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S&T Finance Network and Technological Innovation Performance: An Empirical Study of Chinese Science Park

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Abstract

Along with the economy globalization and the progress of science and technology, Chinese economy has been fleetly developing. Under the background of broad masses' entrepreneurship and innovation, studying how s&t finance network structure characteristics affects the technological innovation performance of high-tech SMEs has theoretical value and positive practical significance. Based on the theory analysis, we adopt the research method of questionnaire. Empirical study shows that: network structure characteristics have direct positive effect on the technological innovation performance of high-tech SMEs, especially the network density and centrality.

Keywords*: s&t finance network; network structure characteristics; high-tech SMEs; technological innovation performance*

1. Introduction

During the past decade, a large number of people especially the graduates have been establishing their own businesses, although, the sound of winter of capital incessantly lingers on. In September 2014, Alibaba group established IPO in the New York Stock Exchange, which arises the faith in Chinese s&t market. In 2015, combined with Xinhua web, Peking University Institute, technological innovation research center of Tsinghua University and other units, CNII and ISC launched the "2015 National entrepreneurship and Innovation propulsion engineering" (the "double hit project"), which encourage innovation and entrepreneurship, as well as inspire the market and social vitality. On the other side, in the context of economic globalization and information technology development, enterprises have been inseparable shared between the internal and external network communication and resource technical innovation.

The Zhongguancun National Demonstration Zone dates back to the "Zhongguancun Electronics Street" in the early 1980s. On March 13, 2009, the State Council approved the construction of the Zhongguancun National Demonstration Zone, and made the plan to build Zhongguancun a s&t innovation center with a global influence. Zhongguancun is the most intensive scientific, education and talent resource base in China. It boasts almost 40 colleges and universities like Peking University and Tsinghua University, and more than 200 national (municipal) scientific institution such as the Chinese Academy of Social Sciences and the Chinese Academy of Engineering. Zhongguancun's venture capital cases and investment amount every year account for about a third of the country's total. Today, the number of listed companies in the zone adds up to 254, comprising of 156 domestic and 98 overseas companies. As many as 38 enterprises have been listed on the Chinese Growth Enterprise Market, Zhongguancun plans to establish a national S&T financial innovation center that involves government and social funds, industrial and financial capital, and direct and indirect finances.

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2. Theoretical Background and Hypotheses

2.1. Science and Technology (S&T) Finance Network

In China, Sci- tech Finance was first mentioned in 1993, but until 2009 it was defined as a range of systematic, innovative arrangements of financial instruments, the financial system, monetary policy and financial services to promote scientific and technological development, the successful conversion and high-tech industrial development. What's more, sci-tech finance is a system consisting of government, business, market, social agencies and other activities, providing financial resources for science and technology innovation activities, and is a significant part of national science and technology innovation system and the financial system [1]. Building s&t financial system is critical to developing s&t finance practice. Yiguo believed s&t financial system should play a role of the banking, securities, insurance, trust, guarantee, under the guidance of the government [2]. Zelei & Shunfa mentioned as the "skeletons" of s&t finance construction, s&t financial system was supposed to follow life cycle, operation mechanism and risk prevention mechanism [3]. Shengzu & Yubo believed building multi-level financial system and improving the venture capital financing chain was needed [4]. Based on the study of Suzhou s&t finance, Yiguo & Daowei constructed a "s&t-finance" theoretical framework [5]. Liyi & Yi mentioned s&t finance network was a combination of s&t system and the financial system, featured as a complex giant system and complex network, and was inseparable of network structure, information transfer mechanism and collaborative innovation mechanism [6].

2.2. Technological Innovation Performance

The concept of technological innovation performance can be viewed as long-term growth opportunities in highly uncertain environments and has been defined in the number of ways. Following Hagedoorn & Cloodt, this study defined innovation performance as the results measuring by the extent of firm's inventions introduced to the market for narrowly, and broadly defined to the performances of inventions, technology and innovation from entire track process starting from conception generated to being introduced to the market [7]. Subsequently, Jian mentioned the concept of technological innovation performance as the efficiency of firm's technology innovation process, the outcomes of production and the contributions to business [8].

