

The Impact of R&D Investment and Invention Patents on The Value of New-Generation Information Technology Firms

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Abstract: Technological innovation is the main criterion for selecting listed companies on the Science and Technology Innovation Board (STAR Market). Research and Development (R&D) and patents are the beginning and result of technological innovation, reflecting the success or failure of technological innovation, relating to the company's operation situation, and then affecting the company's performance in the capital market. This paper studies the impact of R&D investment and invention patents on company value by taking the new generation of information technology industry companies listed on the STAR Market from 2019 to 2020 as samples. The results show that R&D investment and invention patents increase the revenue and profit of the new generation of IT industry companies, which increases the company's value in the capital market. The R&D investment and invention patents of private enterprises increase the value more significantly, and actively promote the transformation of scientific research achievements into production capacity. These studies help investors make investment decisions and tap the value of non-financial data of listed companies.

Keywords: Innovation input, STAR Market, Enterprise value.

1. Introduction

China has long recognized the importance and urgency of R&D and innovation. In order to realize its dream of becoming an innovation powerhouse at an early date, China has formulated a development strategy to build an innovation-oriented country and increased financial support for independent innovation. According to the Statistical yearbook, China's R&D expenditure has been increasing year by year, with the proportion of R&D investment in GDP increasing from 0.94% in 2001 to 2.4% in 2020, with a compound annual growth rate of 4.8%. As the main body of R&D, enterprises' R&D investment accounts for 77% of the total social investment, and their patent holdings have increased by dozens of times. As a major force in innovation activities. In 2020, China entered the stage of becoming an innovation-oriented country and ranked 14th in the Global Innovation Index. However, there are still some shortcomings: first, the key core technologies cannot be realized independently, the investment in basic research is low and the capacity is weak. Second, there is insufficient supply of high-quality innovation achievements, which cannot provide strong support for industrial and supply chains. Third, the effectiveness of the national innovation system has not been fully tapped, and institutional reform remains important.

China's innovation structure has been developed from secondary development and application innovation in the industrialization period to R&D investment and product development. Therefore, a large amount of capital investment is required and accompanied by huge risks. An active capital market can disperse capital pressure and risks and inject vitality into enterprise innovation. The launch of the Science and Technology Innovation Board is a major institutional arrangement for China to accelerate the implementation of the independent innovation strategy and promote the organic integration of science and technology and finance. It is an important supplement to the existing capital market,

constructing a multi-level capital market system and giving full play to the function of the market. Listing is an important way for enterprises to realize financing, and it is also the way to minimize the financing cost. Reasonable value of enterprises is an important performance of capital market to realize its resource allocation function.

In this paper, the main contributions are as follows: based on the Chinese Technological Innovation-Based Enterprises in its prospectus disclosure of information about innovation, from the enterprise internal driving study, R&D and patent for invention for the influence of enterprise value, this helps from the enterprise internal factors caused by information asymmetry and uncertainty to deeply understand the value of enterprise is reasonable; This paper also deepens the use of non-financial information when companies go public, and expands the previous content of using financial indicators to study the value. By analyzing the company attribution, we found that private enterprises have higher enthusiasm in R&D activities and patent applications.

2. Literature Review

Highly developed financial markets can stimulate innovation[1], because enterprises can obtain more financial support, improve the intensity of R&D investment and cultivate the innovation ability of companies[2]. However, the existing literature suggests that it is difficult to determine how innovation ultimately affects a company's value. Lu Dong[3] After the GEM was launched, some "chaos" occurred. On the one hand, the high issue price, high price-earnings ratio and high raised capital made the original shareholders of the company benefit a lot, but did not promote innovation; On the other hand, high-tech companies after listing have not achieved growth in performance, resulting in huge losses for investors.

In order to correctly evaluate a company's innovation capability, investors should pay attention to more information about the company's innovation activities[4][5]. Chen and

Xu[6]The information of innovation activities is divided into innovation input and innovation results. They argue that information from these innovation measurements may have different implications for investors. First, innovation inputs have a higher degree of uncertainty than innovation outcomes. Secondly, the disclosure of innovation input is highly discretionary, and the patent and other achievements information is more credible with the support of legal documents. Therefore, the two dimensions of information have different impacts on the company in the capital market and can play a complementary role.

