

The Influence of R&D Investment on Enterprise Performance

— Based on the Regulatory Role of Equity Structure

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ABSTRACT

Increase r&d strength is an important goal of science and technology policy in China, this study in Shanghai and Shenzhen a-share listed companies from 2015 to 2017 as the research object, and further investigates the company ownership structure factors as regulating variable impact on the relationship between r&d and business performance, improve r&d strength is helpful to the growth of the business performance, ownership structure on r&d generates positive (enhancement) or negative (weaken) the adjustment effect. Research conclusion said: Ownership concentration has a positive regulating effect on business performance brought by r&d investment, while equity balance degree has a significant negative regulating effect on business performance improvement brought by r&d investment. This study suggests that ownership structure has an important impact on r&d investment and corporate performance, and enterprises should strengthen shareholder cohesion while focusing on performance.

Keywords: *r&d investment, enterprise performance, ownership concentration, degree of equity balance*

1. Introduction

In recent years, the state has vigorously promoted scientific and technological innovation, encouraged enterprises to improve their capacity for independent innovation, and strived to show their strong comprehensive strength and international competitiveness in the world. Nowadays, enterprises are facing more and more fierce competition, and innovation has become the main driving force for the economic growth of enterprises. For enterprises, improving their innovation ability is a necessary condition for finding vitality and vitality. Therefore, more and more enterprises increase investment in research and development. Such innovation is not only about product performance or service innovation, but also about changing the competitive position of enterprises in the market, hoping to re-establish the competitive advantage in a new and more favorable point[1]. However, academic circles have different views on whether increasing r&d investment can significantly improve enterprise performance. According to the promotion theory, r&d investment is conducive to improving the production efficiency of enterprises or to the optimization and upgrading of product structure, which can promote the improvement of enterprise performance. While inhibition theory, points out that the early stage of the r&d can bring a lot of money, and this kind of investment is not would move into the effective capital, is likely to bring a high cost of capital, the other r&d need to consume a lot of time, does not conform to the time value of money and the r&d input hindered the growth of productivity or performance[2]. However, when making decisions on r&d investment, enterprises are bound to be influenced by various management levels within the company, and different ownership structure of the company will also have an impact on the proportion of r&d investment. Therefore, whether r & d investment has a significant impact on enterprise performance and what role does ownership structure play is the focus of this paper. In this paper, the data of Shanghai and shenzhen a-share listed companies from 2015 to 2017 are used

as the research object, and the model is constructed to explore the relationship among them.

2. Theoretical Analysis and Research Hypothesis

2.1. R&D Investment and Enterprise Performance

Domestic and foreign scholars have made many studies on the impact of r&d investment on business performance: Johnson & Pazderka [3] pointed out that the fundamental purpose of increasing r&d investment is to gain a more prominent competitive advantage and a larger market share by improving the innovation ability of enterprises. David, Aboody and Barch, Lev [4], taking 83 listed chemical companies in the United States as samples, found through empirical research that the influence of r&d investment on enterprises was very significant in the first three years, and the influence was far-reaching and could last for 7 years. Hirschey and Weygandt [5] from the perspective of the enterprise's main commodities, the research results showed that the intensity of r&d investment had a significant positive impact on the Tobin Q value of the enterprise, whether it was consumables or durable goods. Chinese domestic scholars have also done a lot of research on the impact of r&d investment on enterprise performance: Chen shou et al. [6] discussed the relationship between r&d investment and enterprise performance in different stages of technological innovation from the perspective of enterprise life cycle. The empirical study shows that there is a significant positive correlation between r&d investment and business performance in the growth stage and maturity stage. In the growth stage, the positive relationship is the most significant. Entering a recession, there is no statistical correlation between the two. Si-hai Li [7] will entrepreneurs professional

background and the combination of r&d investment and enterprise performance, from the perspective of the professional background of education, the study found that: the technical background of entrepreneur compared with other background entrepreneurs have more spending on research and development technical background in entrepreneur r&d that promote more conducive to improve enterprise performance in the future. Xin-xia Wang, et al. [8], from the perspective of ultimate control of human nature, believe that r&d investment has a significant positive effect on enterprise performance in private enterprises, which is more obvious in state-owned enterprises. Economy under the new normal, give priority to with technological innovation of new economy development mode gradually replaced with resources to rely on the mode of economic development, the traditional economic model for resource consumption is irreversible, and the new economic model to make market with renewed vigor and vitality, and as a carrier of the realization of technology innovation, research and development, technology innovation is the key to development strategy. Based on the above literature review, the research hypothesis is proposed as follows:

Hypothesis 1: other things being equal, r&d investment has a significant positive impact on corporate performance.

