

The Impact of R&D Investment on Enterprise Market Value—Based on the Moderating Effect of Ownership Concentration

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Abstract: In the new economic era characterized by innovation, R&D investment is the basic guarantee for enterprises to occupy a dominant position in the long-term market competition. This paper takes the listed companies that disclosed R&D investment information in China from 2016 to 2021 as the research object, empirically analyzes the impact of R&D investment on the market value of enterprises by using multiple linear regression model, and further explores the moderating effect of ownership concentration on the relationship between them. The results show that R&D investment is positively correlated with the market value of enterprises. Ownership concentration plays a positive role in regulating the relationship between R&D investment and enterprise market value. At the same time, based on the research conclusion, some countermeasures and suggestions are put forward, such as firmly establishing innovation consciousness, continuously increasing R&D investment, optimizing ownership structure and moderately increasing ownership concentration.

1. Introduction

In the process of China's economy changing from high-speed growth to high-quality development, many enterprises with scientific and technological innovation strength and global competitiveness have emerged. In 2019, for the first time, the number of Chinese enterprises in the world's top 500 companies surpassed the United States to lead the world, and the vitality of Chinese enterprises' development was further highlighted. However, with the changes of the domestic and international situation and the deep adjustment of the globalization development pattern, Chinese enterprises are also faced with practical problems such as weak core competitiveness and low degree of opening to the outside world. To solve these problems, we need to give full play to the driving force of innovation in cultivating technological advantages of enterprises, so that enterprises can become the main body and source of innovation. Guiding enterprises to actively participate in R&D activities and increasing their R&D investment are the concrete measures to achieve the above objectives.

Compared with other factors, R&D investment has the characteristics of gradual and periodic impact on enterprises. On the one hand, R&D investment can promote the technological innovation of enterprises and turn scientific research achievements into their own competitive advantages; On the other hand, listed companies' R&D investment can convey positive market information to investors and enhance investors' expectation of enterprise value. Both aspects will play a positive role in promoting the long-term market value of enterprises. In addition, ownership concentration plays an important role in regulating the relationship between R&D investment and enterprise market value. Generally speaking, it is difficult for enterprises with too scattered equity to form a unified decision-making opinion, and the supervision of managers is correspondingly weakened, which easily leads to short-term decision-making behavior. With the increase of ownership concentration, the controlling shareholder will increase the R&D investment for the sake of the long-term development of the company, thus contributing to the promotion of the long-term market value of the company.

At present, most scholars' research on R&D investment, enterprise market value and ownership concentration mainly focus on manufacturing listed companies and pay more attention to the

short-term or financial performance of enterprises. Few scholars study the long-term market value of enterprises alone. In addition, there is relatively little research on the moderating effect of ownership concentration on R&D investment and enterprise market value. Therefore, this paper selects a total of 11,874 sample data of listed companies in China from 2016 to 2021, and empirically analyzes the influence of R&D investment on the market value of enterprises and the moderating effect of ownership concentration on the relationship between them by using multiple linear regression model.

2. Literature Review

Innovation is the first driving force for development, and scientific and technological innovation has become the core driving force for building an innovative country and promoting the high-quality development of China's economy. And R&D investment is the front link of the whole national innovation chain, which is of great significance to enhance the innovation vitality of our national economy. At the same time, enterprises are the cells of the national economy. In the increasingly competitive market environment at home and abroad, how to seize the initiative in the competition and how to improve the ability of sustainable development are important issues faced by enterprises. To solve this problem, it is necessary to give full play to the basic and fundamental role of R&D investment in cultivating the core competitiveness of enterprises and improving their business performance. For a long time, the relationship between R&D investment and enterprise value has been a hot issue in academic circles. On the basis of generally agreeing that R&D investment can enhance enterprise value, domestic and foreign scholars have further discussed the moderating effect of ownership concentration on the relationship between R&D investment and enterprise value.