Companies are unusually active in innovation activities before they go public[7], most companies decide to go public after a breakthrough in technology[8], in order to improve the success rate of initial public offerings (IPO).Yun-he li etc.[9]Based on GEM companies, it has been confirmed that listing can promote the innovation and development of companies. Although a lot of research has been done on innovation and IPO, the contribution of innovation activities after listing to the company's performance and capital market performance has not been much discussed.

The listing Rules of Sci-Tech Innovation Board of Shanghai Stock Exchange stipulate that companies must disclose all research and development information that will influence investors' value judgment and investment decisions, but the form and scope of disclosure are not clearly defined. Peng Han etc.[10]The study found that the level of voluntary disclosure of innovation behavior has a positive impact on the value of enterprises, but there is no significant result in capital market financing. Liang Weiliang[11]He pointed out that information disclosure should protect the legitimate rights and interests of investors, but excessive disclosure will cause information redundancy, not conducive to investor discrimination, and will raise the cost of the subject of disclosure. Jason hu etc.[12]We found that the disclosure of R&D information improved the rationality of IPO pricing in the primary market, but investors in the secondary exchange market did not fully understand the use of R&D related information to judge the reasonable value of enterprises.

There are many reasons for information asymmetry and opacity, such as technology research and development, product diversification and so on[13]In general, it is difficult to separate the influence of different sources of information asymmetry on enterprise value. The Science and Technology Innovation Board is positioned to promote the growth of strategic emerging industries and innovative enterprises, focusing on supporting the development of enterprises with independent innovation capability. China has introduced many policies to encourage scientific and technological innovation, especially in terms of taxation, which directly reduce the cost burden of enterprises and inject vitality into their development. Feng Ze etc.[14]The study found that the accounting policy of R&D investment deduction can help enterprises to increase the scale and intensity of R&D investment, and play a positive role in enterprise innovation. Yang Songling[15]Research has proved that companies that take advantage of the multi-level capital market system step by step have better performance in terms of R&D investment, and appropriate capital strategies also help companies develop and grow themselves using the capital market.

In-depth research on the reasonable value of science and technology innovation companies is of great significance for improving the efficiency of resource allocation and promoting the healthy development of the science and

technology innovation board market in China. In recent years, domestic scholars have studied the behavior of institutional investors[16], non-cash flow factors[17], and venture capital[18]From the perspective of the company's market value in the stock market, deepening people's understanding. In order to correctly evaluate the value of high-tech companies, investors can use more information about R&D investment and patents obtained by the companies[19][20].Diego Useche[21] found that each additional patent filed by a company on the American stock market helped the company raise an additional 801,000 euros, and 774,000 euros on the European stock market. Meng Tao etc.[22] study patent information and value of unicorn firms, and find that the number of patent applications is the main factor driving the value rise and improving the financing ability of firms.

3. Research Hypothesis

3.1. R&D Investment

Research and development (R&D) is a strategic investment to create new knowledge, technologies and products, and its value is particularly important for innovative companies. Compared with physical capital investment, R&D investment is characterized by strong value uncertainty. Xu Xin etc.[23]Argued that R&D is a high-risk, non-traded asset of enterprises, which is difficult to be evaluated by the market. As a result, potential IPO investors face value issues because they cannot rely on financial statements or prospectuses to get a complete picture of a company's market value. A company with a higher level of research and development creates more uncertainty for investors. The revenue of R&D is also uncertain, and its success is volatile and random. The value generated by R&D cannot be measured as easily as other assets, and the outside world needs the proprietary information of the enterprise to accurately evaluate.

On the one hand, the listing is for financing, and the company's own capital reserve cannot support the huge investment in innovation activities. On the other hand, the cash flow is the guarantee of the normal operation of the company, and the R&D investment will reduce the capital turnover efficiency and bring business risks. Therefore, it is necessary to guide external funds to support innovation. The capital market naturally has the function of risk diversification and strong resource allocation ability, which can help the company accelerate the speed of innovation.

The company's research and development investment and innovation ability can not simply draw the same sign, for two reasons: one is that according to our accounting standards, the enterprise's research and development investment will eventually be classified into two aspects of expensiveness and capitalization. This approach makes it impossible for investors to obtain clear information about innovation capability from the company's R&D investment and balance sheet, leading to mistakes in investment decisions. The second is that the efficiency of R&D inputs cannot be determined directly from a company's balance sheet or prospectus. Educating etc.[24]Pointed out that the effectiveness of R&D investment is determined through a company's value standard system, management process and organizational structure, which are difficult for investors to measure.

