

Research on the Relationship Among Dual Open Innovation, Social Ties and New Product Market Performance

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Abstract

With the increasing competition in the market and the reduction of product lifecycle, “open innovation” has become the dominant approach for increasing a company’s new product market performance. Social ties are the important external social capital of enterprises, which play key roles for enterprises maintaining advantages in the fierce competition environment. Under dual open innovation model, enterprises’ network mainly involves business ties, government ties and university ties. Based on social capital theory, this article discusses the mediating mechanism of university ties, government ties, business ties in the process of dual open innovation influence new product market performance. We initially selected a random sample of 400 firms from 18 cities in East and Mid-China from a registration list of the local industrial and commercial bureau. In total, we had 270 valid questionnaires. Results show that both inbound and outbound open innovation openness have positive effect on business ties, government ties and university ties. Business ties and university ties have significant positive effect on new product market performance. Through the test of mediating effect, we found that the influence of inbound open innovation openness on new product market performance need to be played through business ties and university ties, the influence of outbound open innovation openness on new product market performance need to be played through business ties.

Keywords: open innovation; business ties; government ties; university ties; new product market performance

1. Introduction

With the increasing competition in the market and the reduction of product lifecycle, “open innovation” has become the dominant approach for increasing a company’s new product market resource. Chesbrough (2003) defined open innovation as a firm that “uses external ideas as well as internal ideas, and internal and external paths to market”. According to the flow direction of resource, open innovation can be decomposed into two processes: inbound open innovation and outbound open innovation (Chesbrough & Crowther, 2006). Inbound open innovation refers to knowledge and technical resources flow into the firms’ innovation system by external knowledge search (Laursen & Salter, 2006), outbound open innovation refers to ideas or technical resource flow out of the firms’ innovation system by external technology commercialization (Lichtenthaler, 2009).

Because dual open innovation provides a good external environment for the interaction and cooperation among enterprises and external subjects, it is helpful for enterprises to establish stable social ties with a series of external subjects. Social ties are the important external social capital of enterprises (Hau et al., 2013), which play key roles for enterprises maintaining advantages in the fierce competition environment. Under the dual open innovation model, enterprises’ network mainly involves business ties, government ties and university ties. The relationship with business partners helps enterprises to obtain rich market information and customer trust (Sheng et al., 2011), and increase the market share of new products; The relationship with the government officials can help enterprises to launch new products smoothly and get policy support related to new product development; The relationship with university researchers will help enterprises improve their research and development capabilities, speed up the development of new product and reduce their R&D costs (Wu et al., 2016). Therefore, social ties may be an important mediator in the relationship between dual open innovation and new product market performance.

At present, research on open innovation is still at its early stage, mainly focus on its direct effects on the firm’s performance or innovation performance (Mazzola et al., 2012; Cassiman & Valentini, 2015). There is still a lack of research about the influence mechanism of dual open innovation on new product market performance. Only Bahemia et al. (2017) explored the relationship among breadth, partner newness, depth of inbound open innovation openness, product innovativeness and product competitive advantage. Although, Rass et al. (2013) explored the role of three dimensions of social capital (cognitive dimension, structural dimension and relational dimension) in open innovation. Less attention has been paid to the question of how does inbound and outbound open innovation affect business ties, government ties and university ties, and thus improve the new product market performance.

Based on social capital theory, this article discusses the mediating mechanism of university ties, government ties, business ties in the process of dual open innovation influence new product market performance. The research results have certain guiding significance for Chinese enterprises implementing dual open

innovation to enhance new product market performance.

2. Theory and hypotheses

2.1 Open innovation

Open innovation can be characterized by its porous innovation process, and the strong interaction of the company with its environment (Chesbrough, 2003b, 2006). Normally, two types of open innovation processes are included in the innovation paradigm: inbound open innovation and outbound open innovation. In inbound open innovation, firms extend sources of innovation with customers, suppliers, competitors, universities and other external innovation expert (Laursen & Salter, 2006). Firms can enrich their own knowledge and improve their innovative capabilities (Zhu et al, 2017). In outbound open innovation, firms can utilize unused intellectual property through selling patents, direct licensing, engaging in secondary development, and channeling ideas to external partners (Chesbrough, 2003b; Chesbrough, 2007), firms can find external paths for commercializing internally sourced. (West and Bogers, 2010).

