

# Research on Financing Issues in Early Venture Capital Stage of Chinese Small and Medium-sized Enterprises in the Field of High-tech Innovation

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## ABSTRACT

Due to the entrepreneurial boom in China, more small and medium-sized enterprises have appeared and disappeared, and only a few of them can survive. Based on the background, this article used the method of DEA to investigate of the difference of development of small and medium-sized enterprises in Beijing, Shaanxi, Shanghai, and Shenzhen. Meanwhile, this paper chooses different regions in China to study the different region's enterprises' development in China, and give specific solution for their future development. The research shows that the differences between different regions' enterprises obviously have different background for developing, and the difference is huge. Based on our methodology, this article gives specific solution and advices for their future development.

**Keywords-** *Financing Issues; Small and Medium-sized Enterprises; High-tech Innovation*

## 1. INTRODUCTION

### 1.1 Research Background and Motivation

With the innovations and evolutions in high-technology development, it is more essential to keep on innovating in this field to occupy the future market opportunities. According to the relevant information, it indicates that huge difficulties will be faced by small and medium size high-tech companies in China when financing, especially at the early venture capital stage. Those companies are found difficulties in long-term survival for cash shortage due to finance pressure such as no guarantees made by evaluators that banks are unwilling to make investments. In addition, with the characteristic that more uncertainty in future economic benefits inflow, it is more difficult for high-tech development companies to attract investors. Those difficulties will lead to severe cash shortages and liquidity pressures for SMEs, which will eventually lead to short bankruptcy. Nowadays, with the introduction of relevant support policies and the dramatic development of financial technology, it is more essential to figure out the significant financing pressures for those companies and possible solutions to improve the survival prospects.

### 1.2 Literature Review

Those relevant literatures will be firstly implemented to support the basic idea of qualitative evaluations and quantitative methods of the methodology. In terms of qualitative aspects, the central idea of this article is derived from related theories and previous research results to pave the way for the introduction of quantitative analysis methodology. In addition, qualitative analysis theories are implemented to support the feasibility of quantitative analysis results after the completion of quantitative analysis. Quantitatively, by referring to the quantitative model or data analysis ideas of financing risk, reasonable adoption such as changing the variable set or analysis index in the process of data analysis will be implemented in this article to complete the risk analysis quantification model that reasonably interprets the intention of this article. Moreover, support methods will be introduced to valid the feasibility of the result. The supporting method is mainly hypothesis testing. By implementing a reasonable confidence level, the feasibility of the model will be proved within that level. In addition, DEA method will be introduced to evaluate the fitness of the model [1-3].

According to the review of relevant literature, possible drawbacks and flaws can be observed as follow: Firstly, the research relates to high-tech market is less common in China compared with western countries. Most of the articles focus on the qualitative evaluations on financing risks of high-tech companies and lack of the development of quantitative model for risk measurement, which focus on Chinese high-tech market [4]. Secondly, as lack of considerations on special conditions that more small and medium-sized private companies in Chinese economic market in most articles published in western countries, less bonus issued by the government can be covered by those companies. Therefore, less characteristics of Chinese economy might be covered in current research literatures. In addition, as a developing country, it is less even economic resources are distributed, which contribute to the different strategies, policies and conditions small and medium-sized companies might be faced. Therefore, different financing demands of early venture capital stage might be quite different in different areas categorized by the development situation of local economy, geographical characteristic, and culture. Therefore, to overcome those possible flaws in past research articles, there are some solutions provided in methodology to make this article: The difference between China and Western countries market characteristic will be considered. Based on the current situation of Chinese high-tech development market and with the detailed considerations on quantitative method of measuring financing risks faced by small and medium-sized companies in early venture capital stage, a detailed model of evaluating those risks will be provided in this article. In addition, qualitative evaluations will also be provided to evaluate the quantitative model. In addition, the uneven distributions of financial resources in China will be considered based on the detailed research in Chinese high-tech development market. In this article, four areas of China will be categorized based on the difference in economic development, geographical characteristic, and humanistic characteristic: Northern China with the central of Beijing, Southeast China with the central of Shanghai, Middle-west of China with the central of Chongqing and HongKong and Macao area. Furthermore, those differences will be implemented in making comparison between different areas to strength the persuasiveness of the results provided by the quantitative methodology. Finally, after the detailed quantitative and qualitative analysis, this article will provide possible solutions for those small and medium-sized companies in different part of China, which combines the methods of financial technology. Special support policies issued by the government, innovations in credit evaluation regulations of credit evaluators might be introduced but not be limited [5].