H₁: R&D investment has a positive impact on the market value of science and technology innovation board enterprises.

R&D investment can improve the value of enterprises and enhance investor confidence.

3.2. Invention Patents

Innovation ability has become the main criterion for selecting listed companies on the China Science and Technology Innovation Board. In addition, the Guidelines on the Attributes of Science and Technology Innovation (Trial) (March 2020) and the Interim Provisions on the Application and Recommendation of the Shanghai Stock Exchange Science and Technology Innovation Board (April 2021) issued by the China Securities Regulatory Commission (CSRC) have made it clear that listed enterprises should find their own attributes of science and technology innovation, and the unique institutional environment of the Science and Technology Innovation Board. This provides favorable conditions for this paper to study the impact of R&D investment and invention patents on value.

Technological innovation is a complex process, which goes through a series of stages, such as project initiation, innovation, progress, patent acquisition, product launch and commercialization[25]. Thus, R&D is an input to innovation, not an output. The level of R&D spending is a reliable measure of a firm's innovation activity, and scholars often use this variable as a measure of the effort a firm is putting into increasing its innovation output. Firms with strong innovation capability are able to adapt to changes in market demands, allocate internal resources efficiently, generate new knowledge and technologies, and have more patents and technologies. Patents and technologies are important intangible assets of enterprises, which can greatly reduce the uncertainty of innovation activities. In the era of knowledge-based economy, patents are the main drivers for enterprises to improve productivity and achieve value growth, and they are an important dimension for conducting fundamental analysis of securities. In addition, the Hall[26]The empirical findings show that patents, as a non-financial indicator, provide more sufficient information than R&D for investors to evaluate the market value of R&D activities.

Due to the widespread implementation of patents, the information asymmetry between innovative firms and investors becomes more serious. Investors cannot correctly evaluate the innovation ability of listed companies. For the issuers of new shares, the disclosure of innovation-related information can send positive signals to the market and help the companies to go public successfully. The uncertainty of research and development can be effectively alleviated, information transparency can be improved, and the cost of capital can be reduced. Accordingly, the more patents a patent issuer owns, the stronger its innovation capability will be.

H₂: The filing of invention patents has a positive impact on business value. Enterprises have more technical barriers, are ahead of competitors, and the higher the value in the market.

4. Model Design

From July 22, 2019 to December 31, 2020, this paper selected companies that successfully IPO on the Science and Technology Innovation Board. According to the information published on the website of Shanghai Stock Exchange, the companies belong to a total of 68 new generation information technology industries. The number of invention patents and financial data are collected from the prospectus issued by the company, and the data of the company on the securities market are collected from the Wind database.

4.1. Explained Variables

Market value, the performance of enterprise value, represents investors' confidence in the enterprise and reflects the operation of the enterprise to a certain extent. Reasonable value has always been the focus of scholars and industry research. According to Han Peng et al[10], selecting the company's estimated market value at the time of IPO.

4.2. Explanatory Variables

Research and development needs a large amount of capital investment, which can be related to the success of research and development to a certain extent. At the same time, the main purpose of enterprise listed financing is to continue the subsequent research and development. According to Wei Zhou[27], the mean value of R&D capital investment in the prospectus was selected as the explanatory variable.

As the direct output of R&D, patents are of great significance. Compared with the other two types of patents, invention patents can highlight the innovation ability of the company. The company will also focus on the invention patent information in the disclosure of periodic reports, which represents the core competitiveness of the company. According to Meng Tao et al[22], the number of invention patents in the prospectus was selected as the explanatory variable.

Revenue and profit are important financial indicators of the company's development, and also the main indicators of the company's operation to the outside world. Only with stable profitability can the company attract more investment, accelerate development, and obtain a win-win situation between the company and investors. According to Wei Zhou[26], the main business revenue and profit in the company's prospectus were selected as explanatory variables.

4.3. Control Variables

The P/E ratio, which compares whether stocks are overvalued or undervalued, is typically higher for companies with innovative attributes. But high P/E ratios accompany economic bubbles, so expectations for tech start-ups should be kept rational. According to Wang Yizhi et al[17], the price-earnings ratio was selected as the control variable.

The establishment time of a company and the enterprise life cycle theory mentioned that the development of a company has to go through several stages, and the financing needs of different stages are very different. The new generation of information technology industry is oriented to emerging technologies and industries, and continuous research and development and innovation need a lot of financial support. Listing and financing provide impetus for its subsequent development. According to Wen Qian et al[18], the time of company establishment was selected as the control variable.

