Minority shareholders' participation and corporate green innovation

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Abstract. In recent years, the Internet has greatly reduced the cost of minority shareholders to obtain information, and has also enabled them to participate in corporate governance more conveniently and effectively. Based on the data of China's A-share listed companies from 2011 to 2020, this paper examines the impact of minority shareholders' participation in corporate governance on corporate green behavior. The study found that the minority shareholders can effectively promote green innovation in enterprises. This conclusion still holds true after robustness tests such as replacement variables, multiple fixed effects, addition of omitted variables, and propensity score matching test. Further research finds that state-owned enterprises and non-heavy polluting industries, the participation of minority shareholders in corporate governance will have a more significant role in promoting green innovation. This paper not only enriches the research on minority shareholders of listed companies and green behavior, but also has important theoretical and practical significance for minority investors to protect their own rights and interests.

Key words: Voting for minority shareholders, corporate governance, green behavior.

1. Introduction

With the improvement of the investor protection system, the channels for the participation of minority shareholders are constantly expanding, and their participation is gradually increasing [1][2]. However, there are heated discussions in academic circles about whether the participation of minority shareholders in corporate governance is "effective". On the one hand, Li and Kong[3] found that the lower the level of corporate governance, the higher the enthusiasm of minority shareholders to participate in online voting, and this active behavior effectively improves the firm's future performance. Li et al.[4]found that the high voting rate of minority shareholders will significantly increase the number of corporates' patent applications. But on the other hand, minority shareholders are usually considered irrational and have a weak concept of actively participating in corporate governance [5][6]; Kong et al.[1] and Kong[7]also found that the pressure generated by shareholder activism can distort corporate behavior, and management is more likely to cater to minority shareholders through earnings manipulation. Therefore, it is necessary to evaluate the participation of minority shareholders in corporate governance more comprehensively and objectively.

Most of the existing literature focuses on how to protect the interests of minority shareholders and the pros and cons of minority shareholders participating in corporate governance, but few people link minority shareholders with corporate green innovation. According to the statistics of the State Intellectual Property Office, most of the applications for green patents in China are still dominated by universities, and the green innovation layout of firms needs to be strengthened urgently.

Compared with the previous literature, the contributions of this paper are as follows: First, the research of this paper updates and expands the capital market's understanding of the role and influence of minority shareholders. Secondly, this paper takes minority shareholders as the research object, and thus enriches theories related to corporate green innovation, and provides theoretical reference for China to build a market-oriented green technology innovation system. Finally, this study enriches the literature on shareholder activism. Due to the failure of corporates' internal and external governance mechanisms, the demands to empower minority shareholders to make decisions began to emerge [8], and the activism of minority shareholders gradually returned. This paper emphasizes the incremental

effect of minority shareholders' participation on corporate green behavior, enriches the research on minority shareholders' activism behavior in the Chinese context.

2. Research Hypothesis

Lev and Sougiannis[9]found that capital R&D expenditure and patent output can increase the company's stock return rate. Companies with high innovation capabilities have long-term comparative advantages, and this advantage is reflected in the long-term stock return rate[10]. At the same time, the study found that companies with strong green innovation capabilities perform more prominently in the capital market, and their stock returns are significantly higher than the market average. It is believed that green innovation will bring premiums to the company, and the company will have the motivation to continue to promote green innovation to gain scale, expansion and efficiency improvement[11]. Albort-Morant et al.[12]found that successful green innovation can improve efficiency and enhance core competitiveness. Zhang et al.[13]took Chinese manufacturing companies as an example and found that the more practical green innovations, the better the company's profitability and growth.

Meanwhile, there are a large number of minority shareholders in listed companies and the size of the group is large. They gather by participating in the general meeting of shareholders, and can form a dominant group under a spontaneous or loose organization, and its scale will have a governance effect[14] . In the exchange and interaction of information, once they realize that their common interests are damaged, it is easier for minority shareholders to form an interest alliance[15][13], and then unanimously protect their own interests. Therefore, minority shareholders will support enterprises to carry out green innovation out of consideration of their own interests. At the same time, whether minority shareholders take activism depends on whether they can overcome the tendency of "free riding" and the trade-off between benefits and costs[16][17]. About corporate innovation, Li et al.[4] found that the high voting rate of minority shareholders will significantly increase the R&D investment and the number of patent applications of enterprises. Therefore, minority shareholders will support enterprises to carry out green innovation out of consideration of their own interests. However, Belloc's[18] cross-country empirical study found that due to risk diversification and low exit costs, the opportunistic behavior of minority shareholders will reduce the innovation activities of enterprises, which is not conducive to the long-term development of enterprises. Further analysis above shows that minority shareholders attach importance to green innovation. Based on the above analysis, the following hypotheses are put forward:

Hypothesis H: Limiting other conditions, the higher the participation rate of minority shareholders, the more it can promote green innovation.