Prior knowledge in s&t finance provides evidence that financial investment results in product and market innovation, thus allows firms to achieve better performance. However, previous literatures did not consider the relationship among s&t finance network and technological innovation performance of high-tech SMEs. Therefore, the concept of s&t finance network has attracted considerable interest into our article, using a set of newly accessible SMEs' data. Our study present a rigorously and carefully empirical methods for compiling complete and reliable SMEs' data. The present sample contains data on 70 firms from Zhongguancun National Demonstration Zone. In this paper we test the following hypotheses:

H1: There is an obvious correlation between the structure characteristics of s&t finance network and the technological innovation performance of high-tech SMEs.

H2: The structure characteristics of s&t finance network influence the technological innovation performance of high-tech SMEs positively.

3. Methods

3.1. Data Collection and Sample

This paper takes sample of high-tech SMEs in Zhongguancun National Demonstration Zone as object of research. All the data come from questionnaire survey, and analyzed by SPSS 19.0. Questionnaire use Liket interval scale, each question item identified with the number from 1 to 5 represents "very inconsistent" to "fully comply" five options. Over 100 questionnaires were issued, 74 were recovered. Excluding the invalid samples, we had a total of 70 valid high-tech SMEs as the survey population. These constitute the sample of our empirical study.

3.2. Dependent Variables

Generally, technological innovation performance is measured as the standardization and summation of the research & development (R&D) effectiveness and efficiency, which is defined as the outlays invested and financed by the firm to carry out the innovation activities for the development of product or process innovation [9, 10], and is calculated as the firm's private expenditures on the R&D project [7]. In this study we introduce incremental to measure technological innovation performance, using variables such like market share expansion, organizational efficiency, patent increase, new products increase and so on.

3.3. Independent Variables

The overall development level of s&t finance network depends not only on the operating efficiency of individual actors-- high-tech SMEs, research institutions, government departments, financial organizations and social intermediary agencies--which located on the network node, but also on the characteristics, densities and intensities of the links between them. In this study we choose four independent variables to measure the structure characteristics of s&t finance network: network density (ND), network intensity (NI), network centrality (NC) and network reciprocity (NR). In this study, network density means the quantities and extent of link between nodes; network intensity describes the frequency of contact between nodes, and the efficiency of information transmission; network centrality measures the location of high-tech SMEs in network; network reciprocity measures equality and mutual benefit via resource sharing indicator.

4. Results

4.1. Descriptive Statistic of the Variables

Table 1 provides descriptive statistics for the dependent and independent variables. According to the data, high-tech SMEs keep closely contact with other institutions, have highly frequent contact, located in the center of network, and resource sharing a lot. In addition, the technology innovation level increase fast with the constantly market recognition.

Table 1. Descriptive Statistics

	Mean	Std. Deviation	N
ND*	3.177	1.0324	70
NI*	4.082	0.5173	70
NC*	3.993	0.6566	70
NR*	3.760	0.6781	70
TI*	3.841	0.6213	70

*ND: Network Density; NI: Network Intensity; NC: Network Centrality; NR: Network Reciprocity; TI: Technological Innovation Performance

4.2. The Analysis of Correlations

From Table 2, it shows:

(1) There is a significant positive correlation between TI and ND, Sig. (2-tailed)<0.01;

(2) There is a significant positive correlation between TI and NI, Sig. (2-tailed)<0.01;

(3) There is a significant positive correlation between TI and NC, Sig. (2-tailed)<0.01;

(4) There is a significant positive correlation between TI and NR, Sig. (2-tailed)<0.01.

