

Managerial Overconfidence, Directors' and Officers' Liability Insurance and Corporate Green Innovation

-- Evidence from China

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Abstract

Corporate green innovation plays an important role in balancing economic development and environmental protection, and promotes the high-quality development of China's economy. However, whether the implementation of green innovation is influenced by the cognition of managers. Based on the theory of high ladder team, with the Chinese A-share listed companies from 2010 to 2021, the empirical study of the impact of managerial overconfidence on the green innovation of enterprises, as well as the regulatory role of the liability insurance of directors and officers. Research shows that the inverted U-shaped relationship between managerial overconfidence and corporate green innovation is shown, and the directors' and officers' liability insurance will weaken the inverted U-shaped relationship between managerial overconfidence and corporate green innovation. The research conclusion provides a new perspective for the discussion of enterprise managers and green innovation, and also provides a certain theoretical reference for the government to formulate green innovation related policies.

Keywords

Managerial Overconfidence; Directors' and Officers' Liability Insurance; Corporate Green Innovation.

1. Introduction

In recent years, the frequent occurrence of extreme climate events, the reduction of biodiversity, and the intensified desertification have hindered the sustainable development of human beings. In order to alleviate the serious environmental problems, China proposed in the 75th session of the goal of "*strive to peak carbon emissions by 2030 and strive to achieve carbon neutrality by 2060*". As Xi Jinping has pointed out, "*We need to rely on more and better scientific and technological innovation to build a beautiful China with blue sky, green land and clear water.*" Therefore, to achieve the two-carbon goal, we must fundamentally rely on scientific and technological innovation. Green innovation, as an innovative way to increase the economic interests of enterprises while maintaining the resources and environment, is the key to promote the high-quality development of China's economy and the new international development pattern. The party's 20th report once again emphasized the "*harmonious coexistence between man and nature*", which made promoting the comprehensive green transformation of economic and social development become an important task in China.

Accelerating green innovation is an important strategy for Chinese enterprises to gain international competitive advantages and reduce the pressure on resources and the environment[1]. At present, the research on enterprise green innovation is mainly divided into two aspects: external environment and internal environment. In terms of external environment, environmental regulation[2], green credit policies[3], environmental protection fee reform[4], and institutional investor preference[5] affect the green innovation of enterprises. Compared

with external environmental factors, scholars study the internal environmental factors, mainly focused on executives military experience [6], director overseas background[7], CEO green experience[8]and other managerial background characteristics, and less involved in the psychological characteristics of managers. At the same time, people generally have irrational psychology, and overconfidence is one of the common ones, and the possibility of overconfidence among enterprise managers is significantly greater than that of ordinary people[9]. About the impact of managerial overconfidence on the business, Some scholars believe that managerial overconfidence will inhibit corporate investment in innovation[10], increase the risk of stock price crash[11], Increase the excessive debt degree of enterprises[12]and other negative effects, Some scholars believe that it will promote the implementation of corporate social responsibility[13], reduce the enterprise agency cost[14]and other positive effects, Some scholars believe that its performance and corporate performance[15], Enterprise Value[16]and others showed an inverted U-shaped relationship. However, less existing literature studies the impact of managerial overconfidence on corporate green innovation.

Based on this, this paper selects China's A-share listed companies from 2011 to 2021 as samples, and analyzes the impact of managerial overconfidence on the green innovation of enterprises by using the theory of high ladder team. The results show that the relationship between managerial overconfidence and corporate green innovation is not linear, but inverted U-shaped relationship. At the same time, considering that the directors' and officers' liability insurance plays an important role in the behavior and decision of managers, this paper takes the directors' and officers' liability insurance as a regulatory variable. Further research shows that the directors' and officers' liability insurance play a negative role in the relationship between managerial overconfidence and corporate green innovation.

The possible contribution of this paper is as follows. First, it broadens the influencing factors of green innovation in enterprises. This paper studies the influence of managerial overconfidence on corporate green innovation based on the perspective of managers' psychological characteristics. Second, it enriches the economic consequences of managerial overconfidence. Green innovation of enterprises has greater risk and longer cycle than general innovation. This paper studies the relationship between managerial overconfidence and green innovation of enterprises from the perspective of green production. Third, it broadens the boundary between managerial overconfidence and corporate green innovation. This paper takes the directors' and officers' liability insurance as a regulatory variable, and discusses how the directors' and officers' liability insurance affects the relationship between the two from the perspective of policy supervision.