Prior work is mainly based on theoretical considerations and single case studies, or it analyzes very specific issues in large-scale studies (West et al., 2006). Present research is mostly focused either on inbound open innovation or outbound open innovation (Cassiman & Veugelers, 2006). In reality, open innovation paradigm advances this view by suggesting that innovation processes are opened up in both directions. However, the number of taking an integrative perspective of inbound and outbound open innovation is still limited (West et al., 2006), only a few papers have explored their influence on organizational performance. For example, Cassiman and Valentini (2015) found that engage in inbound and outbound open innovation model is characterized by a higher share of sales from new products than only engaging in single innovation model, but also by an higher R&D costs.

The research of open innovation often considers the effect of its openness on organizational performance (Chesbrough H, 2003). "Openness" is the degree of firm opening to the external organizations, including "the breadth of openness" and "the depth of openness". Open breadth refers to the amount of cooperation between firms and external innovation elements, and the open depth refers to the degree of cooperation between firms and external innovation elements (Laursen & Salter, 2006). Together the two variables represent the openness of firms' external search processes. Thus, our study will research on how the inbound and outbound innovation openness affect the organizational performance.

2.2 Theory and hypotheses

Nahapiet and Ghoshal (1998) pointed out that social capital is mainly created and maintained through communication. As organizations interact and communicate with each other, their relationships grow. Fey and Birkinshaw (2005) pointed out that in open innovation activities, close interaction and resource exchange are all required, no matter whether a technology is purchased or sold (inbound open innovation and outbound open innovation). Therefore, it is easy for enterprises and external subjects to cross organizational boundaries to realize interaction and interconnection, and thus enhancing the relationship between enterprise managers and external subjects.

Inbound open innovation partners including customers, suppliers, competitors, universities, government departments and other innovation partners, can be further divided into business main body, government main body and university main body. The higher the openness of inbound open innovation is, the wider the frequency and range that enterprises buying technology from business partners will be. Close contacting and communicating with external business partners can promote enterprise relationship significantly. Government is the regulator of market, the standard-setter of industry, and holds scarce regulatory resources. In order to obtain policy support and ensure the smooth development of new products and commercialization activities, enterprise managers often actively cooperate with the government in inbound open innovation. When the openness of inbound open innovation is high, it will be easy for enterprises and officials from various government departments to establish a good relationship network, and strengthen the formation of government ties. Universities are an important channel for enterprises to obtain technical resources. Enterprises can purchase university technology patents and services through promoting industry-university-research cooperation. The higher the openness of inbound open innovation, the deeper the involvement of university in the process of product research and development, which will help enterprises maintain a strong relationship with university researchers (Perkmann & Walsh, 2007). Thus, we propose the following:

H1a: Inbound open innovation openness is positively related to business ties.

H1b: Inbound open innovation openness is positively related to government ties.

H1c: Inbound open innovation openness is positively related to university ties.

Under Outbound open innovation, enterprises can transfer valuable innovation results and patented technologies to external organizations for commercialization, through technology transfer, technology licensing,

the establishment of technology spin-off enterprises and other cooperation ways. So through outbound open innovation, enterprises will establish close business contacts with their competitors and enterprises in other industries, and develop a high level of cooperation in personnel, technology and management around technology transfer, so as to improve their business ties.

With the increasing openness of outbound open innovation, the industry influence and reputation of enterprises will be enhanced. Enterprises thus have the opportunity to participate in the Industry standards formulation, technical evaluation and review. In this process, enterprises increase the opportunity to talk with government officials, so the government ties will be improved accordingly. On the other hand, in outbound open innovation, enterprises may encounter many technical difficulties in the process of technology transfer and establishment of technology spin-off enterprises, such as the difficulty of implicit knowledge explicit. Enterprises need to consult and seek help from university researchers, so as to improve the level and value of technology. Therefore, outbound open innovation increases the communication and interaction between enterprises and university researchers, and improves the ties between enterprises and universities. Thus, we propose the following:

H2a: Outbound open innovation openness is positively related to business ties.