Table 2. Correlation

		ND	NI	NC	NR	TI
ND	Pearson Correlation	1	0.394**	0.495**	0.532**	0.627**
	Sig. (2-tailed)		0.001	0.000	0.000	0.000
	Sum of Squares and Cross-products	73.536	14.515	23.169	25.700	27.743
	Covariance	1.066	0.210	0.336	0.372	0.402
	N	70	70	70	70	70
NI	Pearson Correlation	0.394**	1	0.735**	0.559**	0.587**
	Sig. (2-tailed)	0.001		0.000	0.000	0.000
	Sum of Squares and Cross-products	14.515	18.465	17.229	13.530	13.008
	Covariance	0.210	0.268	0.250	0.196	0.189
	N	70	70	70	70	70
NC	Pearson Correlation	0.495**	0.735**	1	0.787**	0.718**
	Sig. (2-tailed)	0.000	0.000		0.000	0.000
	Sum of Squares and Cross-products	23.169	17.229	29.746	24.180	20.208
	Covariance	0.336	0.250	0.431	0.350	0.293
	N	70	70	70	70	70
NR	Pearson Correlation	0.532**	0.559**	0.787**	1	0.698**
	Sig. (2-tailed)	0.000	0.000	0.000		0.000
	Sum of Squares and Cross-products	25.700	13.530	24.180	31.728	20.304
	Covariance	0.372	0.196	0.350	0.460	0.294
	N	70	70	70	70	70
TI	Pearson Correlation	0.627**	0.587**	0.718**	0.698**	1
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	
	Sum of Squares and Cross-products	27.743	13.008	20.208	20.304	26.634
	Covariance	0.402	0.189	0.293	0.294	0.386
	N	70	70	70	70	70

**. Correlation is significant at the 0.01 level (2-tailed).

4.3. Research Methods and the Establishment of Model

It is a simple analysis of the data from the sample firms, and only correlation between two variables is discussed there. In fact, the technological innovation performance is the result of various factors, so it is a multi-function. From the analysis of scatter diagram, it is obvious that there is linear correlation among these factors. Therefore, the method of multiple linear regressions may help to make further analysis.

$$Y = \beta_1 + \beta_2 X_1 + \beta_3 X_2 + \beta_4 X_3 + \beta_5 X_4 + \mu \quad (1)$$

Here, Y means technological innovation performance; X_1- X_4 refers to network density, network intensity, network centrality and network reciprocity, respectively; β_1 is intercept; β_2-β_5 are regression coefficients and, μ is random error.

4.4. Result of Multivariate Regression Analysis

In this study, Stepwise Regression method is operated until neither the regression model variables can be deleted, nor outside variables can be added. From Table 3, it shows only network density and network centrality remained in the regression model.

$$Y = \beta_1 + \beta_2 X_1 + \beta_4 X_3 + \mu \quad (2)$$

Here, Y means technological innovation performance; X_1, X_3 refers to network density and network centrality, respectively; β_1 is intercept; β_2, β_4 are regression coefficients and, μ is random error.

As shown in Table 3, for model 2, R^2 is 61.3%, which represents 61.3% of the total sum of squares (SST) of dependent variable can be explained by independent variables, reflects the multiple linear regression equation can adequately reflect the law of changes of dependent variable, technological innovation performance. R^2 Change represents the fluctuation of R^2, when add or delete some independent variables. For model 1, R^2 Change is 0.515, F Change is 72.328, its significance test is 0.000<α=0.01, which proves network centrality is a good predictor for technological innovation performance. For model 2, R^2 Change is 0.097, F Change is 16.873, its significance test is 0.000<α=0.01, which also proves network density is another good predictor for technological innovation performance. DW (Durbin-Watson) =2.042 ≈ 2, means residual sequence without autocorrelation.

Table 3. Model Summary [c]

				Change Statistics					
Model	R^2	Adjusted R^2	Std. Error of the Estimate	R^2 Change	F Change	df1	df2	Sig. F Change	Durbin-Watson
1	0.515[a]	0.508	0.4357	0.515	72.328	1	68	0.000	
2	0.613[b]	0.601	0.3923	0.097	16.873	1	67	0.000	2.042

a. Predictors: (Constant), NC
b. Predictors: (Constant), NC, ND
c. Dependent Variable: TI

From Table 4, it is known that in model 2, the total sum of squares (SST) =26.634, the regression sum of squares (SSR) =16.324, the residual sum of squares (SSE) =10.310, F-test of the regression equation is 53.042, its significance test is 0.000< α=0.01, which proves that it is sensible in statistics.

