

Directors' and Officers' Liability Insurance and Corporate Green Innovation

-- An Analysis from the Mediating Effect of Risk Taking

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Abstract: Using the data of A-share listed companies in Shanghai and Shenzhen from 2010 to 2021, we empirically test the impact mechanism of directors' and officers' liability insurance on corporate green innovation. The findings show that the introduction of directors' liability insurance plays a significant role in enhancing corporate green innovation, which still holds after robustness test and endogeneity treatment. It is further found that directors' liability insurance affects corporate green innovation by enhancing the level of corporate risk taking.

Keywords: Directors and Officers Liability Insurance, Green Innovation, Corporate Risk Taking.

1. Introduction

With the proposal of the "dual-carbon" goal, the construction of China's ecological civilization has entered a critical period in which carbon reduction is the key strategic direction and comprehensive green transformation of economic and social development is promoted, and the key role of green technological innovation in green and low-carbon development has become more and more prominent. The report of the 20th Party Congress clearly pointed out that it is necessary to improve the scientific and technological innovation system, accelerate the implementation of the innovation-driven development strategy, accelerate the research and development of advanced energy-saving carbon-reducing technologies and the popularization and application of such technologies. The Central Economic Work Conference emphasized the need to accelerate the research and development and popularization and application of green and low-carbon cutting-edge technologies. Obviously, green development and innovation has become an important concept to guide the whole macroeconomic operation and high-quality development, and enterprises, as the main body of the market economy, have an incumbent responsibility in balancing economic and environmental benefits. However, in the process of carrying out green innovation activities, enterprises need to invest more resources and face a higher risk of failure and a longer return on investment period. On the one hand, unlike shareholders pursuing the long-term goal of corporatization, managers tend to have a strong tendency of wind avoidance [1] (Hu Guoliu and Hu Jun, 2017) for the consideration of career development and possible litigation risks and property compensation, and are unwilling to choose high-risk and high-yield green innovation activities, resulting in insufficient motivation for green innovation in the enterprise; on the other hand, in the background of the separation of the two powers, due to the information asymmetry and lack of effective supervision, it will trigger the moral hazard behavior of management, and there may be a situation in which managers misappropriated green innovation resources, leading to a decline in green innovation

efficiency [2] (Wang Xu and Wang Lan, 2020). Therefore, the lack of green innovation motivation and moral risk have become the two major problems restricting the green innovation of enterprises, leading to the deviation of green innovation effect from the expected value.

As an emerging external governance mechanism, directors' and officers' liability insurance (hereinafter referred to as "directors' and officers' liability insurance") refers to compensating the directors, supervisors and executives of a company for misconduct in the course of performing their duties and providing protection for the liability risks they may incur. The enhancement of the civil liability of securities in the new Securities Law in 2019 and the improvement of the civil litigation system of securities have significantly improved the civil liability of securities, and the new Securities Law has also improved the civil litigation system of securities. securities civil litigation system have significantly increased the penalties for unlawful acts of listed companies and directors and supervisors, as well as the likelihood of their exposure to litigation risks. As a result, the demand for directors' liability insurance by listed companies has gradually increased, and the number of companies subscribing to directors' liability insurance has continued to rise, which has also aroused the attention of the industry and academia to directors' liability insurance. Existing studies have shown that the introduction of directors' liability insurance can hedge the practice risk of managers, improve the risk-taking level of enterprises [1] (Guoliu Hu and Jun Hu, 2017), and stimulate the innovation motivation of executives [3] (Donghua Zhou, 2022); at the same time, the directors' liability insurance also plays an external supervisory role [4] (Liou, 2016), and reduces the shareholders and executives by mitigating the first type of agency conflict agency costs between shareholders and executives [5] (Xu Rong and Wang Jie, 2012), and improve governance efficiency. This facilitates the development of corporate green innovation activities [6] (Xiao Xiaohong and Pan Yuya, 2021) and in which internal control (Gao Kai, 2022) and financing constraints (Zhang Ruizang, 2023) play the role of intermediary mechanisms. Therefore, it is particularly important to incentivize corporate green innovation with the

help of the external mechanism of directors' liability insurance, and it has become the focus of research to explore the relationship between directors' liability insurance and corporate green innovation in depth.

