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The Effects of Boundary-Spanning Search, Network Ties, and Absorptive Capacity for Innovation: A Moderated Mediation Examination

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Abstract: Innovation is a key driver for organizations to survive and thrive in increasingly hyper-competitive markets. This study investigates the effects of boundary-spanning search on innovation capability. Specifically, it examines the mediating and moderating effects of network ties and absorptive capacity on boundary-spanning search and innovation in Chinese companies. We constructed a theoretical model of an organization's boundary-spanning search and innovation capability and distributed a survey questionnaire to a sample of specific industries with upstream and downstream relations in Sichuan Province in China for their responses. Results from the study reveal that boundary-spanning search has a positive and significant impact on innovation capability as well as a positive moderating effect on absorptive capacity and innovation capability. This paper shows that enterprises need to continuously focus on exploring networking opportunities in direct and indirect ways to get access to effective flow and diffusion of resources, which in turn can enhance innovation capability.

Keywords: boundary-spanning search; network ties; innovation capability; absorptive capacity; moderated mediation

1. Introduction

Scholars have noted the importance of innovation to firm growth and development [1]. With today's turbulent competitive environment, innovation is a critical factor to ensure the growth and survival of business organizations in most economies. Firms that are eager to strive for a competitive edge mostly depend on their ability to manage their innovation prowess [2]. Over the past decades, innovation has had tremendous exponential effects on industries that pay attention to transformation and radical change.

Admittedly, for firms to command competitive advantage in the innovation cycle, knowledge management plays a key factor in competitive endurance [3]. Proponents of open innovation models posit that for firms to maintain an innovative advantage in a dynamic environment, they can break organizational barriers, including visible geographic networks and invisible knowledge networks, to search for new combinations of knowledge or technologies from different fields that hold commercial potential [4–6]. This phenomenon can be referred to as boundary-spanning search. It has led global organizations to acquire knowledge resources from external sources to complement their internal value network activities and resource accumulation to enhance or develop innovative capability toward gaining competitive advantage [7,8]. Leonard-Barton (1992) [9] posits that knowledge acquired from

external sources through boundary-spanning search aids organizations in loosening fundamental rigidities. In 1988, Levitt and March described external knowledge from boundary-spanning as a strategy that helps organizations to overcome competency snares [10]. Thus, scholars and practitioners have acknowledged the role of boundary-spanning search from the environment as a significant driver of firms' innovation capability [11–13]. Firms mostly establish intra- and extraorganizational boundaries and crisscross within and outside organizational, geographic, and spatial boundaries to share heterogeneous resources. This in turn strengthens their network ties to create synergy and value co-creation for innovation opportunities. For instance, General Electric (GE) has set up a global knowledge exchange system, the "GE Store" platform, through which businesses share and access technology, market information, structure, and intelligence. This aids businesses in acquiring various unique capabilities and advanced technologies to fuel product research and development, cross-border innovation, and value co-creation to deliver better results for customers. This in turn leads to achieving the effect of one plus one being greater than two. Also, Procter & Gamble has adopted an open innovation strategy dubbed "linkage and development" to make use of social advantages of the enterprise to fully absorb and utilize excellent innovation resources emanating from external resource searches and external network innovation platforms to push its innovation agenda toward sustainable ecological competitive advantage. These examples demonstrate that firms' or organizations' partners have gradually become important sources of innovation resources. Partnership and collaborative efforts among firms enhance innovation capability and competitive advantage [14]. From the extant literature, studies show that effective collaboration among firms for boundary-spanning search could effectively help them to avoid falling into rigidity and competency traps and also get rid of the "innovator's dilemma" and construct innovative ecological advantages [15,16], as the accumulation of and interaction with new knowledge resources could positively enhance firms' innovation capability or performance [17]. However, researchers opine that firms must manage outside sources of knowledge carefully, as they may not yield the expected positive results after a certain point in time [11]. They believe that outside sources of knowledge need to be carefully scrutinized to avoid cost implications. Therefore, it is important for practitioners and scholars to get a clear understanding of how resources or knowledge along the boundary-spanning search line influences innovation capability outcomes of business organizations for maximum returns. This research intends to broaden our understanding of how firms can tackle this paradox.

