Research and Development Manipulation and Financing Constraints: Based on Empirical Evidence of Science and Technology Innovation Board Company

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Abstract. In order to speed up the implementation of innovation-driven development, Shanghai Stock Exchange set up Science and Technology Innovation Board to serve the scientific and technological innovative enterprises with certain potential. Science and Technology Innovation Board reduces the requirement of profit scale and emphasizes patent and science and technology R & D ability However, some IPO companies, which lack the momentum of innovation, invest in packaging research and development in order to take advantage of the policy dividend. This project takes Science and Technology Innovation Board's listed companies from 2019 to 2022 as research samples, tests whether Science and Technology Innovation Board listed companies have the behavior of pre-listing R & D manipulation, and explores the impact of financing constraints on R & D manipulation. It is found that a high proportion of enterprises do have R & D manipulation before the listing of the application board. Further research shows that there is an obvious positive relationship between the financing constraints and R & D manipulation. This study hopes to provide regulators and market investors with a better way to identify whether there is R & D whitewashing by grasping data, and to give reference suggestions and governance mechanisms.

Keywords: Science and Technology Innovation Board; R & D manipulation data analysis; financing constraints; Management mechanism

1   Introduction

On April 21, 2023, Jinping Xi presided over the first meeting of the 20th Central Committee for Comprehensive deepening Reform, deliberated and adopted the "opinions on strengthening the main body position of Scientific and technological Innovation in Enterprises," re-emphasizing strengthening the support for enterprise innovation and promoting enterprises to play a role in key core technological innovation and major original technology breakthroughs. Under the background of mass entrepreneurship and mass innovation, many start-ups in our country already have high valuation and broad

prospects for development, but these companies have high technology and strong innovation ability, but at the same time, they lack the funds to carry on R & D and innovation upgrading. Because the access mechanism of gem in our country is too high, many valuable scientific and technological innovative enterprises can not enter the gem financing and activate their own funds, so the state set up Science and Technology Innovation Board to further solve this problem.

Science and Technology Innovation Board focuses on small and medium-sized enterprises that have not yet entered the mature period but have the potential to grow, and meet the relevant normative, scientific and technological, innovative characteristics, which facilitates the listing and financing of more high-tech enterprises. It is an important decision for the state to encourage innovation and encourage emerging industries. However, Science and Technology Innovation Board still has a certain audit threshold for listing. In 2020, the CSRC issued the guidelines on the Evaluation of Science and Innovation attributes (trial), which clarifies the listing standards and audit rules. In 2022, the Shanghai Stock Exchange issued the guidelines for the Application of Science and Technology Innovation Board listing rules of Shanghai Stock Exchange No. 7-the fifth set of listing standards for medical device enterprises to further clarify that innovation is the fundamental attribute of Science and Technology Innovation Board enterprises.

Science and Technology Innovation Board registration system makes the securities regulatory department pay attention to the inspection of the technological innovation ability of enterprises and the continuity of R & D investment when examining the declaration information disclosed by the company. Therefore, it has also triggered speculation of enterprises to a certain extent, manipulation of financial statements, "pooling" R & D investment[1]in order to seize policy dividends, obtain tax concessions and government subsidies. And research and development manipulation to meet the relevant standards of industrial policy[2].

2   Literature Review

At present, some literature has paid attention to the R & D manipulation of listed companies[3][4]but the research focuses on the relationship between digital transformation and R & D whitewashing[5]Operation of capitalization or expense of R & D expenditure[6]The influence of R & D whitewashing on IPO pricing efficiency [7]And explore the impact of financing issues on R & D cooperation decisions[8]. Therefore, this paper mainly explores whether there is unreasonable data in the disclosure information of registered companies to show the existence of R & D manipulation, as well as clearly explore the direct relationship between financing constraints and R & D manipulation and explore the governance mechanism.

The main contributions of this paper are as follows: first, to test whether the companies in the application department have R & D manipulation, to help the regulatory authorities and the market to increase vigilance and strengthen the audit of disclosure information. The second is to explore the impact of financing constraints on R & D manipulation, which is helpful to identify which characteristics of enterprises are more

prone to manipulation behavior, strengthen the pertinence of audit and improve accuracy and efficiency. The third is to explore the governance mechanism to restrain the speculative and deceptive behavior of enterprises, protect the rights and interests of investors, and build a good and orderly market environment to truly promote the growth and development of innovative scientific and technological enterprises.

