

Analysis of Influence Factors on Scientific and Technological SMEs' Financing Based on DEMATEL

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Abstract. Capital is the booster which is support the scientific and technological SMEs growing from embryonic stage to growth stage, it also one of the important scarce resources that makes the scientific and technological SMEs mature. This paper not only has a theoretical analysis on the influencing factors on scientific and technological SMEs' financing but also has a quantitative analysis which uses the DEMATEL method. The analysis is sought to identify the important factor of the influencing factors on scientific and technological SMEs' financing and the relationship between each factors. This can optimize the financing environment of scientific and technological SMEs and make appropriate recommendations in constructing a healthy financing system.

Keywords: Financing; Scientific and technological SMEs; DEMATEL

1. Introduction

SMEs is an integral part of our economy. At the same time the development of technology industry has become the key power which decide the comprehensive national strength and the prospects for development, on the one hand the development of scientific and technological SMEs in China has contributed to the growth of GDP, on the other hand the scientific and technological SMEs provide the technical support and intellectual assurance for economy, technology, information, military, health care, agriculture, energy and other industries. High investment of high-tech enterprise is the premise of high returns, that is why Capital is the booster which is support the scientific and technological SMEs growing from embryonic stage to growth stage, it also one of the important scarce resources that makes the scientific and technological SMEs mature, so the enterprise's development and growth has been severely constrained by the financing. The financing of the SMEs has been an urgent problem which the enterprise and government all want to address. Therefore, research and analysis of influencing factors on the financing of scientific and technological SMEs has an important significance for the healthy development of scientific and technological SMEs.

Stiglitz and Weiss (1981) published a classic paper "Credit rationing in incomplete information market" in "American Economic Review", this article firstly analyzed the phenomenon of credit rationing according to the perspective of information structure comprehensively and systematically.

Bygrave and Timmons (1992) calculated the relationship between the net profit of investment and a variety of exit channels, and then they found that entrepreneurial enterprises publicly listed through risk capital market and venture capital firms choose to exit through the venture capital market is a more profitable way.^[1]

Wu Jie, Li Xirong (2006) considered that the concept about financing of SMEs is unenlightened, the financing method is single, the risk awareness is light, the credit is low, the benefits is poor. It is these problems which lead to difficulties in financing.

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Liu Xuefeng (2009) proposed that innovative enterprises requires a lot of capital, but the current financing system restricted the development of the scientific and technological SMEs, if the financial system especially the financing system cannot reform, there can not have a breakthrough development in scientific and technological industry.^[2]

Through the analysis of the literature, we can find out there are many factors must be considered in financing activities, but the factors are all around cost and risk, cost and risk constraints with each other. The financing of scientific and technological SMEs is study based on the costs and risks and according to four aspects; they are enterprise itself, markets, economic conditions and policy systems.

2. Influencing Factors on the Financing of Scientific and Technological SMEs

The financing of scientific and technological SMEs in China has the situation that over-reliance on endogenous financing, external financing has less proportion. Then this paper will analyze the influencing factors on the financing of scientific and technological SMEs according to enterprise itself, markets, economic conditions and policy systems and etc.

2.1 From the view of scientific and technological SMEs' own development

R&D capability is the core of scientific and technological SMEs. Generally the R&D capability is closely related to innovation, an enterprise's survival and development can only dependent on the constant innovation. The R&D capability can measure with the technical staff and expenditure.

Choosing the right financing strategy can enable enterprises to reduce financial costs and improve capital efficiency and even enable enterprises to be leaps and bounds. Indirect financing of enterprises, such as bank loans for enterprise development can be achieved through financial leverage, and corporate direct financing such as equity financing impact on enterprise development and management can be realized through the management control of the perfection of the system.^[3]

Commercial banks, venture capital and credit guarantee agencies are all like the enterprise that has good credit and good financial situation, so the enterprise with good credit and good financial situation can obtain the capital easier and the cost of financing is lower.

