



## The Impact of R & D Intensity on Innovation Performance under Financing Constraints

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**Abstract:** Manufacturing industry often directly reflects a country's productivity level, and occupies an important proportion in the national economy, which is an important feature distinguishing developing countries from developed countries. With the advent of the information age, scientific and technological innovation has become the key point of economic growth, and the important means to improve the innovation ability of enterprises is research and development activities, and financing constraints are undoubtedly the main problems that many enterprises will face when carrying out innovation and research. Therefore, this paper takes 2013-2017 Shenzhen Stock A-share manufacturing listed companies as the sample data to conduct empirical research. Through the research, it is concluded that R & D intensity can promote innovation performance; financing constraints can inhibit the R & D investment intensity of enterprises; Under high financing constraints, R & D intensity has an inhibitory effect on innovation performance, while in low financing constraints, R & D investment intensity has a positive effect on innovation performance.

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**Key words:** Financing constraints; R & D intensity; Innovation performance

### 1. Introduction

Since the reform and opening up, China has always focused on economic construction and achieved rapid development. At present, China's GDP has leapt to the second place in the world, and most of the economic indicators are in the world's leading position. According to the "economic blue book", China's GDP in 2019 is 99086.5 billion RMB¥, and the economic growth rate is 6.1%. Compared with the previous years, although China's GDP has been increasing, the growth rate has slowed down significantly. As China still relies mainly on resource intensive and labor-intensive industries to promote economic development, sustainable and healthy economic development is facing great challenges. With the continuous development of information technology, in order to take the sustainable development path of low energy consumption, low pollution and high economic benefits, China must rely on technological innovation. Therefore, scientific and technological innovation is imminent, and the core of scientific and technological innovation is research and development investment. Therefore, China has been increasing the investment in research and development. The 13<sup>th</sup> five year plan of national science and technology innovation clearly points out that by 2020, the proportion of R & D investment in GDP will increase to 2.5%, and the added value of knowledge

intensive service industry will account for 20% of GDP. In addition, in order to encourage enterprises to carry out R & D innovation, on September 21, 2018, Ministry of Finance, State Administration of Taxation and Ministry of Science and Technology jointly announced that China will increase the R & D expenses of enterprises before tax calculate the deduction proportion. Innovation has become an important way for an enterprise and even a country to improve its core competitiveness. It is beneficial to enhance the anti risk ability of enterprises and enhance the status of enterprises in the industry.

While R & D activities can bring profits and core competitiveness to enterprises, they also have the characteristics of high risk, high confidentiality and uncertainty. Just because of these characteristics of R & D projects, it brings great pressure to the company's financing. Moreover, the company's R & D is a long-term process. In the process of R & D input and output, it needs to maintain a complete capital flow, which means that we should continuously invest human, material and financial resources in R & D investment, otherwise it will lead to the failure of R & D activities. In the actual innovation, due to the problems of incomplete market and information asymmetry, combined with the characteristics of uncertainty and long cycle of R & D, when other creditors invest their funds into the R & D activities of

enterprises, they will inevitably face huge risks. In addition, China's capital market is not perfect enough, the financing channels are also limited, and the financing cost is too high, which may make it difficult for enterprises to obtain enough funds for R & D innovation, which also causes financing constraints. R & D innovation is an investment project of the company. Whether the capital flow is continuous will affect the company's decision on R & D. In order to improve the core competitiveness and industry discourse power of enterprises, many enterprises should have increased the intensity of R & D investment. However, due to the existence of financing constraints, enterprise funds are restricted by both channels and costs, which will affect the R & D activities of enterprises to a certain extent. When financing constraints exist and external funds are not enough, what kind of R & D decisions should enterprises make and what impact on innovation performance? In order to solve this problem, make enterprises better carry out research and development activities, so as to improve the innovation performance of enterprises, this paper studies the impact of R & D intensity on innovation performance under financing constraints, and discusses the relationship among the three.

## 2. Literature review

Ughetto (2008) verified the financing constraints of R & D investment based on the sample data of Italian enterprises. Its research also showed that many Italian enterprises used bank loans in production and operation activities and investment activities, and used internal retained funds for R & D innovation. Falk (2012) used the minimum absolute deviation method to empirically analyze the data of Australia from 1995 to 2006, and found that R & D investment was significantly positively correlated with the growth rate of business income in two lagging periods, and the promotion effect of R & D investment on sales revenue decreased significantly over time. Lukose and komera (2015) used dynamic R & D investment model to study the financial data of Indian manufacturing enterprises from 1991 to 2011. The research shows that there is a positive correlation between R & D investment and internal cash flow, which has an impact on the financial performance of enterprises.