2.2. The Regulatory Role of Equity Concentration

According to the principal-agent theory, with the increase of ownership concentration, shareholders are more motivated to supervise the management, and the separation of ownership and management will buffer the conflicts of interests between shareholders and management, so as to solve the problems of "information asymmetry" and "free riding" [9]. Excessive dispersion of equity is prone to the phenomenon of "free-riding". Small and medium-sized shareholders tend to lay more stress on short-term financial investment and pursue short-term returns, which means that small shareholders have lower risk tolerance. The controlling shareholders of enterprises with higher ownership concentration tend to have stronger cohesion and focus on long-term operating performance, which is conducive to improving the long-term operating performance of the company and cultivating the core competitiveness of the enterprise. In addition, the degree of risk that the major shareholders can bear is greater than that of the minor shareholders. The ability and willingness to take greater risks to invest in research and development [10]. Jensen and Meckling [11] pointed out in the study of enterprise agency problems that improving the shareholding ratio of internal shareholders who have control over enterprises can effectively generate management incentives, reduce agency costs and improve enterprise value. Ling-ling Xu [12] from the perspective of China's regional institutional environment found through empirical test that enterprises located in regions with a low marketization process, more concentrated equity is more conducive to promoting technological innovation and bringing more powerful competitive advantages. Jing-lu Li [13] believes that shareholding concentration has a positive regulating effect on management compensation and management shareholding respectively, and that the listed company maintains a reasonable shareholding concentration and makes an effective compensation plan, which is conducive to its r&d investment. When the ownership is concentrated, the interests of shareholders are closely combined with the innovation effect of enterprises, and the owners have a strong incentive to collect information and supervise the innovation of enterprises, so as to

supervise the innovation activities of operators, so as to avoid the problem of insider control and "free-riding" behavior. Therefore, it is assumed that:

Hypothesis 2: when other conditions remain unchanged, ownership concentration has a positive regulating effect on r&d investment and enterprise performance.

2.3. The Regulatory Role of Equity Balance Degree

Enterprise r & d investment is affected by the degree of equity balance. Equity balance is a new corporate governance mechanism, which means that a company is jointly controlled by several major shareholders to achieve internal containment, making it impossible for any one of the largest shareholders and managers to independently control the decision-making of the company, so as to achieve the effect of mutual supervision and suppression of plunder. Xiao-kang Chai [14] believes that the more dispersed stock rights are in gem listed companies, the more adverse to the development of the company's research and development activities, and the implementation of the company's decision-making is difficult. The low shareholding ratio of major shareholders will lead to insufficient effective incentives for major shareholders to actively participate in corporate governance, while small shareholders will only pay attention to short-term investment interests and make long-term decisions if they are too dispersed. Therefore, equity concentration should be further increased. Other special institutional background in China, because the shareholders are more inclined to gain control of huge to seek private interests, therefore, there are checks and balances between shareholders and the shareholders for control of the phenomenon, and this kind of competition tend to cause a decline in the value of the company, also have a certain advantage to the company managers, have a greater agency conflict [15]. From another perspective, excessive degree of equity checks and balances often means that the shareholding concentration of the largest shareholder decreases, which will weaken the controlling shareholder's ability to influence the company, reduce their diligence and due diligence and the corresponding positive incentive effect, increase agency cost, and ultimately lead to the decline of the company's operating performance. The following hypothesis is put forward:

Hypothesis 3: other things being equal, equity balance degree has a negative regulating effect on r&d investment and enterprise performance.

3. Research Design

3.1. Sample Selection and Data Sources

In this study, a-share listed companies in Shanghai and shenzhen from 2015 to 2017 were selected as research samples, and the following screening procedures were conducted. (1) ST and PT companies that may cause errors in data results due to abnormal financial conditions were excluded. (2) financial listed companies were excluded (3) companies with missing data were excluded, and the continuous variables were indented at 1% and 99%. The financial data in this paper were collected from the choice financial database, and the data processing was mainly completed with Excel2007 and Stata13.0.

