanisms. To ensure the reliability and robustness of the findings, the study was thoroughly validated using a variety of statistical methods including instrumental variable method, placebo test, and Heckman's two-stage method, all of which consistently supported the findings.

Further analyzing the mechanism of D&O insurance, it is found that it contributes to the enhancement of corporate ESG performance through two main paths: firstly, it enhances management's optimism and risk tolerance, and motivates them to take more forward-looking strategic decisions; secondly, the introduction of D&O insurance facilitates the development of green innovation activities, which directly contributes to the positive performance of corporations in terms of environmental protection and social responsibility.

In addition, the study reveals the variability of the impact of D&O insurance on ESG performance in different contexts. Specifically, the contribution of D&O insurance to ESG performance is more pronounced among firms with high institutional investor shareholding, high media attention, and in heavily polluting industries, which further emphasizes the indispensability of external monitoring forces and market pressure in amplifying the positive effects of D&O insurance.

Finally, this study also delves into the positive impact of D&O insurance on corporate governance structure. The results show that D&O insurance not only significantly improves the transparency of corporate disclosure and strengthens the solidity of the internal control framework but also effectively reduces the operational risk of corporations, laying a solid foundation for long-term prosperity and stability. In summary, this study provides strong empirical evidence for D&O insurance as an indispensable tool in modern corporate governance and further verifies its unique value in enhancing overall corporate value and promoting sustainable development.

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Appendix A. Variable Definitions

Variable name	Definitions
ESG	ESG score by Sino-Securities Index Information Service (Shanghai) Co., Ltd
Insu	A dummy variable that is equal to 1 if a given firm purchases D&O insurance in the fiscal year, and 0 otherwise
Roa	Return on assets, calculated as the net profit divided by the book value of total assets at the fiscal year-end
Board	The number of board directors
Size	Firm size, measured by the natural logarithm of the fiscal year-end total assets
Growth	The difference between sales of the current and the prior year divided by prior year sales
Ehold	Number of shares held by executives as a percentage of total shares at the fiscal year-end
Ind	The proportion of independent board directors
Age	Firm age, measured by the natural logarithm of one plus the number of listing years of a given firm
Loss	A dummy variable that is equal to 1 if the net profit i s less than 0 in the fiscal year, and 0 otherwise
Soe	A dummy variable that equals 1 if the ultimate controlling shareholder of a listed firm is the State in the fiscal year, and 0 otherwise
Lev	Total liabilities divided by total assets at the fiscal year-end
Cash	Net operating cash flow divided by total assets
Dual	Equals 1 if the CEO is the firm's chairperson at the same time, and 0 otherwise
Tobin's Q	The ratio of market value to the book value of assets, all measured at the fiscal year-end
BH	A dummy that equals 1 if the firm is cross listed
Feerate	The ratio of expenses incurred by managers

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Appendix B. Correlation Analysis

Variables	ESG	Insu	Size	Roa	Board	Growth	Ehold	Ind	Age	Loss	Soe	Dual	Lev	Cash
ESG	1													
Insu	0.062***	1												
Size	0.210***	0.260***	1											
Roa	0.025***	-0.005	0.007	1										
Board	0.028***	0.074***	0.266***	0.001	1									
Growth	-0.018***	-0.002	0.009*	0.000	-0.005	1								
Ehold	0.101***	-0.141***	-0.321***	0.016***	-0.209***	-0.005	1							
Ind	0.072***	0.018***	0.019***	0.003	-0.483***	0.005	0.063***	1						
Age	-0.100***	0.201***	0.400***	-0.015***	0.151***	-0.001	-0.538***	-0.014***	1					
Loss	-0.183***	0.041***	-0.065***	-0.092***	-0.033***	-0.002	-0.088***	0.021***	0.114***	1				
Soe	0.041***	0.154***	0.342***	-0.010*	0.286***	0.008	-0.482***	-0.053***	0.470***	0.020***	1			
Dual	-0.001	-0.076***	-0.175***	0.015***	-0.178***	-0.004	0.258***	0.097***	-0.249***	-0.009*	-0.316***	1		
Lev	-0.049***	0.016***	0.011**	-0.417***	0.017***	0.001	-0.065***	0.001	0.073***	0.063***	0.042***	-0.032***	1	
Cash	0.075***	0.016***	0.092***	-0.409***	0.040***	0.003	0.004	-0.008	-0.014***	-0.148***	0.003	-0.016***	-0.037***	1