Zhang Botao et al. (2008) conducted an empirical study on patent data and financial data of listed companies in China's machinery manufacturing industry, and found that there was an inverted U-shaped relationship between invention patents and operating profits, utility model patents and operating revenues and operating profits. This shows that patent output can promote enterprise performance, but if R & D output is too high, it will inhibit enterprise

performance. Dai Xiaoyong et al. (2013) conducted a study on industrial enterprises in China and found that there is a threshold effect on the impact of R & D investment intensity on enterprise performance. Only when the R & D investment intensity reaches a certain threshold value can it have a positive effect on enterprise performance, and if it exceeds a certain threshold value, the impact will drop or disappear, there is an optimal range of R & D investment intensity, and at the same time, there are differences among different industries. Qiu Liya (2017) selected the financial data of GEM listed companies for five years from 2012 to 2016 to analyze the impact of R & D investment intensity on enterprise performance. On this basis, the SA financing constraint index model is used to classify and compare the research samples, and the financing constraints are taken as the moderating variables. The results show that the R & D investment intensity has a positive effect on the operating profit margin of the enterprise, and this significant positive correlation has obvious lag period, and the financing constraint also has a positive moderating effect, that is, the financing constraint has a positive regulatory effect. The higher the bundle level is, the more significant the effect of R & D investment on firm performance. Xu Chaoyang et al. (2018) found that R & D investment of strategic emerging industry enterprises is more dependent on internal cash flow, which has serious financing constraints; Financing constraints and enterprise R & D investment are significantly negatively correlated, that is, financing constraints will inhibit R & D investment of enterprises. There is a higher positive correlation between R & D investment and firm performance under high financing constraints.

Based on a comprehensive analysis of domestic and foreign literature, there are two main conclusions in the research on the relationship between R & D intensity and enterprise performance under financing constraints. One is that financing constraints will strengthen the positive relationship between R & D investment intensity and enterprise performance, and the second conclusion indicates that financing constraints will weaken the positive relationship between R & D investment intensity and enterprise performance. The main reason is that scholars' research perspectives, research methods and data collected are different, industry and economic development level will also have an impact on their research. The previous research is focused on the financial performance of enterprises, while the research of this paper focuses on innovation performance. Therefore, this paper focuses on whether there is a relationship between R & D intensity and innovation performance when enterprises are at different levels of financing constraints, so as to

broaden the existing research perspective.

### 3. Research design

#### 3.1 Research hypothesis

Based on Schumpeter's "technological innovation" theory, technological innovation is the key factor to promote the rapid development of economy. Under the background of information age, whether an enterprise can achieve the leading position in the industry depends on its innovation ability. Therefore, the enterprise will increase the R & D intensity to promote the innovation output of the enterprise. Enterprises develop new technologies, new products and new markets by investing in R & D expenses, so as to bring more profits for enterprises and improve their innovation performance. At the same time, it also increases the R & D expenses of enterprises and forms a healthy and sustainable virtuous circle. Based on the above analysis, this paper puts forward the hypothesis.

H1: R & D intensity is positively related to innovation performance.

When an enterprise wants to invest, if the internal capital flow of the enterprise is insufficient, the free cash flow is relatively small, and the funds available to the managers are insufficient, then the expenses invested in R & D will become extremely scarce resources. Due to the high risk and uncertainty of R & D activities, once the capital chain breaks, it is difficult to form innovative output, and the previous investment fails. When the internal capital of enterprises is insufficient and it is difficult to provide continuous financial support for R & D activities through other financing channels, the problem of financing constraints arises. Based on the theory of financing priority in imperfect market, the difference of internal and external financing costs, that is, the degree of financing constraints faced by enterprises, is positively related to the degree of information asymmetry. If an enterprise is faced with serious financing constraints, it will lead to higher financing costs, and it is difficult to raise funds from the external market. If R & D fails, it will cause business risks and even bankruptcy. In order to avoid the negative impact of R & D failure caused by financing constraints on themselves, the managers of enterprises will be very cautious in selecting R & D projects, and the flow direction and research of R & D funds will be determined. With strict management and supervision of development personnel, financing constraints will reduce the investment intensity of enterprise managers in R & D. Based on the above analysis, this paper puts forward the hypothesis.

