

A Study on the Factors Affecting the Financing of High-Tech SMEs

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Abstract

High-tech small and medium-sized enterprises (SMEs) have played an important role in promoting the development of Chinese national economy, but most of them are still facing the difficulty in financing. This paper determines the major factors affecting the financing for high-tech SMEs by using multiple linear regression (MLR) method and significance test then comes to a conclusion that enterprise scale, enterprise growth, tangible asset ratio and equity liquidity have positive relationship with the financing of high-tech SMEs while profitability, accumulation, non-debt tax shield and solvency have negative effects.

Keywords: High-Tech SMEs, Factors, Multiple Linear Regression, Significance Test

1. Introduction

During the continuous development of Chinese socialist market economy, small and medium enterprises are in a pivotal position in the national economy. High-tech SMEs, as the promoter of science and technology innovation, they are also playing an important role in some crucial problems, such as employment opportunities expansion, national economy development, scientific and technological innovation, industrial structure adjustment and upgrading (Xiao, North, 2012). But, high-tech SMEs in China are still facing some financial problems, such as lack of financing resources and low efficiency in financing. The business activities and development of these high-tech SMEs don't have enough funding. Financing problem becomes a bottleneck, limits and impedes the transformation from scientific and technological achievement to productivity (Feng, 2002). Specifically, the three major financing problems for high-tech SMEs are the uncertainty of operating, asymmetry of information and difficulty in property mortgage (Duan, 2009).

Technical innovation projects in high-tech SMEs are affected by more uncertainty than in traditional small and medium enterprises, so that the investors are confronted with more risk (Xiao, 2011). Plus, high-tech SMEs usually have longer period of development and less return on investment before they finish the technical innovation, this cannot satisfy the expectation for investors who are seeking for steady property and high return. In the meantime, there exists some relatively serious information asymmetry problems between high-tech SMEs and their investors, the core value of high-tech SMEs mainly reflected on their new technology and technical R & D results, this brings the uncertainty for the future economic benefits and enterprise development. Hence it is difficult for the investors to evaluate the credit of these SMEs, as well as the return and risk for their investment. Because new technology stands a low proportion in the enterprises' assets structure, which is the core value for high-tech SMEs, and is also the usable property guarantee for financing (Zhang, Miao, 2006).

Studying the influencing factors of high-tech SMEs' financing is of great practical meaning, this can provide a reference for investors who try to make decision on whether the enterprise is lack or over financing. It can also provide some advises on high-tech SMEs' operating and development, determining the best financing strategy according to their own situation. Many works about the financing problems and capital structure of SMEs have been done. Chung's work (Chung, 2007) study the dynamic adjustment capital structure of listed firms in China. Wu and Song summarized several causes for SMEs financing difficulties (Wu, Song, 2008). In this paper we will use multiple linear regression, based on the financial data of some listed high-tech SMEs in China, carried out the empirical analysis for the influencing factors to high-tech SMEs' financing.

2. Research of factors affecting the financing of China's high-tech SMEs

There are lots of researchers studied the influencing factors of high-tech SMEs' financing, this article referred to others' work, like Chen's work in (Chen, 2004), Yong's work in (Yong, 2004), and Tongkong's work in

(Tongkong, 2012), etc. In this paper we selected the following variables to build the multiple linear regression model.

2.1 Factors selection

2.1.1 Explained Variable: Capital structure of enterprise – Debt Asset ratio

This article will use debt asset ratio to stand for enterprises' capital structure. Debt asset ratio can be easily and correctly obtained and calculated, also, when considering the liability ratio of enterprises, investors usually use the debt asset ratio as a reference (Yong, 2004). Generally speaking, the lower the debt asset ratio, the capital funds is of greater proportion in the total assets of the enterprise. This also indicates a higher level of the credit of the enterprise, and easier for the enterprise to get the financing, and vice versa. Therefore, debt asset ratio can give a very good explanation of the enterprise's capital structure. To a certain content, this can also reflect the high-tech start-up's financing capacity.