This paper examines the impact of directors' liability insurance on corporate risk-taking and corporate green innovation through empirical research using a sample of Chinese A-share listed companies in Shanghai and Shenzhen from 2010 to 2021. The results show that the introduction of directors' liability insurance promotes corporate green innovation, in which corporate risk-taking plays the role of intermediary mechanism. Compared with previous studies, The contingent contribution of this paper may be: enriching the research in the area of director's liability insurance and corporate green innovation, and analyzing in depth the influence mechanism of director's liability insurance on corporate green innovation through the path of corporate risk taking.

2. Literature Review and Research Hypotheses

2.1. Directors' liability insurance and corporate green innovation

Directors' liability insurance is a kind of professional indemnity insurance, which can provide protection for the liability risks that may arise from the misconduct of directors, supervisors and executives of a company in the course of their duties. The implementation of corporate green innovation projects is affected by the decision-making of managers, who are often reluctant to take the initiative to carry out such investment activities due to the long cycle, high risk and high uncertainty of green innovation activities. By subscribing to directors' liability insurance, it can reduce the risk of property damage caused by managers due to innovation failure and other reasons, and provide protection for their liability risk behaviors [7, 8] (Core, 2000; Hu Guoliu et al., 2019), which is conducive to transferring potential liability risks faced by the management to the insurance company, thus alleviating the tendency to short-sightedness of the managers; at the same time, the purchase of directors' liability insurance is equivalent to introducing a professional and independent third-party institution, the insurance company, to the enterprise. insurance company, a professional and independent third-party institution to conduct external supervision of management, which can alleviate internal agency conflicts [9] (Guan, Xin, 2021), reduce the risk of corporate violations [10] (Yuan, 2016), effectively prevent executives from misappropriating innovation resources [11] (Li, Congang and Xu, Rong, 2020), and facilitate the development of green innovation activities. In addition, subscribing to directors' liability insurance conveys internal information such as managers' risk preferences to the outside world [12] (Gupta and Prakash, 2012), which mitigates the problems of adverse selection and moral hazard due to information asymmetry to a certain extent [13] (Guoyu Zhao, 2022). Based on the above analysis, this paper proposes the following hypotheses:

H1: All other things being equal, corporate subscription to director's insurance has a positive promotion effect on their green innovation activities.

2.2. The mediating role of corporate risk-taking

Corporate organizational characteristics can have a certain impact on corporate green innovation [14] (Gao and Bansal, 2013), and the existing literature has mostly investigated the influence mechanism of director's insurance on corporate green innovation from the perspectives of agency costs, financing constraints, and internal control. However, there is little literature on the mechanism of action between the two from the perspective of corporate risk-taking capacity.

Managers have an important impact on corporate risk-taking, and managers' risk-taking attitude reflects the level of corporate risk-taking to a certain extent [15] (Wang Jinghua and Mao Ning, 2019), and enhancing the risk-taking ability of the management will be accompanied by an increase in the level of corporate risk-taking. The main motivation for the introduction of directors' liability insurance in listed companies is to alleviate management's risk aversion tendency and reduce its short-termist behavior. On the one hand, the introduction of directors' liability insurance transfers the potential risks of management to the insurance company, which is equivalent to providing a layer of protection mechanism for management's performance of duties, providing risk underwriting and property protection for management, alleviating their concerns about compensation costs, reputation decline and performance damage, and thus improving their risk aversion in decision-making and enhancing their risk-taking. In addition, director's liability insurance closely links the interests of insurance companies with listed companies, prompting insurance companies to actively monitor the daily business behavior of the insured, helping to alleviate the ethical problems caused by information asymmetry, and prompting managers to be diligent and responsible.

Enterprise risk taking is a key consideration for enterprises to make innovation decisions [16]. Compared with ordinary innovation activities, green innovation activities have higher risks, greater uncertainty, and require more input resources. Therefore, enterprises with a high level of risk-taking are more capable of bearing the loss of R&D failure of green innovation projects, and such enterprises can better grasp the projects with high return and conducive to the long-term development of the enterprise, i.e., they are more inclined to carry out green innovation R&D activities with high risk, long cycle time, and high technological content, and the enterprise's green innovation capability will be enhanced accordingly. Therefore, companies with higher levels of risk-taking tend to have higher green innovation capabilities; while companies with weaker risk-taking capabilities have a relatively weaker ability to bear project failures and tend to reduce green innovation investment activities with high uncertainty.

