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Financing Capacity Impact: Small & Medium Enterprise Research and Development Investment

Ge Dong Xia
Professor, Harbin University of Commerce, School of Accountancy, Harbin, China

Abstract:
R&D investment is the main driving force for technological innovation, and a steady source of fund is he key to business R&D investment. Research taking 2009-2013 period sampling small medium technology enterprises from Shen Zhen Stock market and explore the impact of corporate finance ability towards R&D investments. The article use profitability, operational, solvency, ability to grow, enterprise size as five affect variables of small medium technology corporation R&D investment. The result shows that the profitability of R&D expenses have a significant negative impact, but the investment has a major positive impact on R&D personnel; operational, solvency have obvious positive impact on R&D expenditures; corporation sizes, ability to grow have substantial negative on R&D expenditures and R&D personnel. Further analysis showed that the regional difference of the enterprise affects the relationship between financing capacity and R&D investment.

Keywords: *Financing Capability, R&D Investment, Variable Analysis*

1. Introduction

Technological innovation is the revolutionary power that constantly move society forward, is the key factor in promoting economic growth, but also maintain the core competitiveness in the market, it is the fundamental driving force and source of developing sustainability. Corporation R&D is the driving power of enterprise developing sustainability; the problem of how to improve the R&D investment quality and enhance research efficiency is the hot topic in theoretical study field. The existing studies about R&D investment factors could probably be classified as macro and micro two perspectives. Wei hong Ma (2011) analyzed 67 small medium companies' sampling data, she pointed out tax incentives and government subsidies have contributed to the enterprise R&D investment. Li wei Chen and Xiao yong Dai (2012) also had a study about R&D investment distribution and R&D investment intensity factors based on 2005-2007 year 300 000 industrial enterprises sampling data. Most of domestic scholars had studies about R&D investment factors based on Micro level and from enterprises' perspective. The majority of the research discussed the how does corporate management effects R&D investment from angles like structure of board, incentives of board, composition of equality; however, compare with western developed countries our R&D investment density remain to be improved, the lack of funds has been the restriction of technology innovation. Xiao Hong Chen and her colleagues (2012) based on small medium public traded companies sample data proved that the extra financial resources would promote R&D investment. R&D investment is the major driving power of technology innovation for small medium technology enterprise. Therefore, this paper using small medium technology companied as starting point to discuss how financing capacity affect R&D investment, this research will have positive guiding suggestions.

2. Theory Analysis & Research Hypothesis

This study analyzed, summarized existing researches, and concluded the indicators that small medium technology companies need to consider while financing the equality. And using SPSS21.0 software based on factor analyze method concluded five comprehensive financing factors, they are profitability factor, firm size factor, operational ability factor, solvency factor and growth capacity factor, and using this five factors as the analytical variables for financing capacity.

2.1. Profitability

Caifen Zou (2013) based on our domestic information technology industry analysis the enterprise capital structure affect R&D investment, the result shows that the profitability has the positive impact on R&D investment. Jizhong Wu (2015) using new starting entrepreneurship 2007-2012 sample data as study object, concentrated on the relationship between companied ability character and R&D investment, the result showing the profitability have positive impact on R&D investment. Because of the fiercely competitive environment technology industry have, it is crucial to maintain the innovation power, and to have a share in the market. As the result, compare with the traditional industry, information technology enterprises trend to do more investment for research and development under limited financial resources. Based on the above analysis we have this hypothesis need to be tested:

- Hypothesis 1: Small medium information technology enterprises, profitability has positive impact on R&D investment.

2.2. Size of Firm

R&D investment in recent years has changed along with the enterprise scale. Shefer and Frankel (2005) in study about influence factor about R&D investment identified, for information technology companies the form size is negative related with R&D investment. Tongliang an (2006) had a research about Jiang Su province manufacturing enterprise. The research result shows that the small medium large company R&D investment enforcement have obvious inclined V-shaped trend in Jiang Su province. Therefore, among technology small medium large enterprise how does the firm size affect R&D investment and will that result consistent with scholars' conclusion worth discussion. Based on this concern, we promote below hypothesis:

- Hypothesis 2: Small medium information technology enterprises, firm size has negative impact on R&D investment.