### ***1.3 Research Contents and Framework***

From the perspective of financial scholars, this paper makes a qualitative and quantitative analysis and assessment of the financing risks of small and medium-sized enterprises in the early stage of venture capital investment in China's high-tech innovation field and makes reasonable tests and supporting evidence based on the quantitative model of specific characteristic of Chinese development. Then, the quantitative model is further verified with qualitative analysis to ensure accuracy. Finally, a reason analysis of the above data analysis results will be provided, possible solutions will be proposed, and a conclusion will be made.

## **2.METHODOLOGY**

### ***2.1 Development Theory of Medium-sized Technological Enterprises***

The predecessor of data enveloping analysis is Farrell's concept of production boundary, which is based on equal production. The efficient production boundary is constructed by linear programming. If each decision making unit (DMU) is located above the production boundary, it indicates that the technology is efficient. Below the production boundary indicates that technical inefficiencies exist. In 1978, famous operational research scientists A.Charnes, W.Cooper and E. Rhodes first proposed the production efficiency evaluation model CCR model with multiple inputs and multiple outputs under the fixed return to scale (CRS). In this model, the production frontier is composed of the most efficient decision making units, and its efficiency is defined as 1. Meanwhile, the DMU within its frontier boundary is regarded as a pair of non-effective, its efficiency value. It's defined between 0 and 1. The assumption of constant return to scale (CRS) implies the DMU can be scaled up proportionally by increasing inputs. It's a pretty strict assumption to say that the size of the DMU doesn't affect its efficiency. Not in the case of imperfect competition, economic environment and even policy restrictions are not fitted. Thus, Banker, Charnes and Cooper(1984) proposed CRS. An improvement of the model to account for variable model compensation (VRS) (also called the BCC model), the assumption that returns to scale are variable enables the calculation of technical efficiency can remove the impact of scale efficiency. This paper uses the DEA method VRS model [6-7].

### ***2.2 Sample Data Selection***

In order to better reflect the overall situation of financing efficiency of technology-based firms in the analysis results, this paper elects 60 listed enterprises, 20 of which are located in Beijing, 20 in Shanghai and 20 in Shenzhen. This paper only selects the data of 2016 and 2017 to analyze the financing efficiency of technology-

based firms with direct financing ability in mainland China. This article selected firms from electronic equipment, pharmaceutical manufacturing, internet software application services and other industries. This paper analyzes the VRS model of Shanghai, Beijing and Shenzhen, and compares and analyzes the financing efficiency of the three regions.

### 2.3 Selection of Evaluation Index

#### 2.3.1 Selection of input index

According to the above definition, the input cost of financing efficiency mainly refers to the weighted capital cost of funds financed through various channels. Internal financing is generally considered to have no financing cost. Therefore, this paper decomposed the input index of financing efficiency into debt Service financing (Rd), equity financing cost (Re) and debt-to-equity ratio(DE) [8-9].

Denoted by X1 as Rd, which represents the cost of debt,  $a_1$  represents the interest paid by an enterprise for its debt,  $a_2$  represents the debt capital, A represents the income tax rate, and the debt capital D is equal to the total interest-bearing debt, which is equal to short-term loans, long-term loans due within 1 year, long-term loans, The sum of bonds payable and other loans, excluding accounts payable, bills payable, other payables and other commercial credit liabilities. According to existing research, there is the following relationship between them.

$$X1 = \alpha 1 * (1 - A) / \alpha 2 \tag{1}$$

Denoted by X2 as Re,  $B_1$  represents the risk-free return,  $B_2$  represents risk of market portfolio return rata,  $\beta$  represents a risk index used to measure the price volatility of individual stocks or stock funds relative to the overall stock market. According to existing research, there is the following relationship between them.

$$X2 = B1 + \beta * B2 \tag{2}$$

Denoted by X3 as DE,  $a_3$  represents equity capital, Debt capital is equal to the total interest-bearing liabilities plus equity capital, and it is also equal to the sum of ordinary shares plus minority equity. According to existing research, there is the following relationship between them.

