Managerial Ties and Innovative Performance: An Open Innovation Perspective[*]

Wang Qin[1], Gao Shanxing[2]
School of Management, Xi'an Jiaotong University, Xi'an, P.R.China, 710049
(E-mail: wangqinxjtu@gmail.com, gaozn@mail.xjtu.edu.cn)

Abstract   The value of the open innovation is now widely recognized, previous studies highlighted the importance of external factors as innovation sources, however, a key issue is still little known in the open innovation model is how firms acquire ideas and knowledge from external actors. Integrating social network theory and open innovation perspective, this paper explores the relationship between the firms' external managerial ties and their innovative performance in an emerging economic context. This study attempts to measure that impact by analyzing a sample of 270 manufacturing firms located in China. The results show how business ties and R&D ties can contribute to the firm's innovative performance by facilitating external knowledge acquisition. It demonstrates ties are valuable as a conduit for knowledge. Moreover, the role of business ties and R&D ties are different, R&D ties contribute to innovative performance more than a channel for knowledge flow. Our findings suggest several theoretical and practical implications in the field of R&D and strategic management.
Key words   Open innovation; Business ties; R&D ties; Knowledge acquisition

1 Introduction

This paper explores the relationship between the firms' external managerial ties and their innovative performance from an open innovation perspective. Open innovation models such as that of Chesborough (2003), von Hippel (2005), and Boudreau (2006) have suggested that openness could stimulate innovation by combining a large and diverse pool of external sources, leading to increased product diversity and better matching of products and consumer preference[1][2][3].

A key issue in the open innovation model is how firms acquire ideas and knowledge from external actors. The role of networks, communities, and linkages has come to the fore in investigations of innovative performance. The open innovation models have highlighted the interactive character of the innovation process, suggesting that firms rely heavily on their interaction with lead users, suppliers, and with a range of institutions inside the innovation system[2]. Managers in firms often invest considerable amounts of time, money and other resources to develop and maintain external social ties[4]. Ties are especially prevalent in emerging economies because of the 'institutional voids'[5]. Such managerial ties increase the ability to contact, acquire, use, and recombine new and existing knowledge[6]. However, the previous literature on open innovation has not yet investigated the role of social ties with external actors.

A social capital perspective posits that ties are valuable as a conduit for knowledge[7]. Particularly, managerial ties, which are defined as the boundary-spanning interpersonal connections of top managers [4,7], are very important mechanisms to acquire knowledge. There are many prior studies focusing on managerial ties with suppliers, customers, competitors, government[8], relatively few studies discuss the ties with universities and public research institutes.

Extending Peng and Luo (2000)'s study, we investigate the influence of managerial ties for external knowledge acquisition[8]. In doing so, we develop the concepts of managerial ties, define R&D tie as a specific type of managerial ties which mainly investigate the interpersonal relationships between top managers in firms and professors, scientists and engineers in universities and public research institutes. In this study, we incorporate ideas from the social capital theory into open innovation studies, an approach which may support an increased contribution of external knowledge and R&D to a firm's innovation. We found that knowledge acquisition play a mediating role in the relationship between managerial ties and firms' innovative performance.

The research is based on a statistical analysis of an innovation survey in Chinese manufacturing industries. The survey contains a sample of 270 manufacturing firms. The paper is organized as follows. First we explore the literature and examine the influence of external managerial ties on innovative

performance, develop the hypotheses. The next sections outline the method and describe the sample. Then we report the results and the final section contains the discussion and conclusions.

2 Theories and Hypothesis

Personal relationships have increasingly become a core component of innovation. According to social capital theory, there exists a micro-macro link from managerial connection to social capital and to a firm's performance[9]. More specific, interpersonal relationship is regarded as a main source for knowledge spillover and knowledge flows in innovation literature.

Although experienced massive and complex changes during its institutional translation[10], China possesses its own idiosyncrasies. First, the Chinese government has maintained a central role in economic activities[11]. Moreover, the Chinese business environment is under the heavy influence of the historical and cultural tradition[12]. As a result, the utilization of personal ties is still prevalent and crucial.