2.3. Operational Ability

Haisheng Chen's (2010) study about how cash flow impact on R&D investment strength. Through 2003-2008 domestic public trade company she points out that in non-state owned domestic public traded company, listed cash flow and R&D investment strength have significant positive relationship. Rongxin Sun (2012) based on 199 electronic information technology public traded companies provide in the sample, he concludes that stock turnover rate and R&D investment intensity have great positive effect. Cash flow, stock turnover rate both reflected the turnover ability, stronger turnover capability indicates a company has better chance of develop and survive. Specifically, within small medium sized technology corporation, most of the operational cash flow came from internal equity financing and it is more favor of company's R&D investment. Based on the above discussion we have this hypothesis assumption:

- Hypothesis 3: Small medium information technology enterprises, operational ability has positive impact on R&D investment

2.4. Solvency

Chuangfeng Dai (2012) using Shang Hai manufacturing public traded companies 2007-2010 sampling data as research object, pointed out domestic public traded company have positive relationship between R&D investment and solvency. YU Song (2013) based on domestic Shen Zhen stock market stream A share public treaded company year 2009-2011 data, her research about R&D investment factors identified that company's solvency has great impact for R&D investment. Solvency is the most directly benefit protection from shareholder and investor's perspective. As the result a company with better solvency rate definitely with attract more investing opportunity, which will provide more adequate funding for R&D investment program. Based on that we have below hypothesis:

- Hypothesis 4: Small medium information technology enterprises, solvency have positive impact on R&D investment.

2.5. Growth Capability

In David's research, he indicates that R&D investment will promote the future growth of a company, a company with more growth potential will be more motivated to increase R&D investment, in order to maxim company's expanding opportunity. Technology innovation is the first driving power of technology small medium enterprises' development. It is important of constant R&D investment, continuity of product improvement, to ensure the leading position within the field. Company with better grows potential will constantly investing for more research and development program in order to crate broad growth opportunity. As conclusion we have below hypothesis:

- Hypothesis 5: Small medium information technology enterprises, growth capability has positive impact on R&D investment.

3. Research Design

3.1. Sample Selection & Data

This article using technology small medium enterprise as research object, select 2009-2013 non-balanced sampling data. According toNational Bureau of Statistics Division's criteria for technology small medium enterprise, classified petroleum, chemical, electric, machinery, equipment, medical, pharmaceutical and information technology industries related corporation as small medium technology enterprise. Meanwhile, this paper screening the study sample though below exception: (1) exclude company identified as *ST, ST within research interval; (2) exclude company related with this study but with inconstant database. Based on the exceptions this study has 386 sampling enterprise, in total of 1563 observation point. In addition, this research required related data is support from Guo Tai a database (CSMAR). During this research public traded company R&D expense and technician amount not been provided by annual reported declaration, this part of data will be collected manually according to key word search based on annual report. The data process software used in this study are SPSS21.0, Stata 12.0, Excel.

3.2. Variable Definitions

3.2.1. Explained Variables

R&D investment: R&D investment an important condition for the company's technology innovation, consist of human resources, financial support and material investment three perspectives. And considering human resources and financial support is more important factors, this article choice R&D expenditure ratios and R&D technician input ratios represent the R&D investment variables. Within this discussion R&D expenditure ratio as "R&D expenditure/Revenue", R&D technician input ratio as "R&D technology/ Total number of employee".

3.2.2. Explanatory Variables

Financing capacity: according to related research, this paper selected 14 indicators as evaluation of corporate finance capacity factor analysis. Through KMO value (0.654) and Bartlett testing value (0), it brings the study to further analysis of chosen indicator, and got five finalized comprehensive factors, this five comprehensive have 86.43% cumulated contribution of this study. See table 1 for each comprehensive factor presentation.