H2b: Outbound open innovation openness is positively related to government ties.

H2c: Outbound open innovation openness is positively related to university ties.

The higher the business ties, the closer the cooperation between the enterprise and its business partners. Therefore, enterprises can get effective support from business partners in all aspects of new product R&D (such as marketing planning, promotion, publicity, etc.), which can guarantee the smooth development and launching of new products, and get the corresponding value return. Specifically, business ties provide enterprises with important and unobtainable market information in the open market, such as market change information, partner information, minimize the uncertainty of cooperation with competitors and the risk of failure to commercialize new products (Sheng et al., 2011). Close communication between enterprises and business partners enhance mutual learning, which can promote the organic integration of internal and external knowledge, improve the efficiency of knowledge utilization and the ability of new product research and development (Chung et al., 2015). In addition, enterprises with high business relations can gain legitimacy in the social network, win more customers' trust and loyalty, and increase new product sales. Therefore, business ties can effectively improve the new product market performance.

The closer the relationship between enterprise and government, the more valuable resources the enterprise can get from the government to support new product development activities. In the process of new product launching, enterprises need to have frequent interaction with the government, including the application and maintenance of enterprise intellectual property, product testing and so on. When enterprises have a good relationship with government, the process of new product launching will be more smoothly, the management cost will be reduced, so the new product market performance can be effectively promoted (Zhu & Chung, 2014). At the same time, through the strong government ties, enterprises can get more information about government regulations and new policy, to help enterprises adjust the innovation strategy, access to land, bank loans, tax breaks and the opportunity of government procurement. In addition, enterprises with higher government ties can obtain the trust and respect from other innovation main body, so as to gain financial capital and human capital needed for new product development. Therefore, government ties can effectively improve the new product market performance.

The better the relationship between enterprises and universities, the technical support from the universities for the development of new product is more. Universities are important sources of original technological achievements and product design of enterprises. Advanced technical results are helpful to improve the efficiency and novelty of new product (Wu, 2014). At the same time, enterprises may encounter problems in the production and marketing of new product, and universities are the intellectual support for the operation of new product. Managers can train company employees and participate in development strategic of new product by using personal relationships with professors and scientists (Hsu et al., 2015), so as to effectively reduce the costs and risks of the research and development of new product. The better the relationship between universities and enterprises, the more trust, dependence and commitment they have with each other. While information and resources is transferred effectively and the rapid of development and commercialization of new products is promoted. Therefore, university ties can effectively improve the market performance of new products. Thus, we propose the following:

H3a: Business ties are positively related to new product market performance.

H3b: Government ties are positively related to new product market performance.

H3c: University ties are positively related to new product market performance.

Social capital theory believes that various resources accumulated by enterprises from embedded inter-organizational relationship network can ensure the sustainable competitive advantage of enterprises (Moran P,

2005). Enterprises can strengthen the ties between enterprises and their business partners, government officials, university researchers by improving the openness of both inbound and outbound innovation. Since all these three social ties can bring resources and information needed for new product development to enterprises, it will effectively improve the new product market performance. Therefore, this study expects that business ties, government ties and university ties play mediating roles between dual open innovation and new product market performance. Thus, we propose the following: .

H4a: Business ties play a mediating role between inbound open innovation openness and new product market performance.

H4a: Business ties play a mediating role between outbound open innovation openness and new product market performance.