2.1 Ties and firm's innovation

Business activities are closely embedded in networks of interpersonal relations[13]. Managerial ties are defined as executives' interpersonal contacts with external entities[8]. Many studies have proved that managerial ties have critical influences on firms' strategies[14] and could be a source of innovation [6].

Ties are vital to help companies acquire necessary external resources and information which will enable them to be continually innovative and to produce new products and services and achieve superior performance[13,14]. Managerial ties are especially prevalent in emerging economies, since the 'institutional voids' force managers to rely on personal relationships to substitute for formal institutional support[5]. Empirical studies have demonstrated that managerial ties could increase performance for firms operating in emerging economies such as China[8]. In this case, business ties and R&D ties should be an important issue in firm's innovation.

Hypothesis 1a The strength of a firm's business ties is positively associated with its innovative performances.

Hypothesis 1b The strength of a firm's R&D ties is positively associated with its innovative performances.

2.2 Ties and knowledge acquisition

The trend of economic globalization and the relentless technological change lead to an emergence of knowledge-intensive society, which has changed the nature of competition and innovation[1], external knowledge become vital to the success of an enterprise. Open innovation models argued that key sources for firms are often lead users, suppliers, or universities[2].

A basic issue in open innovation refers to building an infrastructure across organizational boundaries for knowledge acquisition and exploitation. The concept of social capital was originally used in community studies to describe relational resources embedded in personal ties in the community. Nahapiet and Ghoshal (1998) argued that social capital facilitates knowledge acquisition and exploitation by affecting conditions necessary for the creation of value through the exchange and combination of existing intellectual resources[15].

Because the acquisitions of knowledge are predominantly social processes [16], a social capital perspective posits that ties are valuable, in which ties operate as a conduit for knowledge [7]. Since technologies become more complex, and tacit knowledge is transferable only through intensive interpersonal interactions, direct connections between organizational members are crucial for effective learning[18]. As one of the most important units of firms, top managers would play a critical role in knowledge acquisition. Managerial ties may aid in acquiring new knowledge improve firm's competitive advantage, because other companies cannot efficiently replicate.

In Chinese context, ties may be more valuable because they grant access to trusted information, because ties are embedded in a social context of obligation and trust, this information is deemed trustworthy, especially compared with information from new acquaintances or strangers[13,18]. We believe that knowledge acquisition play a mediating role in the relationship between managerial ties and firm performance.

Hypothesis 2a Knowledge acquisition plays a mediating effect between business ties and innovative performance.

Hypothesis 2b Knowledge acquisition plays a mediating effect between R&D ties and innovative performance.

3 Data and Methodology

3.1 Sampling and data collection

We tested the hypotheses using survey data from 270 manufacturing firms all over the whole China. Most of the sample firms are located in six cities (Shenzhen, Suzhou, Tianjin, Shenyang, Zhengzhou and Xi'an), which represent typical regions of China. Thus provide an appropriate setting for testing the effectiveness of ties in a complicated and volatile national conditions and economic environment. The samples were randomly selected from the company lists provided by local government. These firms span diverse manufacturing industries, such as industrial and commercial machinery, electronic and other electrical equipment and components, chemicals and allied products, fabricated metal products, etc.

An English-language version of the questionnaire was prepared first, and then translated into Chinese. To confirm the consistency and accuracy, the Chinese version was back translated into English by two independent translators. Any conflicts were discussed by the researchers and translators until they reached agreement[8].

Before the formal survey, we selected 4 enterprises as pilot cases to make the questionnaire more comprehensive, appropriate, and easy to understand. The pilot survey was processed by graduate students with the assistance of the top managers in the corporation. This process improved the questionnaire. The final formal questionnaire was combined with the questions found in the preliminary survey and revised in detail.