Variable Type	Variable Concept	Variable Symbol	Variable Select Method &Description
Explained Variables	R&D Expenditure	Invest	R&D expenditure/Revenue
	R&D Technician Input	Tech	Technician count/total employee count
Explanatory Factor	Profitability Factor	EP	Return on equality/Return on asset/Earning per share
	Size of Firm Factor	Size	Total asset ratio/Revenue ratio
	Operational Ability Factor	Operation	Operating cycle, Inventory turnover, Total asset turnover
	Solvency Factor	Lev	Liquidity ratio, debt ratio, tangible net debt ratio
	Growth Ability Factor	Growth	Total asset growth rate, Revenue growth rate
Controlling Factor	Years of Public Traded experience	Age	Year of company being public traded, based on annual report
	Leadership Structure	Dual	President and Manager combined position as 1, President and Manager as two positions as 2
	Share Density	First5	The proportion of the shareholding of the top five shareholder

Table 1: Variable Definition

3.2.3. Controlling Variable

Considering R&D investment not only affected by financing capacity, but also affected by other causes, according to related researches, this paper selects five controlling variables: Public traded years of experience (Age), Leadership structure (Dual), Share density level (First5), Period (Year), and industry (Industry).

3.3. Model Selection

Based on research's assumption, establish the following model:

Invest（Tech）= b0 + b1EP + b2Size + b3Operation +b4Lev + b5Growth + b6Age + b7Dual+b8First5+b9Industry+b10Year+e （1）

4. Empirical Analysis

4.1. Descriptive Statistics

According to the Table2 statistic results, the average of R&D expenditure is 0.050, the standard deviation is 0.045, which means domestic technology small medium enterprises have relatively low R&D expenditure, company's R&D cost intensity need to be increased. The average technician input rate is 0.221, standard deviation is 0.180, compare with minimum value, maxim value and all quintile there is imbalances of R&D investment visible presence though all selected sampled enterprise. The public traded year average rate is 3.700, standard deviation is 2.982, it is clearly to recognized that our domestic small medium technology firms are experience rapid developing period. The leadership structure has average rate of 1.617, standard deviation of 0.486, which identified that domestic small medium technology enterprise is more preferring to have separated president and manager position. The proportion of the shareholding of top five shareholder have average rate of 0.592, standard deviation of 0.155, the median is relatively close to average rate, which present domestic small medium technology enterprise tend to have more share intensity.

Variable	N	mean	s.d.	min	25%	50%	75%	max
Invest	1563	0.050	0.045	0.000	0.030	0.381	0.056	0.248
Tech	1563	0.221	0.180	0	0.110	0.160	0.280	0.860
Age	1563	3.700	2.982	0	2	3	5	10
Dual	1563	1.617	0.486	1	1	2	2	2
First5	1563	0.592	0.155	0.142	0.481	0.601	0.706	0.980

Table 2: Descriptive Statistic of Sample Enterprise

4.2. Empirical Analysis Result

For the control of non-observed effect on ending result, this paper choice Hausman testing method. The ideology of Hausman testing method is: sample statistics obey degree K's distribution X^2, when H is greater than obvious level of critical value, the fixed effect is existed within this model. On the other hand, when H is smaller than critical value, the random effect model is chosen. In this paper, the test result rejected the random effects model, as the result we are using fixed effect model as the solution of regression model of endogenous problem.