3. Study Design

3.1. Sample and data

Taking Shanghai and Shenzhen A-share listed companies as research samples, minority shareholders' voting uses the information files of the general meeting of shareholders and the top ten shareholder files in the CSMAR database. The data of corporate green patents refer to China Research Data service platform (CNRDS). This article selects the data from 2011 to 2020, and excludes ST, *ST, PT companies and financial companies. At the same time, the continuous variable is winsored by 1% up and down, and finally 5741 valid observations are obtained as the initial sample.

3.2. The definition of variables

(1)Corporate Green Behavior

This paper refers to the ideas of Chen et al.[19], and uses the amount of green patents obtained by listed companies to measure corporate green behavior.

(2)Minority shareholders vote

The total shares attended by the general meeting of shareholders include on-site voting and online voting. Academic circles generally believe that minority shareholders refer to shareholders with a shareholding ratio of less than 5%. This article refers to the ideas of Xu and Wu[20] to construct the voting participation indicator (*Vote*) of minority shareholders. In the follow-up calculation, this paper expanded the explanatory variables by 100 times. A refers to Total shares attended at shareholders' meeting, B refers to shareholders holding more than 5% of the total shares, the details are as follows:

$$Vote = 100 \times \frac{A-B}{B} \quad (1)$$

(3)Control variables:

Referring to the research of Kong and Liu[1], Zheng et al. [2], Wang et al.[21], this paper controls some factors that may affect the amount of green patents obtained by enterprises. Control variables are company size, operating cash flow, corporate growth, board size, company listing years, asset-liability ratio, total Return on assets, Tobin Q. Table 1 gives the specific definition.

Table 1. Variable definition

Symble	Defination
Patent	The total number of green patents obtained by the group company each year
Vote	Minority shareholders vote
Size	The natural logarithm of total assets at the end of the period
Cashflow	Net cash flow from operating activities divided by total assets at the beginning of the period
Growth	(Total assets at the end of the current period−Total assets at the end of the previous period)/Total assets at the end of the previous period
Board	The natural logarithm of number of directors of the board of directors
Listage	The natural logarithm of Company listing years
Lev	Total Liabilities/Total Assets
Roa	Net profit/Total assets
TobinQ	Market Value/Total Assets
Dual	If the chairman of the company is also the general manager, Dual=1, otherwise 0
SOE	If the enterprise is a state-owned enterprise, SOE=1, otherwise 0
INST	Total shares held by institutional investors divided by total shares

3.3. Research model

In order to test the hypothesis of this paper and investigate the impact of minority shareholder voting on corporate green behavior, the following model is designed:

$$Patent_{i,t+1} = \beta_0 + \beta_1 Vote_{i,t} + \sum_k \alpha_k Control_{k,i,t} + \sum Industry + \sum Year + \varepsilon_{i,t} \quad (2)$$

Among them, $Patent_{i,t+1}$ is the total number of green patents obtained by the i-th listed company in the year of t+1. $Vote_{i,t}$ is voting participation rate of minority shareholders. $Control_{k,i,t}$ represents a series of control variables. $\sum Industry$ and $\sum Year$ control the double fixed effects of industry and year. β_1 indicates the impact of minority shareholder voting on corporate green behavior. β_1 is positive, indicating that minority shareholder voting is beneficial to the acquisition of corporate green patents. In this paper, the clustering robust standard error is adopted. In order to control the reverse causality of contemporaneous variables to a certain extent, the explanatory variables are lagged by one year.