3   Theoretical Analysis and Research Hypothesis

First, in the current scientific innovation attribute evaluation index system, the concept of R & D personnel has not been clearly defined, so some scientific innovation enterprises will take advantage of the loopholes in the system. On the other hand, the R & D investment of enterprises is very uncertain, whether they can develop new technologies and new products is difficult to predict, so the R & D investment of enterprises is easy to manipulate and difficult to find, and the benefits of preferential treatment after listing are greater than the cost of manipulation. For example, Gong et al. (2021)[9]found that gem enterprises will appear the strategic behavior of patent surge before listing, which is not a normal real R & D activity.

Second, the problem of financing constraints has always been a difficult problem in the process of enterprise development in our country. In recent years, the economic growth rate of our country has slowed down, and enterprise financing is facing more severe challenges. According to the 2016 questionnaire report on Chinese Enterprise operators, 35.1% of entrepreneurs think that the most important difficulty encountered in the development of enterprise management is the shortage of funds, and 41.6% of entrepreneurs think that enterprises are in a state of capital shortage at present. The report on government work in 2020 once again places the issue of alleviating the difficulty of financing in the real economy as the focus of the government's work.

Since Fazzari et al. (1988)[10]innovatively constructed the financing constraint index of enterprises, a large number of domestic literature have regarded this index as the agent variable of financing constraint, and have been used to explain the mismatch between financing obstacles and enterprise innovation resources. For example, Zhang et al. (2012) found that the source of funding for R & D investment of private enterprises in China mainly depends on their own funds within the enterprise, and the external financing such as bank loans is very limited[11]. Financing constraints significantly inhibit the R & D investment of private enterprises. It can be said that there is a structural mismatch problem in R & D investment innovation activities and external financial support of Chinese enterprises. Financing constraints are an important factor restricting the promotion of R & D investment. Therefore, on the basis of the above analysis, the false theory is put forward:

H1: enterprises applying for gem have R & D manipulation and have a positive relationship with the degree of financing constraints they face

4   Research and Design

4.1   Data Sources and Sample Processing

This paper takes Science and Technology Innovation Board's listed companies from 2019 to 2022 as the research samples, and the main data sources are as follows: the latest disclosure of the IPO statement, CSMAR database and RESSET database in the creation edition of the company, and finally formed a database containing the information of 683 enterprises in 2019 / 2021.

The following processing is carried out: eliminate the sample of missing information in the data for three years, and eliminate the company whose operating income is less than 50 million yuan. Categorize samples by successful listing and unsuccessful listing All continuous variables were treated with 1% quartile tail reduction to eliminate the influence of extreme value and abnormal value. Finally, 1160 observations of 683 companies are obtained for empirical research.

4.2   Research Methods

(1) Definition of main variables

1. Research and development whitewash behavior

Referring to the method of Gunny (2010)[12], the normal value of R & D cost / operating income is estimated to measure the R & D whitewashing behavior by regression of each industry, that is, there is a difference between the actual value and the normal value of R & D expenses / operating income. If the actual value is larger than the normal value, the behavior of R & D whitewashing is more likely. In this paper, the average value of the difference is taken as the definition standard, and the enterprises whose difference is greater than the average value of the sample have R & D whitewashing behavior, bearing in mind that OverRD is 1, otherwise it is 0. The estimated model of the normal value of R & D expenses / operating income is as follows:

$$\frac{RD_{i,t}}{Sales_{i,t}}=\alpha_0+\alpha_1\frac{1}{Sales_{i,t}}+\alpha2\frac{INT_{i,t}}{Sales_{i,t}}+\alpha3\frac{RD_{i,t-1}}{Sales_{i,t}}+\varepsilon_{i,t} \tag{1}$$

Among them, RD/Sales represents R & D expenditure / operating income, INT/Sales represents (net profit + depreciation) / operating income.

two。 Financing constraint SA

High-tech enterprises are faced with loss and long growth cycle in the initial stage, lack of stable profit model and cash flow, foreign financing, due to information asymmetry, will be subject to greater financing constraints. Referring to the practice of Li (2023)[13], the absolute value of the SA index is used to measure the extent to which companies are subject to financing constraints. The formula is as follows:

$$SA=-0.737*size+0.043*size^2-0.04*Age \tag{2}$$

It only contains two relatively exogenous variables: asset size (Size) and operating year (Age). It has little change with time and has a strong externality. The calculation is relatively steady and simple. Although Science and Technology Innovation Board is a newly established plate, the development of his enterprise life cycle obeys the general law.