2. Theoretical Analysis and Research Hypothesis

2.1. Managerial Overconfidence and corporate Green Innovation

First, based on the theory of high ladder team, enterprise managers will make decisions and strategic choices based on their experience and values. Green innovation is closely related to enterprise strategic decision-making. As the psychological characteristics of managers, overconfidence will inevitably have an impact on the green innovation of enterprises. Overconfident managers will produce a "superior to average effect", tend to overestimate their ability, and think that their behavior is better than other managers, which will stimulate managers' ambition, dare to change the existing strategic plan of the enterprise, and set high goals to achieve their value[17]. Compared with general innovation, green innovation of enterprises needs to achieve economic goals and environmental protection goals at the same time, which increases the innovation pressure and challenges of enterprises. However, overconfident managers have a strong desire to show themselves. They believe that they can

control the development of the enterprise in order to increase the research and development of green innovation of enterprises to highlight their ability. In addition, overconfident managers are too optimistic and have the substantial risk tolerance, which causes them to overestimate the profitability of enterprises and underestimate the risk of decision-making. Green innovation of enterprises can not only enhance their competitive advantages and improve economic benefits but also transmit the positive signal of sustainable development of enterprises to the outside world, as well as respond to the national call to protect the environment to obtain more external financing and government subsidies[18]. Therefore, Overconfident managers will reduce "short-sighted" behavior, ignore the characteristics of green innovation risk and long cycle, and enlarge the future benefits of enterprises, so as to increase the investment in green innovation projects of enterprises[19]. Second, Based on the theory of reputation, overconfident managers' management decision-making ability is more vital, and have a higher social reputation, in order to continue to obtain social respect and affirmation, managers are more willing to increase the proportion of green innovation in the overall innovation, to the public to the positive impression of environmental protection, so as to improve the social evaluation of the enterprise, and make it get more reputation in the society[20].

However, when the confidence of managers is too high, they may ignore the suggestions of people around them and reduce the sensitivity to external information processing, as well as the behavior of excessive investment in short-term income projects of enterprises, thus reducing the investment in green innovation with long cycle and uncertain income. At this point, managers who are full of information about the future development of enterprises are more willing to choose debt financing rather than diluting the equity financing of existing shareholders, resulting in excessive debt of the enterprise and transmitting the information of the unsustainable development of the enterprise to external investors, thus deepening the financing constraints of enterprises and further reducing the willingness of enterprises to make green innovation. Meanwhile, severely overconfident managers have a stronger sense of superiority, a stronger desire for power and fame, and a more urgent recognition from the public[21]. Because the green innovation of enterprises needs to maintain the balanced development of the economy and environmental protection, it makes it more risky and more cyclical. In order to quickly realize their value, managers are more willing to invest in general innovation projects or fulfill other social responsibilities to show themselves and improve their social reputation. From the above analysis, H1 is proposed.

H1: Managerial overconfidence has an inverted U-shaped relationship with corporate green innovation.

2.2. Managerial Overconfidence, Directors' and Officers' Liability Insurance and Corporate Green Innovation

Managers are limited and rational, and their decision-making behavior will be influenced by their cognitive situation and psychological characteristics. Based on the principal-agent theory, managers with low confidence are risk-averse, who are cautious and conservative. In order to safeguard personal property safety, social reputation, and other interests, they are more inclined to avoid risks and are unwilling to invest in innovative projects with high risks. However, director executive liability insurance has the role of dispersing risks and providing economic compensation, which can improve the risk tolerance of managers, encourage managers to increase enterprise innovation, and reduce enterprise agency costs[22]. At the same time, the directors' and officers' liability insurance also plays a role in helping the bottom, which enhances the confidence of managers and makes them have no worries when making decisions, so as to pay more attention to the sustainable development of the enterprise and make contributions to the good social image of the enterprise[23]. In addition, green innovation

can not only increase the economic benefits of enterprises but also help enterprises to establish the image of environmental protection, making managers more willing to increase the investment in green enterprise innovation. In addition, the director and executive liability insurance will also have the effect of external supervision. First, the insurance company, as the insurer, will conduct a comprehensive evaluation of the insured enterprises, supervise the decision-making behavior of the managers, and reduce the possibility of damage to their interests[24]. Managers with high confidence are too optimistic about the development prospects of enterprises, and are more inclined to invest in projects with short cycle and conduct debt financing, which leads to excessive debt of enterprises and further leads to the low level of green innovation of enterprises. For insurance companies, this is a violation, and insurance companies will require managers to actively perform their duties and improve the efficiency of green innovation of enterprises. Second, the director and senior management liability insurance can alleviate the information asymmetry and allow the stakeholders to have more information related to the business activities of the enterprises[25]. Overconfident managers tend to pay more attention to public evaluation. Information transparency makes managers actively assume social responsibilities, enhance the strength of green innovation of enterprises, and thus improve the environmental performance of enterprises. From the above analysis, H2 is proposed.