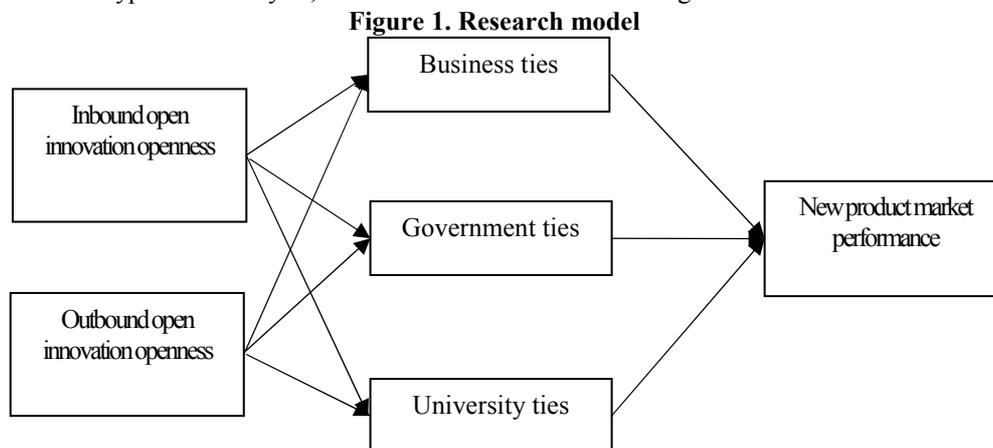
H4c: Government ties play a mediating role between inbound open innovation openness and new product market performance.

H4d: Government ties play a mediating role between outbound open innovation openness and new product market performance.

H4e: University ties play a mediating role between inbound open innovation openness and new product market performance.

H4f: University ties play a mediating role between outbound open innovation openness and new product market performance.

Based on the above hypothesis analysis, the research model is shown in figure 1:



3. Methodology

3.1 Sample and Data Collection

We selected firms in China for our empirical study. Since the economic reforms, Chinese firms have attempted to manage innovation activities by incorporating various modes of an open-oriented strategy, such as sourcing external knowledge by acquiring foreign technology (Chen et al, 2011) and output unused technology by selling patents. As a result, China represents an ideal research setting in which to explore the link between innovation openness and performance.

Guided by interviews and an extensive review of existing literature, we developed an English version of the questionnaire, translated it into Chinese, and then appointed two independent translators to back-translate it to guarantee conceptual equivalence. Then, we invited ten managers to provide answers to all the survey items, to clarify the survey questions, and to provide feedback on the appropriateness of the terminology used in the questionnaire. On the basis of the results, we refined the original questionnaire and finalized the survey.

For the formal survey, we initially selected a random sample of 400 firms from 18 cities in East and Mid-China from a registration list of the local industrial and commercial bureau. All the firms need to meet the following conditions: (1) Firms should adopt inbound open innovation and outbound open innovation and had actually practiced this innovative approach; (2) New product or service should exist at least 6 months in the market. We called all the managers to set up appointments and recruited experienced interviewers to present the questionnaire and collected the surveys after their completion. Of the 400 firms surveyed, we received surveys from 292 respondents, for a 73% response rate. However, because some surveys were filled at random or not standardized, we excluded 22 surveys. In total, we had 270 valid questionnaires.

Table 1. Profiles of the sample companies (N=270)

Sample characteristics		Frequency	%
Number of employees	< 100	21	7.7
	100~499	130	48.1
	500~999	54	20
	> 1000	65	24.2
Number of years	< 10	25	9.2
	10~24	170	63
	25~49	50	18.5
	> 49	25	9.3
Ownership	State-owned	89	32.9
	Private-owned	163	60.4
	Foreign capital	4	1.5
	Joint venture	14	5.2
Industry	Manufacturing Industry	146	54.1
	Service Industry	124	45.9

3.2 Measurement

3.2.1 Inbound open innovation openness

Inbound open innovation openness reflects the level of using the external sources involved in firms' innovation activities. This study followed Laursen and Salter (2006), we included 10 sources, including consumers, suppliers, distributors, competitors, venture capital investment corporations, intellectual property rights organizations, university/research institutions, technology intermediary organizations, unrelated firms, government departments. Respondents were asked to indicate the level of each source's importance on a five-point Likert-scale (1=not important at all, to 5=very important). According to the measurement method of Laursen & Salter (2006), Cruz-González et al (2015), openness contains the breadth of openness and depth of openness. When measuring the breath of openness, we coded each of the given sources as a binary value of 1 if low important (2), medium important (3), rated important (4) or very important (5) and as 0 for no important (1). Then, we summarized the new values of the 10 sources used to reflect the breath of inbound innovation openness, which ranged from 0 to 10. When measuring the depth of openness, we coded 1 if rated important (4) or very important (5), and as 0 for all other ratings. Summarized the new values to reflect the depth of inbound open innovation openness. According to the method of Lazzarottia et al (2015), we added the standardized value of depth and breadth of openness as the final degree of inbound innovation openness.