4. Empirical Analysis

4.1. Descriptive statistics and correlation coefficient analysis

(1)Descriptive statistics

Table 2 reports descriptive statistics for each variable. The mean value of *Patent* is 7.469, the median is 1, and the standard deviation is relatively large. It indicates that most companies have obtained fewer green patents. There is little difference between the mean and median of *Vote*, but the standard deviation is relatively large. Generally speaking, most of the companies in the sample have low voting rates of minority shareholders. The distribution of the remaining control variables is roughly consistent with the existing literature.

Table 2. Descriptive statistics

Variables	mean	sd	min	p25	p50	p75	max
Vote	10.530	11.110	0.014	2.477	6.863	14.520	53.980
Patent	7.469	18.070	0	0	1	6	122
Size	23.050	1.220	20.480	22.160	22.960	23.850	26.160
Lev	0.479	0.195	0.077	0.327	0.491	0.629	0.867
Roa	0.046	0.055	-0.147	0.016	0.039	0.073	0.208
Cashflow	0.057	0.065	-0.125	0.017	0.054	0.097	0.228
Growth	0.121	0.264	-0.485	-0.022	0.094	0.222	1.258
Board	2.187	0.199	1.609	2.079	2.197	2.197	2.708
TobinQ	1.883	1.122	0.840	1.148	1.507	2.151	7.010
Listage	2.520	0.566	0.693	2.197	2.639	2.944	3.296

(2) Correlation coefficient analysis

Table 3 reports the Pearson correlation coefficient matrix for the main variables. *Patent* is significantly positively correlated with *Vote*, the hypothesis is partially supported.

Table 3. Correlation coefficient matrix

	Patent	*Vote*	*Size*	*Lev*	*Roa*	*Cashflow*	*Growth*	*Board*	*TobinQ*	*Listage*
Patent	1									
Vote	0.059***	1								
Size	0.365***	-0.045***	1							
Lev	0.157***	-0.064***	0.514***	1						
Roa	-0.026*	0.065***	-0.070***	-0.447***	1					
Cashflow	-0.008	-0.005	-0.021	-0.246***	0.462***	1				
Growth	-0.001	0.081***	0.017	0.016	0.268***	0.043***	1			
Board	0.014	0.058***	0.204***	0.116***	-0.029**	0.018	-0.042***	1		
TobinQ	-0.112***	0.099***	-0.453***	-0.418***	0.339***	0.200***	0.083***	-0.138***	1	
Listage	0.043***	-0.084***	0.290***	0.250***	-0.164***	-0.022	-0.113***	0.066***	-0.125***	1

4.2. Basic regression results

In order to test the impact of minority shareholder voting on corporate green behavior in listed companies, basic regression is performed based on the model. The total number of green patents obtained by listed companies, *Patent* is taken as the explained variable, and *Vote* is taken as the explained variable, as shown in Table 4. Table 4(1) only performs basic regression on *Vote* and *Patent*, and the results are significantly positively correlated. Table 4(2) does not carry out the double fixed effect of industry and time. Table 4(3) adds control variables and carries out the double fixed effect of industry and time. The conclusion remains unchanged, indicating that the participation of minority shareholders in corporate governance will significantly promote green innovation in enterprises.

At the same time, the table also reports the impact of control variables on the company's green behavior, which is basically consistent with the conclusions of Chen et al.[19]. For example, the larger the company size, the stronger the risk-taking ability of the company, so it is more conducive to the company's green behavior. The longer the company's listing time, the more inclined to stable development, so the enthusiasm for investing green behavior is not high. The higher Tobin Q value is, the higher the market value of the enterprise will be, and the investment expenditure will increase, which is conducive to the green innovation of the enterprise.

Table 4. Basic regression table

	(1)	(2)	(3)
Variables	*Patent*	*Patent*	*Patent*
Vote	0.084***	0.132***	0.085***
	(3.40)	(5.76)	(3.85)
Size		6.794***	6.801***
		(17.27)	(17.16)
Lev		-1.609	1.812
		(-1.35)	(1.38)
Roa		-3.216	5.860
		(-0.75)	(1.30)
Cashflow		-2.745	-9.384***
		(-0.82)	(-2.88)
Growth		-0.880	-0.620
		(-1.12)	(-0.82)
Board		-5.593***	-3.180**
		(-3.97)	(-2.34)
TobinQ		1.294***	1.064***
		(6.47)	(4.88)
Listage		-2.412***	-2.243***
		(-5.19)	(-5.06)
Constant	-2.827***	-133.490***	-149.975***
	(-5.04)	(-16.33)	(-17.35)
Observations	5,346	5,346	5,346
Adjusted R^2	0.092	0.162	0.243
Year FE	Yes	No	Yes
Industry FE	Yes	No	Yes

4.3. Robustness test of empirical results

In order to test whether the above regression results are robust, this paper uses a variety of fixed effect model regression, replacement variable regression, adding missing variables, propensity score matching model (PSM) and many other methods.