Prior studies have focused on the impact of boundary-spanning search on innovation capability through a single or binary approach in most organizational sectors. In particular, we lack an integrated conceptual framework that shows us the underlying mechanisms through which boundary-spanning search influences innovation capability through multiple organizations, specifically, a link between the mediating and moderating roles of network ties and absorptive capability in boundary-spanning search and innovation capability. Against this backdrop, the fundamental question addressed in this research is: How can boundary-spanning search from external sources impact innovation capability? Specifically, we discuss the direct role of boundary-spanning search on innovation capability and the mediating and moderating role of absorptive capability and network ties in enhancing its effect through multiple organizations. This argument is based on the view that organizational network ties and absorptive capability play an influential role in organizational innovation capability [18,19].

The paper is divided into five sections. The first section introduces the study. We then discuss the theoretical background and hypothesis development in the second section. The following section delves into the methodology of the study. This section is followed by a description of the empirical results. The final section concentrates on the conclusion and limitations as well as directions for further studies.

2. Theoretical Background and Hypotheses

2.1. Boundary-Spanning Search and Innovation Capability

The resource-based view (RBV) approaches the uniqueness of an enterprise's resources and abilities as a key to its competitive advantage. Resources and capabilities play a key role in the activities of an organization, enhancing its performance in a competitive market environment. Rosenkopf and Nerkar (2001) postulated that an enterprise's ability to search and process combined knowledge across boundaries can effectively promote the improvement of sustainable competitive advantage [8]. Proponents of open innovation believe that an enterprise's ability to get access to knowledge inflows can accelerate internal innovation and expand potential markets served [20]. Indeed, enterprises that are eager to compete well in the market environment can enhance their knowledge or resource portfolio from external sources through boundary-spanning search.

The boundary-spanning search concept integrates knowledge, technology, information, and other resources from different industries and lessens the challenge of unmatched enterprises' direct experience with differentiated innovation resources on products and technology. It is regarded as an important driving force for enterprises to maintain information superiority [15,21]. Through boundary-spanning search activities, enterprises acquire new resources to augment their internal resources. As a result, enterprises increase their internal variety to make effective innovation [22]. Tortoriello (2010) asserted that boundary-spanning search helps enterprises to acquire new knowledge, information, technology, and other resources outside the organizational boundary to combine with their own knowledge to enhance innovation capability and performance [21]. Studies conducted by Tushman (1977) established a positive association of informational boundary-spanning and innovation [23]. Although the impact of boundary-spanning search has been theoretically demonstrated, few studies have empirically tested the connection between boundary-spanning search and innovation capability. In this paper, we argue that for enterprises to maintain their competitive advantage in this turbulent market environment, the quest for new heterogeneous resources is essential to generate exploratory innovation [24]. We therefore propose the following hypothesis:

Hypothesis 1 (H1). *Boundary-spanning search has a positive impact on the innovation capability of enterprises.*

2.2. The Mediating Role of Network Ties

Network ties create a platform, such as an open innovation platform ecosystem, for enterprises and their partners to share and acquire resources. For instance, information on new business opportunities, financial capital, new markets, technology, flexibility, and reliability of partner selection is shared through network ties [25]. Network ties are usually important for technology and innovation companies [26], as these companies typically operate in complex systems, and their final products and services usually consist of a number of complementary products and services [25,27]. Enhancing the productivity and innovation capability of such companies largely depends on external sources of knowledge, technology, information, and other factors [28]. Therefore, cooperation among enterprises and their external partners plays a crucial role in amending a deficiency of internal innovation capability [29,30].