H2: Directors' and officers' liability insurance will weaken the inverted U-shaped relationship between managerial overconfidence and corporate green innovation.

3. Research Design

3.1. Data and Sample

In this paper, China's A-share listed companies from 2011 to 2021 are selected as the research objects, and the sample data are processed as follows: excluding financial industry and ST listed companies; excluding missing data or abnormal samples; shrinking all continuous variables at 1% level. After data processing, a total of 4452 sample observations were obtained. The primary financial data of this paper are from the CSMAR database, and the above data is processed using Stata17.0 software.

3.2. Variable

3.2.1. Dependent Variable

Drawing on the practice of Lian et al. (2019), the green innovation of enterprises is measured by the logarithm plus 1 [4].

3.2.2. Independent Variable

Referring to the calculation method of Wei (2018), the arithmetic means of managerial personal characteristic scores such as age, gender, and educational background was used as the total score to measure managerial overconfidence[26].

3.2.3. Regulated Variable

Referring to the practice of Hu (2019), executive liability insurance is measured by whether the enterprise buys the insurance for executive liability[27].

3.2.4. Control Variables

Following Xu and Cui (2020), Liu and Zhang (2022), control other variables that may affect the enterprise green innovation, including enterprise size (Size), asset-liability ratio (Lev), the proportion of fixed assets (Ppe), profitability (Roa), growth (Grow), cash flow (Cash), equity concentration (Top1), enterprise age (Age), Tobin Q (TobinQ). Meanwhile, year and Industry dummy variables are also controlled[28][29]. The variables are described in Table 1.

Table 1. Variable definition and description

Category	Variable name	Sign	Implication
Dependent variable	corporate green innovation	GTI	The number of green patent applications in that year is + 1 log taken.
Independent variable	managerial overconfidence	OC	Comprehensive score for the individual characteristics of the managers.
Regulated Variable	directors' and officers' liability insurance	DO	If the enterprise buys the director executive liability insurance, the DO is 1, otherwise it is 0.
Control variables	enterprise size	Size	Total assets at the end of the term are taken in a log of value.
	asset-liability ratio	Lev	Total liabilities / total assets
	proportion of fixed assets	Ppe	Net fixed assets / total assets
	profitability	Roa	Net profit / average total assets
	growth	Grow	increase rate of business revenue.
	cash flow	Cash	Net cash flow from operating activities / total assets
	equity concentration	Top1	The shareholding ratio of the largest shareholder.
	enterprise age	Age	Enterprise listing time + 1 to take the log.
	Tobin Q	TobinQ	Market value / capital replacement cost

3.3. Model Construction

Based on the above theoretical analysis, models (1) and (2) are constructed to test hypotheses.

$$GTI_{i,t} = \alpha_0 + \alpha_1 OC_{i,t} + \alpha_2 OC^2_{i,t} + \alpha Controls + \sum Industry + \sum Year + \epsilon_{i,t} \tag{1}$$

$$GTI_{i,t} = \beta_0 + \beta_1 OC_{i,t} + \beta_2 OC^2_{i,t} + \beta_3 DO_{i,t} + \beta_4 OC^2_{i,t} * DO_{i,t} + \beta Controls + \sum Industry + \sum Year + \epsilon_{i,t} \tag{2}$$

Where, $GTI_{i,t}$ is corporate green innovation, $OC_{i,t}$ is managerial overconfidence, $DO_{i,t}$ is director executive liability insurance; Controls represents a series of control variables; Industry and Year represent industry and year fixed effects respectively; $\epsilon_{i,t}$ is random disturbance items.

4. Results

4.1. Descriptive Statistics

Table 2. Descriptive statistics

Variables	Sample	Mean	SD	Min.	Max.
GTI	4452	1.414	1.263	0.000	4.369
OC	4452	0.662	0.142	0.310	0.935
Size	4452	22.601	1.303	19.768	25.871
Lev	4452	0.444	0.197	0.046	0.907
Ppe	4452	0.226	0.158	0.003	0.674
Roa	4452	0.043	0.053	-0.260	0.197
Grow	4452	0.327	0.768	-0.680	7.098
Cash	4452	0.049	0.063	-0.164	0.232
Top1	4452	0.325	0.148	0.085	0.714
Age	4452	2.296	0.710	0.000	3.296
TobinQ	4452	1.975	1.217	0.877	8.751

As can be seen from Table 2, the average value of corporate green innovation is 1.414, the maximum value is 4.369, and the minimum value is 0, indicating that there are significant differences in the green innovation level among enterprises. The maximum value of managerial overconfidence is 0.935, the minimum value is 0.310, and the standard deviation is 0.142, indicating that the degree of overconfidence of the different managers varied greatly.