2.1.2 Explanatory variable

1) Enterprise scale

Enterprise scale is of great importance to the financing activities. Compared to enterprises of relatively smaller scale, large scale enterprise has more transparency for corporate information, more stability for operating activities, and lower risk of broken. Enterprises of relatively larger scale usually disclose more information to outside world, have more transparency for information. Relatively larger enterprises are higher in operating stability, and are usually stronger to resist risks, hence are less likely to become broken, compared to relatively smaller enterprises. Relatively larger enterprises are more likely to get the financing opportunities. In this article, we chose the natural logarithm of the total assets of the enterprise (in billion yuan) to explain the enterprise scale.

2) Enterprise potential

Enterprise potential is an important factor for financing (Dongwei, Haijian, 2007). Enterprises of higher potential usually have better prospects, thus need more funding to support their development, therefore have stronger will for funding. Higher potential enterprises usually will have better income and return for investment. In this article, we chose main business's increasing rate of income to explain the potential of the enterprise.

3) Profitability

Enterprises have stronger profitability can usually create more cash flow from operating income, therefore the cash flow can be put into on-going projects or used to adjust the capital structure. Better profit can also bring the enterprises more attention from investors. Asset Profit Ratio/profit rate of asset is used to stand for profitability.

4) Tangible asset ratio

Enterprises can use the funds from debt financing for technical innovation projects, realize the transfer of wealth from creditor to major shareholders, thus generated the agency costs for debt. Tangible assets can be used for mortgage, thereby decrease the agency costs for debt. In this article, we will use the ratio between fixed assets and total assets to explain the tangible asset ratio.

5) Internal accumulation ability

Consider the development characteristics of high-tech SMEs, most high-tech SMEs will choose to use their own retained profits for internal financing, thereby grow their business. This leads to the relatively less external financing. Higher profit level implies higher net interest rates, which indicates the high-tech start-up has more retained profits for their development, thus enhanced their ability to use retained profits for internal financing, decreased the dependency to external funds. We will use the proportion of undistributed profits in total assets to stand for the internal accumulation ability

6) Non-debt tax shield

The tax relief result from depreciation of assets is called non-debt tax shield. Non-debt tax shield has an alternative effect for debt tax shield. In this article, we will use the ratio of depreciation of fixed assets to total assets for non-debt tax shield (Huang, 2006).

7) Debt-paying ability

Stronger debt-paying ability for enterprises indicates higher credit level in bank and financial institutions, therefore can obtain larger amount of loan. The quick ratio / acid test for enterprises reflect the ability for paying the debt. Fluid capital are those can be used to pay for current liabilities, after deducting non-fluid capital such as

fixed assets. With higher ratio of fluid assets in total assets, the enterprises' ability for paying current liabilities become stronger. In this article, we will use quick ratio to evaluate for the debt-paying ability.

8) Equity liquidity

The purpose for the investors are obtaining return, not holding the stock. Enterprises with higher market liquidity are more conducive for investors to control risks by capital withdrawal, thereby are more attractive to investors. In this article, we will use the ratio of circulating shares in total assets to evaluate the equity liquidity.

9) Time

The investment environments are different in different years; therefore, we will use the year as virtual variable to deal with the changes of the macro factors in the investment environment.

2.2 Construction of the Model

In order to study the relationship between enterprises' capital structure and enterprise scale, enterprise potential, profitability, tangible assets ratio, internal accumulation ability, non-debt tax shield, debt-paying ability, equity liquidity and time, we will construct a multiple linear regression model, fitting the sample data use regression, therefore determine the significant variable to the enterprises' capital structure. And in the end, analyze the logic behind how the significant variables affect the capital structure.

Our multiple linear regression model is as follows:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_9 X_9 + \varepsilon$$

In which:

Y: Debt asset ratio, which is the ratio of total debt to total assets

X1: Natural logarithm of total assets for enterprise scale

X2: main business's increasing rate of income for enterprise potential

X3: Net profit rate for total assets for profitability

X4: Ratio between fixed assets and total assets for tangible asset rate

X5: Proportion of undistributed profit to total assets for internal accumulation ability

X6: Ratio of depreciation of fixed assets to total assets for non-debt tax shield.

