R&D Investment, Market Competition and Cost of Equity Financing
——An Empirical Study Based on Mediating Effect

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ABSTRACT

This article uses the 2010-2019 data of China's A-share listed companies as a research sample, explore the impact of R&D investment on the cost of equity financing, study the mediating role of corporate competitiveness. The empirical results show that R&D investment could significantly reduce equity financing costs, enhanced the competitiveness of enterprises in the market, market competitiveness can produce a partial intermediary effect between R&D investment and equity financing costs. Companies should increase their emphasis on R&D activities and enhance market competitiveness to reduce the cost of corporate equity financing.

Keywords: *R&D Investment, Market Competition, Cost of Equity Financing.*

1. INTRODUCTION

R&D activities are an important source of power for the sustainable development of enterprises. With the deepening of China's Science and Technology Strategy for National Construction, the R&D investment of Chinese companies is also increasing year by year. Enterprise's R&D investment requires numerous funds, the long-term nature of equity financing can provide stable financial support for the company's R&D investment, Therefore, how to obtain high-quality and stable equity financing is an important part of the smooth development of corporate R&D activities. However, the high risks and high returns of R&D activities coexist. What is the impact of R&D investment on the cost of equity financing? How does R&D investment affect the cost of equity financing? Scholars have not yet reached a consistent conclusion. So this article starts from the perspective of market competitiveness, explore the relationship between R&D investment and equity financing costs and the path of the action to provide theoretical support for the promotion of enterprise's R&D activities.

2. THEORY AND HYPOTHESIS

2.1. R&D Investment and Cost of Equity Financing

R&D investment as a corporate activity with both high risks and high returns, its impact on the cost of equity financing is currently inconclusive. Chen, Li and Ma (2014)[1] found that there is a significant negative relationship between the company's innovation input and the company's equity financing cost . But Huo Xiaoping and Ren Yi (2020)[2] believe that R&D investment is significantly positively correlated with the cost of corporate equity financing . Some scholars believe that corporate R&D investment cannot affect the cost of equity financing (Xie Xiaofang, Li Yidong and Tang Qingquan 2009)[3]. Therefore, this article proposes the following competitive hypotheses:

H1a: R&D investment can reduce the cost of equity financing.

H1b: R&D investment can increase the cost of equity capital.

2.2. R&D Investment and Market Competitiveness

Through research and development activities, companies can optimize their products, improve production efficiency, and expand their market positions while expanding into new markets, providing endogenous motivation for the sustainable development of the company's competitive strength. China's innovation activities have become normal, and 'smart' capital has become an important part of the core competitiveness of enterprises (Su Ming, 2018)[4]. However, R&D investment occupies a large amount of funds, which also makes enterprises subject to financial constraints in market expansion. Zhou Dan (2014)[5]pointed out that the impact of enterprise innovation investment on market competitiveness is negative. Based on above, this article proposes hypotheses:

H2a: R&D investment can enhance the company's market competitiveness.

H2b: R&D investment can reduce the company's market competitiveness.

2.3. R&D Investment, Market Competitiveness and Equity Financing Costs

Scholars have few researches on R&D investment and equity financing costs and their conclusions are inconsistent. Sahar and Yalali (2014)[6]found that high-intensity R&D investment can reduce the cost of equity financing in monopolistic enterprises. The competitiveness of enterprises can ensure that enterprises will not be exposed to too much external pressure in a risky market, and they can have stronger self-insurance capabilities when faced with systemic risks, and strengthen the confidence of equity investors in the market. R&D investment can affect the cost of equity financing by affecting the market competitiveness of enterprises. Therefore, this article proposes hypothesis:

H3: Market competitiveness is an intermediary factor that influences the cost of equity financing by R&D investment.

3. MODEL SETTING

3.1. Sample Selection and Data Sources

This article selects 2010-2019 data of listed companies in the non-financial industry in my country's A-share market as the sample source. In order to ensure the authenticity and reliability of the data, samples with ST and *ST marks and missing important variable data are eliminated, and all continuous variables are processed with Winsorize at the beginning and end of 1%. The data processing tool is Stata15.