4.2. Correlation Analysis

Table 3 shows the results of Pearson's correlation coefficient test for the main variables. The correlation coefficient of managerial overconfidence and corporate green innovation is 0.066, which is significant at the 1% level, indicating that managerial overconfidence will significantly promote corporate green innovation. Whether the two relationships are, linear or inverted U-shaped relationship needs to further testing. The VIF test was also performed, with all VIF values below 10, excluding multicollinearity.

Table 3. Correlation analysis

Variables	GTI	OC	Size	Lev	Ppe	Roa	Grow	Cash	Top1	Age	TobinQ
GTI	1										
OC	0.066***	1									
Size	0.386***	-0.034**	1								
Lev	0.180***	-0.074***	0.562***	1							
Ppe	-0.141***	0.159***	0.140***	0.169***	1						
Roa	-0.016	0.027*	-0.011	-0.366***	-0.097***	1					
Grow	0.028*	0.004	-0.048***	-0.010	-0.255***	0.027*	1				
Cash	-0.008	-0.044***	0.126***	-0.114***	0.256***	0.419***	-0.104***	1			
Top1	-0.063***	-0.074***	0.159***	0.136***	0.137***	0.081***	-0.032**	0.109***	1		
Age	0.207***	-0.097***	0.521***	0.436***	0.179***	-0.148***	-0.030**	0.120***	-0.029*	1	
TobinQ	-0.059***	0.089***	-0.347***	-0.318***	-0.174***	0.282***	0.051***	0.144***	-0.081***	-0.113***	1

***p<0.01, **p<0.05, *p<0.1.

4.3. Benchmark Regression

Table 4 reports the benchmark regression results between managerial overconfidence and corporate green innovation. From columns (1) and (2), no matter whether the control variable is added or not, the primary regression coefficient of managerial overconfidence is significantly positive at the level of 1%, and the quadratic coefficient is significantly negative at the level of 1% respectively, indicating that the inverted U-shaped relationship between managerial overconfidence and corporate green innovation, and H1 is verified. The results show that when managers lack confidence, managers will tend to avoid risks, in order to ensure their own interests, they will produce self-interest behavior, and reduce investment in green innovation with high risks and uncertain returns. With the deepening of managerial confidence, managers will affirm their ability and be optimistic about the development of the enterprise so that they are more willing to increase the investment in green innovation to establish an environmental image and enhance the social reputation of the enterprise. However, overconfident managers can be too arrogant and too optimistic about business conditions. In turn, the resources used for green innovation will be used to invest in short-term economic benefit projects, resulting in excessive debt, the improvement of financing constraints, and the weakening of green innovation of enterprises.

Table 4. Benchmark regression

Variables	(1) GTI	(2) GTI
OC	5.102*** (7.022)	2.440*** (3.644)
OC ²	-3.598*** (-6.384)	-1.768*** (-3.401)
Controlled variable	No control	Control
Industry	Yes	Yes
Year	Yes	Yes
N	4452	4452
Adj.R ²	0.262	0.397

Robust t-statistics in parentheses; ***p<0.01, **p<0.05, *p<0.1.

4.4. Robustness Tests

First, we replace the dependent variable. Referring to the practice of Zhang and Shi (2022), the explanatory variable is replaced with the proportion of all green patent applications in the current year (GTIR)[30]. The results are shown in column (1) of Table 5, with the primary term coefficient of 0.425 and the second term coefficient of -0.343, which are significant at the 1% level, verifying the reliability of the above conclusions.

Second, we vary the sample interval. Due to the operating conditions of domestic enterprises severely impacted by the COVID-19 epidemic in 2020, to prevent this factor from affecting the empirical results, the sample range was adjusted to 2011-2019 according to the practice of Zhou (2021)[31]. The regression results are shown in column (2) of Table 5, which are basically consistent with the previous conclusions, further verifying the hypothesis H1.

