The Influence of Institutional Investor Shareholding on the Innovation Level of Listed Companies

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Abstract: This paper aims to study the interaction between institutional investor ownership and innovation level of listed enterprises in China. Using Python crawling and manually collected data of listed companies as samples, the innovation level is measured by two dimensions of innovation input and innovation output, and the innovation output is divided into high and low standard innovation. The results show that the shareholding ratio of institutional investors has a negative effect on the proportion of R&D investment and R&D personnel of listed companies. Furthermore, institutional ownership has a negative correlation with high standard innovation, but no correlation with low standard innovation.

Keywords: Institutional Investors, Technological Innovation Capability, R&D, Patent License.

1 INTRODUCTION

Innovation plays a key role in the survival and development of enterprises. The level of innovation is affected by a series of factors, the institutional shareholding factor is more prominent. At present, the academic circles have not formed a consensus on the connection between the two, which can be divided into three schools: effective supervision theory, myopic theory and irrelevant theory.

According to the effective supervision theory, institutional investors have a better understanding of the internal and external conditions of enterprises, have a positive direction for the long-term returns of innovation activities of enterprises, and will urge enterprises to increase their R&D investment to increase the return on investment of institutions [1]. Long-term R&D projects of enterprises are beneficial to enhance the competitiveness of enterprises. In order to ensure future profitability, organizations will pay attention to the stability of the rate of return of the company's projects [2]. According to Wahala & MC Connell, one of the main reasons for the increase in corporate investment spending is institutional ownership, and the level of R&D spending increases as institutional ownership increases [3]. Based on the agency cost theory and the system characteristics of China's financial market, Henry found that with the increase of the share quota of institutional investors, the shortcomings of innovation input of enterprises could be better avoided [4]. Due to the rights obtained by holding shares, institutions are more willing to participate in the daily management of the company, so as to exert influence

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on strategy formulation and investment project selection [5]. Hu Yuming and Fan Haifeng recognized the convergence of interests between institutions and enterprises, and believed that they had common goals and deep connections, including interests and reputation [6]. He Mingqin found that most listed companies with certain institutional investors have a large amount of expenditure on innovation projects [7].

Myopic theory, in contrast, argues that institutions are more keen on short-term returns because of market evaluations and the pressure to report regularly on their investments [8]. Mitra also believes that the reason why institutions are averse to high-risk long-term investment may be the impact of performance assessment faced by institutions. The management will reduce innovation activities to retain institutional shares and prevent the impairment of the company's stock [9]. Ren Haiyun also concluded that institutional investors have similar behavior of "seeking advantages and avoiding disadvantages" based on the assessment methods in the institutional industry [10]. Non-independent institutional investors believe that supervision will increase their business costs [11]. Based on information asymmetry, institutions may think they are at an information disadvantage and hold a pessimistic attitude toward long-term investment activities that require a large amount of information [12]. Chinese scholars believe that Chinese institutional investors are still in the initial stage of development, and the governance of participating enterprises is still in a wait-and-see state [13]. An Tongliang and Qi Jiebin took a different approach, which was different from the linear conclusion of previous studies, and found that different institutional investment shareholding ratio had different impacts on the innovation ability of enterprises. There was a critical point, namely the so-called threshold, and only when the shareholding ratio reached a certain level would it have a positive impact on the innovation ability of enterprises [14].

Unrelated theory thinks that institutional holding has no correlation with innovation ability of listed company in our country [15].

To sum up, the possible reason is that the internal organization is a diversified whole, and different types of institutional investors have different degrees of participation in enterprise management. The countervailing of effective supervision theory and myopic theory and the different degrees of countervailing eventually lead to three different views, which need further study.

2 THEORETICAL ANALYSIS AND HYPOTHESIS

Institutional investors have natural advantages, such as professional team and capital scale, and it is easier to obtain internal and external information of the enterprise to judge the long-term value of the enterprise, so as to support the R&D investment of the management. However, due to reputation considerations and performance competition under market expectations, some institutions tend to obtain short-term benefits through portfolio adjustment and avoid high-risk long-term capital injection projects as much as possible. Therefore, the following alternative hypotheses are put forward:

H1a: The shareholding of institutional investors is positively correlated with the R&D investment intensity of enterprises.

H1b: The shareholding of institutional investors is not correlated or even negatively correlated with the R&D investment intensity of enterprises.