The survey was administered through face-to-face interview and mail between July 2007 and January 2008. With the help of local governments, the investigators contacted senior managers via telephone, solicited their cooperation, and made an appointment with them. Through interview, investigators usually selected CEO or a top officer in charge of strategic planning and technology management as the key informant in each firm. Each visit took one to two hours. The interviewers informed the managers of the purpose of the project and the confidentiality of their responses and promised them a summary report in return for their participation. This process significantly increased the response rates. A total of 600 questionnaires were distributed and 308 responses were returned, 38 of which were unusable because necessary data were missing. The 270 responses included in the study gives a final useable rate of 45%.

3.2 Measures and analysis

We adapt the measures in the survey from established studies and measure all perceptual scales using 7-point Likert scale (1 = strongly disagree; 7 = strongly agree). Measurement items are as Table 1.

Managerial ties: The managerial ties were decomposed into business and R&D ties. Business ties involve three items that assess top managers' use of ties with managers of other firms (i.e., buyers, suppliers, and competitors); R&D ties contains two items examining top managers' use of connections with members of universities and public research institutes during the past three years.

Knowledge acquisition: We measured knowledge acquisition with three statements reflecting the technological and market knowledge that a firm may acquire through the managerial ties (see Table 1). The items were modified from Yli-Renko et al.'s (2001) study and based on measures of organizational learning. Preview studies have suggested that this approach was appropriate for assessing knowledge acquisition [17].

Innovative performance: We chose to measure innovative performance by focusing on three indicators: (1) R&D cost reduction, (2) patent counts and (3) new product announcements. Since many Chinese managers view exact figures of performance as secrets, the comparative method is more effective at avoiding non-responses[19]. In particular, we examine the change ratios of these indicators in the past three years (1=decrease greatly, 7=increase greatly).

Control variables:

Because previous studies have suggested that both organizational and environmental factors may affect managerial ties[20], we included firm size, firm age, and industry as control variables in our analyses.

Firm size: The size of the firm may influence knowledge acquisition. In this study, we use the logarithms of the number of employees in 2007 of each corporation as the indicator of a firm's size. The employee figures were validated using data from the local statistical department.

Firm age: The age of the firm may influence the firm's ability to acquire external knowledge [21] and utilize their managerial ties. As a result, we modeled firm age as a control and calculated a firm age as the number of years elapsed since its foundation.

Industry: The industry classification is also related to a firm's innovation outcome, since competitive intensity and extent of knowledge acquisition from external sources may vary across industries[22]. In our study, industry classification was measured by Standard Industrial Classification (SIC) code. We controlled for the industry effect by utilizing a dummy variable to distinguish between high-tech and traditional industries. High-tech industries include electronics (SIC 36), computer equipment (SIC 35) and pharmaceutical (SIC 2834). The dummy variable was coded 1 for high-tech industries and 0 otherwise.

Ownership: We obtain this information from survey and archival data. Therefore, we code firm ownership as a dummy variable, such that 1 = SOE (including state-owned enterprises and joint-ownership enterprises) and 0 = other firms (including private enterprise, personal holding companies, wholly foreign-owned and foreign holding companies).

3.3 Analyze model

We analyzed the data using ordinary least squares (OLS) regressions. In order to examine the influence of main effects of business ties, R&D ties and the intermediary effects of knowledge acquisition, we ran several models for each of the dependent variables. In Model I, innovative performance was regressed solely against control variables, namely firm size, firm age, SOE and industry and in Model II we added ties variables. In order to test the intermediary effects of knowledge acquisition, Model IV tested the effects of control and ties variables on knowledge acquisition. Finally, Model V tested the complete effects of all independent variables. To further examine the mediation, we followed Preacher and Hayes (2004) and conducted the Sobel test[23].

