The impact of R&D investment on business performance----- Based on the regulating effect from ownership structure

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Abstract. Based on the data in 2015 -2017 of listed software service companies of China industry .This paper empirically analyzes the relationship between R&D investment and corporate performance, and the impact of ownership structure on R&D investment and corporate performance. The research shows that the R&D investment of listed software service companies has a significant positive impact on corporate financial performance, no lag; equity concentration is positively regulating the relationship between R&D investment and corporate performance. Equity balance is negatively regulating R&D the relationship between investment and business performance.

1. Introduction

The main subject of technological innovation is enterprises. The purpose of enterprises focusing on innovation is to improve the core competitiveness of enterprises and maximize the value of enterprises. Increasing R&D investment is the main way for enterprise innovation. The fundamental purpose of innovation is to improve the performance of enterprises. In the trend of globalization, how do listed companies in the software service industry seize opportunities and face unprecedented challenges, improve the efficiency of R&D investment transformation, and promote the improvement of corporate performance has become a hot topic of our concern. On the basis of combing the literature, based on the establishment of multiple regression models, based on the statistical analysis of the financial data of China's software service industry listed companies in 2015-2017, this paper deeply explores the impact of R&D investment on corporate performance, and is committed to software. Listed companies in the service industry understand the importance of R&D activities and improve the status of R&D investment, and provide reasonable suggestions for the long-term development of the company.

2. Theoretical analysis and research hypothesis

2.1 Relationship between R&D expenditure and corporate performance

R&D investment will bring new products, new processes and new technologies to enterprises, so that enterprises can open up new markets and develop new customer groups, which will help enterprises to obtain differentiated advantages, thereby enhancing their competitiveness, expanding brand awareness and improving corporate performance. Fortune and Shelton (2012) focused on research and development investment in US pharmaceutical industry companies, and selected 303 companies. Empirical research found that R&D activities were significantly positively correlated with corporate performance. [1] Shui Huili (2017) found that there is a significant positive correlation between R&D investment and corporate performance of listed companies in China's manufacturing industry, reflecting the positive signal of disclosure R&D intensity to the market, which is conducive to maintaining and improving market share and improving enterprises. value. [2] Therefore, this paper believes that R&D investment can promote the growth of corporate performance and make the following assumptions:

H1: The R&D investment of listed companies in the software service industry is positively correlated with corporate performance

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R&D activities are a long-term process, and they are not successful in the short term. Lu Keying (2017) found that the R&D investment of listed companies in China's software and information technology services is conducive to the improvement of corporate net asset interest rates, R&D capital investment and enterprises. There is a significant positive correlation between performance, but it takes two years to show up, and there is no lag in the performance of R&D personnel. [3] In summary, the paper makes the following assumptions:

H2: There is a lag in the impact of R&D investment on the performance of listed companies in the software service industry

2.2 The adjustment effect of ownership structure on the relationship between R&D expenditure and corporate performance

Yafeh & Yosha (2003) found that as the shareholding ratio increases, the major shareholders will then strengthen their supervisory functions and promote the expenditure of research and development innovation activities. Hosono (2004) also believes that moderate equity concentration is conducive to enterprise development, moderate equity concentration is conducive to moderate control of the board of directors, and at the same time, more comprehensive operators can be selected. On the one hand, the more concentrated the equity, the less liquid, the shareholders tend to consider the long-term interests of the company when making decisions, so more emphasis on corporate innovation activities (Qiu Shuai 2017), on the other hand, can effectively suppress small The behavior of shareholders "free riders" (Wu Xiang 2017). [4,5] According to this, this paper proposes:

H3: The concentration of equity in listed companies in the software service industry positively regulates the relationship between R&D investment and corporate performance

Equity checks and balances refer to the power of multiple major shareholders to jointly control the company. Any major shareholder will be restricted by other major shareholders when making decisions. However, the balance of equity is too high, and the risk of major shareholders competing for power will increase, which will easily lead to internal chaos and affect the efficiency of decision-making. The original Huili (2016) research results show that the equity balance has negatively adjusted the relationship between R&D investment and corporate performance. [6] Based on the above analysis, this paper makes the sixth hypothesis:

H4: The balance of equity in listed companies in the software service industry negatively regulates the relationship between R&D investment and corporate performance

3. Research design

3.1 Sample selection and data source

This paper selects China's software and information technology service industry listed companies (herein referred to as: software service industry listed companies) as research samples in 2015-2017. All data were obtained from the listed company's annual report disclosed by Eastern Fortune Network, and 63 companies were selected to meet the requirements. The principle of screening the initial data in this paper is as follows: first, exclude samples with missing values, companies with abnormal changes; second, exclude companies with ST and ST* in any one year; third, exclude undisclosed R&D investment The situation of the company. This paper uses data statistical analysis software Excel2010 and EViews8 to analyze data.

3.2 Definition of variables

Explained variable. Interpreted variables are used to measure corporate financial performance. Operating profit margin is a key indicator to measure a company's business ability. The higher the indicator, the stronger the profitability of the company. The main business is the source of the company's final profit. Since the R&D investment of the software service industry is mainly used for the research and development of its core products, this paper uses the operating profit rate of the listed company as the explanatory variable to measure the enterprise performance.

Explanatory variables. he explanatory variable is the enterprise R&D expenditure. Due to the different asset scales of enterprises, there is a big difference in the stock data of R&D inputs. Therefore, the R&D capital investment intensity indicates the R&D investment level of listed companies in the software service industry.

Adjust the variables. Moderator, also known as interaction variable, refers to the relationship between dependent and independent variables. A variable or weak (or positive or negative) variable. The concentration of equity is measured by the shareholding ratio of the largest shareholder. The proxy variable of equity balance is the ratio of the shareholding ratio of the second to the tenth largest shareholder to the shareholding ratio of the largest shareholder Z10.

Control variables. In addition to R&D investment, other factors can also affect business performance. This paper selects the enterprise size, asset-liability ratio, enterprise growth, and cash flow as control variables. The variables in the model are defined in Table 1.

Table 1 Variable indicator system

Variable type	variable		symbol	Indicator definition
Explained variable	Business Performance	Operating profit margin	OPE	Operating profit / operating income
Explanatory variables	R&D Input	R&D capital investment intensity	R&Dm	Total R&D capital investment / operating income
Moderator	Equity structure	Equity concentration	HERF	The shareholding ratio of the largest shareholder
		Equity balance	Z10	The sum of the shareholding ratio of the second largest shareholder/the shareholding ratio of the largest shareholder
Control variable	Business scale		SIZE	Natural logarithm of total assets
	Assets and liabilities		LEV	Total liabilities / total assets
	Business growth		GROWTH	(This year's operating income - last year's operating income) / last year's operating income
	cash flow		CASH	Operating cash net flow / total assets

3.3 Modeling

According to the basic assumptions put forward above, this paper constructs the following three regression models to carry out empirical tests.

Model 1: This model not only examines the relationship between H1: R&D capital input intensity and firm performance, but also verifies the lag effect of H2: R&D capital input intensity on firm performance.

$$OPE=\beta_t+\beta_t R\&Dm_t+\beta_1 SIZE+\beta_2 LEV+\beta_3 GROWTH+\beta_4 CASH+\varepsilon \quad (1)$$

Model 2: This model is mainly used to verify the impact of H3 and H4 on the relationship between R&D investment and corporate performance.

$$OPE=\beta_0+\beta_1 R\&Dm+\beta_2 HERF+\beta_3 SIZE+\beta_4 LEV+\beta_5 GROWTH+\beta_6 CASH+\varepsilon \quad (2)$$

$$OPE=\beta_0+\beta_1 R\&Dm+\beta_2 Z10+\beta_3 SIZE+\beta_4 LEV+\beta_5 GROWTH+\beta_6 CASH+\varepsilon \quad (3)$$

$$OPE=\beta_0+\beta_1 R\&Dm+\beta_2 HERF+\beta_3 R\&Dm*HERF+\beta_4 SIZE+\beta_5 LEV+\beta_6 GROWTH+\beta_7 CASH+\varepsilon \quad (4)$$

$$OPE=\beta_0+\beta_1 R\&Dm+\beta_2 Z10+\beta_3 R\&Dm*Z10+\beta_4 SIZE+\beta_5 LEV+\beta_6 GROWTH+\beta_7 CASH+\varepsilon \quad (5)$$

Where β0 is a constant term, βi is a coefficient (i=1-7), and ε is a random error term. t represents the year (t=2015—2017).