There are three types of authorized patents in China -- invention types, utility models and design types. The patents with a high level of innovation and technology belong to the invention patents, and the patents that only improve the appearance or performance of the products are called design patents and utility model patents. From the perspective of R&D difficulty and application difficulty, the invention patent belongs to the high standard patent, and the other two types belong to the low standard patent. Information asymmetry makes customers believe that the products of enterprises with more authorized patents will be better and more competitive. Enterprises are willing to advertise the number of national patents as their advantages, so as to attract the investment of institutional investors. In addition, China implements the innovation-driven development strategy, the government encourages the innovative behavior of enterprises, and spends funds on the application of patents, which reduces the innovation cost of enterprises and relieves the capital pressure of enterprises. However, some institutions prefer the high rate of return and long-term benefits brought by high-standard patents. However, the scarcity of resources and limited capital also determine that more investment in high-standard innovation leads to less attention on low-standard innovation. To sum up, the following hypotheses are proposed:

H2: Institutional investor ownership has a reverse effect on high-standard innovation, but has no obvious effect on low-standard innovation.

3 STUDY DESIGN

3.1 Sample Selection

In this paper, A-share listed companies with complete R&D investment and number of patent grants for ten consecutive years from 2010 to 2019 were selected as the original research samples. Part of the data were from CSMAR, Juchao Information Network and publicly disclosed annual reports of listed companies. Supplementary data were obtained through Python crawling and manual collection.

3.2 Variable Design

1) Explained variable: innovation level

Innovation investment: the ratio of R&D investment to operating revenue & the ratio of researchers to total employees.

Innovation output: high standard patents and low standard patents.

2) Explanatory variable: Shareholding ratio of institutional investors.

3) Control variables: company Size (Size), financial leverage (LEV), company Growth (Indep), company performance (ROE), ownership concentration (TOP10ratio), company value (TobinQ), Dual.

Specific variable names and definitions are shown in Table 1.

TABLE I. TABLE OF VARIABLES AND INDICATORS

Variable type	Variable symbol	Variable definitions
Explained variable	IHratio	The proportion of shares held by institutional investors to the total share capital of listed companies
Explanatory variables	RDSpendSumRatio	The proportion of the total amount of R&D investment in the company's main business income at the end of the year
	RDPerson Ratio	The proportion of R&D personnel in all employees of the enterprise
	Invia	High standard innovation
	zpata	Low standard innovation
Control variables	Size	The natural log of total assets at year-end
	Lev	Asset-liability ratio = total liabilities/total assets at year-end
	Growth	Growth rate of operating income
	Indep	The ratio of independent directors to the board of directors
	ROE	Return on equity
	TOP10ratio	The proportion of total shares held by the top 10 shareholders
	TobinQ	Measured by Tobin Q
	Dual	Whether the chairman of the board and the general manager concurrently

3.3 Model Building

This study the following multiple regression model was constructed, in which F enterprise technology innovation ability, RDs of r&d spending accounted for the enterprise, RDp for enterprise research and development personnel accounted for, Invia high standards for the enterprise innovation, the patent zpata low standards for the enterprise innovation patent license number, the Control for the set of Control variables in the table above, epsilon for random disturbance.

To test the correlation between the shareholding ratio of institutional investors and the innovation level of enterprises:

$$RD\text{s} = \alpha + \alpha_1 IH + \alpha_2 C\text{ontrol} + \varepsilon \tag{1}$$

$$RD\text{p} = \beta + \beta_1 IH + \beta_2 C\text{ontrol} + \varepsilon \tag{2}$$

$$I\text{nvia} = \delta + \delta_1 IH + \delta_2 C\text{ontrol} + \varepsilon \tag{3}$$

$$\text{zpata} = \eta + \eta_1 IH + \eta_2 C\text{ontrol} + \varepsilon \tag{4}$$

To sum up, the influence of overall shareholding of institutional investors on technological innovation capability of enterprises is measured as follows:

$$F = \alpha_3 RD\text{s} + \beta_3 RD\text{p} + \delta_3 I\text{nvia} + \eta_3 \text{zpata} + \varepsilon \quad (5)$$

4 EMPIRICAL TEST AND RESULT ANALYSIS

Table 2 shows the descriptive statistics of each variable in this paper.