3.2. Variable Selection and Measurement

3.2.1. Explained Variables

The explained variable in this paper is enterprise performance. Taking the method of qian Shu [16] for reference, InPR represents the operating performance of a company and takes the logarithm of its operating profit.

3.2.2. Explanatory Variables

The explanatory variable in this paper is r&d input. Based on the methods of qi-xiu zhang [17], qian Shu [18] and others, r&d

expense is selected as the indicator to measure r&d input.

3.2.3. Moderating Variables

The objective of this paper is to explore the impact of r&d investment on corporate performance under different ownership structures. Therefore, in this paper, equity checks and balances and equity concentration are introduced to measure equity structure. Equity balance degree is measured by the ratio of the total shareholding ratio of 2 to 3 major shareholders to the shareholding ratio of the largest shareholder. Equity concentration is measured by the shareholding ratio of the largest shareholder [18]. Specific variable definitions are shown in Table 1.

Table 1 Variable Names and Definitions

	The variable name	Variable symbol	Variable definitions
Explained variable	Enterprise performance	InPR	Logarithm of operating profit
Explanatory variable	R&d spending	RD	Research and development costs
	Ownership concentration	SC	The shareholding ratio of the largest shareholder
Adjust the variable	Degree of equity balance	EB	The ratio of the total shareholding ratio of the second and third largest shareholder and the first largest shareholder
	The company size	SIZE	The natural log of total assets
Control variables	Cash availability	CA	Net cash flow from operating activities/operating income
	Debt paying ability	SOL	Liabilities/assets
	Operation ability	OC	Total revenue/total assets
	growth	Growth	Year-on-year growth rate of operating revenue
	industry	Ind	Virtual variable
	year	Year	Virtual variable

3.3. Model Design

The following three measurement models are constructed to verify the hypotheses proposed in this study.

$$InPD = \alpha_0 + \alpha_1RD + \alpha_2SIZE + \alpha_3CA + \alpha_4SOL + \alpha_5OC + \alpha_6Growth + \alpha_7Ind + \alpha_8Year + \varepsilon$$

model 1

$$InPD = \beta_0 + \beta_1RD + \beta_2SC + \beta_3RD1 * SC1 + \beta_4SIZE + \beta_5C + \beta_6SOL + \beta_7OC + \beta_8Growth + \beta_9Ind + \beta_{10}Year + \varepsilon_1$$

model 2

$$InPD = \gamma_0 + \gamma_1RD + \gamma_2EB + \gamma_3RD1 * EB1 + \gamma_4SIZE + \gamma_5CA + \gamma_6SOL + \gamma_7OC + \gamma_8Growth + \gamma_9Ind + \gamma_{10}Year + \varepsilon_2$$

model 3

Where, RD1 represents the decentralized treatment of r&d investment RD, namely, the mean value is subtracted. SC1 and EB1 represent the decentralization of ownership concentration degree and ownership balance degree respectively, i.e. the mean value is subtracted.

4. Empirical Results

4.1. Mainly Descriptive Statistics

Table 2 Descriptive Statistics of Major Variables

Variable	Obs	Mean	Std. Dev	Min	Max
InPD	7464	416.913	1080.916	-918.504	7882.81
RD	7464	136.0746	285.5975	0.741	2054.74
SC	7464	34.33274	14.54381	8.526	75.124
EB	7464	0.5629108	0.437250	0.025	1.836
SIZE	7464	3.579261	0.5425139	2.59	5.272
CA	7464	9.122859	15.7157	-47.452	60.019
OC	7464	1.208104	1.153709	0.122	6.708
Growth	7464	19.06431	36.16581	-47.822	201.06
SOL	7464	0.3881017	0.1975478	0.048	0.862

The descriptive statistical analysis results in Table 2 show that the maximum value, minimum value and standard deviation of BP are 7882.81, -918.504 and 1080.916, respectively, indicating that there is a big difference between the two levels of enterprise performance of the sample companies, which is necessary for research. The maximum value, minimum value, standard deviation and mean value of RD are 2054.74, 0.741, 285.5975, and 136.0746, respectively, indicating that the sample company's r&d input is also highly differentiated. The mean value of equity concentration degree (SC) is 34.33, the

maximum value is 75.124, the minimum value is 8.526, the mean value of equity balance degree (EB) is 0.56, the maximum value is 1.836, and the minimum value is 0.025, which indicates that the difference in equity concentration degree of sample companies is relatively large, and the total shareholding ratio of the second and third shareholders is less than that of the first shareholder.