Table 4. Anova[c]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	13.728	1	13.728	72.328	0.000[a]
	Residual	12.907	68	0.190		
	Total	26.634	69			
2	Regression	16.324	2	8.162	53.042	0.000[b]
	Residual	10.310	67	0.154		
	Total	26.634	69			

a. Predictors: (Constant), NC
b. Predictors: (Constant), NC, ND
c. Dependent Variable: TI

From Table 5, both of the significance test of NC and ND indexes are 0.000<α=0.01, showing statistical significance in the regression equation. Hence, the model involved technological innovation performance and structure characteristics of s&t finance network is as following:

$$Y = 1.114 + 0.216X_1 + 0.511X_3 \quad (3)$$

Here, Y means technological innovation performance; X_1, X_3 refers to network density and network centrality, respectively.

Table 5. Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1	(Constant)	1.128	0.323		3.491	0.001		
	NC	0.679	0.080	0.718	8.505	0.000	1.000	1.000
2	(Constant)	1.114	0.291		3.827	0.000		
	NC	0.511	0.083	0.540	6.170	0.000	0.755	1.325
	ND	0.216	0.053	0.359	4.108	0.000	0.755	1.325

a. Dependent Variable: TI

5. Conclusion

There is a significant positive correlation between TI and ND, TI and NI, TI and NC, TI and NR, respectively. Therefore, one conclusion can be made that there is an obvious correlation between the structure characteristics of s&t finance network and the technological innovation performance of high-tech SMEs, which means H1 is tenable. The regression model shows the significant direct linear correlation between ND, NC and TI. In other words, some structure characteristics of s&t finance network could influence the technological innovation performance of high-tech SMEs positively, which proves H2 is partially tenable.

High-tech SMEs are supposed to make full use of resource advantages inside and outside, since the inherent features, like high-risk return on investment, labor-intensive and resource-intensive character. In s&t finance network, high-tech SMEs should expand and enhance ties and interaction with upstream and downstream enterprises, research institutions, government departments, financial organizations and social intermediary agencies, in order to stimulate innovation inspiration. Furthermore, high-tech SMEs should also maintain the idea of mutual equality to ensure the smooth flow of information and stability of the network structure, while using the advantages of core status to obtain the information superiority and control advantages.

In summary, this reported results shed light on the relationship between structure characteristic of s&t finance network and technological innovation performance of high-tech SMEs. Like most empirical studies, our study is limited in many respects, which in turn provide opportunities for the consideration of future research. First, the data set was not sufficiently large that we could be sure that the success to find positive effects of network density and network centrality on technological innovation performance is because the effects are there, or because the effects are too strong to be distinguished in the data. A larger study might also find positive effects among network intensity, network reciprocity and technological innovation performance, and would give better indication. Second, this study has not taken into account the strong ties and weak ties of network [11], hence we might missed some important effects of network intensity on technological innovation performance. It would be beneficial to extend this research in future studies by exploring above factors. These extensions of the current study would be to examine these

internal and external determinants that influence the relationship between structure characteristics of s&t finance network and technological innovation performance.

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References

[1] Z. Changwen, C. Chunfa and K. Yingkai. Science Publishers, Beijing **(2009)**
[2] X. Yiguo. The Chinese Banker. 5 **(2008)**
[3] X. Zelei., H. Shunfa and Y. Zhigao. Science & Technology Progress and Policy. 18, 28 **(2011)**
[4] G. Shengzu,, C. Yubo and Y. Wei. Commercial Times. 18 **(2012)**
[5] M. Youjia and M. Daowei. *Social Science Research.* 9 **(2012)**
[6] M. Liyi and Y. Yi. Science Research Management. 12, 34 **(2013)**
[7] J. Hagedoorn and M. Cloodt. Research Policy. 8, 32 **(2003)**
[8] G. Jian, W. Jianfei and W. Ping. Science Research Management. 2, 25 **(2004)**
[9] A.G. Hu. Journal of Comparative Economics. 1, 29 **(2001)**
[10] E. Ozcelik and E. Taymaz. Research Policy. 2, 37 **(2008)**
[11] M. S. Granovetter. American Journal of Sociology. 6, 78 **(1973)**

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