3.2. Model Design and Variable definition

This article refers to Professor Wen Zhonglin[7] on the test method of the mediation effect and establishes the following model for regression test . The definition of each variable is shown in Table 1.

$$COC = \alpha_0 + \alpha_1 R\&D + \alpha_2 Size + \alpha_3 Lev + \alpha_4 Roe + \alpha_5 Soe + \alpha_6 Turnover + \alpha_7 Eps + \alpha_8 Age + \sum Year + \sum Ind + \varepsilon \quad (1)$$

$$HHI = \beta_0 + \beta_1 R\&D + \sum controls + \varepsilon \quad (2)$$

$$COC = \gamma_0 + \gamma_1 R\&D + \gamma_2 HHI + \sum controls + \varepsilon \quad (3)$$

Table 1 Definition of Main Variables

Variable Type	Name	symbol	Definition
Dependent variable	Equity financing cost	COC	PEG model calculated
Independent variable	R&D investment intensity	R&D	R&D investment/operating income
Mediating variable	Corporate Competitive Strength	HHI	Herfind Index
Control variable	Enterprise size	Size	ln (total assets)
	asset-liability ratio	Lev	liabilities/assets
	Enterprise ownership	Soe	State-owned enterprises take 1 , otherwise take 0
	Return on equity	Roe	Net profit /net assets
	Turnover rate	Turn	Annual turnover rate
	Earnings per share	Eps	Profit after tax / number of shares
	Enterprise age	Age	Enterprise duration

4. EMPIRICAL TEST

4.1. Descriptive Statistics

Table 2 shows the descriptive statistical results of this article. Through descriptive statistics, it can be seen that the average equity financing cost of the sample companies is 0.111, and the median is 0.106. It can be seen that the equity financing cost of listed companies in my country is still at a high level. The minimum value is 0.014 and the maximum value is 0.290, indicating that there is a huge difference in equity financing costs between different enterprises, and which characteristics cause the differences in equity financing costs between enterprises need to be studied. Regarding R&D investment, the average R&D investment of the sample

companies is 0.041, and the median is 0.032, indicating that the level of R&D investment of listed companies in my country is still low. The median value is lower than the average, indicating a greater degree of data dispersion. The enthusiasm for investment needs to be improved. The minimum value of R&D investment is 0, and the maximum value is 0.259. There is a significant gap in R&D investment between different companies, and some companies have basically zero investment in R&D activities. Other variables median and the average difference and the degree of data dispersion is small.

Table 2 Descriptive Statistics

Var	N	Mean	Sd.t	Min	P50	Max
COC	13474	0.111	0.047	0.014	0.106	0.290
R&D	13474	0.041	0.044	0	0.032	0.259
Size	13474	22.37	1.299	20.01	22.19	26.38
Lev	13474	0.422	0.200	0.049	0.420	0.865
Roe	13474	0.076	0.103	-0.41	0.074	0.362
Soe	13474	0.371	0.483	0	0	1
Yurn	13474	0.023	0.017	0.002	0.018	0.087
Eps	13474	0.365	0.481	-1.18	0.280	2.270
Age	13474	15.92	5.530	4	16	30

4.2. Regression Analysis

Table 3 reports the regression test results of the above three hypotheses. In column (1), the coefficient of R&D investment and equity financing cost is -0.035, which is not negative at the level of 0.01, indicating the strength of R&D investment of listed companies can significantly reduce the cost of equity financing of enterprises. The hypothesis H1a is verified.

According to column (2), it can be seen that in the regression test of enterprise competitiveness and R&D investment, the coefficient of R&D investment is 0.645, and it is significant at the level of 0.01, indicating that the competitiveness of enterprises is significantly positively correlated with R&D investment. The investment has significantly enhanced the competitiveness of the company. The specific performance is that the company can create new products and new processes through R&D investment, so as to use its own advantages to make the company occupy a larger share in the market and promote the continuous development of the company. The hypothesis H2a is verified.

In column (3), after adding corporate competitiveness (HHI) to the model, the absolute value of the coefficient of corporate R&D investment (R&D) is reduced from 0.645 in column (2) to 0.029 in column (3), and is at 0.01 The level is significant, indicating that corporate competitiveness (HHI) plays a part of the mediating role in the impact of R&D investment on equity financing costs , and the mediation effect accounts for 18.43% of the total effect of R&D investment in reducing equity financing costs (0.645*-0.01/-0.035), which means that

18.43% of the R&D investment in reducing the cost of corporate equity financing is achieved by improving the competitiveness of the company , which validates the hypothesis H3 .

Table 3 Regression Result

Var	（1） COC	（2） HHI	（3） COC
R&D	-0.035***	0.645***	-0.029***
	（-4.26）	（29.36）	（-3.41）
HHI			-0.010***
			（-2.96）
Size	0.004***	0.000	0.004***
	（10.54）	（0.11）	（10.54）
Lev	0.008***	0.005	0.008***
	（5.49）	（1.39）	（5.52）
Roe	0.001	0.006	0.001
	（0.30）	（0.80）	（0.31）
Soe	-0.009***	0.004	-0.009***
	（-8.63）	（1.58）	（-8.60）
Turn	-0.001	0.814***	0.007
	（-0.03）	（10.54）	（0.24）
Eps	-0.001	-0.001	-0.001
	（-1.59）	（-0.30）	（-1.60）
Age	0.000***	0.000	-0.000***
	（-3.19）	（1.02）	（-3.16）
_cons	0.020**	0.250***	0.023**
	（2.17）	（9.96）	（2.41）
Year	Control	Control	Control
Ind	Control	Control	Control
N	13474	13474	13474
Adj.R2	0.160	0.079	0.120
Prob>F	0.000	0.000	0.000