(1) Boundary-spanning search and network ties

The core of innovation is new ideas, which originate from the integration of heterogeneous information, knowledge, and resources [31]. Innovation creates value for an enterprise through new technologies, products, and services, as well as new markets. For enterprises to improve on their innovation activities, they need to apply active network knowledge search and exploitation strategies to maximize the utilization of network resources of their alliances [32]. This involves search, evaluation, development, and application to integrate and recreate knowledge for enterprise innovation development. For instance, boundary-spanning search leads enterprises to identify and acquire heterogeneous resources across organizational boundaries to overcome path dependency [24]

and to reorganize them to create new resources for their innovation agenda. The existing literature on innovation emphasizes the unique role of boundary-spanning search in organizational innovation activities [8,33]. First, it increases the resource stock or portfolio of an enterprise and facilitates innovation activities [34–37]. Second, Lopez-Vega, Tell, and Vanhaverbeke (2016) [15] opine that enterprises in need of specific technology can link up with external suppliers through boundary-spanning search to provide technical and scientific solutions to enhance competitive advantage and innovation capability. Third, technology and knowledge resources from different fields are often needed in the process of technological innovation. Therefore, working with a number of partners can make it easier to acquire complementary skills so as to enrich the knowledge reserve of the enterprise, thereby enhancing its innovation capability [38]. Fourth, boundary-spanning search among enterprises can promote knowledge sharing and diffusion and realize a scale effect of innovation [19]. Furthermore, boundary-spanning search can promote cooperation among enterprises and strategic partners to increase the free flow of resources along the network line. We argue that promoting participation and developing common tasks break internal inertia in the process of enterprise innovation to create new opportunities toward innovation capability [32,39]. Lavie's (2007) [40] research on alliance portfolios and firm performance revealed that for enterprises to obtain more network resources, expand organizational boundaries and scope of learning, and develop new business portfolios, they need to establish alliances with different partners. Studies conducted by scholars [41,42] have established a positive association of boundary-spanning and network performance. Although the impact of boundary-spanning search has been theoretically demonstrated, few studies have empirically tested the connection between boundary-spanning search and network ties. In this paper, we argue that for high-technology enterprises to maintain their competitive advantage in this turbulent market environment, they need to establish good ties with their development partners. We therefore propose the following hypothesis:

Hypothesis 2 (H2). *Boundary-spanning search has a positive impact on network ties of enterprises.*

(2) Network ties and innovation capability

As an exploratory activity, innovation emerges from a diversity of resources [39]. The innovation capability of enterprises emanates from searching, transferring, combining, and recreating resources. Enterprises obtain greater benefits from networks of alliances to improve creativity and learning ability toward competitive advantage [36]. Network ties usually identify, exploit, and absorb enterprises that possess potentially useful knowledge and that can maximize knowledge creation potential. At present, research on social networks mainly emphasizes that network ties have an important influence on resource acquisition of doers in the network [43]. Based on social network theory, network ties consist of entities representing nodes (such as individuals, enterprises, organizations) and links between them [44]. Within networks of alliances, entities reflect a closed organizational network of enterprises focusing on common tasks and collaborating with working partners. From the perspective of social networks, network ties among partners in an organizational network may have a positive influence on the diffusion of knowledge, technology, information, and other resources [45]. Burt (1992) [46] postulated that doers would have a leading edge in gaining diversified information if they linked with doers in other organizations. Granovetter (1973) [47] emphasized that weak ties built with social groups or partners that are not associated with the enterprise enable doers to acquire more heterogeneous resources and new opportunities for innovation, while strong ties with partners that share similar or common resources would enhance the spillover effect of knowledge diffusion in the network, accelerate resource flow, and strengthen relationship anchors as well as facilitate stability of the organization. Ahuja's (2000) [38] research on the relationship between self-centric networks and innovation of enterprises shows that both direct and indirect ties between partners have a positive influence on an enterprise's innovation. However, in the same network, significant differences in network benefits obtained by doers focusing on direct and indirect ties exist. Direct ties produce

resource sharing and information spillover effects, while indirect ties only produce a knowledge spillover effect. The study of Vanhaverbeke (2012) [48] also confirmed the view that direct ties provide a basis for the development of strong relationships based on mutual trust between partners, and also direct ties have a positive impact on the incremental innovation of enterprises. However, weak links in alliance networks have a spillover effect on the improvement of an enterprise's breakthrough innovation capability. The research work conducted by Lavie (2006) [49] showed that enterprises that are focused will enjoy more competitive advantage because of the spillover effect. Besides, network ties provide a more extensive channel for multiple knowledge interaction and sharing of technology, information, and other resources in the alliance network, which can promote cooperation among enterprises to enhance the enthusiasm of innovation activities within the alliance. From the ongoing discussion, we propose the following hypothesis:

Hypothesis 3 (H3). *Network ties have a positive influence on the innovation capability of enterprises.*

In addition, Gupta (2007) [50] sees interlinkages among enterprises as an essential factor in innovation. He believes that mutual cooperation between enterprises facilitates open and shared resources among different partners and reduces the possibility of enterprises being locked in by prior knowledge. Studies of single alliances show that enterprises can get more benefits when they collaborate with partners who possess different resources, while cooperation with partners possessing similar resources often inhibits an enterprise's exploration and innovation [39]. We argue that enterprises that participate in multiple alliances could absorb, utilize, restructure, and reconstruct diversified resources from different partners and apply them to generate more innovative ideas and solutions to promote the development of new technologies and products [51]. Thus, network ties between enterprises can promote knowledge sharing and diffusion among partners and realize scale effect of innovation [19]. We therefore propose the following hypothesis:

Hypothesis 4 (H4). *Mediating effects of network ties exist between boundary-spanning search and innovation capability.*

2.3. The Moderating Role of Absorptive Capability

For a long time, absorptive capacity has been recognized as an important driving factor for enterprises to carry out innovative activities [52]. The term was coined in 1990 by Cohen and Levinthal. It is defined as the ability to identify, acquire, absorb, and apply external knowledge in an enterprise [53,54]. They believed that the capability to identify the best knowledge potential is a key factor in an organization's innovation [55].

Previous studies have shown that enterprises usually have difficulty understanding the value of external knowledge. As network resources fail to flow directly, enterprises must absorb and utilize these useful resources effectively in order to obtain additional benefits related to innovation capability, even though network ties promote rapid dissemination and proliferation of knowledge, technology, information, and so on within networks of alliances. In addition, ties give partners the possibility to obtain resources. Meanwhile, according to organizational learning theory, enterprises with strong absorptive capacity engaged in a heterogeneous environment can effectively absorb and use external diversified ideas and concepts to create new knowledge to enhance innovation capability [56,57]. Therefore, absorptive capacity is critical for enterprises to acquire innovation capability from external knowledge. From the perspective of learning, absorptive capacity drives enterprises to acquire new knowledge by establishing long-term cooperative relationships [58]. Tortoriello's (2015) [52] study on absorptive capacity showed that effective utilization of external knowledge and creative reorganization can effectively promote the construction of network ties across different regions or spaces. He also observed that network ties between organization members can help enterprises to obtain more innovation opportunities. Easterby-Smith (2008) [58] emphasized that absorptive capacity and internal organizational transfer ability are interrelated, and an organization that is

good at absorbing knowledge from outside also has the ability to spread knowledge within its own organizational boundaries. From the perspective of social networks, absorptive capacity can help enterprises to acquire and absorb external information and knowledge from partners within networks of alliances. It also ensures that enterprises have sufficient partners to share ties, thus increasing the interaction level of the networks. The research work of Inkpen (2005) [59] showed that mutual ties based on multiple knowledge connections can help enterprises to "flexibly exchange knowledge" with other partners, so as to improve flow and sharing of network resources among partners, realize value creation of knowledge, and enhance their sustainable competitive advantage. In addition, enterprises can still gain knowledge from cooperative networks in the absence of high absorptive capacity, but the effect of using this information to improve their own innovation capability will be limited [14]. From the ongoing discussion, we propose the following hypothesis:

Hypothesis 5 (H5). *Absorptive capacity regulates the impact of network ties on innovation capability in a positive way.*

Combining Hypotheses 1, 2, 3, 4, and 5, we propose a moderated mediation model, shown in Figure 1, to test the relationship between boundary-spanning search and innovation capability; the model incorporates network ties as a mediator and absorptive capacity as a moderator.