2.1 Related Research Abroad

The research on the influence of foreign R&D investment on the market value of enterprises started earlier, and the related research had already appeared in the early 20th century. George Libik(1969) found that there is a significant positive correlation between R&D investment and enterprise value through empirical research, and the correlation degree is different in different industries, with the strongest correlation degree in technology-intensive industries ^[1]; Theodore Sougiannis(1994) found that the R&D expenditure of an enterprise in the current year has nothing to do with the company's performance this year, but it will have a positive impact on the company's performance in the next year ^[2]; Collins L.(2005) thinks that it takes a certain time for R&D expenditure to be converted into corporate profits, that is, there is a lag, which will make managers ignore the effects of R&D expenditure. Using scientific evaluation model is helpful to measure the real utility of R&D expenditure ^[3]; Ben Branch(1974) found that R&D investment will significantly affect the future profitability of enterprises through an empirical study of 111 companies in seven industries in the United States ^[4]. As for the moderating effect of ownership concentration on R&D investment and company value, Sanghoon Lee(2012) found that ownership concentration can positively affect investment expenditure and promote the promotion of company value on the basis of empirical research on Korean manufacturing companies from 1999 to 2008 ^[5]; Liao et al. (2017) found that good corporate governance can promote the R&D activities of companies by studying the influence of corporate governance and market competition. The more concentrated the equity, the greater the value created by R&D activities to enterprises and thus the more it can promote the long-term development of enterprises ^[6]; Manali Chatterjee(2020) found that the impact of R&D intensity on the stock market performance of 134 small Indian R&D companies is positive but not significant, and it will be significantly improved when the ownership concentration is taken into account ^[7].

2.2 Domestic Related Research

The research on the impact of domestic research investment and enterprise market value started late, and the impact of data availability was mostly limited to listed companies, especially listed

companies in manufacturing industry. Zhou Guohong and Lu Lijun (2002) made an empirical study on the statistical data of 1,162 small and medium-sized scientific and technological enterprises in Zhejiang Province, and concluded that the level of R&D investment is one of the most important behavioral factors affecting the innovation performance of enterprises [8]; Radium Cheung et al. (2013), based on the panel data analysis of 33 listed companies in Shanghai, found that R&D investment is positively related to corporate performance, and its impact on corporate performance is lagging behind [9]; Feng Jiacong et al. (2017) used high-tech listed companies in China as the data source, and found that the impact of R&D investment of high-tech listed companies on enterprise value was significantly positively correlated when it lagged one to five years [10]; Zhou Wanyi et al. (2011) took small and medium-sized high-tech enterprises as the research object, and by means of the improved Fama-French model, found that R&D investment was significantly positively correlated with company value [11]. Furthermore, many domestic scholars also found that ownership concentration has a moderating effect between R&D investment and enterprise value. Xu Min et al. (2012) found that ownership concentration has a positive moderating effect on the relationship between R&D investment and enterprise performance [12]; Shu Qian et al. (2014) conducted research on manufacturing listed companies by building an interactive effect model, and found that only when the ownership concentration reaches a certain level, R&D investment will positively promote enterprise performance [13]; Lin Jun (2016) selected listed companies in information technology industry as a sample, and found that ownership concentration is a homogeneous adjustment variable, which will positively adjust the relationship between R&D investment and business performance. However, the degree of equity balance is a pure adjustment variable, which has a negative adjustment effect on R&D investment and business performance [14]; Li Hongxia et al. (2021) took listed coal enterprises as the research object, and found through empirical research that the increase of R&D investment in coal enterprises can significantly improve the comprehensive performance level of enterprises, and its influence presents an “inverted U-shape” with a positive lag. Ownership concentration plays a positive role in adjusting the R&D investment in coal enterprises to the comprehensive performance of enterprises [15].