4.3. Robustness test

4.3.1. Endogenous test

The previous research shows that R&D investment can significantly reduce the cost of equity financing of enterprises. As the cost of equity financing decreases, low-cost sources of funding give companies the incentive to invest more in R&D activities. This is a good thing as a virtuous circle between corporate R&D investment and equity financing costs. However, it brings difficulties to the research on the influence relationship between them. The two-way causality brought about by this virtuous circle has caused the endogenous problem in the study of this article. In order to solve the endogenous problem caused by the two-way causality, this paper adopts the instrumental variable method to perform the two-stage least squares regression on the model, in order to solve the endogenous problem caused by the two-way causality. Drawing on the research of Zhou Mingshan, Zhang Qianqian, and Yang Dan (2017)[8], this paper uses the industry's annual average R&D expenditure capitalization as an instrumental variable.

The instrumental variable method test results are shown in Table 4. In one stage, the instrumental variable coefficient is 0.012 and is significantly positive at the level of 0.01. The weak instrumental variable test F value is 74.315, which is greater than 10, indicating that the choice of instrumental variables in this article is reasonable. In the second stage, the coefficient of R&D investment and equity financing cost is -0.336, and it is significantly negative at the 0.05 level, and the P value of the over-identification test is 0, indicating that the instrumental variable test supports the previous research results. The effect of enterprise R&D investment in reducing the cost of equity financing has not been affected by the endogenous problems of mutual cause and effect.

Table 4 2sls Instrumental Variable Method

	First Stage	Second Stage
Var	R&D	COC
R&D		-0.336**
		(-1.99)
Captialize	0.012***	
	(8.62)	
Size	-0.000	0.003**
	(-0.17)	(2.37)
Lev	-0.026***	0.004
	(-7.97)	(0.55)
Roe	-0.013***	-0.006
	(-5.20)	(-1.50)
Soe	0.001	-0.010***
	(0.71)	(-3.59)
Turnover	-0.009	-0.366***
	(-0.44)	(-12.45)
Eps	-0.003***	0.000
	(-3.36)	(0.19)
Age	0.001***	0.000
	(8.22)	(0.39)
_cons	0.037**	0.067***
	(2.14)	(2.63)
Year	Control	Control
Ind	Control	Control
N	12174	12174
Adj-R2	0.09	0.12
Prob>F	0.000	0.000
Overidentification test:P-Value		0.000
Weak identification test Robust F-statistic (insturments)	74.315	

4.3.2. Bootstrap Mediating Effects Test

Table 5 reports the results of the Bootstrap test. In the test of the mediating effect of corporate competitiveness, the coefficient of direct effect is not much different from the regression coefficient of R&D investment and equity

financing cost in the previous article. It is significantly negatively correlated at the level of 0.01 and the upper and lower limits of the BC95% confidence interval are both less than zero. It shows that the R&D investment of enterprises can reduce the cost of equity financing. In the test of indirect effects, the upper and lower limits of the BC95% confidence interval of corporate competitiveness are both less than zero, indicating that the mediation effect exists. Sobel's test mediation effect accounts for 17.56%. The above conclusions are consistent with the previous test results of the mediation effect, which further proves the robustness of the empirical results of this article.

Table 5 Bootstrap Mediating Effects Test

Mediating Variable	HHI	
Effect type	Direct effect	Indirect effect
Estimate	-0.02892365	-0.0061590
Std.Err.	0.01101611	0.0016797
95% Conf.Interval lower limit	-0.0544287	-0.0090677
95% Conf.Interval upper limit	-0.0098266	-0.0026374
P>|t|	0.00	0.00
Sobel-Goodman Mediation Tests	17.555718%	

5. CONCLUSION AND INSPIRATION

This paper uses data from China's listed companies from 2010 to 2019 as a sample to empirically study the impact of R&D investment on equity financing costs, and study the mediating role of corporate market competitiveness in the impact of R&D investment on equity financing costs. The study found that R&D investment can reduce the cost of equity financing of enterprises by improving the competitiveness of enterprises in the market.

Based on the above research conclusions, this article puts forward the following policy recommendations: companies should increase the importance of R&D activities, send positive corporate innovation signals to the market, and attract equity investors. At the same time, the expected remuneration of equity investors to enterprises is affected by the competitiveness of enterprises in the market. Enterprises should make a reasonable allocation of funds between R&D investment and market expansion, and actively transform R&D results to enhance market competitiveness, thereby reducing their own equity financing costs.

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