Table 1   Measurement Items, Reliability and Validity Assessment

Construct/ indicator	Measurement item	Cronbach alpha	Standardized loadings	Variance extracted
Innovative performance		.705		.631
	Reduction in R&D cost		.778	
	Increase in patent counts		.793	
	Increase in new product announcements		.812	
Knowledge acquisition		.808		.723
	We are able to obtain a tremendous amount of market knowledge because of top managers' utilization of ties		.857	
	We get a lot of our valuable information from top managers' utilization of ties		.861	
	We are able to obtain a tremendous amount of technical know-how because of top managers' utilization of ties.		.833	
Business ties		.789		.704
During the past three years, top managers at our firm have heavily utilized personal ties, networks, and connections with				
	1. Top managers at buyer firms.		.864	
	2. Top managers at supplier firms.		.861	
	3. Top managers at competitor firms.		.790	
R&D ties		.603		.716
During the past three years, top managers at our firm have heavily utilized personal ties, networks, and connections with				
	1. Professors, scientists and engineers in universities		846	
	2.Professors, scientists and engineers in public research institutes		846	

4 Results

4.1 Reliability and validity

As shown in Table 1, all variables display satisfactory levels of reliability, as indicated by the composite reliabilities (Cronbach Alpha) ranging from 0.789 to 0.859. Convergent validity, which measures construct identity, can be judged by looking at the item loadings. Each loading for the multi-item variables of business ties, political ties and external knowledge acquisition is significantly related to its underlying factor. All standardized item loadings are well above the cutoff of 0.50[24],

supporting convergent validity.

As most of our data are collected from one single survey instrument and one single informant per corporation, there is a serious concern of common method bias and single informant bias. We use several procedural remedies such as reducing item ambiguity, separating scale items for the ties and new product development measures to mitigate these biases. Besides, we obtain data of several control variables from secondary sources and from field interviews, and use statistical remedies include logarithms of data and Harman's one-factor test. Factor analysis results show that tall factor loadings are above 0.32, which indicate that neither a single factor nor a general factor accounted for the majority of the covariance in the measures[25]. These procedures and statistical remedies leave us confident that neither common method nor single informant bias is a serious problem in our study.

4.2 Result descriptive

Table 2   Means, Standard Deviations, and Correlation Coefficients (n=270)

Variables	Mean	SD	1	2	3	4	5	6	7
1.Firm size	2.7952	.88834							
2.firm age	27.4106	116.89794	.071						
3.Industry	.23	.421	.126(*)	-.045					
4.SOE	.44	.498	.303(**)	.015	-.240(**)				
5.knowledge acquisition	4.6963	1.04383	.155(*)	.059	.103	.075			
6.business ties	4.8864	1.13206	.054	.040	.068	-.033	.303(**)		
7.R&D ties	3.9655	1.44074	.202(**)	-.031	-.085	.201(**)	.246(**)	.097	
8.Innovative performance	4.1747	1.17437	.126(*)	-.100	.194(**)	-.029	.350(**)	.191(**)	.263(**)

*p< 0.05, ** p<0.01

Table 2 presents descriptive statistics，including the mean values, standard deviations, and correlations for all the measured variables. The correlation matrix indicates positive and statistically significant correlation between managerial ties, knowledge acquisition variables and performance. Among managerial tie variables, we find that the correlation between business ties and new product development are stronger than political ties. Besides, the political ties are significantly and positively correlated with SOE but the business ties are not, which suggest that the ownership structure still heavily influences political ties and vice versa.

4.3 Tests of hypotheses

Table 3   Results of Regressions

Variables	Innovative performance				
	Model I	Model II	Model III	Model IVa	Model V
Firm size	.119*	.065	.076	.066	.048
	(1.752)	(.983)	(1.194)	(1.047)	(.746)
Firm age	-.099	-.093	-.117**	.055	-.108*
	(-1.559)	(-1.530)	(-1.979)	(.956)	(-1.831)
Industry	.169**	.176***	.137**	.110*	.150**
	(2.531)	(2.748)	(2.181)	(1.802)	(2.413)
SOE	-.022	-.052	-.037	.047	-.057
	(-.322)	(-.780)	(-.566)	(.739)	(-.875)
Business ties		.146**		.269***	.083
		(2.402)		(4.638)	(1.349)
R&D ties		.252***		.208***	.186***
		(3.991)		(3.474)	(2.932)
Knowledge Acquisition			.334***		.257***
			(5.581)		(3.997)
R2	.058	.146	.166	.161	.201
Adjusted R2	.042	.125	.148	.141	.177
Incremental F-test	3.655***	6.718***	9.608***	8.134***	8.408***
Model *df*	4	6	5	6	7

a: Dependent variables: knowledge acquisition
T-values are in parentheses.
*p<0.10; **p<0.05; ***p<0.01