Table 3 presents the regression result of this paper. According to column (1) and column (2) result from Table 3, it is easily to identify the profitability of the business and R&D expenses is positive related at 1% level. Profitability and R&D expenses have negative relationship that is contrast as hypothesis, the reason could be for the small medium technology company who is experience profit growth period, they might tend to deduce the R&D expenses in order to increase ending profit, thus hypothesis 1 is invalid. Secondly, by comparing the enterprise sizes and R&D expenditure's regression ratios, it is obvious to see firm size and R&D expenditure is negatively related. firm size will have negative effect on R&D technician input at 5% level, this is a great interpretation of the previous scholars' result of the "V" shape R&D behavior during corporation growth. Technology small medium company still in the position of beginning "V" concept, at this period of time company is usually focus more on expanding firm scale rather than R&D investment, it is easily to understand that expanding the firm scale is the bases of long term development, hence hypothesis 2 is proved. Moreover, giving the significance regression result of operational ability and R&D investment, operation ability and R&D expenses is positive related at 1% level, and negative related at 5% level. This present the better operational ability will have stronger financing capacity, this will provide a relatively adequate funding, while having the awareness of creative innovation is crucial for small medium technology company. In order to maintain the core competitive ability of a company it is necessary to increase R&D investment, this response support hypothesis 3. At the same time, solvency and R&D expenses is obvious positive related at 10% level, and positive related with R&D technician input at 5% level, the solid solvency ability is the most directly investment protection for the investor, with the adequate funding the company will be possible to have more R&D investment, this match hypothesis 4, thus hypothesis 4 proven. Lastly, growth ability and R&D expenditure is positive related at 1% level, and negatively related with R&D technician input at 1 level, growth ability and R&D technician input is not relevant, therefore hypothesis 5 is invalid. The reason might be because of a business having rapidly growing profit; it is easily to neglected R & D investment for new product.

4.3. Further Analysis

Considering level of economic development may have impact on the relationship of financing capacity and R&D investment. Based on above discussion, this paper will provide further classified for sampling company locations as East region and Middle West region, and processed separated regression testing on two sets of sample data. East region including Beijing, Tianjin, Hebei, Liaoning, Shanghai, Jaingsu, Zhejiang, Fujian, Shandong, Guangdong etc. 10 provinces and municipality city, these regions have relatively faster economic developing condition, the rest region is middle west region. According to table 3 column (3), (4), (5), (6) we could conclude that: (1) East district profitability and R&D expenditure impacts match main sample result, but in middle west region we could not find noticeable relevant relationship between profitability and R&D expenditure. The possible causes might be the difficulty of financing; the fund is invested to maximize the return in short period of time. We also find with profitability increased 1 unit, central west region R&D technician input will be greater than east district. The reason could be central west region have limited financial resources, so it is more important to select human talent, increased R&D technician input in order to maximize creative innovation. (2) Firm sizes and R&D investment is negative related this condition does not affect significantly by region, however, based on data result east region decrease slower, central west region decline faster. This indicate east region have better consciousness of R&D investment than central west region. (3) The improvement of operational ability will definitely promote R&D investment, with every 1-unit increase of operational ability; the relative investment in east region is considerably higher than central west region. It is easily to notice that based on the limited financial resources and lack of R&D awareness central west region have much less R&D investment compare with east region. (4) Solvency effect of east region match main sample test, but does not showing a liner relationship. The possible causes might be, central west region having an overall lower economic development level, financing is relatively more difficult, so solvency could not be considered as major measuring factor of R&D investment. (5) East district have growth ability and R&D investment positive related, which matched main sample test, though growth does not show perceptible linear correlation with R&D technician input, the possible cause might be the long term enterprise already having an existing R&D team, and it will not have substantial change within short period of time. For the company located at central west region, the growth ability does not affect R&D investment significantly, because central west market is less competitive, rapid growing firm without external competitor do not need to spend a lot of financial resources on research and development investment.

