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Research on Financing Preference and Performance of Sci-tech Finance for Sci-tech SMEs

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Abstract. To solve financing problem of sci-tech SMEs in different enterprise life cycle, this paper uses the panel data of Chinese sci-tech SMEs from 2010 to 2016, establishes individual fixed effect model to examine financing preference of sci-tech finance including government finance, capital market, commercial bank, and venture capital, and to assess financing performance for sci-tech SMEs. The results show that: as a whole, capital market channel positively promotes the innovation and development performance of sci-tech SMEs; but in different enterprise life cycle, different sci-tech finance preference have different performance on sci-tech SMEs. In the growth period, the capital market and government finance are the main channels. In the mature period, the capital market and commercial bank support are the chief factors. But in the recession period, SMEs primarily rely on government finance.

1. Introduction

Science and technology (sci-tech) finance is the effective coordination of sci-tech and finance to boost the national economy and enterprise innovation development. Sci-tech small and medium enterprises (SMEs) play a increasingly important role in scientific and technological progress, achievements transformation and industrial upgrading. However, such enterprises usually have the characteristics of high investment, high risk, high return and large proportion of intangible assets, and are faced with financing difficulties. In addition, enterprises in different stages of the life cycle have different financing preference and financing performance due to their different development conditions and risks. Most of the related researches are analyzed from the macro level, while few studies focus on the micro level of enterprises, especially sci-tech SMEs. There are relatively few researches on the choice of financing channels in different life cycle stages. Therefore, this paper aims to provide appropriate financing scheme and financial channel selection for SMEs in different life cycle, to improve financing performance of sci-tech finance support, better solve the problem of financing difficulties, and promote innovation and development of enterprises.

2. Literature reviews

Sci-tech finance is a systematic and innovative arrangement of financial instruments, financial systems, financial policies and financial services to promote the development of science and technology, the transformation of achievements and the development of high-tech industries. Schumpeter (1912) believed that banks is important to technological innovation. Claessens (2003) and Sasidharan (2015) have stated that in countries with high financial development level, enterprises tend to get external funds more easily, the cost of financing is lower, and the enterprises grow better. Moreover, scholars found that government financial support (Pergelova,2014), capital market (Brown, 2009) and venture capital (Guariglia,2014) have significant impact on enterprise.

The performance of sci-tech finance refers to the rate of financial input and the sci-tech output. Financial input usually include sci-tech investment, venture capital investment, enterprise R&D expenditure, scientific and technological loan, scientific and technological capital market and science and technology insurance, etc, while sci-tech output contain the number of three major retrieval papers, the number of patent, output value of new product, transaction volume of technology market and so on.

Haire (1959) studied the enterprise problem with the "life cycle" view for the first time. He thought that the enterprise is like a life body, and it also needs to experience the process from birth to death, from prosperity to decay. The life cycle of an enterprise is usually divided into initial stage, growth period, maturity period and recession stage (Cameron,1981). The criteria and measurement methods of the division are not determined, mainly including: (1) single index analysis method, using the scale of enterprise, sales growth rate, patent number, or main business income growth rate as the basis for dividing life cycle stages; (2) comprehensive index analysis, that is using several indexes to divide life cycle stages; (3) cash flow group, Dickinson (2011) explained the relationship between cash flow (operating cash flow, investment cash flow and fund-raising cash flow) and enterprise life cycle.

3. Empirical analysis and results

3.1 Sample selection and enterprise life cycle division

The initial samples for the analysis are 910 listed companies on the SME board of Shenzhen stock exchange from 2010 to 2016. Then according to the standard of technology-based SMEs: the proportion of the number of sci-tech personnel accounts for more than 10% of all employees, the total amount of R&D cost accounts for 2% of the total sales income, and quantity of intellectual property rights in the period of validity are more than 1. The total number of samples are 223 in the end.

The division of life cycle in this paper is simplified into three stages of growth, maturity and recession. We select five indicators including operating income growth rate, net profit growth rate, R&D investment growth rate, total assets growth rate and business duration to divide life cycle. Firstly each indicator is sorted from high to low rank, and then the high, medium and low groups are assigned by trisection, evaluating 2-1-0 or 0-1-2 respectively. Finally, the whole samples are divided into three stages according to the total score. 0~3 is divided into growth period (69 samples), 4~6 is divided into mature period (84 samples), and 7~10 is divided into recession period (70 samples).

3.2 Variable explanation and data source

Financing preference and financing performance are mainly measured from two aspects: sci-tech finance input and innovation and development performance of enterprises.

Dependent variable is performance of enterprises (*performance*), which is judged by innovation capability (measured by the proportion of enterprise R&D investment to income, the number of patents, the proportion of technical market turnover to government R&D expenditure, and the proportion of new product income to the main business income) and development capability (measured by capital growth rate, total asset growth rate, net profit growth rate, business profit growth rate and business income growth rate). Data are from annual reports of listed companies, www.eastmoney.com/, www.sipo.gov.cn/, statistical yearbook of China and high and new technology industry statistical yearbook. The above 9 indicators are standardized by mean-standard deviation method firstly, and then the comprehensive index performance is calculated by factor analysis.

Independent variables are government finance (*gov,* local government expenditure on science and technology divided by local fiscal expenditure), capital market (*marke,* the amount of local stock financing divided by local GDP), commercial bank (*bank,* loan balance of local commercial banks divided by local GDP), and venture capital (*vc,* local venture capital divided by local GDP), and they are four kinds of input channels for sci-tech finance. Data are from www.stats.gov.cn/, the provincial securities regulatory bureau, the provincial statistical yearbook, national economic and social development statistics bulletin and www.pedata.cn.