(2) Regression model

Build the following model based on the above variables:

$$OverRD_{i,t+1}=\alpha_0+\alpha_1 SA+\sum Controls_{i,t}+\alpha_2 Age+\varepsilon_{i,t+1} \qquad (3)$$

Where Controls is a set of control variables, including: 1Age represents the age of the company 2Size represents the size of the enterprise, measured by the natural logarithm of the total assets 3LEV is solvency, measured by total liabilities divided by total assets 4ROA indicates profitability, measured by net profit divided by total assets 5Fshare is the degree of equity concentration, that is, the largest ratio of private equity holdings 6SOE is a virtual variable, indicating the nature of property rights. The value of state-owned enterprises is 1, and the value of non-state-owned enterprises is 0. 7Lnv is a virtual variable, indicating whether there is a direct projection background. 8Dual is the case of the unity of the two posts, if the chairman of the company and the general manager are the same person, the value is 1, otherwise it is 0.

5 Empirical Results and Analysis

5.1 Descriptive Statistics

Table 1. descriptive statistics of variables

Variable	(1) Observation number	(2) Mean value	(3) Standard deviation	(4) Minimum value	(5) Maximum value
OverRD	1,160	0.394	0.489	0	1
SA	1,160	21.01	12.33	13.93	62.00
Age	1,160	2.874	0.317	1.946	3.784
Size	1,160	20.39	1.081	17.62	**25.47**
LEV	1,160	0.393	0.218	0.0428	1.876
ROA	1,160	0.0732	0.211	-4.599	0.733
Fshare	1,160	9.512	9.708	0.500	71.73
SOE	1,160	0.0793	0.270	0	1
Lnv	1,160	0.679	0.467	0	1
Dual	1,160	0.469	0.499	0	1

Table 1 descriptive statistics show that the average R & D manipulation behavior of enterprises is 0.394, indicating that 39.4% of the companies applying for listing in Science and Technology Innovation Board have R & D manipulation, which is a higher proportion. The maximum financing constraint is 62.00 and the minimum value is

13.93, which indicates that the financing constraints of different enterprises are obviously different, and it is very difficult for some enterprises to obtain enough funds for R & D, which may be related to the financial environment of the region, industry and the nature of the enterprise.

5.2   Correlation Analysis

Table 2. correlation analysis and test

	OverRD	SA	Age	Size	LEV	ROA	Fshare
OverRD	1						
SA	0.123 *	1					
Age	-0.209 *	-0.0320	1				
Size	0.24 / 4 *	0.0290	0.00100	1			
LEV	0.059 *	-0.051 *	-0.099 *	0.324 *	1		
ROA	-0.131 *	0.0310	0.154 *	-0.106 / *	-0.202 *	1	
Fshare	0.056 *	0.159 *	0.071 *	0.118 *	-0.00900	-0.0100	1
SOE	0.0440	-0.060 *	0.074 *	0.265 *	0.146 / *	-0.0290	0.143 *
Lnv	0.081 *	0.067 *	-0.089 *	0.096 *	-0.050 *	-0.0180	0.00300
Dual	0.066 *	0.108 *	-0.125 / 0.125 *	-0.152 *	-0.0120	0.00700	0.0160
	SOE	Lnv	Dual				
SOE	1						
Lnv	0.079 *	1					
Dual	-0.199 / *	-0.0280	1				

Note: * p < 0.01, * * p < 0.05, * p < 0.1

The results of correlation analysis in Table 2 show that the correlation value between OverRD, the explanatory variable of enterprise SA, is positive, indicating that there is a positive correlation between financing constraints and R & D manipulation, and it is significant at the significant level of 1%. The preliminary verification of this hypothesis shows that the greater the financing constraints, the more tight the funds, the easier it is to carry out R & D manipulation. The variance expansion coefficient (VIF) is used to test that there is no multiple collinearity problem between collinear variables.

5.3   Regression Result

Table 3. regression test results

Variable	(1) OverRD	(2) OverRD	(3) OverRD	(4) OverRD
SA	0.005 *	0.004 *	0.004 *	0.00384 *
	(4.20)	(3.43)	(3.94)	(3.433)
Age			-0.318 *	-0.191 / *

			(- 7.43)	(- 6.621)
Size			0.109 *	0.114 *
			(8.69)	(8.252)
LEV				-0.121 *
				(- 1.798)
ROA				-0.206 *
				(- 3.136)
Fshare				0.000981
				(0.685)
SOE				0.0216
				(0.406)
Lnv				0.0323
				(1.101)
Dual				0.0718 *
				(2.562)
Constant	0.292 *	-1.175 *	-1.000 *	-1.175 *
	(10.36)	(- 3.90)	(- 3.52)	(- 3.897)
N	1,160	1,160	1,160	1,160
R-squared	0.015	0.130	0.115	0.130
Id FE	NO	YES	NO	NO

Note: * $p < 0.01$, * * $p < 0.05$, * $p < 0.1$

Table 3 reports the regression results of financing constraints on R & D manipulation. Column (1) (2) does not add control variables, column (3) adds enterprise age and size control variables, column (4) is the regression result of adding all control variables, and column (2) is fixed effect control. From the regression results, whether or not the control variables are added, the regression coefficient of enterprise financing constraints is significantly positive at the statistical level of 1%, and has passed the significance test. It is shown that the greater the restriction of funds, the easier it is for enterprises to carry out R & D whitewashing, and this hypothesis has been verified.