X7: Quick ratio to evaluate for the debt-paying ability.

X8: Ratio of circulating shares in total assets to evaluate the equity liquidity.

X9: Time for time variable

ε : residual for disturbance items

β_i : Regression coefficients to each variable, where $i = 1, 2, \dots, 9$.

Because time is a virtual variable, therefore, in multiple regression model, we define for 0-1 variables D_{2012} , D_{2013} , D_{2014} and D_{2015} for years. $D_{2012} = 1$ means that the time variable is 2012, in the meantime time variable D_{2013} , D_{2014} and D_{2015} are all set to be 0 and so on. If the time is set to be 2011, then $D_{2012} = D_{2013} = D_{2014} = D_{2015} = 0$, therefor, 4 0-1 variable contains the time variable for 5 years (Tang et al., 2011).

By converting time to virtual variable, the linear model becomes.

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_8 X_8 + \gamma_9 D_{2012} + \dots + \gamma_{12} D_{2015} + \varepsilon$$

2.3 Descriptive Statistics of the Variables

To build the data set for the numeric experiment in this literature, listed high-tech SMEs are main research subjects. Because listed companies will disclosure their financial data to public. However, those companies which are marked with ST were not used as subjects due to poor management, to reduce the errors. And we require complete financial data from 2011 to 2015, companies without loss of data were chosen and their data were used to construct the dataset. By these criteria, we chose 76 high-tech SMEs stocks of SME Board (Shenzhen Stock Exchange) as research subjects from the Wind database.

As we can see from Table 1 above, small and medium-sized technology-based companies are all sharing the same features below: Firstly, the debt to assets ratio is low with an average ratio of 36.60%. Also, the growth of the companies is high, with an average proportion of tangible assets of 22.40%, which means the proportion of the fixed asset of the total assets is low.

Table 1. Descriptive Statistics of the Variables

Variables	Y	X ₁	X ₂	X ₃	X ₄	X ₅	X ₆	X ₇	X ₈
Mean	0.3660	3.0468	0.1801	0.0743	0.2240	0.1213	0.0220	2.3217	0.7068
STD	0.1854	0.7975	0.4352	0.1450	0.1319	0.3394	0.0170	2.1793	0.2332
Minimum	0.0422	0.5853	-0.6872	-1.0967	0.0013	-5.9681	0.0018	0.2719	0.2047
Maximum	0.8913	6.2648	5.9850	0.4833	1.0180	0.4729	0.1779	16.853	1.0000

2.4 Numeric Result

We use the multivariate linear regression equation model to fit the data of 75 small and medium-sized enterprises in China, the result of the regression model is conducted as follows:

Table 2. Result of regression model

R	R ²	Adjusted R ²	Residual STD
0.7801	0.6085	0.5966	0.1167

As we can see from Table 1 above, R² of regression model is 0.6085 and adjusted R² is 0.5966, which means 59.66% capital structure of SME can be explained by the factors we chose.

To verify if the factors we chose have significant relationship with capital structure of SME or not, we conduct F-test as follow:

$$H_0: \beta_i = 0, \text{ for all } i = 0, \dots, 9$$

$$H_1: \beta_i \neq 0, \text{ exist } i = 0, \dots, 9$$

Table 3. F-test for multivariate linear regression model

	Degree of Freedom	Sum of Square	Mean Square	F-value	p-value
Model	12	8.0713	0.67261	50.05	<0.0001
Error	366	4.9185	0.01344	-	-
Corrected Total	378	12.990	-	-	-

From Table 3 above, we reject the null hypothesis since $p < 0.05$, which means that detp asset ratio is significantly effected by enterprise scale, enterprise potential, profitability, tangible asset ratio, internal accumulation ability, non-debt tax shield, debt-paying ability and equity liquidity.