H2: Financing constraints are negatively correlated with R & D intensity, which will inhibit R & D intensity.

According to the theory of market failure, information asymmetry and pecking order, under the

condition of information asymmetry and market friction, financing constraint is a common problem for enterprises. The cost of external financing is higher than that of internal financing. When the enterprise does not have enough ability to pay the higher cost of external financing, the internal financing becomes the only financing channel. However, the fund demand of R & D activities can hardly be met only through endogenous financing, so the phenomenon of insufficient investment will appear. Enterprises with low degree of financing constraints may lead to excessive investment, waste of R & D funds and low efficiency of R & D due to abuse of funds, random selection of R & D projects and slack management, thus reducing the promotion effect of R & D investment on innovation performance. Enterprises with high financing constraints may have insufficient investment due to the lack of funds or being too cautious in choosing R & D projects, which will lead to the promotion of R & D investment on innovation performance.

Based on the above analysis and current situation, this paper puts forward the following assumptions:

H3a: Under the high level of financing constraints, R & D intensity has a positive relationship with innovation performance.

H3b: Under the low level of financing constraints, R & D intensity has a negative relationship with innovation performance

#### 3.2 Sample selection and data sources

This paper selects the data of Shenzhen Stock Exchange A-share manufacturing industry from 2013 to 2017 as the research object. In order to ensure the validity of the sample, the following companies are excluded: (1) ST and ST\* listed companies with abnormal financial situation; (2) Companies that withdraw halfway; (3) Companies with incomplete data disclosure. After screening, a total of 4805 observations of 961 enterprises were obtained from 2013 to 2017. The financial data is from Guotai'an database, and the number of patents is from CNRDS database. In order to eliminate the influence of extreme values, all continuous variables were Winsorized at the level of 1% and 99%. The data processing software was EXCEL 2007 and STATA15.0.

#### 3.3 Definition of variables

##### 3.3.1 R & D intensity

R & D intensity is a widely used indicator to measure the R & D investment of enterprises. At present, the disclosure of R & D manpower and material resources of listed companies is not standardized, and it may be difficult to obtain relevant data. Therefore, this paper uses R & D to measure R & D investment. In order to better study the R & D investment of enterprises of different sizes, this paper

uses Seraina et al. (2008) and Lu Xin et al. (2013) for reference, and selects the relative index (R & D investment intensity) to measure the R & D investment of enterprises. It is generally believed that R & D investment is related to the main business of an enterprise, so the ratio of R & D investment cost to main business income is selected to measure the intensity of R & D investment.

### 3.3.2 Innovation performance

In the measurement of innovation performance indicators, this paper uses Feng Zongxian's practice for reference, and selects the number of patent applications in the year as an important indicator to reflect the innovation performance of enterprises. This paper concludes that the number of patents applied by enterprises is often mentioned and used in the study of enterprise innovation performance. At present, China's Securities Regulatory Commission requires enterprises to disclose limited data information. This paper obtains the number of patent applications of GEM listed enterprises from the patent retrieval and analysis system of the website of National Bureau of Statistics, and uses the natural logarithm of the number of patents applied as an analysis index to measure the innovation performance of enterprises, which is expressed by inpatient.

### 3.3.3 Financing constraint index

At home and abroad, the measurement of financing constraint variables mostly choose the change index of cash holdings. However, there are many factors that affect the degree of financing constraints. Therefore, this paper uses KZ index to measure the level of financing constraints. For each year of the whole sample, the operating net cash flow / total assets of the previous period (CF), cash dividends / total assets of the previous period (Div), cash holdings / total assets of the previous period (C), asset liability ratio (DAR) and Tobin's Q were used (Tobin Q). If CF is lower than the median, kz1 is taken as 1, otherwise 0; if Div is lower than the median, kz2 is taken as 1, otherwise 0; if C is lower than the median, kz3 is taken as 1, otherwise 0; if DAR is higher than the median, kz4 is taken as 1, otherwise 0; if Q is higher than the median, kz5 is taken as 1, otherwise 0. Calculate the KZ index so that  $KZ = kz1 + kz2 + kz3 + kz4 + kz5$ . KZ index was used as dependent variable to regress CF, Div, C, DAR and Q, and using Ordered Logistic Regression the coefficients of each variable were estimated. According to the estimation results calculated by the above regression model, the KZ index of each listed company's financing constraint level is obtained. The larger the KZ index is, the higher the degree of financing constraint faced by the listed companies and the lower the financing efficiency of the enterprises.