	Main Sample		Central West Region		East Region	
	(1)	(2)	(3)	(4)	(5)	(6)
	Invest	Tech	Invest	Tech	Invest	Tech
EP	-0.0026***	0.0111***	-0.0016	0.0195***	-0.0028***	0.0100***
	(-0.377)	(3.57)	(-0.97)	(2.69)	(-3.57)	(2.86)
Size	-0.0063***	-0.0116**	-0.0076***	-0.0188**	-0.0063***	-0.0095**
	(-5.54)	(-2.45)	(-4.00)	(-2.23)	(-4.52)	(-2.06)
Operation	0.0066***	0.0042**	0.0055***	0.0013**	0.0077***	0.0080***
	(7.25)	(2.07)	(4.21)	(2.22)	(6.46)	(2.74)
Lev	0.0015*	0.0072**	-0.0006	0.0060	0.0016*	0.0065
	(1.83)	(2.01)	(-0.28)	(0.65)	(1.73)	(1.63)
Growth	-0.0019***	-0.0001	0.0002	-0.0003	-0.0027***	0.0005
	(-3.51)	(-0.00)	(0.19)	(-0.07)	(-3.99)	(0.18)
Age	0.0014	0.0088**	0.0028	0.0126*	0.0009	0.0082**
	(1.47)	(2.56)	(1.63)	(1.82)	(0.83)	(2.04)
Dual	-0.0009	-0.0115	-0.0074**	-0.0349***	0.0014	-0.0044
	(-0.53)	(-1.53)	(-2.49)	(-2.59)	(0.68)	(-0.49)
First5	0.0027	-0.0114	0.0077	0.0096	0.0017	-0.0084
	(0.42)	(-0.41)	(0.62)	(0.17)	(0.22)	(-0.26)
Year	yes	yes	yes	yes	yes	yes
Indus	yes	yes	yes	yes	yes	yes
Cons	0.0340***	0.1730***	0.0331***	0.1790***	0.0341***	0.1680***
	(5.03)	(6.22)	(2.79)	(3.47)	(4.25)	(5.12)
N	1553	1553	347	347	1206	1206

Table 3: Regression Result

*Note: ***, **, * present at 0.01,0.05,0.1level more obvious; t value within brackets*

5. Conclusion and Forecast

This paper using 2009-2013 small medium technology enterprise panel data as testing sample, research on financing capacity and R&D investment effect relationship, based on the analysis, we have following conclusion.

Firstly, technology small medium enterprise should raise awareness of innovation. Technology innovation is the driving power of technology small medium enterprise development, and also is the support of maintaining core competitiveness of the firm. However, technology innovation could not live without financial support and professional technician. This circumstance require enterprise continually support R&D investment, should not focus on short term profit, should not sacrifice R&D investment to increase financial return because of short term profitability and grow. The only way to protect enterprise's brand and leading position in the market is maintain awareness of creative innovation, planning long term project, continually support R&D input, keep improve product and technology.

Secondly, government should introduce appropriate polices to guiding R&D investment in Central West region. Compare with east, Central West region's economy is not as developed, the financial system is not as fully established, thus the problem of financing for small medium technology enterprise is the obstacle of development. Technology small medium enterprise is the most energetic and promising element in domestic innovation system. Government should provide supportive guiding function, and solve the financing problem they are facing. This study suggest government should launch provincial entrepreneurship guiding fund, building the communication channel between social capital and technology small medium enterprise, directing social capital invest in technology small medium firm to get more financial support. Suggest company increase R&D investment; encourage corporations to have a new development concept that is high technology level, low resource consumption, less environmental pollution. Not only achieve sustainable development system but also contribute to upgrading industrial structure.

Thirdly, since it is proven the year of public traded experience have positive impact of R&D technician input, which explained with more experienced company it is easier to recognize the importance of R&D technician input. This inspired the enterprise that has smaller scale, shorter year of experience and limited financial resources increase R&D technician input, allow innovative talents maximize the result. In the less developed area such as Central west region, leadership structure has great impact on R&D investment, which identified that because of the special nature of central west region and the character of technology small medium enterprise, the appropriate centralized management will allow company leader to make decision easier, improve the efficiency of management and better for long term development.

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