To verify which factors have significant effect on the capital structure of SMEs, we conduct t-test for each variable and the result is shown as follows:

Table 4. t-test for each variables

Coefficients	Estimate Value	STD	t-Value	p-Value
β_0	0.1741	0.0426	4.086	<0.0001
β_1	0.0792	0.0083	9.517	<0.0001
β_2	0.0371	0.0149	2.484	0.0134
β_3	-0.0673	0.0578	-1.164	0.018
β_4	0.1673	0.0753	2.222	0.027
β_5	-0.2326	0.0573	-4.063	<0.0001
β_6	-1.5743	0.4327	-3.639	<0.0001
β_7	-0.0446	0.0032	-13.908	<0.0001
β_8	0.1543	0.0298	5.172	<0.0001
Y ₂₀₁₂	0.0029	0.0192	0.150	0.8809
Y ₂₀₁₃	-0.0318	0.0199	-1.597	0.1112
Y ₂₀₁₄	-0.0508	0.0200	-2.535	0.0117
Y ₂₀₁₅	-0.0682	0.0202	-3.371	<0.0001

As we see from the result, p-value for variables are below 5% confidence interval. Especially we conduct F-test

for because we have converted time to dummy variable. F-value and p-value for the regression model are 4.5040 and 0.0014 respectively. Therefore we conclude there exist significant relationship between capital structure of high-tech SMEs with the factors at 5% significance level. Therefore, the regression model is:

$$Y = 0.1904 + 0.0795X_1 + 0.0399X_2 - 0.1114X_3 + 0.1673X_4 - 0.1979X_5 - 2.8071X_6 - 0.0425X_7 + 0.1554X_8 + 0.0041D_{2012} - 0.0293D_{2013} - 0.0490D_{2014} - 0.0673D_{2015}$$

2.5 Collinearity Inspection

It is necessary to examine if the variables are collinear to ensure the effectiveness of the above regression model, because collinear variables may result in the increases of the regression error. Noticed that variable X_9 is a virtual variable, which means that there is no collinearity between X_9 and others variables. So X_9 is not included in the following collinearity inspection.

Firstly, we examine it by the scatter plot of each variable:

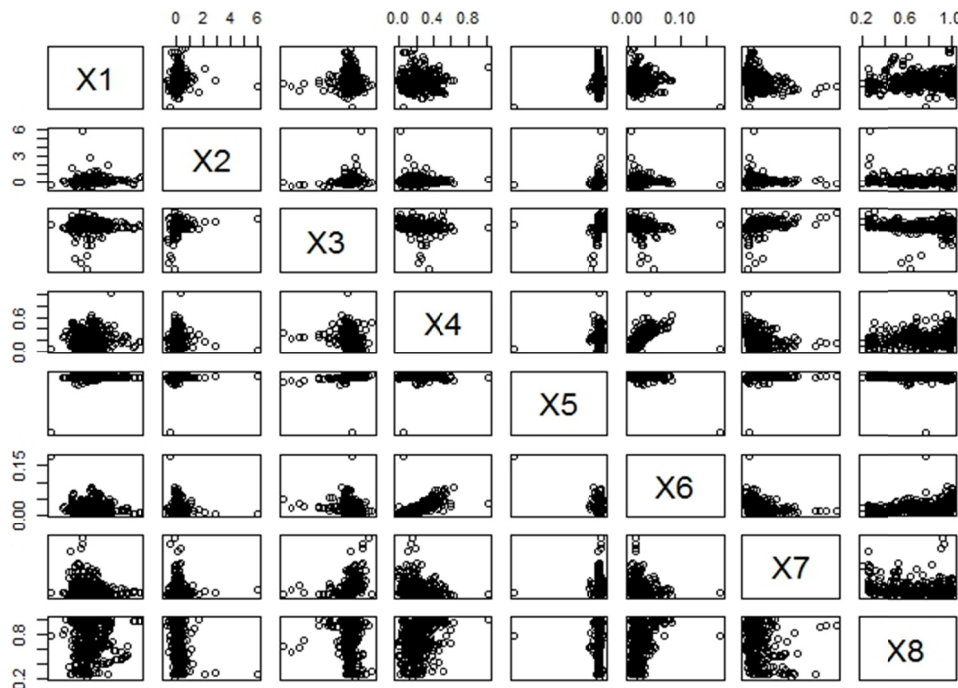


Figure 1. Scatter plot of each variable

From an intuitive point of view, there are not obvious collinearity between other variables. In order to accurately estimate whether there is a collinearity problem in the multiple linear regression model, we perform collinearity test on the explanatory variables in the regression model by applying variance inflation factor (VIF). VIF refers to the ratio between the variance when there is collinearity relationship between variables and the variance when there is no multiple collinearity. Generally, $VIF < 10$ indicates there is no serious collinearity between variables, and $VIF > 10$ signify there is collinearity between variables. The calculation result of VIF of explanatory variables is shown as follow:

Table 5. Result of VIF

X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8
1.22	1.18	1.30	2.77	1.97	3.42	1.44	1.34

The maximum value of VIF is 3.42, so we conclude that there is no collinearity relationship between explanatory variables.

2.6 Result Analysis

From the result of regression coefficient, enterprise scale, Enterprise potential, tangible asset ratio and equity liquidity are positively correlated with the capital structure of SMEs. Because enterprises with larger scale have higher transparency in information, strong operational stability, and lower risk of bankruptcy to get more

financing opportunities. And enterprise potential represents the development prospects of enterprises, high growth of enterprises means that it will have a better development opportunities in the future, the value of the enterprise will be improved. Investors are more willing to invest stocks with potential, thus gaining greater returns in the future. As investors do not always hold enterprises' stocks, they need to withdraw from or stop their investment, so investors are more willing to invest in high liquidity stocks to ensure that their funds turnover.

Profitability, internal accumulation level, non-debt tax shield and debt-paying ability are negatively correlated with the capital structure of small and medium-sized enterprises. The profitability of the enterprise is high, and its operating cash flow is sufficient, which can be financed internally, thus reducing the dependence of corporate activities on external financing. As China's high technology SMEs tend to financing internally, the higher the level of internal accumulation, the enterprise will give priority to the use of undistributed profits, corporate development to reduce the dependence on external financing, and thus lower asset-liability ratio. Non-debt tax shield has a substitute for the role of non-debt tax shield, with more non-debt tax shield, SMEs will be relatively less debt.

Although the tangible asset ratio is under 5% significance level, it is the lowest level of all variables, indicating that tangible asset ratio has no significant effect on the capital structure of high technology SMEs. Because the crucial value of high technology SMEs is mainly in its grasp of high technology and technology such intangible assets. In the process of financing investors are more willing to consider the core competitiveness of high technology SMEs, fixed assets is not the most important factor for considering. The level of profitability of small and medium-sized enterprises is also lower than most variables. As during the development of the life cycle, high technology SMEs will be in a low profit or even non-profit state for a period of time, high technology SMEs will spend a lot of time and money on technology research and development to ensure the future development of enterprises, resulting in lower profitability of the moment.

3. Model Improvement

In the previous section, we performed multiple linear regression of the model. However, the adjusted R² of the model is 59.66%, meaning that the result of the regression model does not perform well. In this section, we improve the regression model by box-cox transformation. Box & Cox (Box, Cox, 1964) proposed a parametric power transformation technique to reduce anomalies such as non-additivity, non-normality and heteroscedasticity (Sakia, 1992). In this case, we transform the explained variable by the following form:

$$y_i^{(\lambda)} = \begin{cases} (y_i^{\lambda_i} - 1) / \lambda_i & \lambda_i \neq 0 \\ \log y_i & \lambda_i = 0 \end{cases}$$

To do this transformation for Y , we use three packages: MASS, car, and caret in R. The value of λ is -0.132. So, we substitute Y with $Y = (Y^\lambda - 1) / \lambda$.