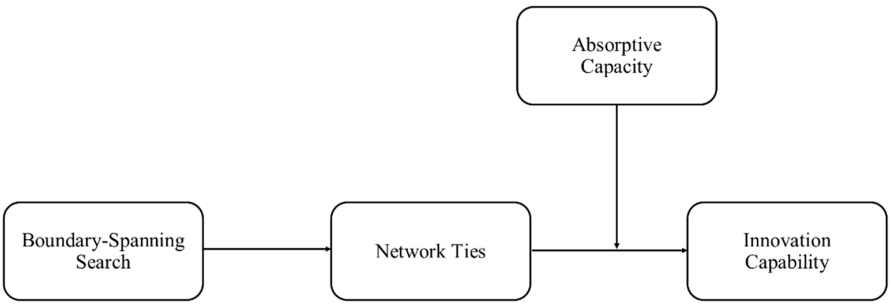

Figure 1. Conceptual model.

3. Methods

3.1. Samples and Data

To test the hypotheses, we designed a questionnaire survey to collect relevant data to ascertain the effect of boundary-spanning search on the innovation capability of enterprises, and also the mediating and moderating roles of network ties and absorptive capability in the boundary-spanning search and innovation capability link. First, the population of the study consisted of high-tech industries operating in Sichuan Province in China as of June 2017. Second, we selected 450 firms possessing upstream and downstream relationships within the industrial chains or industrial technology innovation cooperation through purposive sampling. However, only 389 of the respondents returned their questionnaire for the analysis. This represents 86.44% and is good for studies of such nature. Finally, after removing questionnaires with missing items, we were left with 340 valid questionnaires for the study.

Prior to administering the entire questionnaire for the study, a pilot test was conducted in Chengdu, Sichuan Province, with 20 firms to update the content of the final questionnaire. We conducted a validity and reliability test, which provided fruitful results. First, we compared differences between the top 27% and the bottom 27% of the total score of the scale, that is, compared critical ratio, and items with a p value less than a significance level of 0.05 in the t-test of independent sample were excluded. Second, items were tested for homogeneity. Items that had a p value less than 0.05 and correlation coefficient with a total score less than 0.4 were excluded. We then performed a reliability test on the scale, and recorded $\alpha = 0.946$, which is higher than 0.8. The internal consistency between items was ideal for the study. We also conducted principal factor analysis, and items whose common extraction value was less than 0.2 or factor loading value was less than 0.45 were excluded.

In order to ensure reliability and validity of the data, we selected a maturity scale of relevant studies. A five-point Likert-type scale ranging from 1 (strongly disagree) to 5 (totally agree) was used to line up the levels of various statements for the survey.

3.2. Variable Measurement

The Kaiser–Meyer–Olkin (KMO) test of the questionnaire has a value of 0.925, which is good according to Kim and Mueller (1978) [60]. The value of Bartlett's test of sphericity is 9296.939, with 325 as its degree of freedom, therefore the effect is significant. All MSA(Measurement System Analysis) of the diagonal data of the anti-image correlation coefficient matrix are above 0.5, which shows that common factors exist among variables and meet the requirement of factor analysis. The main variables (network ties, absorptive capacity, boundary-spanning search, and innovation capability) were extracted through exploratory factors.

Moreover, we used Harmon's single factor test method to test for common method bias of data to ensure data quality. Without rotation, the variance by the first factor can explain 37.087%. The result shows that no such factor from the analysis could account for most of the variables, which indicates that common method bias is relatively low.

3.2.1. Boundary-Spanning Search (BS)

This study used a 6-item measurement of boundary-spanning as suggested by Martini et al. (2017) [56] and Sidhu et al. (2007) [61]. The 6 indices record a Cronbach's value of 0.889. Items include: "Timely access to the industry's technology development status and trends" (0.810), "Ability to learn about changes in market preferences for products or services" (0.808), "Awareness of services and trends of enterprises providing alternative products" (0.789), "Acquiring information of similar technology industries and companies" (0.750), "Knowing technological progress of products, services and processes of affiliated enterprises" (0.737), and "Ability to find partners to provide complementary products or services for enterprises" (0.528).

3.2.2. Network Ties (NTs)

This study adapted a 6-item measurement of network ties designed by Todo et al. (2016) [45], Gilsing (2005) [62], and Petróczi et al. (2007) [63]. The 6 indices record a Cronbach's value of 0.906. Items include: "Enterprises often engage in formal and informal cooperation and exchanges with partners" (0.857), "Relationship between enterprises and their partners are very close" (0.789), "Cooperative relationships exist among enterprises or institutions in the organization" (0.786), "Cooperative behaviors with each other exist among the majority of enterprises in the organization" (0.782), "Cooperative relationships among partners are stable and they mutually trust each other" (0.777), and "Partners in the organization provide effective assistance for enterprise development" (0.561).