Intangible assets of the company. With the development of economy, intangible assets have become the core of competitiveness in enterprises, representing the innovation results and competitiveness of enterprises. Accounting standards in China are very strict on the recognition of intangible assets, can be identified as intangible assets must be on the development of the company has played a great role. According to Li Zhong Fei et al[27], company intangible assets were selected as control variables.

The nature of the company is that private enterprises account for the majority of the enterprises listed on the science and Technology Innovation board, and the private economy is also the most active part of the socialist market

economy. Therefore, the financing difficulties of private enterprises need to be solved urgently. The capital market should actively guide the capital flow to private enterprises to help the private economy develop better and realize the reasonable allocation of resources. According to Xu Xin et al[23], company nature was selected as a control variable.

The reputation of underwriters, institutional investors have more professional business ability than ordinary investors, can get more comprehensive information, reduce the information mismatch between investors and enterprises, reduce investment risk. According to Li Zhong Fei et al[28], the reputation of the underwriter was selected as the control variable.

4.4. Endogenous Problem and Selection of Instrumental Variables

Endogenous issues can arise when using OLS (ordinary least squares) regression. The increase of company expenses, the decrease of profits, and the decrease of investors' returns will reduce investment confidence, which is reflected in the decrease of market value in the capital market; Companies with high market value have high visibility, reduce publicity expenses, reduce operating costs, and lead to increased profits. Therefore, there is a reverse causality relationship between profits and market value. In order to solve the endogenous problem, the 2SLS (two-stage least squares) regression analysis was performed by selecting the selling expenses and administrative expenses as instrumental variables.

The first stage:

$$\text{Operating profit} = \mu_1 + \beta_1 * \text{Operating income} + \beta_2 * \text{Sales expenses} + \beta_3 * \text{Overhead expenses} + \varepsilon_1 \quad (1)$$

The Second stage:

$$\text{Market value} = \mu_2 + \beta_4 * \text{R\&D funding} + \beta_5 * \text{Number of Invention Patents} + \beta_6 * \text{Operating income} + \beta_7 * \text{Operating profit} + \beta_8 * \text{Time} + \beta_9 * \text{Intangible Asset} + \beta_{10} * \text{P/E Ratio} + \varepsilon_2 \quad (2)$$

$$\text{Market value} = \mu_2 + \beta_4 * \text{R\&D funding} * \text{Company Attribute} + \beta_5 * \text{Number of Invention Patents} * \text{Company Attribute} + \beta_6 * \text{Operating income} + \beta_7 * \text{Operating profit} + \beta_8 * \text{Time} + \beta_9 * \text{Intangible Asset} + \beta_{10} * \text{P/E Ratio} + \varepsilon_2 \quad (3)$$

$$\text{Market value} = \mu_2 + \beta_4 * \text{R\&D funding} * \text{Reputation of Uderwriter} + \beta_5 * \text{Number of Invention Patents} * \text{Reputation of Uderwriter} + \beta_6 * \text{Operating income} + \beta_7 * \text{Operating profit} + \beta_8 * \text{Time} + \beta_9 * \text{Intangible Asset} + \beta_{10} * \text{P/E Ratio} + \varepsilon_2 \quad (4)$$

The summary of variable selection in this paper is shown in Table 1.

Table 1. Explanation of variables

Variable types	The variable name	Variable declaration
Explained variable	Market Value	The company's projected market capitalization at the time of its IPO on the Science and Technology Innovation Board
	R&D funding	Investment of R&D funds in the company's prospectus
Explanatory variables	Number of Invention Patents	The number of invention patents in the company's prospectus
	Operating income	Operating income in a company's prospectus
	Operating profit	Operating profit in a company's prospectus
Instrumental variable	Sales expenses	Sales expenses in a company's prospectus
	Overhead expenses	Overhead expenses in a company's prospectus
	P/E Ratio	The company's P/E ratio at the time of its IPO on the Science and Technology Board
	Time	The length of time the company has been registered and operated
Control variables	Intangible Asset	Intangible assets in a company's prospectus
	Company Attribute	Dummy variable, the value is 1 for private enterprises and 0 for other types of enterprises
	Reputation of Underwriter	Dummy variable, according to the 2020 revenue ranking of securities companies disclosed by the Shanghai Stock Exchange, the value is 1 for the top 10 and 0 for the others

5. Research Results

5.1. Descriptive Statistics

Descriptive statistics are shown in Table 2. The new generation of information technology industry companies attach great importance to R&D and innovation activities, and the average investment in R&D is close to 100 million yuan, much higher than the R&D expenses of similar companies on the GEM and Shanghai main board. Judging from the number

of invention patent applications, each company has its own patented technology and strong core competitiveness. The statistical results show that the top five companies in the number of invention patents have state-owned capital background, and the number of patent applications accounts for 46.94% of the total number of invention patent applications of all companies, which is extremely unbalanced. It can be seen that R&D and innovation need a large amount of capital support.