Table 3 presents regression results. We conducted hierarchical regressions to compare successive models by using incremental F-tests. The comparison of models indicates that ModelⅡ(p<0.01), which includes ties variables and control variables, explains innovative performance significantly better than ModelⅠ (p<0.01). Similarly, the global test indicates that ModelⅤ, which includes knowledge acquisition variables, explains the ROA significantly better than ModelⅡ (p<0.01).

Managerial ties utilization: business ties vs. R&D ties

H1a and H1b predict that the strength of a firm's managerial ties is positively associated with innovative performance. Compared to ModelⅠ, the adjusted R2 in ModelⅡ increases from 0.058 to 0.146, and the F change is significant (p<0.01), indicating that the managerial tie variables have a significant positive effect on firm performance. Hypothesis 1a and 1b are supported. Among the managerial ties, R&D ties have a consistently significant effect in ModelⅡ (β=0.252, p<0.01) and ModelⅤ (β=0.186, p<0.01), while business ties have an insignificant impact in ModelⅤ, indicating that the role of business ties and R&D ties are different.

Mediation of knowledge acquisition

As we can see in Model and Model, the coefficient of knowledge acquisition is positive and significant (β=0.375, p<0.01), indicating that the ability to acquire knowledge is likely to increase innovation.

We follow MacKinnon, Warsi & Dwyer (1995) to demonstrate the mediating effects by examining the three conditions necessary[26]. To further examine the mediation of knowledge acquisition, we conducted Sobel test to test whether a mediator carries the influence follow Preacher & Hayes's (2004) advice. Result shows that knowledge acquisition acts as a complete mediator in the relationship between business ties and innovative performance (Sobel test p=0.00024094<0.05), while it just plays a partial mediation role for R&D ties (Sobel test p=0.01946243<0.05), indicates the impacts of R&D ties on innovation is more than a channel of knowledge acquisition. The Hypothesis 2a is supported while the Hypothesis 2b is just partly supported.

5 Conclusions
5.1 Contribution

We believe there are three sets of contributions emerging from our study. First, integrating social network theories and open innovation model, this paper is one of the first to examine the role of managerial ties in open innovation context. The result supported the view that business ties and R&D ties are channels for external innovation sources.

With a social capital view, we argue that ties are valuable as a conduit for knowledge acquisition and knowledge flows from external actors. With an open innovation model, we found that both ties with business partners such as suppliers, users or competitors, and ties with universities and public research institutes are source of innovation. With managerial ties, firms could acquire ideas and knowledge from external actors.

Second, we provide an empirical test to distinguish the effects of two types of managerial ties in Chinese context, which extended the previous work (Lee et al., 2001; Peng & Luo, 2002) in terms of research context and strategic focus. This study provides support for the effectiveness of business ties and R&D ties in innovation.

Besides, this study explores the effects knowledge acquisition in open innovation models. Through hierarchical regression analysis, we found that knowledge acquisition mediated the utilization of managerial ties and performance. The mediate effect of knowledge acquisition between business ties and innovative performance is stronger than R&D ties. R&D ties could influence innovation more than providing knowledge.

5.2 Limitations and future research directions

This study has several limitations. First, we measure innovation variables by the change ratios. This is not a perfect measurement. Future research could examine the impact of ties on different types of firm performance, including financial performance.

Second, the difference of industries may affect how firms gain external innovation source. Although we try to rule out the effect of industries by including industry types as control variables, the future studies in different industries, especially the comparison between specific industries, are very helpful to explore to a more insightful understanding of this topic.

Finally, although this study supported the view that ties could facilitate knowledge transfer and thus enhances innovation in China, the generalizability of these effects in the context of other economies seems to be a promising direction for future research considering the differences of the culture and institution.

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