Corporate risk-taking can be understood to a certain extent as a centralized representation of the risk-taking willingness of the company's management, and the introduction of director's liability insurance forms a protection for the management, which in turn affects the management's risk tolerance as well as the risk-taking level of the company, and further influences the company's green innovation activities. Therefore, in the face of green innovation projects, directors' liability insurance has both a protective and an external supervisory effect on the management, which enhances their willingness to take risks, strengthens their professional

responsibility, and motivates them to take the initiative to carry out green innovation activities with higher risks. Based on the above analysis, this paper proposes the following hypothesis:

H2: Other things being equal, directors' liability insurance can promote green innovation by increasing the level of corporate risk-taking.

3. Research Design

3.1. Sample Selection and Data Source

Taking Chinese A-share listed companies from 2010 to 2021 as the research object, this paper empirically examines the impact of director's liability insurance on corporate green innovation capability. The samples of listed companies are mainly from CSMAR database and screened as follows: (1) excluding financial and insurance industries; (2) excluding ST and *ST companies; (3) excluding companies with missing data; and (4) in order to eliminate the influence of outliers, this paper Winsorize continuous variables at 1%~99% level. Finally, 18,544 valid observations are obtained.

3.2. Variable Description

Explained variable (lnGI). The number of green patent applications of enterprises can well reflect the green innovation achievements of enterprises, and the disclosure of relevant data is more comprehensive. Generally speaking, invention-based innovation is the most important measure reflecting the innovation capability of enterprises. Therefore, on the basis of existing studies [17, 18] (Wang Zhenyu and Cao Yu, 2020; Wang Xiaoqi and Hao Shuangguang, 2020), in addition to adopting the total number of green patent applications (lnGI) of the enterprise in the current period to measure the enterprise's green innovation capability, this paper also separately takes the green invention patent applications as the core explanatory variable, i.e. (lnGI_inv).

Explanatory variable (DO). Since it is not mandatory for enterprises to disclose information on DO in China, it is difficult to obtain relevant data such as the amount of DO insurance. Therefore, drawing on the research methodology of existing literature [8], the purchase of directors' liability insurance is represented with the help of a dummy variable (DO): if a firm announces the purchase of directors' liability insurance in the current year, it is recorded as 1, and vice versa, it is recorded as 0. Meanwhile, this paper refers to the practice of Hu Guoliu and Li Shao-hua [19] (2014), which regards firms as continuing to subscribe to the purchase of directors' liability insurance if they introduce it in the subsequent year without announcing the cessation of the purchase. The above approach has been adopted by most relevant studies.

The mediating variable RISK. the measure of the level of corporate risk-taking, drawing on the approach of Yu Mingguai [20] (2013), selects earnings volatility (RISK) as its measure, which uses the degree of volatility of the firm's return on assets (ROA) over a period of three years (from year t to year t+2) as its measure. It is calculated by first adjusting the firm's ROA for each year using the industry average, and then calculating the standard deviation of the firm's industry-adjusted ROA for each observation period, i.e., the firm's risk-taking.

Control variables Controls. Drawing on existing literature [21, 22] (Lai, Lai et al., 2019; Li, Conggang and Xu, Rong, 2019), this paper selects firm size (Size), gearing ratio (Lev), firm age (Age), profitability (ROA), nature of property rights (Soe), proportion of shareholding of the top ten shareholders (Top10), enterprise value (Tobinq), free cash flow (Cashflow), firm growth (Growth), management shareholding (Mshare), two positions (Dual), whether Big 4 auditing (Big4), and the percentage of independent directors (Indep) are used as control variables; industry fixed effects and year fixed effects are also controlled. See Table 1 for detailed variable descriptions.

Table 1. Variable Definition

Number	Scheme 1	Scheme 2	Scheme 3
dependent variable	Green Innovation	lnGI	ln(total number of green patent applications filed by firms in the current period + 1)
		lnGI_inv	ln(total number of green patent applications filed by enterprises in the current period+1)
independent variable	director's liability insurance	DO	If the enterprise purchases director's liability insurance in the current period, it takes the value of 1, otherwise it takes the value of 0.
Intermediation Variables	Risk taking	RISK	Volatility of return on assets
Control Variables	Firm size	Size	ln (total assets at year-end)
	Gearing ratio	Lev	Total liabilities/total assets at year-end
	Return on total assets	ROA	Net Profit/Average Total Assets
	Company age	Age	ln (years of listing + 1)
	Enterprise Value	Tobinq	Total market capitalization of the firm/total assets
	Free cash flow	Fcf	Net cash flow from operating activities for the year/total assets
	Growth	Growth	Increase in operating income/previous year's operating income
	Nature of ownership	Soe	1 for state-owned enterprises and 0 for non-state-owned enterprises
	Shareholding ratio of top ten shareholder	Top10	Sum of top 10 shareholders
	Percentage of Independent Directors	Indep	Number of independent directors/total number of directors
	Combination of two positions	Dual	If the chairman of the board of directors is also the general manager, the value will be 1, otherwise the value will be 0
	Big4 Audit	Big4	1 if Big4 audited, 0 otherwise
	Management shareholding ratio	Mshare	Total number of shares held by management/total number of shares
	Year	Year	Dummy variable for year
	Industry	Ind	Industry Dummy