Table 2. Descriptive statistics

variable	The mean	The median	The maximum	The minimum value
Market cap (billion)	171.94	59.54	1,742.12	16.12
R&D Investment (billion)	0.9	0.46	7.32	0.09
Number of invention patent applications (pieces)	63	27	571	1
Operating revenue (billion)	14.52	5.08	377.92	1.01
Operating profit (million)	2.32	1.11	31.88	0.23
Selling expenses (million)	1.25	0.33	38.6	0.03
Overhead expenses (million)	0.78	0.41	11.22	0.1
P/E (multiple)	85.357	63.067	551.417	25.763
Duration of company establishment (years)	14.5	14.5	28	5
Intangible assets of the Company (100 million)	0.56	0.23	4.83	0.000 2

Data preprocessing, Normalize the data by:

$$\bar{X} = \frac{X_i - X_{Min}}{X_{Max} - X_{Min}}$$

the market value of the issue

This paper uses Eviews software to conduct regression analysis, and the results are shown in Table 3, Table 4 and Table 5.

5.2. Empirical Analysis

1. The impact of R&D investment and invention patents on

Table 3. Market value effect of R&D capital investment and invention patent application

variable	Market value			
	OLS	2SLS	OLS	2SLS
R&D funds	0.711 0*** (0.000 0)	0.694 7*** (0.000 0)	0.687 4*** (0.000 0)	0.672 2*** (0.000 0)
Invention patent application	9-0.038 - (0.5895)	8-0.027 - (0.6923)	8-0.114 - (0.117)	0.092 0 (0.206 9)
Operating income	-1.4275*** (0.0001)	0.9402*** (0.0042)	1.627 3*** (0.000 0)	0.9492*** (0.000 9)
Operating profit	1.107 1*** (0.000 0)	1.029 2** (0.0125)	1.177 6*** (0.000 0)	1.068 2*** (0.003 7)
Management expenses	-0.0721 (0.8244)		0.147 3 (0.647)	
Sales expenses	0.4927* (0.078 3)		0.668 2** (0.0272)	
P/E Ratio			0.093 9 (0.1126)	0.109 5* (0.085 9)
Company attribute			-0.088* (0.051 9)	-0.0826* (0.0525)
Intangible Asset			0.111 6 (0.106 8)	0.038 6 (0.524 0)
constant	-0.0184 (0.1011)	0.0189 (0.1136)	0.004 4 (0.8422)	0.005 7 (0.812 8)
Adjust the R ²	0.833	0.829	0.857	0.849
observations	68	68	68	68

Notes: 1) *, **, *** mean significant at the statistical level of 10%, 5%, and 1%, respectively; 2) Values in parentheses are test p-values

The regression analysis was performed using OLS and 2SLS, and the results are shown in Table 3. The regression results show that R&D investment is significant at the 1% level, and its regression coefficient is positive, which verifies the hypothesis that "R&D investment has a positive impact on the market value of the company". As the first step of innovation, R&D investment plays a key role. The establishment of the Science and Technology Innovation Board is to guide the capital flow to scientific and technological innovation, rationally allocate market resources and transform the economic growth model. While implementing the national policy requirements, the board, with its more inclusive attitude, increases the flexibility of trial and error in the exploration and innovation of science and technology innovation enterprises, gives sufficient room for trial and error for technology research and development in no man's land or in scarce areas, allocates resources to the most efficient places, and gives full play to the vitality of the market.

The possible reasons for the lack of significance in the regression results of invention patents are as follows: the disclosure of patents focuses on form and does not explain the actual benefits brought by patents. Investors cannot accurately evaluate the value of invention patents, and cannot have a positive effect on the value of companies; The application of patents requires time and cost, and may also face failure, which short-term investors regard as "negative" information. Patents can be acquired in a variety of ways, with in-house patents being more valuable and those bought and sold having less impact on a company's value. Even in industries with high-tech attributes, the patent index has a weak value of companies, which indicates that the Chinese capital market has no way to accurately evaluate the innovation results of enterprises.