The average ratio of R&D intensity is 4.85%, which is lower than the internationally recognized 5%. The minimum value is 0, and the maximum value is 88.56%, indicating that there are significant differences between the R&D investment intensity of A-share listed enterprises. Some enterprises attach importance to the level of R&D investment, but the overall level of R&D still needs to be improved. The average shareholding ratio of institutions is 35.14%, the lowest is 0, the highest is 98.66%, and the standard deviation is 0.2374, indicating that there is a certain difference in the share ratio of listed companies owned by institutional investors. The average number of patented inventions authorized by listed companies is 12, with a standard deviation of 94.6523.

TABLE II. DESCRIPTIVE STATISTICS

variable	N	mean	sd	min	max
RDPerson Ratio	10,579	0.1606	0.1371	0.0000	0.9371
RDSpendSum Ratio	10,579	0.0485	0.0522	0.0000	0.8856
Invia	10,579	12.3389	94.6523	0.0000	5,495.00
IHratio	10,579	0.3514	0.2374	0.0000	0.9866
Size	10,579	22.1365	1.2645	19.5603	27.4677
ROE	10,579	0.0689	0.1362	-1.2901	0.4072
Growth	10,579	0.2106	0.4982	-0.7266	5.8301
Indep	10,579	0.3770	0.0538	0.3000	0.5714
TOP10ratio	10,579	0.1524	0.1079	0.0015	0.7942
Lev	10,579	0.3940	0.1950	0.0268	0.9907
Dual	10,579	0.3162	0.4650	0.0000	1.0000
TobinQ	10,579	2.2005	1.4627	0.8153	17.7288

Correlation analysis is shown in Table 3.

The absolute value of the correlation coefficient between the main variables is lower than 0.5, indicating that there is no phenomenon of multicollinearity among the main variables selected in this paper, and the final regression results will not produce large deviation. For reasons of space, Table 3 only selects part of the variables to show.

TABLE III. CORRELATION ANALYSIS

	Invia	IHratio	Size	ROE	Growth	Indep
Invia	1.000					
IHratio	0.061***	1.000				
Size	0.173***	0.480***	1.000			
ROE	0.028***	0.040***	0.049***	1.000		
Growth	-0.008	-0.033***	0.047***	0.211***	1.000	
Indep	0.005	-0.038***	-0.002	-0.027***	-0.012	1.000

*, **, and *** indicate statistical significance at the 10%、5%, and 1% levels. Same as below.

The empirical results are shown in Table 4.

The regression coefficients of enterprise innovation input level and institutional shareholding level are -0.021 and -0.062, respectively, and both of them are significant at the level of 1%. In other words, the more institutional shareholding, the less conducive to the improvement of innovation input level, which preliminarily supports the research hypothesis 1a in this paper.

The correlation coefficient between institutional shareholding ratio and the number of high standard patents of listed companies is negative, which is significantly higher than 1%, indicating that institutional investors will inhibit enterprises from carrying out invention patent R&D projects with high technology content but also high risk. However, there is no significant relationship between institutional ownership and low standard innovation. This preliminarily verifies hypothesis 2 in this paper.

TABLE IV. REGRESSION RESULTS

	Innovation input		**Innovation output**	
	RDSpendSum Ratio	RDPerson Ratio	Invia	zpata
IHratio	-0.021***	-0.062***	-16.024***	-1.950
	(-7.83)	(-8.86)	(-3.04)	(-0.46)
Size	0.001**	-0.001	18.192***	11.144***
	(2.12)	(-0.66)	(16.23)	(12.48)
ROE	-0.039***	-0.028***	10.282	22.411***
	(-10.22)	(-2.74)	(1.34)	(3.66)
Growth	-0.002**	0.014***	-4.866**	-5.366***
	(-2.11)	(4.94)	(-2.36)	(-3.26)
Indep	0.044***	0.136***	-4.709	-2.796
	(4.83)	(5.56)	(-0.26)	(-0.19)
TOP10 ratio	-0.040***	-0.120***	-19.983**	16.092**
	(-8.21)	(-9.11)	(-2.02)	(2.04)
Lev	-0.054***	-0.101***	-11.204*	0.730
	(-17.42)	(-12.25)	(-1.81)	(0.15)
Dual	0.007***	0.012***	5.635***	4.945***
	(6.90)	(4.26)	(2.58)	(2.84)
TobinQ	0.007***	0.012***	3.314***	1.382**
	(17.76)	(12.57)	(4.45)	(2.33)
Constant	0.027**	0.181***	-384.739***	-239.238***
	(2.21)	(5.56)	(-15.75)	(-12.29)
Observations	10,141	10,141	10,140	10,140
R-squared	0.134	0.100	0.034	0.031

*, **, and *** indicate statistical significance at the 10%、5%, and 1% levels. Same as below.