3. Research Hypothesis and Research Model

3.1 The Relationship between R&D Investment and Enterprise Market Value

The relationship between R&D investment and enterprise market value has a profound theoretical basis, among which the most representative view is the core competitiveness theory. Harad and Hamel(1990) clearly put forward the concept of core competence in the article “Core Competence of Companies” and defined it as “a kind of unique skills and technologies that can make companies bring special benefits to customers”, emphasizing the importance of having irreplaceable and hard-to-imitate resource heterogeneity for enterprises. For modern enterprises, R&D investment is the material guarantee to obtain this important resource heterogeneity. Enterprises' achievements through R&D to form their own core competitiveness can not only help them occupy a place in the market, but also achieve more value creation. At present, academic circles generally agree that R&D investment has a positive correlation with enterprise market value. Yang Zhonghuan (2013) found that the R&D investment of Chinese enterprises has a strong value positive correlation [16] based on the empirical research of Chinese listed companies after the implementation of the new accounting standards; Liu Hui et al. (2020) discussed the relationship between R&D investment and enterprise value from the perspective of life cycle, and found that R&D investment is conducive to enhancing enterprise value, but there is a big difference in the enhancement effect in each life cycle [17]; Zhang Chunyang et al. (2021) used statistical analysis and regression analysis to study the correlation between R&D investment and enterprise value of listed companies in science and technology innovation board, and found that R&D investment has a significant role in promoting enterprise value (financial value and market value), and the lag time of its impact on financial value and market value is different [18]. Based on the above analysis, this paper puts forward the following assumptions:

H1: R&D investment is positively correlated with enterprise market value.

3.2 The Regulating Role of Equity Concentration

Ownership structure is the foundation and core of corporate governance structure, which determines the company's investment decision and value realization. Among them, the ownership concentration is the key index to reflect the ownership structure of a company. When the equity is too scattered, the company's decision-making management rights are scattered in the hands of small and medium shareholders, making it difficult to make a unified decision, which is not conducive to the company's long-term development and value enhancement. In addition, most scholars at home and abroad generally agree that ownership concentration can regulate the relationship between R&D investment and company value. Xie Wengang (2017) took 4,975 listed companies as samples to explore the relationship between innovation investment and enterprise value under the influence of ownership structure, and found that ownership concentration helps enterprise managers to make scientific R&D investment decisions to enhance enterprise value [19]; Liu Yi et al. (2022) made an empirical study on the relationship between ownership concentration and R&D investment and enterprise value by using multiple linear regression model, taking manufacturing listed companies as data sources. It was found that ownership concentration plays a positive role in regulating the relationship between R&D investment and enterprise value, but the higher the concentration, the more companies tend to increase R&D investment to enhance enterprise value [20]. The development of modern enterprise system has led to the emergence of principal-agent problem. Major shareholders are concerned about the long-term interests of enterprises, and are more willing to increase the R&D investment of enterprises to enhance the sustainable development ability of enterprises. However, managers pay more attention to the short-term performance of enterprises and their own performance, which is prone to adverse selection to reduce R&D investment in order to obtain short-term profits. In enterprises with concentrated stock rights, the major shareholders will attach importance to and increase the R&D investment of enterprises for the long-term interests of enterprises, and restrain the short-term profit-making behavior of managers, so that the interests of shareholders can be closely combined with the effect of R&D investment, and finally the purpose of enhancing the value of enterprises can be achieved. Based on the above analysis, this paper puts forward the following assumptions:

H2: Ownership concentration plays a positive role in regulating the relationship between R&D investment and enterprise market value.

4. Research Design

4.1 Sample

Based on the 2016-2021 financial statements of listed companies in China, this paper selects 19,540 sample observations in CSMAR database. Using Stata, 1215 sample observations with missing or undisclosed related data and 6451 discontinuous sample observations from 2016 to 2021 were eliminated in turn, and finally 11874 qualified sample observations were obtained. The data was screened and matched by Excel.2019, and an empirical analysis was made by SPSS 26.