3.3. Model setup

In order to test the direct effect of director's insurance on corporate green innovation, the following two-way fixed effect model is developed with reference to Wenjing Lai and Manny Zheng (2016) and Xin Wang (2022):

$$GI_{i,t} = a + \beta DO_{i,t} + \Sigma \gamma_i Controls_{i,t} + \Sigma Ind + \Sigma Year + \varepsilon_{i,t} \quad (1)$$

Among them, the explanatory variable $GI_{(i,t)}$ is the firm's green innovation, which is measured by the firm's total number of green patent applications and the number of green invention patent applications in the year. $DO_{(i,t)}$ is the explanatory variable of the model, which indicates whether firm i subscribes to director's liability insurance in year t , and it takes the value of 1 if it subscribes to the insurance, otherwise it takes the value of 0. $Controls_{(i,t)}$ is all the control variables of firm i in year t . Ind and $Year$ are the industry and year dummy variables, respectively, indicating that the model controls for firm industry effects and year effects. $\varepsilon_{(i,t)}$ is the random error term of the model. Ind and $Year$ are industry and year dummy variables, respectively, indicating that the model controls for firm industry effects and year effects. $\varepsilon_{(i,t)}$ is the model random error term.

In order to test the mediating role of corporate risk-taking between director's insurance and corporate green innovation, model (2) and (3) are designed to synthesize model (1) to study the mediating role of risk-taking, drawing on Wen Zhonglin et al. (2004).

$$RISK_{i,t} = a + \beta_1 DO_{i,t} + \Sigma \gamma_i Controls_{i,t} + \Sigma Ind + \Sigma Year + \varepsilon_{i,t} \quad (2)$$

$$LnGI_{i,t} = a + \beta_1 DO_{i,t} + \beta_2 RISK_{i,t} + \Sigma \gamma_i Controls_{i,t} + \Sigma Ind + \Sigma Year + \varepsilon_{i,t} \quad (3)$$

Among them, model (2) takes corporate risk taking (RISK) as an explanatory variable to study the effect of directors' insurance on risk taking; model (3) adds the mediating variable risk taking to examine its mediating effect between directors' insurance and green innovation.

4. Empirical Results and Analysis

4.1. Descriptive statistics analysis

Table 2 reports the descriptive statistics of the main variables. The mean value of director's liability insurance is 0.04, indicating that nearly only 4% of the enterprises in the study sample have purchased director's liability insurance, reflecting that the percentage of listed companies that have purchased director's liability insurance in China is still low. The mean values of the total number of green innovation patent applications and green invention patent applications are 1.36 and 0.70 respectively, which are at a lower level, indicating that the sample enterprises do not pay enough attention to green innovation activities; the standard deviation is 3.95 and 2.17 respectively, which is a big change, indicating that the differences in the level of green innovation among the sample enterprises are more significant. Table 2 also lists the rest of the control variables, and the descriptive statistics values are all at normal levels, indicating that the interference of outliers can be basically excluded after Winsorize processing.

Table 2. Descriptive statistics results

Variable	Observations	Average value	Standard deviation	Minimum value	Median value	Maximum Value
GI_all	18 544	1.360	3.950	0.000	0.000	26.000
GI_inv	18 544	0.700	2.170	0.000	0.000	14.000
DO	18 544	0.040	0.200	0.000	0.000	1.000
Size	18 544	22.070	1.160	19.660	21.930	26.040
Lev	18 544	0.420	0.200	0.050	0.410	0.880
ROA	18 544	0.040	0.050	-0.210	0.040	0.190
Age	18 544	2.030	0.870	0.000	2.200	3.260
Tobinq	18 544	2.830	2.210	0.690	2.170	38.850
Fcf	18 544	0.040	0.060	-0.180	0.040	0.250
Growth	18 544	0.340	0.780	-0.720	0.140	8.160
Soe	18 544	0.350	0.480	0.000	0.000	1.000
Top10	18 544	58.460	14.360	22.960	59.390	90.320
Indep	18 544	0.370	0.050	0.250	0.330	0.570
Dual	18 544	0.270	0.440	0.000	0.000	1.000
Big4	18 544	0.040	0.190	0.000	0.000	1.000
Mshare	18 544	0.140	0.200	0.000	0.0100	1.150