4. The empirical results and analysis

4.1 Descriptive statistical analysis

Descriptive statistical analysis was performed on the collected panel data using EViews8 data processing software. The results are shown in Table 1-1. As can be seen from the table, the gap in operating profit margins of listed companies in the software services industry is very significant, with a maximum of 75.48 and a minimum of 0.36. The maximum and minimum values of equity concentration in the regulatory variables are 54.77 and 4.15, respectively, and the average value is 24.303, indicating that most enterprises have moderate concentration of equity, and some small enterprises have higher equity concentration, which is easy to produce “one. The problem of stocks alone. From the perspective of equity checks and balances, the maximum value of Z10 is 7.19, the minimum value is 0.074, and the average value is 1.53, which indicates that the second to tenth largest shareholder of the sample has a large difference between the maximum and minimum values of the first major shareholder's balance. There is a phenomenon of highly dispersed and highly concentrated equity. From the descriptive statistical analysis of control variables, there are differences in firm size and cash flow, but the difference is not obvious, and there is a significant difference between asset-liability ratio and firm growth.

Table2 Full sample descriptive statistics

stats	average value	median	Maximum	Minimum	Standard deviation
OPE	15.5745	13.208	75.4835	0.3552	11.5866
R&Dm	11.3846	9.650	46.530	1.420	8.407855
HERF	24.30311	21.340	54.770	4.150	11.37702
Z10	1.537954	1.433227	7.187935	0.074474	1.093517
SIZE	21.84268	21.76352	23.69373	20.0451	0.725888
LEV	30.20594	28.93299	64.85295	4.235863	12.43909
GROWTH	44.57233	24.020	927.710	-30.990	92.15846
CASH	4.77433	3.8504	45.3838	-10.2553	7.1078

4.2 Correlation analysis

As can be seen from Table 2, the correlation coefficient between R&D capital investment intensity and operating profit rate is 0.18438, and a 5% significance test is passed, indicating that the R&D capital investment intensity is significantly positively correlated with the enterprise operating profit rate. It is assumed that H1 and H2. The correlation coefficient between equity concentration and operating profit margin is 0.1518, and the hypothesis H4 is preliminarily verified by a 5% significance test.

The correlation coefficient of the proxy variable Z10 of the equity balance is -0.0990, which fails the 5% significance test, indicating that the correlation between the equity balance and the operating profit rate is not significant, but it can be initially verified that the equity balance has a negative impact on the operating profit margin. . There was a significant positive correlation between firm size and cash flow and operating profit margin, while asset-liability ratio was significantly negatively correlated with operating profit margin. There is a positive correlation between corporate growth and operating profit margin, but it has not passed the significant test. Of course, the correlation analysis between the above variables is only a preliminary analysis, and the more reliable results depend on the regression analysis below.

Table 3 Correlation analysis between variables

Correlation / Probability	OPE	R&Dm	HERF	Z10	SIZE	LEV	GROWTH	CASH
OPE	1							
R&Dm	0.18438	1						
	0.0111	-----						
HERF	0.151784	-0.197446	1					
	0.0371	0.0065	-----					
Z10	-0.099012	0.063436	-0.744226	1				
	0.1753	0.3858	0.0000	-----				
SIZE	0.201311	-0.07534	-0.035225	0.013085	1			
	0.0055	0.3028	0.6304	0.8582	-----			
LEV	-0.228536	-0.318492	0.044335	-0.026641	0.219629	1		
	0.0016	0.0000	0.5447	0.7159	0.0024	-----		
GROWTH	0.111119	-0.153337	0.041636	-0.014961	0.13698	0.03755	1	
	0.1280	0.0352	0.5695	0.8381	0.0602	0.6080	-----	
CASH	0.405708	0.104986	0.363409	-0.244794	-0.028112	-0.045793	0.016317	1
	0.0000	0.1505	0.0000	0.0007	0.7010	0.5315	0.8237	-----

4.3 Regression analysis

4.3.1 The impact of R&D capital investment intensity on firm performance

According to regression model 1, linear regression analysis was performed on the sample data using Eviews version 8.0 to verify H1 and H2. The regression analysis results of Model 1 are shown in Table 4.