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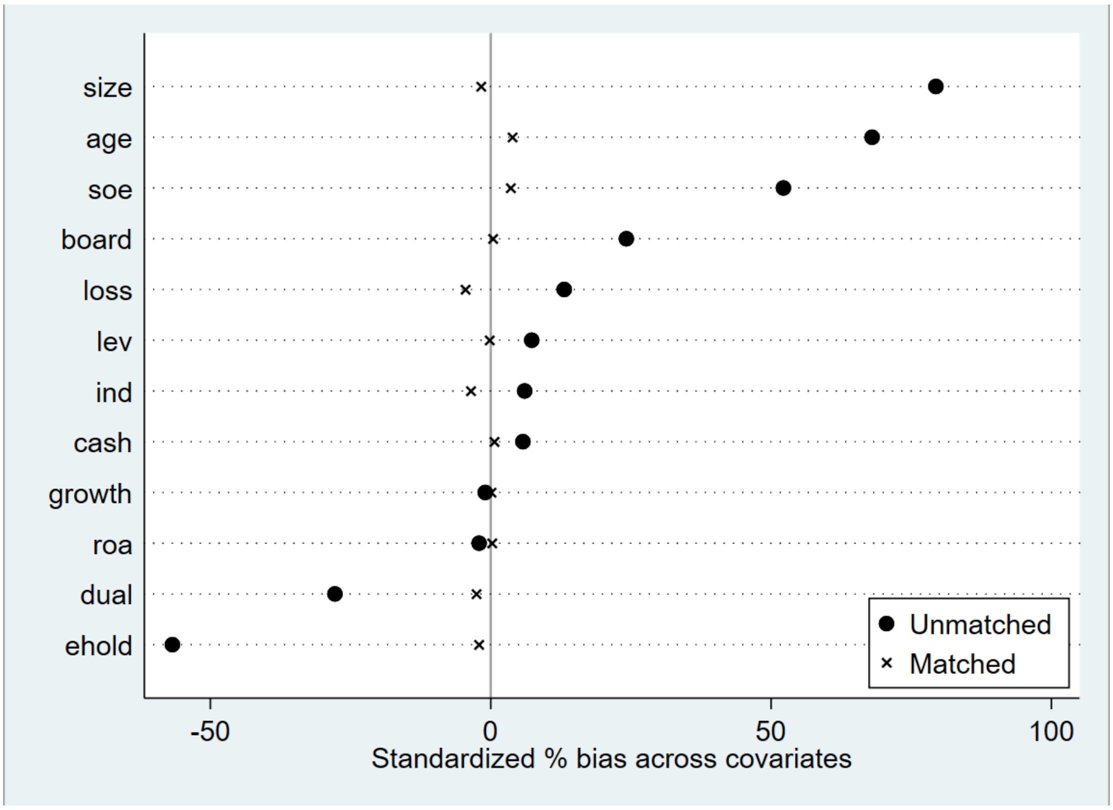
Appendix C.PSM First Stage Regression Results



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Appendix D. Alternative Measures for ESG Score

Variables	(1)
	Bloomberg ESG
Insu	2.877***
	(6.731)
Roa	0.027
	(0.341)
Age	1.502***
	(39.290)
Size	1.268***
	(5.844)
Growth	0.000
	(1.243)
Soe	-0.038
	(-0.073)
Dual	-0.177
	(-0.736)
Ehold	0.034**
	(2.462)
Board	0.039
	(0.524)
Ind	0.049***
	(2.693)
Loss	-0.797***
	(-4.980)
Lev	-2.215***
	(-3.606)
Cash	1.400*
	(1.752)
Intercept	-16.350***
	(-3.065)
Industry	Yes
Year	Yes
N	12445
Adj. R^2	0.735

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Appendix E. Robustness Test Results

Variables	(1) Entropy balancing ESG	(2) $ESG_{(t+1)}$
Insu	0.092***	0.106***
	(4.575)	(2.818)
Size	0.318***	-0.025***
	(33.304)	(-3.038)
Roa	0.088	0.009
	(0.810)	(0.968)
Board	0.008	0.200***
	(1.330)	(11.592)
Growth	-0.002***	-0.000***
	(-6.339)	(-7.752)
Ehold	0.010***	0.011***
	(7.758)	(10.502)
Ind	0.014***	0.012***
	(7.499)	(6.089)
Age	-0.013***	-0.032***
	(-8.478)	(-9.111)
Loss	-0.303***	-0.188***
	(-8.627)	(-9.015)
Soe	0.264***	0.064
	(10.478)	(1.349)
Dual	-0.027	-0.029
	(-1.018)	(-1.255)
Cash	0.253*	-0.192***
	(1.877)	(-2.765)
Lev	-0.940***	-0.013**
	(-8.113)	(-2.213)
Intercept	-3.827***	-0.478
	(-18.009)	(-0.989)
Industry	Yes	Yes
Year	Yes	Yes
N	36993	32453
Adj. R^2	0.285	0.049