Revenue and profit, as the basis of a company's growth, play a key role in the company's value. In the regression results in Table 3, both variables are significant at 1% level, which proves that revenue and profit are an important link

between the consumer market and the capital market. At the same time, in the endogeneity test of variables, the test result ($P = 0.0547$) rejected the null hypothesis of "profit is exogenous variable" at the significance level of 10%. Although the requirements for the company's income and profit are relaxed under the registration system, in the actual process, investors still care about the financial indicators of the enterprise, and take this as one of the decision-making conditions. Combined with descriptive statistical analysis, the profit margin of science and technology innovation board companies is very low, the innovation intensity and breakthrough need to be strengthened, and the strategy of innovation-driven development needs to be made efforts.

The P/E ratio of science and technology innovation board companies is higher than that of main board companies as a whole, so the traditional P/E value method is not applicable.

The regression results of the establishment time of the company are significant, indicating that the stability of the company has an impact on the market value, and the company is successful in the market competition. The negative coefficient may be due to the fact that the long-established firms occupy the market share, attach importance to the advantages of scale economies, reduce the investment in R&D and innovation, and also face the impact of new start-ups. Intangible assets, as the accumulation of knowledge activities, do not play a significant role in company value, indicating that science and technology innovation enterprises need valuable innovation activities and innovation achievements can be accepted by the market.

2. The impact of company nature and underwriter reputation on company market value

Table 4. The moderating effect of firm nature on R&D capital investment and invention patent application market value

variable	Market value			
	OLS	2SLS	OLS	2SLS
R&D funding * Nature of the enterprise	0.8674*** (0.0000)	0.6178*** (0.0000)	0.8829*** (0.0000)	0.6758*** (0.0000)
Patent applications for inventions * Nature of the enterprise	-0.1128 (0.1770)	-0.1294 (2) 0.169	-0.1937** (2) 0.016	-0.2451*** (2) 0.003
Operating income	-0.4437 (0.2902)	1.5540*** (0.0000)	-0.2927 (5) 0.509	-1.2902*** (0.0000)
Operating profit	1.3236*** (0.0000)	1.8869*** (0.0000)	1.4652*** (0.0000)	1.5456*** (0.0000)
Management fees	0.2602 (0.410)		-0.0877 (0.7875)	
Cost of sales	-1.0981*** (0.0049)		-1.0168** (0.0152)	
Control variables			control	control
constant	-0.0134 (0.2585)	-0.0111 (0.4314)	0.0417* (0.092)	-0.0267 (0.271)
Adjust the R ²	0.816	0.775	0.847	0.836
observations	68	68	68	68

Notes: 1) *, **, *** mean significant at the statistical level of 10%, 5%, and 1%, respectively; 2) Values in parentheses are test p-values

Table 5. Market value moderating effect of underwriter reputation on R&D capital investment and invention patent application

variable	Market value			
	OLS	2SLS	OLS	2SLS
R&D funding * Underwriter reputation	-0.0107 (0.9423)	-0.0687 (0.6793)	0.0260 (5) 0.849	-0.0586 (0.6869)
Invention patent application * Underwriter reputation	-0.0205 (0.8484)	0.0751 (0.4928)	-0.1414 (0.1853)	-0.0515 (0.6081)
Operating income	-1.595*** (0.0013)	-1.544*** (0.0002)	-1.8076*** (0.0005)	-1.2627*** (0.0003)
Operating profit	1.4365*** (0.0000)	2.3432*** (0.0000)	1.5608*** (0.0000)	2.0563*** (0.0000)
Management fees	0.8268** (0.036)		0.5015 (0.215)	
Cost of sales	0.1702 (0.6655)		0.5583 (0.2046)	
Control variables			control	control
constant	-0.0012 (0.9352)	-0.0102 (0.5576)	0.0059 (0.8423)	-0.0118 (0.7070)
Adjust the R ²	0.699	0.642	0.743	0.722
observations	68	68	68	68

Notes: 1) *, **, *** mean significant at the statistical level of 10%, 5%, and 1%, respectively; 2) Values in parentheses are test p-values