To scientific and technological SMEs, first-class human resources system , excellent entrepreneurs, managers, technical personnel and a large number of highly qualified technical workers are the key factors which deciding the fate of the enterprise.^[4]

2.2 From the view of scientific and technological SMEs' market conditions

The market condition should consider the industry environment and balances with financial institutions; it includes the mode of the competition, the timeliness of information, and the symmetry of the information. Financing has credit risk and purchasing power risk; the greater the credit risk is, and the greater the risk compensation will accordingly required.^[3] The greater credit risk the investors need to take, the more difficult to the financiers. The amount of financing channels of scientific and technological SMEs and financial institutions are all will affect the financing.

2.3 From the view of scientific and technological SMEs' economic conditions

Contraction and expansion of the economic cycle is crossing with each other, the cost of financing will change with it. In the expansion phase, market conditions changed for the better, the cost the enterprise wants to pay is increasing so as to expand the production scale and occupy the market. Instead, companies may only willing to rely on their own part of the re-investment of profits or even to repay the loan and reduce the scale of production. The development of different economic region is unbalanced, so the growth rate and basic features of industry is different in different economic region too.^[5]

2.4 From the view of scientific and technological SMEs' policy environment

This part mainly about the monetary policy, fiscal policy and science technology policy, at a certain stage the changes of policy will affect the financing of enterprises. When the central bank adopt austerity policy to reduce money in circulation in the market, rising interest rates will lead to the increasing of cost of

capital, thus affecting the cost of financing. Conversely, when the central bank adopted an expansionary monetary policy, financing costs will down.

The above is the analysis of influencing factors on the financing of scientific and technological SMEs; it shows more clear in figure 1.

A1:R&D capability of scientific and technological SMEs, A2: Financing strategy of scientific and technological SMEs, A3: Credit condition of scientific and technological SMEs, A4: Financial condition of scientific and technological SMEs, A5: Periodicity of scientific and technological SMEs, A6:Human resource situation of scientific and technological SMEs, A7: Development strategy of scientific and technological SMEs, A8: Industry environment of scientific and technological SMEs, A9: Information’s access of scientific and technological SMEs, A10: Credit risk and purchasing power risk of scientific and technological SMEs, A11: Financing system, A12: The economic cycle, A13:Economic region, A14:Policy and Regulation.

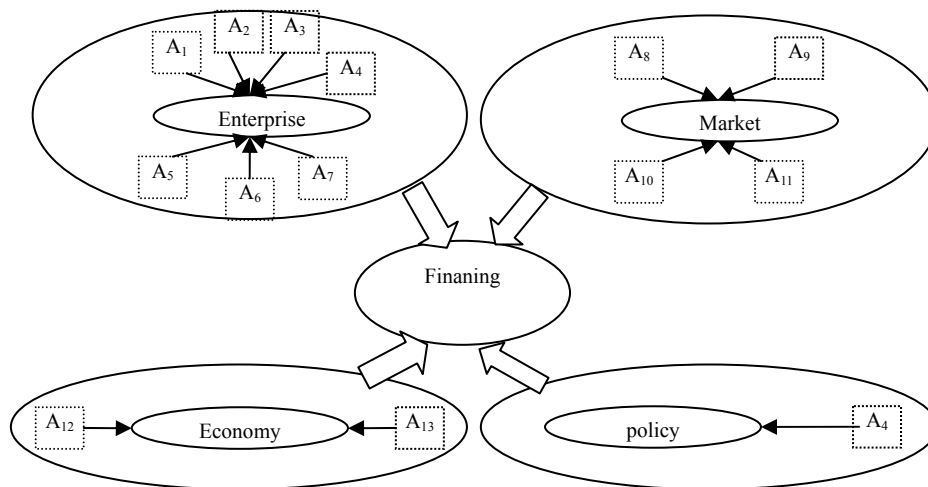


Fig.1: Impact factor system of scientific and technological SMEs’ financing

3. Used DEMATEL to Analyze

This paper has a theoretical analysis of the financing, and based on this, it has a quantitative analysis which uses the DEMATEL method. DEMATEL (Decision Making Trial and Evaluation Laboratory) is one of tools on decision making of multiple criteria and is able to transform qualitative issues into quantitative tasks for analysis.^[6] It constructs a direct influence matrix to calculate the influencing degree of factors. This paper seems the financing as a system, then their own capabilities, market environment, economic environment and policy framework is one of the subsystems.^[7] By analyzing we can identify the importance and the relationship among the factors, and then identify the key factors that affect the financing and at last provide a scientific basis for the financing decision.