### 3.3.4 Control variable

**Enterprise scale:** When the enterprise scale reaches a certain degree, it will produce scale effect, which will have different impact on R & D investment and innovation performance. In order to accurately analyze the relationship between financing constraints and R & D investment and innovation performance, we need to control the variable of enterprise size.

**Rate of return on assets:** The higher the rate of return on total assets is, the higher the efficiency of asset utilization, indicating that the enterprise has achieved good results in increasing income and saving capital use; the lower the index is, it indicates that the enterprise's asset utilization efficiency is low and the capital turnover is slow. Therefore, the return on assets has an impact on R & D investment, which needs to be controlled.

**The first largest shareholder's shareholding ratio:** In the previous empirical studies, there are many examples that incorporate it into the influencing factors of innovation performance, but few people can explain the mechanism. In order to study the robustness, this paper uses the proportion of the number of shares held by the largest shareholder in the total number of shares.

**Growth:** This indicator can measure the product cycle of the company, judge the stage of the company's development, and understand the growth law and future development of the enterprise. High business growth rate means that the company is in the start-up period or growth period, maintaining a benign upward momentum. Low business growth rate means that enterprises begin to transition from stable period to recession period. At this time, it is very difficult for enterprises to maintain the market share they occupy, and the profits begin to decline. The enterprises in the growth period attach great importance to R & D investment, and the efficiency of R & D investment is high, and the output of innovation performance is also more. During the recession, enterprises may reduce the importance of R & D investment. Growth rate of operating revenue: measured by (current year's operating revenue - last year's operating income) / last year's operating income.

**Total asset turnover:** Research shows that asset management efficiency is significantly related to innovation performance and should be controlled.

**Asset liability ratio:** Capital structure refers to the composition of various sources of funds and their proportional relationship. It reflects the proportion of assets provided by creditors in all assets of enterprises and the risk degree of credit funds provided by creditors to enterprises. It also reflects the ability of enterprises to borrow money, which will have an impact on the innovation performance of enterprises. This paper uses the percentage of total liabilities to

total assets to calculate the capital structure of enterprises.

Enterprise age: The establishment time of an enterprise will affect its R & D investment and innovation performance. If the enterprise is established

for a long time, its enthusiasm for R & D projects will decrease, and the innovation efficiency will decrease. The age of a company is measured by subtracting the initial listing time plus one in 2019 (Table 1).

Table 1. Variable definition

Variable type	Variable name	Variable symbol	Variable definition
Explained variable	Innovation performance	Patents	Natural logarithm of the number of patent applications
Explanatory variables	R & D intensity	RDI	Proportion of R & D investment in main business income
Adjustment variable	Financing constraint index	FCI	Comprehensive calculation by using five indexes of enterprises
	Enterprise size	Size	Total assets of the company at the end of the year plus 1, take the natural logarithm
	Return on assets	ROA	(Net profit + Interest expense + Income tax) / Average total assets
	Total assets turnover rate	TAT	Operating revenue / Average total assets
	Asset liability ratio	DAR	Total liabilities / Total assets
Control variable	Shareholding ratio of the largest shareholder	First	Number of shares held by the largest shareholder / Total shares
	Natural logarithm of the number of patent applications	Growth	(Operating revenue of the current year - Operating revenue of the previous year) / Operating revenue of the previous year
	Age of company	Age	2019 - year of listing + 1

### 3.4 Model building

In order to test hypothesis H1, a regression model (1) is constructed:

$$\begin{aligned} Patents = & \beta_0 + \beta_1 RDI_{i,t} + \beta_2 ROA_{i,t} + \beta_3 Size_{i,t} + \beta_4 First_{i,t} + \beta_5 Growth_{i,t} \\ & + \beta_6 Age_{i,t} + \beta_7 Year + \varepsilon_0 \end{aligned} \quad (1)$$

In order to test hypothesis H2, a regression model is constructed:

$$RDI_{i,t} = \beta_0 + \beta_1 FCI_{i,t} + \beta_2 TAT + \beta_3 DAR + \beta_4 Size_{i,t} + \beta_5 Year + \varepsilon_1 \quad (2)$$