(1) Multiple fixed effect model regression

The results are shown in Table 5 below. The first column shows the regression results of industry and year crossover, and the second column shows the regression results of controlling the year, industry and region. The conclusion still holds after excluding the influence of specific factors that change over time, industry, and region.

Table 5. Multiple fixed effect model regression

Variables	(1) *Patent*	(2) *Patent*
Vote	0.089***	0.090***
	(4.37)	(4.03)
Constant	-142.466***	-152.803***
Control Variables	Yes	Yes
Observations	5,333	5,346
Adjusted R^2	0.239	0.259
Year FE	Yes	Yes
Industry FE	Yes	Yes
Rigion FE	No	Yes

(2)Substitution variables

Refer to the relative index of online voting of minority shareholders constructed by Xu et al.[22](2020), this paper uses *Vote_r* as a replacement variable for explanatory variables, the regression results are shown in Table 6(1) below. The formula of *Vote_r* is shown below.

$$\text{Vote_r} = 100 \times \left(\frac{\text{Vote}}{100 - \text{Vote}}\right) \quad (3)$$

The regression coefficient of the newly constructed variable *Vote_r* is 0.041, which is significant at 1% level. The number of green patents independently obtained by subsidiaries is used as the replacement variable *Patent_r*, the regression results are shown in Table 6(2). It shows that the replacement of the measurement indicators does not affect the conclusion of this paper.

Table 6. Substitution variable regression results

Variables	(1) *Patent*	(2) *Patent_r*
Vote		0.093**
		(2.32)
Vote_r	0.041***	
	(3.09)	
Constant	-149.855***	-163.634***
Control Variables	Yes	Yes
Observations	5,346	2,590
Adjusted R^2	0.243	0.117
Year FE	Yes	Yes
Industry FE	Yes	Yes

(3)Add missing variables

Referring to the research of Duan et al.[23], Dou et al.[24], *Dual* and *INST* are added.

The regression results with omitted variables are shown in Table 7 below. After sequentially adding control variables, the coefficient of *Vote* is always significantly positive. It means that the participation of minority shareholders in corporate governance will still promote corporate green behavior.

Table 7. Added missing variables

Variables	(1) *Patent*	(2) *Patent*	(3) *Patent*
Vote	0.085***	0.079***	0.063***
	(3.85)	(3.62)	(2.93)
Control Variables	Yes	Yes	Yes
Dual		2.315***	2.185***
		(3.32)	(3.20)
INST			-3.261***
			(-2.96)
Constant	-149.975***	-152.162***	-156.738***
	(-17.35)	(-17.29)	(-16.86)
Observations	5,346	5,346	5,346
Adjusted R^2	0.243	0.246	0.246
Year FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes

(4)Propensity Score Matching Test

Group according to the median of votes, and perform 1:2 nearest neighbor matching to get the results shown in Table 8. The first column reports the results of the control year and industry, and the coefficient of *Vote* is significantly positive. The second column reports the results of no control year and industry, it is also significantly positive. It shows that the participation of minority shareholders will promote the green behavior of enterprises.