3.2.2 Outbound open innovation openness

The level of outbound open innovation openness reflects the level of using external commercialization activities for firms' innovation practices. In line with Cassiman and Valentini (2015), Zhu et al (2017), we measured the level of outbound innovation openness by asking how important (on a five-point scale) the following three activities were: providing R&D contracting, selling the rights to use internal inventions, and consulting on R&D for others. Similar to inbound innovation openness, we independently coded each answer with a binary value and recalculated it to generate the degree of outbound innovation openness.

3.2.3 Social ties

In the measurement of social ties, there is no comprehensive authoritative scale at present. This paper uses the method of Zhu et al. (2017), combining the scale of business ties, government ties and university ties by Sheng et al. (2011), Peng and Luo (2000), George et al. (2002), Perkmann and Walsh (2007), formed the three dimensions of social ties. Business ties measure the relationship with "company executives", "suppliers", "customers", "competitors", "marketing partners", "technical partners" and other business partners. Government ties measure the relationship with "governments at all levels", "industry departments" and "supervisory and supporting departments such as tax departments, state-owned banks and administration for industry and commerce". University ties measure the relationship with "company executives", "university leaders", "research teams" and "researchers".

3.2.4 Control variable

This study considered 4 control variables, namely, the industry type, the firm size, the firm ownership and the firm age as control variables. Specifically, manufacturing and service firms may have significant differences in management and strategies. Thus, we treated industry type as a dummy variable, such that 1 indicates the manufacturing industry and 0 represents the service industry, based on whether the firm manufactured physical products or provided services. The firm size may be crucial to a firm's ability and performance, so we treated

firm size as the control variable and measured it by the number of full-time employees. Firm ownership represents a dummy variable that controls for potential variations between state-owned enterprises (coded as 1) and private and foreign-owned firms (coded as 0). Finally, we defined firm age as the number of years the firm had been in business (Zhu et al, 2017).

4. Analyses and findings

4.1 Assessment of measures

We assessed Cronbach's alpha, composite reliability of constructs, and average variance extracted (AVE) to test convergent validity. Due to the inbound open innovation openness and outbound open innovation openness are constitutive variables, we just analyze the reliability and validity of organizational performance. As Table 2 reports, Cronbach's alpha ranged from 0.830 to 0.927, items are well above the benchmark value of 0.70. The values of composite reliability ranged from 0.887 to 0.954 and were above the benchmark value of 0.70. These results showed that the measurement had satisfactory reliability. The factor loading values ranged from 0.624 to 0.944, were above the benchmark value of 0.60. And the AVE scores ranged from 0.614 to 0.873 and were above the benchmark value of 0.50. These results indicated that the measurement model had satisfactory convergent validity. In addition, as Table 3 shows, the square roots of the AVEs for all constructs were greater than the correlations between constructs, which confirmed the discriminant validity of the measurement model.

Table 2. Reliability and validity test of variables (N=270)

variable	Items	Factor loading	Cronbach's <i>alpha</i>	Composite reliability	AVE
Business ties	5	0.624~0.836	0.830	0.887	0.614
Government ties	3	0.930~0.938	0.927	0.954	0.873
University ties	3	0.860~0.944	0.890	0.932	0.821
new product market performance	4	0.759~0.915	0.868	0.914	0.727

Table 3. Means, standard deviation, and correlations (N=270)

	Means	SD	1	2	3	4	5	6
1.Inbound innovation openness	—	1.01	—					
2.Outbound innovation openness	—	0.993	0.469***	—				
3.Business ties	4.087	0.475	0.275***	0.341***	(0.784)			
4.Government ties	4.182	0.578	0.243***	0.266***	0.569***	(0.934)		
5.University ties	3.840	0.622	0.277***	0.262***	0.523***	0.449***	(0.906)	
6.new product market performance	3.656	0.652	0.304***	0.335***	0.440***	0.287***	0.403***	(0.853)

Note : The diagonal elements are the square root of the AVE, *, $p < 0.05$, **, $p < 0.01$, ***, $p < 0.001$.