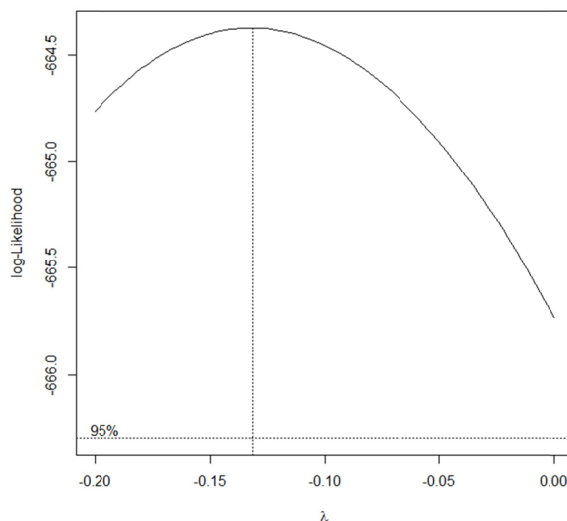


Figure 2. The value of λ

Then we perform multiple linear regression on the model, and the result is shown as follow:

Table 6. Result after Box-Cox Transform

Coefficients	Estimate Value	STD	t-Value	p-Value
β_0	-1.4118	0.1378	-10.240	<0.0001
β_1	0.2158	0.0261	8.245	<0.0001
β_2	0.1101	0.0473	2.334	0.020
β_3	-0.3693	0.1835	-2.012	0.045
β_4	-0.1788	0.2505	-0.714	0.476
β_5	-0.3899	0.1804	-2.161	0.031
β_6	-6.9902	2.2219	-3.146	0.002
β_7	-0.2522	0.0104	-24.133	<0.0001
β_8	0.3691	0.0939	3.929	<0.0001
Y_{2012}	-0.0121	0.0604	-0.200	0.841
Y_{2013}	-0.0842	0.0626	-1.346	0.179
Y_{2014}	-0.1214	0.0630	-1.927	0.055
Y_{2015}	-0.1987	0.0636	-3.122	0.002

After the box-cox transformation the R- square of the regression model increased to 75.56%, which implies that the relationship between the asset-liability ratio of high-tech SMEs with the scale of enterprises, the potential of enterprises, the profitability, the ratio of tangible assets, the level of internal accumulation, non-debt tax shield, solvency, equity liquidity and time variables is not simply linear. The positive and negative relation between explained variable and explanatory variables are the same as previous result.

4. Conclusions and Suggestions

4.1 Conclusions

In this paper, we use multiple linear regression to analyze the data of 76 listed high-tech SMEs in China, and analyze the main factors that affect their capital structure with the following results:

- ① Enterprise scale, Enterprise potential, tangible asset ratio and equity liquidity are positively correlated with the capital structure of SMEs while Profitability, internal accumulation level, non-debt tax shield and debt-paying ability are negative.
- ② Tangible asset ratio has the lowest level of significant effect on the asset-liability ratio of all the influencing factors, indicating that the tangible asset ratio has little effect on the financing structure of high-tech SMEs.
- ③ There exist non-linear relationship between the asset-liability ratio of high-tech SMEs with the scale of enterprises, the potential of enterprises, the profitability, the ratio of tangible assets, the level of internal accumulation, non-debt tax shield, solvency, equity liquidity and time variables.

4.2 Suggestions

- ① To obtain more financing opportunities, the primary goal for business managers is to enhance their own quality, strengthen technological innovation, improve the net value of new products, thereby enhancing the core competitiveness of enterprises to ensure their own growth, and gradually improve enterprise scale. And the needs of funds are different during the different stages of development of SMEs. Enterprise managers should combine the development of enterprises to determine the appropriate business development cycle of the financing strategy, making the value of enterprises enhance.
- ② High-tech SMEs have their own life cycle for development, in different life cycle, its own business has different characteristics, while the funds have different degrees of need. Investors should be on the growth of SMEs to have a certain understanding of life cycle of high-tech SMEs to establish an effective credit evaluation system for them and develop appropriate investment strategy.
- ③ Technological innovation of High-tech SMEs and project R & D will be affected by many uncertain factors. In order to reduce the loss of financing opportunities due to information asymmetry, enterprises and investors should establish an effective platform for information exchange, through the exchange and communication between the two sides to reduce the information asymmetry between enterprises and investors.
- ④ Besides equity financing and debt financing, high-tech SME can integrate funds into other ways and broaden the financing channels such as finance leasing, asset securitization and the internet financial platform. Different financing methods have different financing efficiency and financing costs, enterprises should develop their

financing strategy based on actual needs, choose the appropriate financing methods and control financing costs.

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