$$X3 = \alpha 2 / \alpha 3 \tag{3}$$

#### 2.3.2 Selection of output index

This article uses return on total assets as one of the output indicators, marked by ROA.  $Y1$ 、 $X^1$  and  $X^2$  represent the ROA、 net profit and average total assets respectively, ROA reflects the utilization effect of enterprise assets on the whole, and shows the ability of

enterprise to obtain profits by using assets. According to existing research, there is the following relationship between them.

$$Y1 = \chi 1 / \chi 2 * 100\% \tag{4}$$

Denoted by Y2 as TATR,  $X^3$  represents main business income. TATR reflects the transfer speed of all assets from input to output during the operation period of an enterprise, and reflects the management quality and utilization efficiency of enterprise assets. According to existing research, there is the following relationship between them.

$$Y2 = \chi 3 / \chi 2 * 100\% \tag{5}$$

### 3. DEA MODEL

According to the rule of thumb, the number of samples required to construct VRS model is at least twice the sum of input and output items. In this paper, the sample size is more than twice the sum of the input and output items, which conforms to the empirical rule in use. In this survey, a total of 30 small and medium-sized listed companies in Shenzhen, Shanghai, Beijing and Shaanxi are selected. If ROA of some companies is 0, DEA is judged to be not effective. Deap2.1 software is used to solve the linear programming of DEA model, and the financing efficiency value of China's high-tech firms in 2018 is calculated. The evaluation results are sorted out and the chart is as follows:

TABLE 1 DEAS MODEL RESULTS OF DIFFERENT CITIES

Beijing			
	Combined efficiency	Pure technical efficiency	scale efficiency
DEA efficient	7 ( 23.34% )	7 ( 23.34% )	7 ( 23.34% )
Non-DEA efficient	23 ( 76.67% )	23 ( 76.67% )	23 ( 76.67% )
The efficiency of the mean	0.76	0.91	0.83
Shanxi			
	Combined efficiency	Pure technical efficiency	scale efficiency
DEA efficient	2 ( 6.67% )	3 ( 10% )	2 ( 6.67% )
Non-DEA efficient	28 ( 93.33% )	27 ( 90% )	28 ( 93.33% )
The efficiency of the mean	0.70	0.89	0.77

Shenzhen			
	Combined efficiency	Pure technical efficiency	scale efficiency
DEA efficient	6 ( 20% )	8 ( 26.67% )	6 ( 20% )
Non-DEA efficient	24 ( 80% )	22 ( 73.33% )	24 ( 80% )
The efficiency of the mean	0.80	0.96	0.82
Shanghai			
	Combined efficiency	Pure technical efficiency	scale efficiency
DEA efficient	7 ( 23.34% )	9 ( 30% )	7 ( 23.34% )
Non-DEA efficient	23 ( 76.67% )	21 ( 70% )	23 ( 76.67% )
The efficiency of the mean	0.75	0.86	0.86

It can be seen that Beijing, Shenzhen, Shanghai's comprehensive efficiency is generally higher than that of Shaanxi. The comprehensive efficiency of Shaanxi is only 0.7, and the scale efficiency of Shanxi is generally lower than the other three cities. However, the pure technical efficiency level of Shaanxi and other cities, there's not a huge distance. It can be seen that Shaanxi's financing efficiency and the comprehensive efficiency or scale efficiency was effected by its geographical location, and there is still a lot of potential for Shanxi to improve in the later stages. In general, the comprehensive efficiency and pure technical efficiency of the 30 small and medium-sized listed companies sampled in Shenzhen are generally higher than those of other cities, and the investment is obviously more efficient. In conclusion, among the 30 listed enterprises in each region investigated, the DEA efficiency rate in coastal areas is only about 20%-23%. Generally, the financing efficiency of small and medium-sized technology enterprises in China is still low, and the capital has not been utilized to the maximum extent.

#### 4.RESULTS AND DISCUSSION

Based on our analysis in part two, this paper used 60 enterprises each separately from Shanghai, Beijing, Shanxi and Shenzhen. The reason for choosing the four regions of China is that this article considers that each region of China has different development backgrounds and advantages and disadvantages. For example, Shenzhen has an absolute advantage over Beijing in terms of import and export. But Beijing is the capital of China, which means that Beijing has a competitive

advantage over other cities in terms of policy support. As one of the world's financial centers, Shanghai has a large number of enterprises, resulting in a fierce competitive environment. As a representative of traditional inland cities, Shanxi is completely different from coastal cities such as Shanghai and Shenzhen. For this reason, this article chooses to use companies in these four cities to analyze and research the problem. The studies have shown that there are some differences between the companies in the above four cities, but we are not sure that the reason for this difference is definitely the assumption we made, which means there are other possibilities. But what is certain is that the development background is definitely a factor, or even an important factor, that affects the development of small and medium-sized high-tech enterprises in different regions of China.