4.2 Variable Definition

4.2.1 Explained Variable

Enterprise market value (Qc). The market value of an enterprise is an important standard for investors to judge the operating results and investment value of an enterprise. In this paper, Tobin Q value, which is generally recognized and applied by scholars at home and abroad, is used as an index to measure the market value (Qc) of an enterprise. It indicates the ratio of the company's stock market value to the replacement cost of the company's assets, which can avoid the inherent defects of financial indicators that are easily manipulated by the management, thus truly and effectively measuring the value-added and growth ability of an enterprise.

4.2.2 Explanatory Variable

Investment in research and development (YF). R&D investment can be measured by absolute index and relative index. The absolute index is expressed by the absolute amount of R&D investment, and the relative index is generally expressed by the ratio of R&D investment to operating income. In order to make the data horizontally comparable, this paper takes the proportion of R&D investment in operating income, that is, R&D investment intensity, as an index to measure enterprise R&D investment (YF).

4.2.3 Regulated Variable

Ownership concentration of enterprises (H10). Alternative indicators of ownership concentration mainly include: the shareholding ratio of the largest shareholder, Z index, and the shareholding ratio of the top five or top ten shareholders. In this paper, the shareholding ratio of the top ten shareholders is selected as the measurement index of ownership concentration.

4.2.4 Control Variable

There are many factors that affect the market value of an enterprise, including external uncontrollable factors such as politics, society and economy, and internal controllable factors such as enterprise scale, operating capacity and growth capacity. Combining the existing research conclusions and data availability, this paper selects the following three indicators as control variables: (1) Enterprise scale (Asset): The larger the enterprise scale, the more capital is accumulated, and the more scale effect can be exerted to promote the enterprise value. Choose the total assets at the end of the enterprise to measure. (2) Asset-liability ratio of enterprises (ZFL): Financial leverage can play a role in tax avoidance and bring greater economic benefits to enterprises. However, an excessively high asset-liability ratio will also cause enterprises to face greater financial risks and have a negative impact on enterprise value. Measure with asset-liability ratio. (3) Growth of enterprises: the growth ability of enterprises reflects the future profitability and development space of enterprises, and the stronger the growth ability of enterprises, to a certain extent, it shows that they have great potential for value enhancement. Choose the growth rate of operating income to measure.

In summary, the specific variable definitions are shown in Table 1.

Table 1 Variable Definition

Variable type	Variable name	Code	Measurement method
Explained variable	Enterprise market value	Qc	Total market value/assets
Explanatory variable	R&D investment	YF	R&D investment/operating income
Regulated variable	Ownership concentration	H10	The shareholding ratio of the top ten shareholders
Control variable	asset size	Asset	Total assets
	Asset-liability ratio	ZFL	Total liabilities/total assets
	Growth ability	Growth	Growth of operating income this year/operating income at the beginning of the year

4.3 Model Construction

Establish a model for testing the positive correlation between R&D investment and enterprise value (1)

$$Qc_{it} = \alpha_0 + \alpha_1 YF_{it} + \alpha_2 Asset_{it} + \alpha_3 ZFL_{it} + \alpha_4 Growth_{it} + \varepsilon_{it} \quad (1)$$

Establish a model to test the moderating effect of ownership concentration on the relationship between R&D investment and market value (2)

$$Qc_{it} = \alpha_0 + \alpha_1 YF_{it} + \alpha_2 H10_{it} + \alpha_3 Asset_{it} + \alpha_4 ZFL_{it} + \alpha_5 Growth_{it} + \varepsilon_{it} \quad (2)$$

Where: “I” represents the enterprise, “t” represents the year, and ε_{it} represents the random interference term.