3.2.3. Absorptive Capacity (AC)

This study used a 4-item measurement of absorptive capacity proposed by Omidvar et al. (2017) [54] and Jansen et al. (2005) [64]. The 4 indices record a Cronbach's value of 0.859. Items include: "Frequent interaction with partners to gain new knowledge" (0.849), "A common goal to make effective utilization of shared knowledge within the partnership" (0.838), "Quick understanding of external technology or opportunities for internal use" (0.803), and "Regular exploration and discussion of market developmental trends, new product development, and identification of useful external resources to enterprises" (0.570).

3.2.4. Innovation Capability (INV)

This study adapted a 5-item measurement of innovation capability designed by Dadfar (2013) [65] and Yang (2009) [66]. The 5 indices record a Cronbach's value of 0.908. Items include: "Improve velocity

of product development and iteration" (0.752), "Enhance enterprise's ability of resource integration and re-creation" (0.716), "Effectively improve the existing production process and management process" (0.698), "Increase the number of patent authorizations" (0.672), and "Develop new products with market competitive advantage" (0.585).

4. Results

4.1. Reliability and Validity

Analysis of reliability was done to verify the stability and consistency of the measurement result. In this study, we used Cronbach's coefficient and SPSS 22 to measure the internal consistency of the data. The results reveal an overall scale of 0.934, which is higher than 0.7, and it proves very strong reliability when the value is above 0.9. In order to confirm the structural validity of variables, we engaged Amos22 (IBM SPSS Amos for Structural Equation Modeling) to conduct a confirmatory factor analysis. Among 21 estimated parameters, standardized factor loading coefficients of remaining estimated parameters were between 0.5 and 0.95, and are significant at the level of 0.001, except five reference indicators that are set as fixed parameters. The analysis shows that there is no negative variance in estimated nonstandardized factor loadings and the standard error of each estimated parameter is very insignificant. We assessed all the main variables by using critical ratio (CR) and average variance extracted (AVE) as follows: network ties: CR = 0.908, AVE = 0.623; boundary-spanning search: CR = 0.894, AVE = 0.587; absorptive capacity: CR = 0.877, AVE = 0.647; innovation capability: CR = 0.910, AVE = 0.670. The composite reliability is greater than 0.6 for all four potential variables, and the extraction value of mean variance is above 0.5, which indicates that each variable has good construct validity. Therefore, the intrinsic quality of the model is good for the study. Additionally, the indicators of one-dimensional confirmatory factor analysis model of the four latent variables match the fitting sample data, thus the goodness of fit of the model is ideal.

Table 1 shows mean value, standard deviation, correlation coefficient, and square root of AVE of variables. Correlation coefficients between variables are below 0.70. In addition, square roots of AVE of all variables are greater than correlation coefficients between variables, which indicates that discrimination validity between latent variables is good.

Table 1. Descriptive statistics and correlation coefficients.

	SD	SE	Industry	Size	NT	BS	AC	INV
Industry	1.918	0.848	–					
Size	2.053	0.793	0.011	–				
NT	4.082	0.697	−0.003	−0.185 **	(0.789)			
BS	4.220	0.684	−0.092	−0.176 **	0.169 **	(0.766)		
AC	4.178	0.717	−0.113 *	−0.161 **	0.361 **	0.389 **	(0.804)	
INV	4.229	0.706	−0.075	−0.178 **	0.685 **	0.372 **	0.407 **	(0.819)

Note: $n = 340$; ** $p < 0.01$, * $p < 0.05$. Data in parentheses are square roots of average variance extracted (AVE). SD, Standard Deviation; SE, Standard Error; NT, network tie; BS, boundary-spanning search; AC, absorptive capacity; INV, innovation capability.