4.2. Correlation Analysis

Table 3 Correlation Analysis of Main Variables

	InPD	RD	SC	EB	SIZE	CA	OC	Growth	SOL
InPD	1.0000								
RD	0.5259***	1.0000**							
SC	0.1598***	0.0884**	1.0000						
EB	-0.0300***	-0.0477**	-0.6449**	1.0000					
SIZE	0.5686**	0.5564*	0.1156**	-0.1344**	1.0000				
CA	0.1373**	-0.0232*	0.0773*	0.0155	0.0197	1.0000			
OC	0.0335*	-0.0138	-0.0477*	0.0322*	0.0487**	-0.0165	1.0000		
Growth	0.0421*	0.0046	-0.0732*	0.0701*	0.0333**	-0.0365*	0.0493*	1.0000	
SOL	0.1655*	0.2650*	0.0857*	-0.1470*	0.5444*	-0.1709*	-0.0166	0.0175	1.0000

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

The correlation analysis results in Table 3 show that: at the level of 1%, there is a significant positive correlation between enterprise performance (BP) and r&d investment (RD) ($\alpha = 0.5259$, $p < 0.01$), indicating that r&d investment has a significant positive impact on enterprise performance. Hypothesis 1 is preliminarily verified. Corporate performance (BP) is significantly positively correlated with ownership

concentration (SC) at the 1% level ($\beta = 0.1598$, $p < 0.01$). Corporate performance (BP) and equity balance degree (EB) were significantly negatively correlated at the 1% level ($\gamma = -0.03$, $p < 0.01$).

4.3. Regression Analysis

Table 4 Regression Analysis

	Model 1	Model 2	Model 3
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	InPD	InPD	InPD
RD	1.140*** (28.30)	0.971*** (23.37)	1.065*** (25.10)
SC		6.990*** (10.72)	
EB			31.51 (1.41)
RD1*SC1		0.0417*** (12.45)	
RD1*EB1			-0.677*** (-5.33)
SIZE	959.9*** (39.00)	949.9*** (39.20)	972.7*** (39.41)
CA	7.582*** (12.20)	7.176*** (11.70)	7.558*** (12.18)
OC	-13.81 (-1.39)	-12.13 (-1.24)	-14.37 (-1.45)
Growth	0.684* (2.56)	0.886*** (3.37)	0.648* (2.43)
SOL	-861.5*** (-14.61)	-890.5*** (-15.34)	-861.1*** (-14.58)
Ind		Virtual variable	
Year			
_cons	-3003.7*** (-39.18)	-3197.6*** (-41.31)	-3060.9*** (-38.73)
Adj R-squared	0.4509	0.4675	0.4534
N	7464	7464	7464

* p<0.05, ** p<0.01, *** p<0.001

Regression results of model (1) in Table 4 show that: enterprise performance (InPD) and r&d investment (RD) have a significant positive correlation at the 1% level ($\alpha = 1.14$, $p < 0.01$), indicating that r&d investment has a significant positive impact on enterprise performance. Hypothesis 1 is further verified. Model (2) the regression results show that after joining equity concentration (SC) for adjusting variable, the enterprise performance (InPD) and ownership concentration (SC) at 1% level significantly positively related to ($\beta = 0.0417$, $p < 0.01$),

the ownership concentration on the impact of r&d investment on enterprise performance have positive regulation, the adjusted R² of 0.4675 shows that better fit of the model, a further validation hypothesis 2. Regression results of model (2) showed that: corporate performance (InPD) and equity balance degree (EB) were significantly negatively correlated at the 1% level ($\gamma = -0.677$, $p < 0.01$). This indicates that equity balance degree has a negative regulating effect on the impact of r&d investment on enterprise performance. The adjusted R² is 0.4534, and the

model fits well. Hypothesis 3 is further verified.