Specifically, this article see the general conclusion in part two emphasize the comprehensive efficiency in Shanxi's enterprises is lower than the other three cities' enterprises, and based on that clue, this article can have the analysis below. Shenzhen is a special case of China. According to the data analysis results of this article, it is found that compared with other cities, Shenzhen has a higher overall efficiency and technical efficiency. That's because Shenzhen has a really interesting history and it is the fastest growing city in China, and its proximity to Hong Kong is also a great factor for its rapid development. As a famous international port, Hong Kong has provided Shenzhen with so many resources and helped Shenzhen develop into a special economic zone. On the whole, the generally it has the advantages of huge number of resources and opportunities helps the enterprises in Shenzhen have a better chance and a higher comprehensive strength than other cities in China.

As the capital of China, local enterprises have many advantages in policy support. This is also a place where Beijing has more advantages than other places, which gives Beijing more opportunities for corporate development. Shanghai has been named as an economic center, financial center, and technology innovation center. The overall efficiency of its city is lower than that of Shenzhen in terms of data. This is mainly because Shenzhen has limited resources and unlimited competition. This is important for small and medium enterprises. Said to be a huge disadvantage. Competition usually means that there are winners and losers. Only winners can take away the resources of big cities like Shanghai and Beijing. This is why the overall efficiency and technical efficiency of enterprises in these two cities is lower than that of Shenzhen. As a traditional representative of China's inland cities, Shanxi has the advantage that it has a very long history, which makes Shanxi a very popular tourist city. Although Shanxi is rich in tourism resources, most of the ancient buildings cannot be demolished, which limits the land for the development of new enterprises. In addition, the

development of new enterprises in Shanxi also has an obvious defect, that is, the inland cities have no import and export capabilities. If local enterprises do export business, they need to invest a lot of money, which increases costs and restricts the development of enterprises.

In fact, the development of an enterprise needs to integrate resources and give play to its existing advantages, and also pay attention to the weaknesses and disadvantages of all enterprises in the development process, which is very important for all enterprises. The rational use of advantages and resources will be a very important factor to be considered when managing a company. With the rapid development of science and technology, this plays a key role in solving the plight of inland cities. In addition, it is also necessary to make full use of the advantages and resources of the enterprise to maximize its strengths and avoid weaknesses. Take Beijing as an example. As the capital of China, Beijing's geographical advantages and policy advantages are undoubtedly, and employment opportunities have increased significantly compared with other cities. But it also has obvious shortcomings. Beijing has more competitive pressures than other cities. At the same time, Beijing is also an inland city like Shanxi. Its resources are limited. Import and export business in Beijing is also difficult, especially during the epidemic. It can be seen from this that in the future, while making full use of superior resources, companies in Beijing need to enhance their competitive advantages in terms of innovation, technology, etc. The development of local companies that do not have export businesses will help

## 5. CONCLUSION

The research in this article shows that there are huge differences between SMEs in different regions of China, which are related to the development background and history of the city in which they are located. Through the above analysis, it can be found that the import and export capacity is a huge factor that affects the development of enterprises. It is difficult for urban enterprises like Shaanxi to operate this capacity, which means that it will have a huge impact on it. Another factor mentioned in this article is policy support. In a city like Beijing, although its import and export capabilities cannot be fully utilized, as the capital of China, policy support has enabled companies there to develop better. Companies in cities like Shaanxi can still export or import because it is closer to a port city than Shaanxi. This is why the overall efficiency and development of Beijing's small and medium-sized enterprises are better than other inland cities. Therefore, the best solution for the development of small and medium-sized enterprises in the future is to allow small and medium-sized enterprises to focus on their existing advantages and strive to transform their disadvantages into advantages and apply them to future

development. For example, Shaanxi's small and medium-sized enterprises have poor import and export capabilities, but they can use the city's long history to develop tourism and expand the company's customer base.

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