4.2. Return to baseline

In this paper, we utilize the model (1) constructed in the previous section to conduct a benchmark regression of directors' insurance on green innovation in order to verify H1, and the results of the benchmark regression are shown in Table 3. As can be seen from Table 3: Columns (1) and (3) do not add any control variables, only industry and time fixed

effects are added, and the regression coefficients of DO are positive and significant at 1% level; Columns (2) and (4) add control variables to the benchmark of Columns (1) and (3), and the regression coefficients of DO gradually become larger and are still significant at 1% level, which strongly verifies the former Hypothesis H1, subscribing to director's insurance can promote the level of corporate green innovation.

Table 3. Benchmark Regression results

Variable	lnGI	lnGI	lnGI_inv	lnGI_inv
DO	0.207***	0.212***	0.212***	0.164***
	(0.039)	(0.039)	(0.039)	(0.031)
Constant	0.384**	-0.204	0.235	-0.346
	(0.184)	(0.324)	(0.147)	(0.259)
Controls	Control	Control	Control	Control
Year		Control		Control
Industry		Control		Control
R2	0.027	0.030	0.017	0.021
N	18 544	18 544	18 544	18 544

Note: ***, **, * denote significant at 1%, 5%, 10% level, respectively, and the values in parentheses are t-test value.

4.3. The mediating role of corporate risk taking between directors' liability insurance and green innovation

The above studies show that firms subscribing to director's liability insurance will have a significant contribution to their green innovation capability, however, what is the internal mechanism of the impact of director's liability insurance on firms' green innovation still needs to be further researched. According to the innovation theory proposed by Schumpeter, the innovation investment activities of enterprises are mainly formulated and implemented by managers, and the initiation and implementation of an enterprise's green innovation project mainly depends on the risk perception and consideration of the project by the executive team. Therefore, the higher the tolerance and ability of directors and executives to bear risks, the more favorable it is to the green innovation activities of enterprises. In this case, if the liability risk of the executive team can be decentralized and transferred to avoid them being punished for decision-making mistakes, it will

effectively stimulate their innovation enthusiasm. Directors' liability insurance is exactly the effective governance mechanism that can fulfill this condition, and risk-taking ability becomes an intrinsic mechanism that affects firms' green innovation.

Table 4 reports the regression results of the mediating role of corporate risk-taking between directors' liability insurance and corporate green innovation. From the results in column (1) of Table 4, the coefficient estimate of DO on RISK is significantly positive at the 1% level, which implies that purchasing directors' liability insurance can increase the level of corporate risk taking. As can be seen from columns (2) and (3), the coefficients of DO on lnGI and lnGI_inv are still significantly positive when DO and RISK are put into the model at the same time, which indicates that directors' liability insurance can promote green innovation of firms by increasing the level of corporate risk taking. The above results show that risk-taking plays a partial mediating effect in the relationship between directors' insurance and corporate green innovation, verifying H2.

Table 4. Intermediation regression results

Variable	RISK	lnGI	lnGI_inv
DO	0.003**	0.209***	0.156***
	(0.002)	(0.040)	(0.032)
RISK		0.590***	0.348**
		(0.216)	(0.174)
Constant	0.174***	-0.501	-0.489*
	(0.013)	(0.345)	(0.277)
Controls	Control	Control	Control
Year	Control	Control	Control
Industry	Control	Control	Control
R2	0.101	0.033	0.021
N	16,896	16,896	16,896