Table 4 Empirical Analysis of R&D Capital Input Strength and Firm Performance

Coefficient	OPE		
Prob.	Current period	One year behind	Lagging two years
2017R&Dm	0.4054		
	0.0054		
2016R&Dm		0.3273	
		0.0206	
2015R&Dm			0.3378
			0.0098
SIZE	4.091	4.2396	4.1347
	0.0173	0.0157	0.0172
LEV	-0.1995	-0.2379	-0.2361
	0.0399	0.0141	0.0133
GROWTH	-0.00498	-0.0066	-0.00644
	0.6224	0.5216	0.5269
CASH	0.558303	0.585322	0.545927
	0.0137	0.0116	0.0167
Adjusted R-squared	0.350	0.322	0.337
F-statistic	7.668	6.884	7.314
Prob(F-statistic)	0.000	0.000	0.000

It can be seen from Table 4 that the correlation coefficient between R&D capital investment and operating profit margin is 0.4054, which is significantly correlated under the significant 1% level. The correlation coefficient between R&D capital investment intensity and operating profit rate is one year behind and two years behind. It is 0.3273, 0.3378, which indicates that the strength of R&D capital investment affects the performance of current enterprises, and there is no hysteresis effect. It is assumed that H1 is verified, and H2 is not tested. In general, the R&D capital investment

of listed companies in the software service industry has a significant effect on improving corporate performance. The listed companies in the software service industry should pay attention to the investment in R&D funds.

4.3.2 The adjustment of ownership structure in the process of R&D investment affecting corporate performance

Regression analysis was performed according to 2.1, 2.2, 2.3, and 2.4 in Model 3, and the regression results are summarized in Table 5.

Table 5 Effect of shareholding structure on the relationship between R&D capital investment intensity and firm performance

Coefficient	OPE				
Prob.	Model 1.1	Model 2.1	Model 2.3	Model 2.2	Model 2.4
R&Dm	0.4054	0.4388	0.4815	0.4138	1.0097
	0.0054	0.0031	0.0027	0.0047	0.0012
HERF		0.1377	0.314		
		0.1999	0.069		
Z10				-0.9052	2.3366
				0.3526	0.176
R&Dm*HERF			0.043		
			0.0018		
R&Dm*Z10					-0.3294
					0.027
SIZE	4.091	4.3247	4.5483	4.1066	4.4824
	0.0173	0.0122	0.0047	0.0171	0.0077
LEV	-0.1995	-0.217	-0.1296	-0.1989	-0.1595
	0.0399	0.0265	0.1642	0.0407	0.0929
GROWTH	-0.00498	-0.00593	-0.00541	-0.00518	-0.00492
	0.6224	0.5563	0.5614	0.609	0.6146
CASH	0.558303	0.431604	0.570934	0.519254	0.638643
	0.0137	0.0762	0.0139	0.0238	0.0057
Adjusted R-squared	0.350	0.357	0.452	0.348	0.393
F-statistic	7.668	6.747	8.318	6.522	6.743
Prob(F-statistic)	0.000	0.000	0.000	0.0000	0.000

Empirical analysis shows that the regression coefficient of R&D capital investment intensity and operating profit margin is 0.004054, which is significantly correlated at 1% level. The concentration of equity has a significant positive effect on the relationship between R&D capital investment intensity and operating profit rate. After adding the interactive term R&Dm*HERF, the coefficient of R&D capital input intensity is 0.4815 slightly larger than the regression coefficient of model 1.1 of 0.4054. Goodness R = 0.552 > 0.350, H3 was verified. Based on the model 1.1, the equity balance degree (Z10) is introduced as the independent variable, and the interaction term between the equity balance and the R&D capital input intensity is introduced to regress the independent variable. The results are shown in the models 2.2 and 2.4 in Table 3-2. It can be seen that the interaction term is negative, indicating that the equity balance has a negative adjustment effect on the relationship between R&D capital investment intensity and firm performance, and H4 is verified.