5. Robustness Analysis

In order to make the research results more convincing, this study conducted a robustness test on the above research hypotheses. In view of the fact that Chen-gang Ye [19] et al took total net profit margin of assets (ROA) as the measurement of enterprise performance. In order to test the moderating effect of ownership structure, the sample range was expanded, and the ratio of the sum of the shares of the second largest shareholder to the fifth largest shareholder and the shareholding ratio of the first largest shareholder was selected to measure the degree of equity balance. The relationship between r&d investment and enterprise performance and the influence of ownership structure ating that the model had a higher fitting degree, and the research

on r&d investment and enterprise performance were re-examined. As shown in Table 5, the coefficient of r&d investment in model 1 was 0.00461, which passed the significance test at the level of 1%. In model 2, ownership concentration degree was added as the moderating variable, and the moderating variable coefficient was 0.0184, which passed the significance test at the level of 1%. Moreover, r&d investment and enterprise performance were still positively correlated, and the regression result was consistent with the previous one. Hypothesis H2 was verified. In model 3, equity balance degree is added as the regulating variable, and the coefficient of the regulating variable is -0.0593. At the level of 1%, significance test shows that equity balance degree has a negative regulating effect on r&d investment and enterprise performance. Hypothesis 3 is verified. The adjusted R2 was 0.3201, 0.3512 and 0.3634, respectively, indic conclusion of this paper had a better robustness.

Table 5 Regression Analysis of Robustness Test

	Model 1	Model 2	Model 3
	ROA	ROA	ROA
RD	0.00461*** (10.62)	0.00510*** (11.37)	0.00470*** (9.88)
SC		0.0870*** (11.97)	
EB			0.350 (1.92)
RD1*SC1		0.0184*** (5.09)	
RD1*EB1			-0.0593*** (-0.58)
SIZE	-1.326*** (-4.94)	-1.518*** (-5.73)	-1.299*** (-4.82)
CA	0.143* (21.32)	0.136** (20.43)	0.143* (21.32)
OC	-0.349 (-3.92)	-0.296* (-3.36)	-0.355 (-3.98)
Growth	0.0666* (23.31)	0.0691* (24.45)	0.0661* (23.02)
SOL	-2.336** (-3.64)	-2.668** (-4.22)	-2.220* (-3.45)
Ind		Virtual variable	
Year			
_cons	11.38*** (13.73)	9.150*** (10.89)	10.98*** (12.83)
Adj R-squared	0.3201	0.3512	0.3634
N	7359	7359	7359

*p<0.05, ** p<0.01, *** p<0.001

6.1. Research Conclusions

Taking Shanghai and Shenzhen a-share listed companies from 2015 to 2017 as the research objects, this study investigated the

6. Conclusion

relationship between r&d investment and enterprise performance and drew the following conclusions : (1) the positive correlation between r&d investment and enterprise performance, that is, the higher r&d investment has A positive impact on enterprise performance, other things being equal. (2) by further testing, equity concentration on r&d input of the positive adjustment effect, the degree of equity balance has a significant negative regulating effect on the improvement of business performance brought by r&d investment. In other words, the higher the degree of equity concentration, the greater the positive impact of r&d investment on enterprise performance; the higher the degree of equity balance, the weaker the impact of r&d investment on enterprise performance.

6.2. Research Enlightenment

Although r&d activities have a long return period and high risk, they are of great significance for the sustainable development of the company in the future. Especially, innovation has become an important measure for the enterprise to compete. Therefore, it is necessary for the enterprise to appropriately increase the r&d expenditure. It is necessary to keep the r&d personnel investment and r&d fund investment in an appropriate proportion range, improve the integration effect of r&d investment, avoid crowding out effect, cause the overflow of r&d capital investment and personnel investment and form the waste of capital, which is not conducive to the improvement of enterprise innovation performance. This paper analyzes the mechanism of the relationship between ownership concentration and ownership balance on r&d investment and innovation performance under the ownership structure, and finds that the higher the ownership concentration, the greater the positive impact of r&d investment on enterprise performance, suggesting that enterprises should strengthen the cohesion of ownership.

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