5. Empirical Analysis

5.1 Empirical Analysis

It can be seen from the descriptive statistical data in Table 2 that the maximum value of enterprise market value (Qc) is 92.25 and the minimum value is 0.52, which indicates that there is a big gap among enterprises. The average R&D investment (YF) is 4.881, which indicates that the R&D investment intensity of listed companies in China needs to be strengthened urgently. The standard deviation is 5.244, indicating that R&D investment fluctuates greatly among different enterprises. The minimum value of equity concentration (H10) is 0.11, and the maximum value is 1, which indicates that some enterprises have concentrated equity concentration. There is a big difference between the maximum value and the minimum value of the enterprise (Asset), and there is a big difference in the asset size of the selected sample enterprises. The average asset-liability ratio (ZFL) is 0.443, indicating that the overall debt ratio of listed companies in China is still in a relatively controllable range, and the overall financial risk is low. As far as enterprise Growth is concerned, the average value is 56.7%, and most enterprises have good growth ability.

Table 2 Descriptive Statistic

Variable name	Sample size	Min	Max	Mean	SD
Qc	11874	0.54	92.25	2.517	2.065
YF	11874	0.10	83.23	4.881	5.244
H10	11874	0.11	1.00	0.379	0.256
Asset	11874	0.55	27331.90	153.933	788.445
ZFL	11874	0.11	5.97	0.443	0.209
Growth	11874	-28.59	1145.18	0.567	12.034

5.2 Correlation Analysis

From the results of correlation analysis in Table 3, we can intuitively see the correlation among explained variables, explained variables, regulated variables and controlled variables. The correlation coefficient between enterprise value (Qc) and R&D investment (YF) is 0.186, which is significantly positive at the level of 5%. There is a significant correlation between explanatory variables and explained variables, so regression analysis can be carried out. The controlled variables, enterprise scale (Asset) and enterprise asset-liability ratio (ZFL), have significant negative correlation with enterprise value, but the correlation coefficient between enterprise Growth and enterprise market value (Qc) is -0.004, which fails the test of 10% significance level, so this controlled variable is discarded in the subsequent analysis.

Table 3 Correlation Analysis

	Qc	YF	H10	Asset	ZFL	Growth
Qc	1.000***					
YF	0.186**	1.000***				
H10	-0.017	0.047**	1.000***			
Asset	-0.093**	-0.073**	-0.006	1.000***		
ZFL	-0.173**	-0.123**	-0.007	0.126**	1.000***	
Growth	-0.004	-0.008	-0.006	0.003	0.019*	1.000***

Note: ***, ** and * are significant at the levels of 0.01, 0.05 and 0.1 respectively.

5.3 Regression Analysis

From the results of sample regression analysis in Table 4, it can be seen that R&D investment (YF) is significantly positively correlated with enterprise market value (Qc) at the level of 5%, and the correlation coefficient is 0.164, which verifies hypothesis 1: R&D investment is positively correlated with enterprise market value.

Table 4 Regression Analysis

	Qc
YF	0.164** (18.137)
Asset	-0.063** (-6.967)
ZFL	-0.144** (-16.000)

Note: The values in brackets indicate the T-test value of the coefficient, and * * *, * * and * are significant at the levels of 0.01, 0.05 and 0.1, respectively.

5.4 Adjustment Effect Test

In order to further verify and analyze the moderating effect of ownership concentration, we introduce the shareholding ratio of the top ten shareholders as the moderating variable, analyze the moderating effect, and draw the moderating effect diagram. It can be seen from Table 5: (1) The correlation coefficient between ownership concentration (H10) and enterprise market value (Qc) is -0.4343, which is significantly correlated at 5%. (2) Introducing the interaction term YF×H10, it is found that the correlation coefficient of the interaction term is 0.0484 and it has passed the significance test of 5%. It shows that the adjustment effect of ownership concentration is obvious and positive, and this conclusion can also be seen intuitively from Fig 1. Therefore, hypothesis 2: Ownership concentration plays a positive role in regulating the relationship between R&D investment and enterprise market value.

Table 5 Regulatory Effect

Outcome variable	regression equation predictor variable	Fitting index R2 F	β
Qc	YF H10 Asset ZFL YF×H10	0.0627 132.3192	0.0454** -0.4343** -0.0002** -1.4235** 0.0484**

Note: * * *, * * and * are significant at the levels of 0.01, 0.05 and 0.1 respectively.