The robustness test results are shown in Table 5 and 6.

In this paper, some control variables are mainly replaced, that is, ROA is used to replace ROE and control year pairs to test the robustness of the dynamic endogeneity model. At the same time, the variables were Winsorized at 1% and 99% quantiles of the sample, and the robust option was added. The results are still robust.

TABLE V. ROBUSTNESS TEST- ROA REPLACE ROE

	Invia	**RDSpendSumRatio**	**RDPersonRatio**
IHratio	-2.60**	-0.022***	-0.073***
	(-2.31)	(-9.84)	(-10.72)
Size	6.206***	0.002***	-0.002
	(13.49)	(3.54)	(1.48)
ROA	24.787***	-0.076***	-0.087***
	(7.64)	(-8.14)	(-3.61)
Growth	-2.956***	-0.002	0.021***
	(-7.11)	(-1.41)	(5.91)
Indep	10.986**	0.039***	0.119***
	(2.29)	(4.88)	(5.01)
TOP10ratio	-5.684**	-0.034***	-0.109***
	(-2.16)	(-8.95)	(-9.13)
Lev	-1.178	-0.054***	-0.097***
	(-0.91)	(-17.83)	(-10.55)
Dual	1.023**	0.007***	0.011***
	(2.03)	(7.25)	(3.62)
TobinQ	1.247***	0.009***	0.021***
	(5.92)	(15.61)	(13.22)
Constant	-128.368***	0.011	0.121***
	(-12.09)	(0.93)	(3.01)
R-squared	0.078	0.1767	0.1185

TABLE VI. ROBUSTNESS TEST - CONTRAL YEAR

	Invia	**RDSpendSumRatio**	**RDPersonRatio**
IHratio	-2.60**	-0.022***	-0.073***
	(-2.30)	(-9.72)	(-10.74)
Size	6.161***	0.002***	-0.002
	(13.47)	(3.46)	(1.39)
ROE	15.558***	-0.04***	-0.044***
	(6.73)	(-8.46)	(-3.34)
Growth	-3.069***	-0.002	0.020***
	(-7.30)	(-1.49)	(5.75)
Indep	11.05**	0.039***	0.119***
	(2.30)	(4.90)	(5.02)
TOP10ratio	-5.606**	-0.035***	-0.111***
	(-2.13)	(-9.31)	(-9.28)
Lev	-2.376	-0.049***	-0.091***
	(-1.89)	(-17.75)	(-10.45)
Dual	0.983**	0.007***	0.011***
	(1.95)	(7.35)	(3.63)
TobinQ	1.25***	0.009***	0.021***
	(5.93)	(15.46)	(13.15)
Year	control	control	control
Constant	-126.76***	0.009	0.121***
	(-12.00)	(0.76)	(2.98)

*, **, and *** indicate statistical significance at the 10%、5%, and 1% levels. Same as below.

5 CONCLUSION AND DISCUSSION

This paper studies the relationship between institutional investor ownership and firm innovation capability in China's capital market. The main conclusions are as follows: Firstly, institutional investors have a restraining effect on firm innovation output. Secondly, institutional ownership has a negative effect on patent authorization for high standard innovation, but has no significant effect on low standard innovation. In general, the overall institutional shareholding has a certain inhibitory effect on the technological innovation ability of enterprises.

There are still many shortcomings in this paper, so we should reconsider. First, the main dependent variable of this paper, institutional shareholding ratio, is selected as the data of sample enterprises at the end of the year for the convenience of data acquisition. However, institutional shareholding of enterprises is a dynamic process and this dynamic change is not reflected in this paper. Secondly, institutional investors belong to a multivariate aggregate. This paper does not classify institutional investors from heterogeneity. The division criteria are also varied and worthy of further discussion. Finally, the research object of this paper is only listed enterprises, while there are a large number of unlisted smes in China. And different industries are not distinguished, perhaps different industries and enterprise nature will get new findings and conclusions.

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