In order to test hypothesis H3, we use the regulation effect test procedure to add new variables, namely financing constraints, on the basis of models (1) and (2):

$$\begin{aligned} Patents = & \beta_0 + \beta_1 RDI_{i,t} + \beta_2 FCI_{i,t} + \beta_3 Size_{i,t} + \beta_4 First_{i,t} + \beta_5 Growth_{i,t} \\ & + \beta_6 DAR_{i,t} + \beta_7 Year + \varepsilon_2 \end{aligned} \quad (3)$$

Where:  $RDI_{i,t}$  represents the R & D intensity of sample  $i$  in period  $t$ ,  $FCI_{i,t}$  represents the degree of financing constraints of sample  $i$  in period  $t$ ;  $\beta_1 \sim \beta_7$  are regression coefficients;  $\varepsilon_0$ ,  $\varepsilon_1$  and  $\varepsilon_2$  are random variables of regression model;  $i$  is the  $i^{\text{th}}$  listed company,  $i=1, 2, 3, \dots, 961$ .

## 4. Empirical analysis

### 4.1 Descriptive statistics

This paper obtains 4805 observations of 961 A-share Manufacturing Listed Companies in Shenzhen stock exchange for 5 consecutive years, and carries out descriptive statistics on each variable in the model. From the statistical results, the research and development investment (RDI) among sample companies, namely the proportion of R & D

investment to main business income, has a large gap among the enterprises, the minimum value is only 0.07, the maximum value is 22.42, and the average is 4.524, indicating that each listed company is listed. However, the listed companies pay more attention to R & D investment, so it is meaningful to study their R & D innovation capability. Innovation performance is the logarithm of the number of newly added patents. The minimum value is 0, the maximum value is 5.969, and the average value is 2.014. The maximum value of financing constraint index is 4.368, the minimum value is -4.326, and the average value is 0.417, which means that different enterprises face different financing constraints, and the financing constraints may be one of the reasons for different R & D intensity (Table 2).

Table 2. Basic information of variables

Variable	Mean value	Standard deviation	Median	Minimum value	Maximum value
lnPatents	2.014	1.406	1.946	0.000	5.969
RDI	4.524	3.576	3.740	0.070	22.420
ROA	0.054	0.056	0.049	-0.165	0.219
FCI	0.417	1.607	0.590	-4.326	4.368
TAT	0.636	0.378	0.556	0.116	2.373
DAR	0.373	0.187	0.357	0.048	0.829
LR	2.760	2.799	1.862	0.441	18.604
Size	12.661	1.031	12.537	10.675	16.027
First	0.327	0.136	0.304	0.090	0.706
Growth	0.199	0.403	0.128	-0.487	2.505
Age	15.485	5.315	15.000	6.000	29.000

## 4.2 Regression analysis

### 4.2.1 R & D intensity and innovation performance

Table 3 shows that the regression coefficient between R & D intensity and innovation performance is 0.044, showing a significant positive correlation at the level of 1%. This shows that the higher the R & D intensity is, the higher the level of innovation performance of enterprises. Therefore, the hypothesis H1 is verified.

Table 3. R &amp; D intensity and innovation performance

	LnPatents
RDI	0.044*** [0.009]
ROA	0.425*** [0.127]
SIZE	0.512*** [0.020]
First	0.183** [0.088]
Growth	-0.014 [0.015]
LR	0.009** [0.004]
DAR	0.322*** [0.105]
AGE	0.083*** [0.017]
_cons	-6.294*** [0.248]
N	4790
R <sup>2</sup>	0.145

Standard errors in brackets;  
\* p < 0.1, \*\* p < 0.05, \*\*\* p < 0.01

### 4.2.2 The impact of financing constraints on R & D intensity

As shown in Table 4, the regression coefficient of financing constraint and R & D intensity is -0.015, which is significantly negatively correlated at the level of 5%. This means that the lower the financing

constraint index is, the greater the R & D investment intensity of the enterprise. This means that when the financing constraint is greater, the R & D intensity of the enterprise is smaller, and the R & D innovation of the enterprise is inhibited. Therefore, we assume that H2 holds.