Private enterprises account for the vast majority of the science and technology innovation board, and are also the backbone of innovation. Under the OLS method in Table 5, the regression coefficient of R&D funds is significantly higher than that in Table 4, and the invention patents are significant, indicating that private enterprises need more

R&D investment to obtain patents, and proprietary technology is a necessary condition for them to survive in the fierce competition environment. Among the 68 enterprises, only two private enterprises have a good development and gained the attention of investors. Most private enterprises are still in the development period, failing to form a breakthrough

growth point and obtaining the long-term attention of investors, which is unfavorable to the development of enterprises. After being listed, the enterprise will be responsible for more investors, the stable development and profit of the company will become the main goal, and the innovation activities have great risks. The anti-risk ability of private enterprises is very weak, and various adverse factors will affect the management's decision on the innovation activities of the company.

Institutional investors have professional judgment ability, but also have a large amount of capital, their participation has played a role in promoting the development of the enterprise. The IPO mechanism after the reform of the science and Technology Innovation board system guides PE, VC and other venture capital to exit in an orderly way, and long-term investors represented by public funds to enter, realizing a more market-oriented arrangement for reducing holdings, realizing an orderly "relay" between long-term investors and venture investors, and helping the market to run smoothly. Sponsor agencies conduct due diligence on the innovation ability information disclosed by issuers, thereby improving the quality of information disclosure of science and technology innovation board companies, increasing credibility, and providing information for ordinary investors to make investment decisions. However, the regression results from Table 6 do not reflect the professional ability of institutional investors, possibly because IPO is a business activity for securities companies, and it is necessary to meet the conditions and be listed successfully, without in-depth analysis of the company's internal value. In the problem of information asymmetry, ordinary investors are still the weak party.

5.3. Robust Test

1. Robustness test of the explained variables

On the first day of the science and technology innovation board, there is no limit on the rise or fall, and the value of the company returns to the reasonable range faster. The market value of the company at the closing of the first day was used as the explained variable for the test, and the regression results were consistent with the previous results, showing robustness.

2. Robustness test of explanatory variables

Research and development takes time, and the investment of research and development funds cannot bring innovation results immediately, which usually takes a long time. The research and development capital investment in the adjusted company prospectus is selected to test the robustness of the company's value, as follows;

$$\text{R\&D fund} = 0.6 * \text{R\&D fund}_{t-3} + 0.8 * \text{R\&D fund}_{t-2} + \text{R\&D fund}_{t-1}$$

In the above equation, t refers to the year of listing. The regression results are consistent with the previous results and have robustness.

6. Conclusion

Since its establishment, the science and Technology Innovation board has adhered to the positioning of the plate, made full use of capital and boosted the industrialization of science and technology. As an incremental plate, the science and Technology Innovation board is an important supplement to the existing main board market, GEM board and small and medium-sized board, etc. It is a part of the multi-layer science and technology capital market system structure, which fully

stimulates market vitality and makes resource allocation more effective.

This paper takes 68 new generation information technology industry enterprises successfully listed on the science and Technology innovation board as samples, and studies the research and development information and invention patent information disclosed by enterprises can help investors, enhance investor confidence, and then improve the company value. The results of the empirical study are as follows:

First, the disclosure of R&D information can reduce the information asymmetry of the company's innovation activities, and help investors more clearly distinguish the strength of the company's innovation capability and whether it is worth investing in.

Second, as the direct output of innovation activities, invention patents represent a company's innovation capability to a certain extent. However, investors have not yet formed professional knowledge in this respect. Private enterprises are more dependent on R&D investment and patent acquisition.

Third, different from the traditional understanding, the professional ability of investment institutions may be well verified in the short-term investment, but the real high-value and high-growth science and technology innovation companies have not been fully identified. The long-term investment ability needs to be improved to better lead ordinary investors to make appropriate decisions.

Innovation can improve total factor productivity and medium - and long-term economic growth. To realize the strategy of being an innovation-driven country, China needs more innovative enterprises to enhance its overall competitiveness. Through industrial policies, the Chinese government actively promotes enterprise innovation and industrial structure optimization, constantly standardizes the operating rules of the securities market, and reforms the listing system to make the financial market allocate resources more efficiently. The establishment of the Science and Technology Innovation Board not only connects scientific and technological innovation with the capital market, but also avoids the loss of resources of China's high-quality science and technology enterprises. In the future, it will surely lead China to take the lead in scientific and technological innovation and development, and give birth to world-class great companies.

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