5.4   Robustness Test

In order to ensure the reliability of the results, the following robustness tests are done again, and the main results are still consistent with expectations: first, replace the description form of financing constraints. Referring to the practice of Wei et al. (2014), the KZ index is constructed to measure the degree of financing constraints of enterprises14, and the results are consistent. Second, replace the measurement method of R & D whitewashing. Referring to Wang et al. (2019)15, it is estimated that the normal R & D investment level, if the normal R & D intensity does not meet the certification standard, and the enterprise will obtain the certification of high-tech enterprises in the next year, which is regarded as the existence of R & D whitewashing behavior, which is 1 at this time, otherwise 0. Third, expand the sample capacity. Considering that Science and Technology Innovation Board has been listing new companies since 2022, the empirical results remain unchanged when the sample size is expanded to the companies that completed the listing review in 2023. Fourth we focuses on the analysis of the

impact of the nature of enterprise ownership.It can be seen that there is a significant correlation between the degree of financing constraints and R & D manipulation for non-state-owned enterprises, all of which are significantly positive at the level of 1%, indicating that it is easier for non-state-owned enterprises to whitewash when faced with financing difficulties. For state-owned enterprises, the relationship between financing constraints and R & D manipulation is not significant.

6   Conclusions and Recommendations

Taking the data of 2019 / 2021 application board and completing the listing audit company as the research sample, this paper explores whether there is R & D manipulation in the disclosure information of listed companies, and empirically analyzes the relationship between financing constraints and R & D manipulation. Research shows that, first, there is a high proportion of companies that apply for gem listing have R & D whitewashing behavior. Second, when enterprises are subject to financing constraints, they will be prompted to carry out R & D whitewashing. It shows that the greater the financing pressure, the more difficult it is to obtain external funds to support enterprises to carry out science and technology research and development, and also need enough internal storage funds to ensure the normal operation of enterprises, that is to say, enterprises need to maintain a higher cash flow, which will make it difficult for enterprises to concentrate on R & D activities. Third, compared with state-owned enterprises, non-state-owned enterprises will be subject to financing constraints to carry out R & D manipulation motivation is more obvious.

Based on the above conclusions and analysis, the following recommendations are made:

First, improve the index evaluation system, strengthen the substantive investigation after listing. It is necessary to clearly and scientifically define the key indicators to measure the intensity of enterprise innovation investment, consider what range of indicators are reasonable for enterprises of different nature and size, and prevent enterprises from taking advantage of the gaps in the system. In addition, it is necessary to strengthen the dynamic evaluation of the index. For example, many enterprises appear the phenomenon of discontinuity of R & D investment in the period of application section creation board, which is distributed near the index threshold. After the completion of listing audit, the number of patents, R & D personnel and other investment has decreased significantly. Therefore, we can strengthen the substantive investigation and continuous dynamic evaluation after the listing is passed.

Second, we should speed up structural reforms in financial markets and ease the problem of financing constraints. It is necessary to enhance the confidence and inclusiveness of the capital market in Kechuang enterprises. Gradually reduce the information asymmetry between R & D enterprises and financial institutions. Smooth Science and Technology and Capital cycle Mechanism to reduce Service cost and transaction cost in external Financial Market In particular, innovative enterprises that are more dependent on external financing will benefit more. In this way, it can improve the con-

fidence and ability of enterprise R & D investment, better carry out scientific and technological innovation activities, promote the innovation and technological upgrading of the overall industry, and achieve high quality economic development.

Third, we should promote digital transformation and improve digital inclusive financial technology. Nowadays, the importance of digital economy in the world is becoming more and more prominent. Digital inclusive finance can detect the risk and repayment ability of enterprises comprehensively and in real time by using the Internet, big data and cloud computing information technology, reduce financial friction, broaden the financing mode of enterprises, not only improve the financing efficiency, but also reduce the cost, thus alleviating the financing constraints on enterprises1617. Therefore, it is necessary to continue to develop 5G, big data and so on, to deeply promote the combination of digital technology and financial markets, such as banks and other traditional financial institutions can continue to launch digital financial products.

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