Table 8. Propensity Score Matching Test

Variables	(1) *Patent*	(2) *Patent_r*
Vote	0.104***	0.077***
	(5.10)	(3.85)
Constant	-87.614***	-106.710***
Control Variables	Yes	Yes
Observations	4,059	4,059
Adjusted R^2	0.125	0.221
Year FE	No	Yes
Industry FE	No	Yes

5. Heterogeneity Analysis

5.1. Whether the firm belongs to heavy polluting industry

Refer to Chen et al.[19] to study the difference in the impact of minority shareholders in heavy pollution industries and clean industries on corporate green innovation, this paper lets Pollution equals 1 in heavy pollution industries, otherwise 0. The grouping regression results are shown in Table 9 , which shows that the minority shareholders of companies belonging to the clean industry can better promote green innovation. Then this paper uses the ttest to test the difference of the mean value between groups for Pollution, the results show that the number of green patents obtained in heavy pollution industries is significantly less than that in clean industries. Companies in heavy pollution industries themselves are more inclined to pollution control and do not attach importance to green patent applications

Table 9. Heterogeneity Analysis

Variables	Pollution=0	Pollution=1
Vote	0.089***	0.036
	(3.05)	(1.56)
Constant	-180.327***	-86.792***
	(-15.62)	(-8.93)
Control Variables	Yes	Yes
Observations	3,525	1,821
Adjusted R^2	0.288	0.203
Year FE	Yes	Yes
Industry FE	Yes	Yes

5.2. Based on the nature of property rights

This paper continues to study the impact of minority shareholder participation on green innovation in state-owned enterprises and non-state-owned enterprises . If the firm is state-owned enterprises, SOE equals 1, otherwise 0.The grouping regression results are shown in Table 10. The P value of chowtest is 0.0012, indicating that state-owned enterprises have a more positive attitude towards green innovation. This is due to the close relationship between state-owned enterprises and the government, compared with private enterprises, they can obtain more innovative resources such as capital, talents, land and technology from outside[25][26]. In addition, state-owned enterprises have more opportunities to undertake or participate in the implementation of key national R&D plans and major projects[27]. And with the deepening of the reform of state-owned enterprises, the protection policy for minority shareholders will also be more perfect.

Table 10. Heterogeneity Analysis

Variables	SOE=0	SOE=1
Vote	0.064**	0.106***
	(2.28)	(2.890)
Constant	-158.156***	-148.629***
	(-9.58)	(-14.550)
Control Variables	Yes	Yes
Observations	2,399	2,947
Adjusted R^2	0.206	0.248
Year FE	Yes	Yes
Industry FE	Yes	Yes

6. Conclusions and Policy Recommendations

This paper finds that the minority shareholders play an important role in promoting corporate green innovation. In further analysis, it is found that in state-owned enterprises and companies belonging to the clean industry, the participation of minority shareholders has a stronger role in promoting green behavior of enterprises.

For heavy pollution industries, in addition to adopting administrative measures such as environmental regulations, government departments can use market-oriented tools to strengthen their environmental awareness. And it can also guide them to establish a business philosophy that emphasizes both economic and environmental benefits. The research shows that minority shareholders can use the formal system to actively exercise their rights to achieve the purpose of protecting their own rights and interests, which has important policy implications.

In practice, the Chinese government should actively guide minority shareholders to participate in corporate governance. It should also issue relevant laws and regulations to encourage listed

companies to carry out green innovation, standardize the green patent approval system, and constantly update relevant standards for green patents.

Under the circumstance that the existing legal system is relatively imperfect, Chinese government should further regulate the shareholders' meetings of listed companies. Let them strictly implement the procedures for convening shareholders' meetings stipulated by the Company Law, and put an end to the behavior of large shareholders, management and other internal personnel of listed companies who in disguised form hinder the participation of minority shareholders.

References

[1] Kong Dongmin, Liu Shasha. Minority shareholder voting rights, corporate decision-making and corporate governance—Evidence from a natural experiment [J].Management World, 2017, 33(9).

[2] Zheng Zhigang, Shi Lina, Huang Jicheng, Guo Jie. Influencing factors and economic consequences of the phenomenon of Small Shareholders' Action of Chinese listed companies [J]. The Journal of World Economy, 2019, 42(1).

[3] Li Wenjing, Kong Dongmin. Information transparency, corporate governance and minority shareholder participation [J]. Accounting Research, 2013, 34(1).

[4] Li Shu, Zhai Shiyun, Gu Pu. The enthusiasm of non-controlling shareholders to participate in decision-making and technological innovation of enterprises [J]. China Industrial Economics, 2018, 35(7).

[5] Harris, L. . Missing in activism; Retail investor absence in corporate elections [J]. Columbia Business Law Review, 2010, vol.104: 104-204.