Table 4 Financing constraints and R &amp; D intensity Model (2)

	Model (2)
	FCI
RDI	-0.015** [0.007]
ROA	-3.973*** [0.276]
Size	-0.669*** [0.103]
First	-0.753*** [0.206]
Growth	-0.335*** [0.017]
LR	-0.072*** [0.006]
DAR	4.103*** [0.184]
AGE	-0.003 [0.025]
_cons	7.812*** [1.182]
N	4432
R <sup>2</sup>	0.266

Standard errors in brackets  
\* p < 0.1, \*\* p < 0.05, \*\*\* p < 0.01

### 4.2.3 The impact of R & D intensity on innovation performance under different financing constraints

The KZ index is constructed to calculate the degree of financing constraint. After calculation, the KZ index is used as the dependent variable to regress CF, Div, C, DAR and Q to estimate the regression coefficient of each variable. Using the estimation

results of the above regression model, we can calculate the KZ index of the financing constraint degree of each listed company. The larger the KZ index is, the higher the degree of financing constraint faced by the listed companies and the lower the financing efficiency. According to the median, the first 50% is the high financing constraint group, and the last 50% is the low financing constraint group. According to the median, it is divided into high financing constraint group and low financing constraint group.

As shown in Table 5, the regression coefficient between financing constraint and R & D intensity is -0.151 in the high financing constraint group, which is significantly negatively correlated at the 1% level. This shows that under the high level of financing constraints, the greater the intensity of R & D investment, the smaller the innovation performance of enterprises. In the low financing constraint group, the regression coefficient of financing constraint and R & D intensity is 0.018, which shows a significant positive correlation at the level of 1%. This means that under the low level of financing constraints, the greater the R & D intensity of enterprises is, the greater the innovation performance, and the more innovation promotion of enterprises (Table 6). Therefore, this paper assumes that H3a and H3b hold.

Table 5. R & D intensity and innovation performance under high financing constraints

	lnPatents
FCI	-0.151*** [0.027]
RDI	0.117*** [0.008]
ROA	1.693*** [0.331]
Size	0.577*** [0.023]
First	-0.362*** [0.108]
Growth	0.120** [0.047]
LR	-0.033*** [0.013]
DAR	0.163 [0.187]
Age	-0.013* [0.007]
_cons	-5.379*** [0.231]
N	2218
R <sup>2</sup>	0.291
Standard errors in brackets	
* p < 0.1, ** p < 0.05, *** p < 0.01	

Table 6. R & D intensity and innovation performance under low financing constraints

	lnPatents
FCI	0.018*** [0.006]
RDI	0.163*** [0.006]
ROA	1.930*** [0.515]
Size	0.684*** [0.009]
First	-0.338*** [0.115]
Growth	0.143 [0.092]
LR	-0.035*** [0.004]
DAR	0.415** [0.174]
Age	-0.009*** [0.002]
_cons	-7.272*** [0.141]
N	2214
R <sup>2</sup>	0.339
Standard errors in brackets	
* p < 0.1, ** p < 0.05, *** p < 0.01	

### 4.3 Robustness test

In order to further verify the robustness of the research results, the main variable indicators were replaced. In this paper, the ratio of R & D investment to total assets is used as an alternative indicator of R & D investment intensity. The above empirical analysis process is repeated, and the results show no significant difference (Table 7).

## 5. Conclusion and suggestion

### 5.1 Conclusion

Based on the sample data of Shenzhen Stock Exchange A-share manufacturing industry from 2013 to 2017, after a series of theoretical analysis and empirical test and result analysis, this paper draws the following conclusions:

- (1) There is a positive correlation between R & D intensity and innovation performance;
- (2) There is a negative correlation between financing constraints and R & D intensity;
- (3) In the case of high degree of financing constraints, there is a significant negative correlation between financing constraints and R & D intensity, which means that the higher the R & D intensity is, the

smaller the innovation performance of enterprises. In the low degree of financing constraints, financing constraints and R & D intensity have a significant positive correlation, which means that the greater the R & D intensity, it will promote the innovation performance of enterprises.