In order to control the influence of other factors on the research results, business duration (*age*), net assets (*assets*), net profit (*profit*), asset-liability ratio (*lev*) and business scale (*size*) are selected as the control variables. Among these, *assets*, *profit* and *size* are processed logarithmically. The data come from the www.eastmoney.com.

3.3 Econometric model

Due to research financing preference and performance of sci-tech finance for SMEs in different enterprises' life cycle, panel model of full sample (i=223), growth period (i=69), mature period (i=84) and recession period (i=70) from 2010 to 2016 is built as follow:

$$performance_{it}=\alpha+\beta_1 gov_{it}+\beta_2 market_{it}+\beta_3 bank_{it}+\beta_4 vc_{it}+\beta_5 age_{it}+\beta_6 assets_{it}+\beta_7 profit_{it}+\beta_8 lev_{it}+\beta_9 size_{it}+\mu_{it},\ i=1,\ \ldots,\ 223/69/84/70,\ t=1,\ \ldots,\ 7 \quad (1)$$

Where, α is intercept, β_1, …, β_9 are the regression coefficient, μ_{it} is error term, i represents the cross section, and t represents the time. The model is estimated by the weighted least square method.

3.4 Panel data regression results

In this paper, the panel data model is estimated by the weighted least square method based on the individual fixed effect model. The results are shown in Table 1.

Results from full sample panel model, regression coefficient of *market* is 2.31, passes the significance test, shows that sci-tech finance input from the capital market channels for enterprise development performance has a significant and positive influence. Every 1% increase in sci-tech finance input from *bank* and *vc* will reduce the development performance of SMEs by 0.26% and 3.67% respectively. The *gov* does not pass the significance test, although it has a negative impact.

Results from growth panel model, capital market (3.70) still plays a significant positive role, which promotes the development of enterprises to a higher degree in the growth stage of life cycle than the full sample regression coefficient of 2.31 without considering the life cycle. Investment from commercial bank (-0.54) and venture capital (-1.64) is still unfavorable to SMEs, but the negative influence of venture capital is weakened. Although government finance(2.29) does not pass the significance test, it plays a positive role.

Results in maturity stage, capital market (1.92) still plays a significant positive role, but the degree of its role is significantly reduced from 3.70 to 1.92 compared with the growth stage. Although commercial bank (0.16) are not statistically significant, it is positive in the development of enterprises. Both government finance (-6.89) and venture capital (-4.44) are significantly negative to enterprises.

Results in recession stage, capital market (-0.70), commercial bank (-0.51), and venture capital (-4.33) all have a negative impact on the development of enterprises. Although fiscal investment (1.52) does not pass the significance test, it plays a positive role in the development of enterprises.

As for the control variables, business duration (*age*) has a significant and negative impact on each stage of the enterprise life cycle, indicating that the longer the business duration is, the weaker its sustainable development performance will be. Net profit (*profit*) can significantly promote the development of enterprises. Net assets (*net*), asset-liability ratio (*lev*) and business scale (*size*) have no significant influence in the full sample, growth period and maturity period.

Table 1. Regression results of panel data model

	full sample		growth		mature		decline	
	Coeff.	Prob.	Coeff.	Prob.	Coeff.	Prob.	Coeff.	Prob.
c	0.19	0.02	0.33	0.09	0.04	0.73	0.60	0.00
gov	-1.39	0.26	2.29	0.36	-6.89	0.00	1.52	0.51
market	2.31	0.00	3.70	0.00	1.92	0.00	-0.70	0.47
bank	-0.26	0.00	-0.54	0.01	0.16	0.22	-0.51	0.00
vc	-3.67	0.00	-1.64	0.10	-4.44	0.00	-4.33	0.00
age	-0.07	0.00	-0.05	0.00	-0.09	0.00	-0.04	0.00
net	0.20	0.34	0.11	0.80	0.83	0.00	-0.89	0.04
profit	0.05	0.00	0.08	0.00	0.05	0.01	0.05	0.01
lev	0.20	0.56	0.04	0.96	0.99	0.05	-1.47	0.04
size	0.25	0.25	0.27	0.53	-0.32	0.29	1.15	0.00
R^2	0.73		0.74		0.74		0.60	
F-statistic	14.57	0.00	14.03	0.00	14.24	0.00	7.20	0.00

4. Conclusions

This paper develops individual fixed effect model, uses cross-section weights least square method to discuss the financing preference and performance of sci-tech finance for sci-tech SMEs from the perspective of enterprise life cycle. The following conclusions are drawn.

(1) Capital market among sci-tech financial investment channels plays a key role in improving innovation and development performance of sci-tech SMEs, government finance plays a supporting role, and the role of commercial bank and venture capital is limited and sometimes even restraining.

(2) It shows that sci-tech finance input has a positive effect on SMEs, but in the different life cycle of enterprises, financing preferences have different performances. In the growth period, capital market is the main source and government financet is supplemented to improve innovation performance of enterprises. In the mature period, enterprises have a certain internal financing capacity, the external financing mainly depends on capital market, and commercial bank channel also plays a positive role. Government financial investment plays a guiding role in recessionary enterprises. In addition, no matter what life cycle the enterprise is in, venture capital plays a negative role.

(3) With the increase of business duration, the performance of innovation and development becomes weaker. The increase in net profit will promote the enterprise R&D investment.

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