4.2 Structural model

To avoid possible multi collinearity on the interaction term in the regression analysis, we centered the constructs on open innovation dimension and moderators. Variance inflation factors (VIF) values on all independent variables to fall below 3.0. The results indicate adequate OLS regression in both hypotheses testing and results interpretation.

Figure 3 presents the results of the structure model. The results indicated that inbound open innovation openness had a positive effect on business ties ($\beta=0.162$, $p < 0.01$), and government ties ($\beta=0.177$, $p < 0.01$), and university relationship($\beta=0.213$, $p < 0.001$), which supported H1a, H1b and H1c. The results further presented that outbound open innovation openness had a positive effect on business ties($\beta=0.298$, $p < 0.001$), and government ties ($\beta=0.196$, $p < 0.01$), and university relationship($\beta=0.166$, $p < 0.05$), which supported H2a, H2b and H2c. At the same time business ties had a positive effect on new product market performance ($\beta=0.342$, $p < 0.001$), university ties had a positive effect on new product market performance($\beta=0.198$, $p < 0.01$), which supported H3a, H3c. But government ties had no effect on new product market performance ($\beta=-0.010$, n.s.).

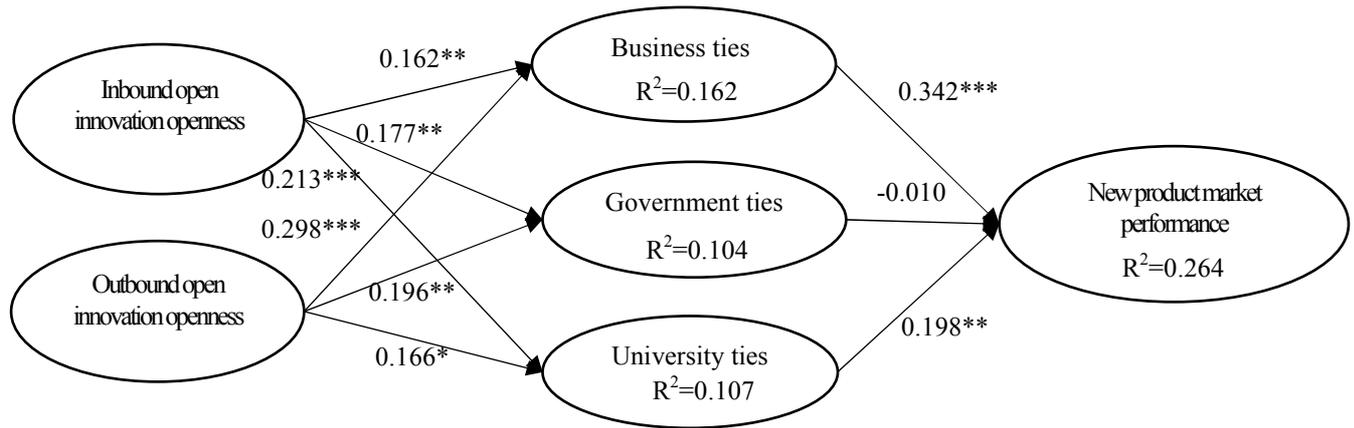


Fig 2. Smartpls analysis of direct effects

4.3 Mediating effect testing

We followed the procedures proposed by Preacher and Hayes (2008) to test the mediating effects of business ties, government ties and university ties. We use the method of Bootstrapping at the 95% confidence interval. We verify the existence of mediating effects by including 0 in the confidence interval.

As shown in the Table 4. The mediating effect of business ties between inbound open innovation openness and new product market performance is 0.034, and the confidence interval is (0.000, 0.078), not including 0, which supported H4a. The mediating effect of business ties between Outbound open innovation openness and new product market performance is 0.083, and the confidence interval is (0.036, 0.143), not including 0, which supported H4b. The mediating effect of university ties between inbound open innovation openness and new product market performance is 0.036, and the confidence interval is (0.005, 0.078), not including 0, which supported H4e. The mediating effect of university ties between Outbound open innovation openness and new product market performance is 0.021, and the confidence interval is (-0.003, 0.055), including 0, H4f is not supported.