The analysis based on DEMATEL is as follows:

Stage 1: Determine the impact factors of scientific and technological SMEs’ financing: A1, A2 ... A14.

Stage 2: Examine the relationships between different factors. Suppose the matrix $X = \{A_{ij}\}$, if the factor A_i have a direct impact on the factor A_j , then defines $X_{ij}=1$, or $X_{ij}=0$. The resulting initial matrix X is show in table 1.

Table 1 The initial matrix X

Factor	A ₁	A ₂	A ₃	A ₄	A ₅	A ₆	A ₇	A ₈	A ₉	A ₁₀	A ₁₁	A ₁₂	A ₁₃	A ₁₄
A ₁	0	1	0	1	1	1	1	1	1	0	1	0	0	0
A ₂	1	0	1	1	1	1	1	1	1	1	1	1	1	1
A ₃	0	1	0	1	1	0	1	0	1	1	1	0	0	0
A ₄	1	1	1	0	1	0	1	0	0	1	1	0	0	1
A ₅	1	1	1	1	0	0	1	1	0	0	1	0	0	1
A ₆	1	1	0	0	1	0	1	1	0	1	1	0	1	1
A ₇	1	1	1	1	1	1	0	1	1	1	1	1	1	1
A ₈	1	1	0	0	1	1	1	0	1	0	1	1	1	1

A ₉	1	1	1	0	0	0	1	1	0	1	1	0	0	1
A ₁₀	1	1	1	1	1	0	1	0	0	0	1	0	0	1
A ₁₁	1	1	1	1	1	0	1	1	0	1	0	0	0	0
A ₁₂	1	1	1	1	1	0	1	1	0	1	1	0	1	1
A ₁₃	1	1	1	1	1	0	1	1	0	0	1	1	0	1
A ₁₄	1	1	1	1	1	0	1	1	0	1	1	1	0	0

Stage 3: Calculate the comprehensive matrix T . $T=X(I-X)^{-1}$, the matrix I is a unit matrix. This stage can compose by the MATLAB software.

Stage 4: Calculate the influence degree e_i and influenced degree f_j . Influence degree is the summation of each row of matrix T and the influenced degree is the summation of each column of matrix T .

Stage 5: Calculate the cause degree and centrality. The influence degree add the influenced degree is centrality m_i . Error between the influence degree and the influenced degree is cause degree n_i , $m_i = e_i + f_i$, $n_i = e_i - f_i$. m_i indicates the importance of all the factors. If $n_i > 0$, n_i can be called the cause factor or it is result factor. The stage 2-5 is shown in table 2.