[6] Yao. S. , Wang, C. , Cui, X. , Fang, Z. . Idiosyncratic skewness, gambling preference, and cross-section of stock returns: Evidence from China [J]. Pacific-Basin Finance Journal, 2019, vol.53: 464-483.

[7] Kong, D.. Minority shareholder participation and earnings management: a test of catering theory [J]. China Finance Review International, 2019, vol.9:73-109.

[8] Fried, J. M. , Kamar, E. , Yafeh, Y. . The effect of minority vote rights on controller pay tunneling [J]. Journal of Financial Economics, 2020, vol.138: 777-788.

[9] Lev, B. , Sougiannis, T.. The capitalization, amortization, and value-relevance of R＆D [J]. Industrial Health, 1996, 53(6): 498—504.

[10] Cohen, L. , Diether, K. , Malloy, C. . Misvaluing innovation [J]. Review of Financial Studies, 2013, 26(3): 635-666.

[11] Fang Xianming, Na Jinling. Research on green innovation premium remuneration for GEM listed companies [J]. Economic Research Journal, 2020, 66(10).

[12] Albort-morant G, Leal-millán A, Cepeda-carrión G. The antecedents of green innovation performance: A model of learning and capabilities [J]. Journal of Business Research, 2016, 69(11): 4912-4917.

[13] Zhang, D. , Zhao, R. , Qiang, J. . Green innovation and firm performance: Evidence from listed companies in China [J]. Resources, Conservation＆Recycling, 2019, 144(1): 48-55.

[14] Huang Zeyue, Luo Jinhui, Li Xiangxi. The governance effect of "many people" of minority shareholders: An examination based on the number of attendees at the annual general meeting [J]. Management World, 2022, 38(4).

[15] Van Zomeren, M. , Spears, R. , Fischer, A. H. , Leach, C. W. . Put your money where your mouth is! Explaining collective action tendencies through group-based anger and group efficacy [J]. Journal of Personality and Social Psychology, 2004, vol.87: 649-664.

[16] Gong, B. . Understanding institutional shareholder activism; A comparative study of the UK and China. 2014, London; Routledge.

[17] Xin Yu, Huang Xinyi, Ji Beibei. The practice of investor protection NGOs and Shareholder litigation in China: A case study based on CSI securities backed litigation [J]. Management World, 2020, 36(1).

[18] Belloc, F. . Law, finance and innovation: The dark side of shareholder protection [J]. Cambridge Journal of Economics, 2013, vol.37: 863-888.

[19] Chen Zhen, Tian Guanjun, Wang Mingrui, Wen Chuanhao. Yangtze River protection strategy and Green Innovation of heavily polluting enterprises: Evidence from listed companies in the Yangtze River economic belt [J]. Science &Technology Progress and Policy, 2022.

[20] Li Zhigang, Li Miao, Li Qian, Guo Jie. The logic of the control arrangement of a concerted action agreement [J]. The Journal of World Economy, 2021, 44(4).

[21] Wang Yutao, Dong Tianyi, Lu Chongluan. The governance effect of "voting with their mouths" and the efficiency of enterprise investment of enterprise investment for minority shareholders [J]. Economic Management, 2022, 44(6).

[22] Xu Shoufu, Wu Xia. Can "hand voting" of minority shareholders promote cash dividends of listed companies [J]. Review of Investment Studies, 2020, 39(7).

[23] Duan Mengran, Wang Ruihua, Guo Jun, Huang Xi. Is stickiness a new investment normal [J]. Journal of Central University of Finance & Economics, 2018, 38(3).

[24] Dou Chao, Luo Jinbo. Whether minority shareholders using social media to "speak out" can improve executive compensation contracts [J]. Finance & Trade Economics, 2020, 41(12).

[25] Michael F, Chen L, Liu P, et al. Inside the black box: Bank credit allocation in China's private sector [J]. Journal of Banking & Finance, 2009, 33(6): 1144-1155.

[26] Wang R Q, Wang F J, Xu L Y, et al. R&D expenditures, ultimate ownership and future performance: Evidence from China [J]. Journal of Business Research, 2017, 71: 47-54.

[27] Motohashi K, Yun X. China's innovation system reform and growing industry and science linkages [J]. Research Policy, 2007, 36(8): 1251-1260.