Table 7. Robustness test

	High constraint group	Low constraint group
	lnPatents	lnPatents
FCI	-0.098*** [0.024]	0.011*** [0.004]
RDI	0.327*** [0.019]	0.357*** [0.019]
ROA	0.208 [0.425]	-1.329*** [0.315]
Size	0.595*** [0.028]	0.732*** [0.012]
First	-0.787*** [0.112]	-0.649*** [0.108]
Growth	0.118*** [0.038]	0.197** [0.096]
LR	-0.002 [0.010]	0.005 [0.003]
DAR	-0.117 [0.164]	-0.147 [0.219]
Age	-0.018*** [0.006]	-0.012*** [0.002]
_cons	-5.517*** [0.293]	-7.550*** [0.146]
N	2219	2215
R <sup>2</sup>	0.333	0.355

Standard errors in brackets; \* p < 0.1, \*\* p < 0.05, \*\*\* p < 0.01

## 5.2 Suggestions

(1) Increasing the evaluation of management R & D performance. The core competitiveness of an enterprise depends on the innovation ability of the enterprise, but the innovation performance can't be achieved immediately, and it needs continuous investment to get income. Therefore, in the performance evaluation, the performance should be evaluated in real time, the assessment period should be extended, and the indicators of learning and growth, internal operation and other indicators should be included in the evaluation system.

(2) Broadening the financing channels of R & D funds, increasing the proportion of market debt financing, and helping strategic emerging industry enterprises broaden the source of R & D funds. The period of R & D activities is long, the amount of

capital required is large, and the risk is high. Therefore, we can increase the support by setting up venture capital fund and industry university research fund, or expand the scope and intensity of financial subsidies for enterprise R & D activities, implement the tax reduction and exemption policy for enterprise R & D expenditure, and establish and improve the government's subsidy mechanism for enterprise R & D investment.

(3) Disclosing the information of R & D projects to be open and transparent. Information asymmetry is an important reason for the serious financing constraints of enterprises. While making rational use of policies, optimizing financing schemes and reducing the cost of R & D funds, enterprises should also disclose the information of R & D projects, reduce the information asymmetry provided by funds and the burden of excessive financing costs, so as to improve the situation of R & D investment constrained by financing. The government should improve the R & D information disclosure system and supervise the R & D projects of enterprises.

(4) Paying attention to the efficiency of R & D and strengthen the management of R & D funds. Capital is the most important part of the company's development, and all the production and operation activities of an enterprise can not do without the support of funds. Therefore, it is more necessary to formulate a reasonable governance mechanism for the R & D funds of enterprises, establish and perfect a reasonable fund management system, and strictly control the use of funds related to the application, use and supervision of R & D funds, so as to improve the capital, the efficiency of the use of gold, to avoid the abuse and waste of funds. The improvement of management mechanism can also alleviate the agency problem of the management. In the performance evaluation of the management, we can also consider the non-financial indicators such as innovation output and the contribution of managers to the company's R & D into the evaluation system. At the same time, we should take different ways to encourage shareholders to alleviate the adverse impact of capital abuse on the innovation performance of enterprises.

## Reference

- 1 Ughetto S. Does Internal Finance Matter for R & D? New evidence from a panel of Italian firms [J]. Cambridge Journal of Economics, 2008, 32(6): 907-925.
- 2 Falk M. Quantile Estimates of the impact of R & D intensity on firm performance [J]. Small Business Economics, 2012, 35(1): 1-19.
- 3 Micucci G, Rossi P. Financing R & D Investments: an analysis on Italian



- Manufacturing Firms and Their Lending Banks [J]. *Economia & Politica Industriale*, 2017, 44(1): 23-49.
- 4 Zhu Naiping, Zhu Li, Kong Yusheng, Shenyang. Research on the synergistic effect of technology innovation investment and social responsibility on financial performance [J]. *Accounting research*, 2014 (2): 57-63.
  - 5 Li Chuanxian, Zhang Qian. Research on the relationship among R & D investment, property right and enterprise performance [J]. *Friends of Accounting*, 2015 (9): 76-80.
  - 6 Wei pan. Financial support, financing constraints and R & D investment of enterprises [J]. *Finance and Accounting Communication*, 2019 (9): 87-90.
  - 7 Ye Jianmu, Chen Feng. Financing constraints, R & D investment and enterprise performance: a comparative analysis based on high-tech listed companies on the main board and the gem [J]. *Monthly Journal of Finance and Accounting*, 2015 (12): 24-28.
  - 8 Cheng Ling, Wang Shun, Liu Qing. Economic analysis of financing constraints and R & D manipulation of enterprises [J]. *Finance and Trade Economy*, 2019 (8): 67-82.

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