5. Conclusions and recommendations

5.1 Conclusions

5.1.1 R&D investment is positively affecting corporate performance, but insufficient attention is paid to R&D investment

Through regression analysis, it is concluded that the R&D investment of listed companies in China's software service industry has a significant positive correlation with corporate performance. The

regression coefficient of R&D capital investment intensity and current operating profit margin is 0.4054, which has passed the 1% significance level test, and the impact of R&D capital investment intensity on operating profit margin has not been delayed. However, through descriptive statistical analysis, it is concluded that the R&D capital investment intensity of listed companies in China's software service industry is relatively high, but the gap between the maximum and minimum values is very large, indicating that the R&D capital investment among various enterprises in the software service industry is very large. The difference is that some companies do not pay enough attention to R&D investment.

5.1.2 The shareholding structure plays an important regulatory role, but the shareholding structure is relatively unreasonable.

The regression analysis shows that the concentration of equity has a positive adjustment effect on the relationship between R&D capital investment intensity and firm performance; equity balance degree plays a negative role in regulating the relationship between R&D capital investment intensity and firm performance. This shows that the shareholding structure is a key indicator that affects the relationship between R&D capital investment and firm performance. However, through descriptive statistical analysis, the maximum and minimum values of listed companies' equity concentration and equity checks and balances are very different. There are two extremes. It can be seen that there is a large irrationality in the shareholding structure of listed companies in the software service industry.

5.1.3 Financial risks are high, and asset-liability ratio negatively affects corporate performance

The regression analysis shows that the asset-liability ratio has a significant negative impact on corporate performance, which can reflect the greater the financial risk and the smaller the enterprise performance. This may be related to the characteristics of the listed companies in the software service industry. Most of the products of the company are high-tech products. The research and development of high-tech products requires a large amount of funds. The company's own funds are limited. The financing through borrowing is more common. However, the transformation of innovation results is more Large risks, so high debt costs do not match profit output, which has a negative impact on business performance.

5.2 Recommendations

5.2.1 Increase the emphasis on R&D and increase R&D investment

R&D investment has a major impact on improving the core competitiveness of enterprises and enhancing corporate value, so companies should invest a lot of energy into research and development activities. In order to carry out research and development activities, enterprises must not only invest huge sums of money, but also have high-end technical personnel, so that R&D activities can be carried out efficiently, ensuring the production of new products or new technologies, thereby improving the efficiency of enterprises. Listed companies in the software service industry should increase investment in research and development, improve research and development efficiency, accelerate the transformation of results, and create excess profits for enterprises.

5.2.2 Optimize the shareholding structure and carefully consider equity checks and balances

The research results show that the concentration of equity is positively regulating the relationship between R&D capital investment and corporate performance. Although high equity concentration is conducive to making business decisions, at the same time, major shareholders believe that they have absolute controlling rights and it is difficult to listen to the opinions of other shareholders. Conflicts of interest between large and small shareholders are prone to adversely improve the company's performance. The high proportion of the first to the tenth largest shareholders may have a negative impact on the improvement of corporate performance. The balance of equity is too high, the strength of major shareholders is basically equal, the power struggle is easy, and the coordination among shareholders is more difficult. The company's R&D investment has a negative effect. Therefore, a listed company should optimize its shareholding structure and choose a reasonable shareholding structure. It must prevent the risk of “one big share” and prevent the equity from

being too scattered. Appropriate ownership structure is conducive to the formulation of the company's decision-making and the interests of all parties.

5.2.3 Reduce financial risk and determine the optimal gearing ratio

China's software service industry listed companies should improve their financial management, reduce financial risks, make full use of various financial instruments, and reduce the financial expense ratio of enterprises. Under the controllable financial risk level, enterprises should control the ratio of their own funds to debt funds, prevent excessive asset-liability ratios, and find and seek the optimal ratio of assets and liabilities in the industry. Rational use of debt funds, guarantee the circulation rate of debt funds, improve the efficiency of the use of debt funds, and reduce the investment risk of debt funds.

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