4.4. Robustness check

4.4.1. Heckman's two-stage approach

There may be an endogeneity problem of self-selection bias in the purchase of director's liability insurance by firms, i.e., listed companies purchasing director's liability insurance may themselves attach more importance to the conduct of green innovation programs, which can lead to biased results of the previous estimation. In view of this, this paper adopts the Heckman two-stage method for robustness testing (Yuan Rongli (2018), Li Conggang and Xu Rong (2019)), which takes the proportion of listed companies in the same industry purchasing director's insurance (IV) as an exogenous variable affecting the director's insurance, and the higher the

proportion of other companies in the same industry purchasing director's insurance, the more likely it is to stimulate the Company to purchase director's insurance, which fulfills the correlation requirement of instrumental variables; At the same time, whether other companies in the same industry purchase directors' liability insurance will not directly affect the level of green innovation of the Company, satisfying the exogenous requirement of the instrumental variable. The specific steps are as follows: in the first stage, the Probit model is used to estimate the IMR (Inverse Mills Ratio) of listed companies choosing to purchase directors' liability insurance, and the regression results are shown in Table 5; in the second stage, the IMR estimated in the first stage is added to the model and regressed again, and the

regression results are shown in Table 5. As can be seen in Table 6, the instrumental variable IV is significantly positive, which indicates that the higher the proportion of listed companies in the same industry that purchase directors' liability insurance, the higher the proportion of other listed companies that purchase directors' liability insurance. The

higher the proportion, the higher the probability of other listed companies purchasing director's insurance, indicating that the selection of instrumental variables is reasonable. As can be seen from Table 6, the coefficient of DO is still positive at 1% significance level, indicating that the test results still support the previous findings.

Table 5. Heckman two-stage regression results

Variable	DO		lnGI	lnGI_inv
IV	62.140*	DO	0.207***	0.160***
	(36.912)		(0.039)	(0.032)
Constant	-7.633***	Constant	-2.843*	-2.063
	(1.498)		(1.657)	(1.322)
Constant	0.174***	Constant	-0.501	-0.489*
	(0.013)		(0.345)	(0.277)
Controls	Control	Controls	Control	Control
Year	Control	Year	Control	Control
Industry	Control	Industry	Control	Control
R2	0.190	R2	0.030	0.021
N	18,259	N	18,433	18,433

4.4.2. Replacement of Explained Variables

In order to verify the robustness of the results, drawing on Qi Shaozhou (2018), this paper uses the total number of green patents granted (*lnGinno*) and the number of green invention patents granted (*lnGinno_inv*) to replace the explanatory variables and re-test them, and the results are shown in columns (1) and (2) of Table 6. From the results, it can be seen that the regression coefficient of DO is positive at the 5% significance level, which is consistent with the results of the benchmark regression.

4.4.3. Lagged explanatory variables

Since the governance effect or incentive for management

to make green decisions after the introduction of director's liability insurance may only appear after a period of time, and green innovation activities may require stricter control as well as a longer period of time compared to ordinary innovation activities, in order to avoid the negative impact on the empirical results from the lagging of green innovation patents, and with reference to the approach of He and Tian (2013), and Jiang Jun (2017), this paper lags the green innovation variables are lagged by one period for further testing. The results are shown in columns (3) and (4) of Table 6. The regression coefficients of DO are still significantly positive after lagging the explanatory variables by one period, which is consistent with the results of the benchmark regression.

Table 5. Robustness test results

Variable	<i>lnGinno</i>	<i>lnGinno_inv</i>	<i>L.lnGI</i>	<i>L.lnGI_inv</i>
DO	0.087***	0.051**	0.169***	0.092***
	(0.032)	(0.020)	(0.044)	(0.035)
Constant	-0.510**	-0.460***	-0.962***	-0.921***
	(0.258)	(0.166)	(0.373)	(0.296)
Controls	Control	Control	Control	Control
Year	Control	Control	Control	Control
Industry	Control	Control	Control	Control
R2	0.037	0.016	0.040	0.028
N	2,842	2,842	2,761	2,761

5. Conclusion

Selecting A-share listed companies in Shanghai and Shenzhen from 2010 to 2021 as the research object, we empirically analyze whether and how directors' liability insurance affects the green innovation of enterprises. The empirical results show that: (1) purchasing director's liability insurance significantly enhances green innovation of enterprises; (2) director's liability insurance can enhance green innovation by improving enterprise risk taking. The findings provide some empirical insights into the combination of directors' liability insurance and the real economy.

Green innovation is a way to realize the long-term development of enterprises and enhance their core competitiveness, which has been widely emphasized at the

national level. As an emerging governance tool, directors' liability insurance has a certain positive effect on corporate governance. Enterprises should correctly recognize the corporate governance function of director's liability insurance, and actively introduce director's liability insurance in combination with the inherent needs of their own development. At the same time, enterprises should improve their risk management system, identify their own risk-taking, and create a good environment for the incentive effect and supervision function of directors' liability insurance.

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