Table 5. Robustness tests

c	(1) GTIR	(2) GTI	(3) OC	(4) OC2	(5) GTI	(6) GTI
OC	0.425** (2.387)	2.101*** (2.866)			3.845*** (1.02)	2.147** (2.221)
OC2	-0.343** (-2.554)	-1.516*** (-2.661)			-2.637*** (0.775)	-1.560** (-2.105)
LOC			0.790*** (14.494)	-0.021 (-0.287)		
LOC2			0.030 (0.732)	0.845*** (15.492)		
Controlled variable	Control	Control	Control	Control	Control	Control
Industry	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes
N	2292	3710	4081	4081	4081	2019
Adj.R ²	0.162	0.395	0.715	0.718	0.193	0.433

Robust t-statistics in parentheses; ***p<0.01, **p<0.05, *p<0.1.

Third, we use the instrumental variable method (IV). To alleviate the endogeneity problem of missing variables, this paper uses the practice of Liu et al. (2020), uses managerial overconfidence (LOC) and its second term (LOC²) as the tool variable of managerial overconfidence, and uses 2SLS to analyze the model[14]. According to columns (3) - (5) of Table 5, the overconfidence is significantly optimistic, and the second term is significantly negative.

There is still a significant inverted U-shaped relationship between overconfidence and the green innovation of the enterprise.

Fourth, we use the propensity score matching method (PSM). To eliminate the sample self-selection problem, when managerial overconfidence is greater than the median value of 1, otherwise, the value is 0, select managers overconfidence value of 1 listed company for the processing group, control group for managers overconfidence value of 0 listed companies, using the nearest neighbor (1:1) matching method of sample processing. The empirical results are shown in section (6) of Table 5, indicating that H1 remains true.

4.5. Regulation Effect Test

Table 6 shows the results of the regulatory effect of directors' and officers' liability insurance on the relationship between managerial overconfidence and corporate green innovation. Columns (1) and (2) for not join the control variables and join the empirical results, in the two columns, the managerial overconfident secondary term and the interaction of the regression coefficient are significantly at the 1% level, indicating that the directors' and officers' liability insurance will significantly weaken managerial overconfidence and enterprise U type relationship of green innovation, H2 is verified. The results show that when managers lack confidence, the directors' and officers' liability insurance will improve the risk-taking level of managers, reduce the opportunistic behavior of managers, encourage managers to pay attention to the long-term development of the enterprise and care about the social image of the enterprise, so as to strengthen the green innovation of enterprises. At the same time, directors' and officers' liability insurance also plays an external supervision role, which will restrain the serious overinvestment of managers, promote managers to actively fulfill their social responsibilities, increase the investment in green innovation, establish an environmental image for enterprises, and make them achieve environmental performance.

Table 6. Regulation effect test

Variables	(1) GTI	(2) GTI
OC	5.107*** (7.070)	2.562*** (3.845)
OC ²	-3.720*** (-6.662)	-1.968*** (-3.802)
DO	-0.278 (-1.610)	-0.658*** (-4.594)
OC ² *DO	1.612*** (4.239)	1.497*** (5.013)
Controlled variable	Control	Control
Industry	Yes	Yes
Year	Yes	Yes
N	4452	4452
Adj.R ²	0.274	0.400

Robust t-statistics in parentheses; ***p<0.01, **p<0.05, *p<0.1.

5. Results

Based on the theory of high ladder team, this paper takes China a-share listed companies from 2011 to 2021 as the research object. It empirically tests the impact of managerial overconfidence on the green innovation of enterprises, as well as the regulatory role of directors' and officers' liability insurance. Research shows that there is an inverted U-shaped

relationship between managerial overconfidence and corporate green innovation, and directors' and officers' liability insurance can significantly weaken the inverted U-shaped relationship between the two, and the conclusion remains true after a series of robustness tests. The research implications of this paper are as follows. First, for the government, it should actively formulate and implement relevant policies to encourage green innovation of enterprises. Moreover, since the directors' and officers' liability insurance can be short-sighted and enhance social responsibility, the government should call on enterprises to ensure the directors' and officers' liability insurance and give full play to the incentive effect of the insurance. Second, for enterprises, they should enhance their awareness of environmental protection and green governance, and increase their investment in green innovation to promote high-quality economic development. At the same time, managerial overconfidence is a double-edged sword. Enterprises should formulate relevant rules and regulations to restrain the irrational behavior of managers and prevent managers from producing excessive investments and other behaviors that damage the interests of the company. Various departments of the enterprise should also coordinate and supervise each other to reduce the possibility of managerial decision-making mistakes. Finally, for enterprise managers, it is necessary to constantly improve their own planning ability, not only to consider the economic interests of enterprises but also to take into account the green environmental protection of enterprises, so as to promote the sustainable development of enterprises. In addition, managers should fully understand the risks of investment projects, and should not blindly invest due to overconfidence.

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