Table 2 The centrality and the cause degree of all the factors

Factor	A ₁	A ₂	A ₃	A ₄	A ₅	A ₆	A ₇	A ₈	A ₉	A ₁₀	A ₁₁	A ₁₂	A ₁₃	A ₁₄	e _i	f _j	m _i	n _i
A ₁	0.2	3.5	5.7	2.8	0	1.3	3.5	-6.8	7	12.3	3.5	-13.3	-11.1	-1.6	7	-0.9	6.1	7.9
A ₂	-0.2	-0.9	-0.5	-0.3	-0.1	-0.2	-0.5	0.6	-0.6	-1.1	-0.4	1.4	1.2	0.2	-1.4	-1.5	-2.9	0.1
A ₃	-0.6	-2.4	-4.6	-2.2	-0.3	-0.7	-2.4	4.9	-3.4	-8.4	-2.4	9.1	8.2	1	-4.2	-1.5	-5.7	-2.7
A ₄	-0.1	-1.5	-2.6	-1.7	0	-0.3	-1.5	2.9	-3	-5.2	-1.5	5.4	4.9	0.7	-3.5	1.4	-2.1	-4.9
A ₅	0.1	0.4	0.7	0.4	-0.5	0.1	0.4	-0.7	0.8	1.2	0.4	-1.5	-1.4	-0.1	0.3	-1.2	-0.9	1.5
A ₆	0.4	2.2	3.7	2	0.3	0.2	2.2	-4.5	3.9	7.9	2.2	-8.4	-7.3	-0.9	3.9	-1.1	2.8	5
A ₇	-0.2	-0.4	-0.5	-0.2	-0.1	-0.1	-1	0.5	-0.6	-1.1	-0.4	1.4	1.2	0.1	-1.4	-1.7	-3.1	0.3
A ₈	0.3	2.3	4	1.9	0	0.5	2.3	-5.2	4.5	8.2	2.3	-8.5	-7.7	-1	3.9	0.6	4.5	3.3
A ₉	0.1	0.4	0.7	-0.1	-0.5	0.1	0.4	-0.7	0	1.7	0.4	-1.5	-1.4	-0.1	-0.5	-1.9	-2.4	1.4
A ₁₀	-0.1	-1.5	-2.6	-1.2	0	-0.3	-1.5	2.9	-3	-5.7	-1.5	5.4	4.9	0.7	-3.5	6	2.5	-9.5
A ₁₁	0.1	0.3	0.4	0.2	0	0.2	0.3	-0.4	0.5	0.9	-0.2	-1.1	-0.9	-0.3	0	-1.5	-1.5	1.5
A ₁₂	-0.4	-1.7	-2.6	1.1	0	-0.8	-1.7	3.1	-3.5	-5.4	-1.7	5.9	5.6	0.7	-1.4	2.5	1.1	-3.9
A ₁₃	-0.3	-1	-1.3	-0.5	0	-0.6	-1	1.7	-2	-3.4	-1	3.7	2.7	0.4	-2.6	2.7	0.1	-5.3
A ₁₄	-0.2	-1.2	-2	-0.8	0	-0.5	-1.2	2.3	-2.5	4.1	-1.2	4.5	3.8	0.1	5.2	-0.1	5.1	5.3

Stage 6: Construct the Cartesian coordinate. The horizontal axis expresses the centrality and ordinate axis expresses the cause degree, it shows more clearly in figure 2.

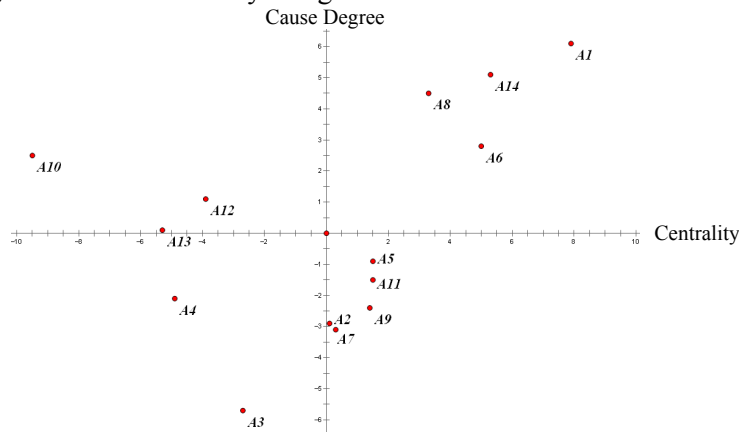


Fig.2 The Reasons - Results Chart

4. Conclusion

We can obtain seven causal factors from figure 2; they are A_1 , A_{14} , A_6 , A_8 , A_{11} , A_5 , A_9 . According to the measurement of the centrality which is larger than 0, A_1 is the biggest, A_{14} and A_8 is next to A_1 , the R & D capabilities of the enterprise has the greatest impact on SME financing. The scientific and technological SMEs must innovate constantly, establish a good image of enterprise, this can form a virtuous cycle between financing and the enterprise's development. Science and technology is the primary productive force in nowadays, so the state should give support in the policy, this can settle the financing puzzle.

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