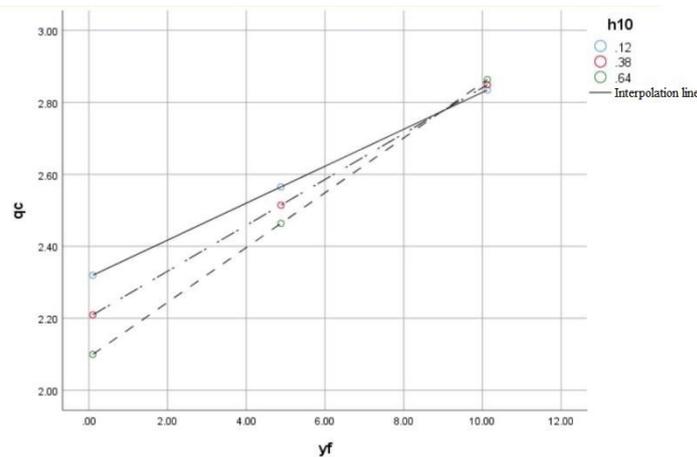


Fig.1 Regulatory Effect

5.5 Robustness Test

In order to further verify the reliability of the research results, this paper uses the substitution variable method to test the robustness: the explained variable enterprise market value (Qc) is replaced by Qd, and the difference between them is that the denominator of Qd deducts the net value of intangible assets more than Qc; Replace the shareholding ratio of the top ten shareholders (H10) with the shareholding ratio of the top five shareholders (H5), and keep the other variables unchanged. The adjusted variables are regressed, and the results are shown in Table 6. According to

the results, the correlation coefficient between enterprise market value (Qd) and R&D investment is 0.0536, which has passed the significance test at 5% level, and the correlation coefficient of interactive items is 0.0476, which has passed the significance test at 5% level, while the significance of other variables is basically unchanged. Assumption 1 and hypothesis 2 are still valid, and the model has passed the robustness test. The research results of this paper have strong reliability.

Table 6 Robustness Test

Outcome variable	regression equation predictor variable	Fitting index R2 F	β
Qd	YF H5 Asset ZFL YF×H10	0.0736 157.0649	0.0536** -0.3906** -0.0002** -1.8262** 0.0476*

Note: ***, ** and * are significant at the levels of 0.01, 0.05 and 0.1 respectively.

6. Research Conclusions and Countermeasures

6.1 Research Conclusion

Based on the data of China's listed companies from 2016 to 2021, this paper makes an empirical study on the relationship among R&D investment, enterprise market value and ownership concentration, and finds that R&D investment is positively correlated with enterprise market value, and increasing R&D investment can significantly improve enterprise market value; Ownership concentration plays a positive role in regulating the relationship between R&D investment and enterprise market value. The higher the ownership concentration, the more beneficial it is for enterprises to play the role of R&D investment in promoting enterprise market value.

6.2 Relevant Suggestions and Countermeasures

According to the research conclusion of this paper, the following two suggestions are put forward:

1) Firmly establish a sense of innovation and continuously increase investment in research and development. Innovation is the source of strength for enterprises to maintain their core competitiveness. Only by adhering to the spirit of pragmatic innovation and continuously increasing R&D investment can enterprises maximize their market value and have the ability of sustainable development. At the same time, the state should also increase the special support for R&D and innovation of enterprises, and provide appropriate policies and funds.

2) Optimize the ownership structure and moderately increase the ownership concentration. When the equity is too scattered, the information asymmetry and conflict of interests among the major shareholders, small shareholders and managers hinder the formulation and implementation of R&D investment decisions, which is not conducive to the promotion of enterprise market value. Therefore, moderately increasing the ownership concentration will help enterprises to make decisions that are in line with their own long-term interests, and avoid the problem that managers focus on short-term performance and ignore the promotion of long-term market value of enterprises, so as to realize the leap-forward development of enterprises.

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