Table 4. Bootstrapping method (5000 Bootstrap sample)

Indirect Paths	Effect	SE	95% confidence interval
Inbound open innovation openness → business ties → new product market performance	0.034	0.020	95%CI[0.000, 0.078]
Outbound open innovation openness → business ties → new product market performance	0.083	0.027	95%CI[0.036, 0.143]
Inbound open innovation openness → university ties → new product market performance	0.036	0.019	95%CI[0.005, 0.078]
Outbound open innovation openness → university ties → new product market performance	0.021	0.014	95%CI[-0.003, 0.055]

5. Discussion and conclusion

Based on social capital theory, this study analysis the influence mechanism of dual open innovation, social ties and new product market performance. Through empirical research, we tested all the hypothesis in this paper, the research results show that: Firstly, both inbound and outbound open innovation openness have positive effect on business ties, government ties and university ties. The results show that inbound and outbound open innovation can construct a wide range of external relations. The higher the openness, the more the enterprises could promote to interactive with different social subjects, and positive impact on the relations between enterprises and business partners, government officials, university researchers. Secondly, business ties and university ties have significant positive effect on new product market performance. The effect of government ties on new product market performance is not significant, which is contrary to our hypothesis. The likely reason is that the government's help to business is inclusive nature rather than targeted at a particular enterprise. At the same time, as a special market subject, government is more willing to introduce and purchase mature products, so government ties have no significant impact on the new product market performance. Thirdly, through the test of mediating effect, we found that the influence of inbound open innovation openness on new product market performance need to be played through business ties and university ties, the influence of outbound open innovation openness on new product market performance need to be played through business ties.

5.1 Theory contribution

From the perspective of social ties, this paper explains the influence mechanism of dual open innovation on new product market performance. This study has the following theoretical contribution:

Firstly, from the perspective of social capital theory, this paper introduces an important variable—social ties, providing a new research perspective for the process of transforming dual open innovation into new product market performance, supplementing the lack of social ties empirical research under open innovation context. In emerging economies, social ties are important channels to acquire knowledge and information, previous study focused on the mediating role of social capital (structure dimension, relationship dimension and cognitive dimension) between open innovation and performance (Rass et al, 2013), but the previous studies did not classify open innovation, and also lack the empirical research on social ties. Based on social capital theory, this research found business ties and university ties play an important mediating role between inbound open innovation openness and new product market performance, university ties play a mediating role between outbound open innovation openness and new product market performance, however, the effect of government ties on new product market performance is not significant. The research results have deepened the understanding of how enterprises can maintain good relationship with external commercial partners and university researchers through two kinds of open innovation, thus improving the new product market performance. It's also an important expansion of social capital theory in the dual open innovation research fields.

Secondly, this paper reveals the significant positive relationship of dual open innovation and social ties, and enriches the researches on the antecedents of social ties. Most studies mainly focus on the government ties and business ties (Dong et al, 2013; Li et al., 2016). Considering that dual open innovation activities are often accompanied by contacting with business partners, government officials and university researchers. From the perspective of open innovation, this paper discusses the influence of inbound and outbound open innovation openness on commercial ties, university ties and government ties, and enriches the dimension division of social ties. It is found that dual open innovation has a positive impact on all the above three ties, which is an important supplement to the research on the antecedent variables of existing social ties.

5.2 Managerial Implications

From the perspectives of social ties, this paper discusses the influence of dual open innovation on new product market performance, finds the mediating role of business ties and university ties, Thus, this study provides a theoretical and practical guidance to help Chinese enterprises implement dual open innovation and promote new product market performance. China is a relationship-oriented society (Dong et al, 2013), and enterprises must realize that successful new product development requires good business ties and university ties. Therefore, in dual open innovation activities, enterprise managers should first actively improve the openness of open innovation and build a stable and good external relationship network. When interacting with external subjects, managers should also adhere to the principle of mutual trust and strengthen the relationship with business partners and university researchers. Finally, according to the research conclusions, in inbound open innovation managers should focus on strengthening business ties and university ties, in outbound open innovation managers should focus on maintaining business ties. Through the above ties, managers could explore and obtain scarce innovative resources, in order to improve new product market performance.

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