4.2. Regression Analysis

In this paper, we adopted hierarchical regression analysis, as shown in Table 2. First, based on the research problems and characteristics of the sample data, we virtualized all control variable items. Second, in order to avoid multicollinearity of interaction terms and independent variables, as well as moderating variables, we processed all variables in a centralization of mediating effect test. Third, we tested the variance inflation factor (VIF) of each regression equation. Results show that the VIF value of each is less than 2, which indicates that multicollinearity of the sample data is low.

Table 2. Hypothetical test and regression analysis.

Variables		Network Ties (M1→M2)			Innovation Capability (M3→M8)				
		M1	**M2**	**M3**	**M4**	**M5**	**M6**	**M7**	**M8**
Control Variables	Industry	−0.013 (−0.001)	−0.226 (0.012)	−1.363 (−0.073)	−0.827 (−0.042)	−1.328 (−0.049)	−1.836 (−0.072)	−1.371 (−0.053)	−1.503 (−0.058)
	Size	−3.445 ** (−0.185)	−2.971 ** (−0.160)	−3.310 ** (−0.177)	−2.280 * (−0.116)	−0.364 (−0.014)	−1.296 (−0.052)	−0.898 (−0.035)	−0.908 (−0.035)
Independent Variables	BS		2.623 ** (0.142)		6.783 *** (0.347)	6.719 *** (0.257)			
Mediating Variables	NT					16.783 *** (0.639)	16.843 *** (0.676)	14.772 *** (0.616)	14.799 *** (0.612)
Moderating Variables	AC							4.143 *** (0.173)	3.657 *** (0.153)
Interaction	AC*NT								−2.832 ** (−0.110)
Model Summary	R^2	0.034	0.054	0.037	0.153	0.540	0.478	0.503	0.515
	F	5.971 ***	6.343 ***	6.457 **	20.216 ***	98.240 ***	102.473 ***	84.843 ***	70.901 **
	ΔR^2	0.034	0.019	0.037	0.116	0.387	0.441	0.025	0.012
	ΔF	5.971 **	6.880 ***	6.457 **	46.009 ***	281.654 **	283.673 ***	17.163 ***	8.022 **

Note: n = 340; *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$; standardized beta coefficient is in parentheses.

4.3. Hypothesis Test

First, Hypothesis 1 postulates that boundary-spanning search has a positive impact on the innovation capability of enterprises. For M4 in Table 2, the results show that there is a significant positive influence of boundary-spanning search (t = 6.783 **, β = 0.347) on innovation capability. Thus, Hypothesis 1 is validated.

Second, Hypothesis 2 states that boundary-spanning search has a positive impact on network ties of enterprises, while it posits that network ties have a positive influence on the innovation capability of enterprises. From Table 2, boundary-spanning search (t = 2.623 **, β = 0.142) of model M2 has a positive influence on network ties; at the same time, network ties (t = 16.843 ***, β = 0.676) of model M6 also have a positive influence on innovation capability. Thus, Hypotheses 2 and 3 are supported.

Third, boundary-spanning search (t = 6.719 ***, β = 0.257) and network ties (t = 16.783 ***, β = 0.639) of M5 have a significant effect on innovation capability. Therefore, network ties have a mediating effect between boundary-spanning search and innovation capability.

Finally, after hierarchical regression analysis of network ties, innovation capability, interaction and innovation capability of network ties, and absorptive ability, models M7 and M8 are both significant. At the same time, R^2 is improved on the basis of the original model. Therefore, absorptive capability has a mediating effect on the relationship between network ties and innovation capability.

4.4. Mediation Analysis

We conducted mediating effect tests on M4 through process, bootstrap = 5000, and a confidence interval of 95%, then an analysis of the mediating effect of X = boundary-spanning search, M = network ties, Y = innovation capability. The test results between variables are shown in Tables 3 and 4.

Table 3. Bootstrap mediator analysis.

		Coeff	SE	T	LLCI	ULCI	Summary	Outcome
M2	Industry	0.01	0.044	0.226	−0.076	0.096	R = 0.232	NT
	Size	−0.141	0.047	−2.971 **	−0.234	−0.048	R^2 = 0.054	
	BS	0.145	0.055	2.623 **	0.036	0.253	F = 6.343	
							p < 0.001	
M4	Industry	0.042	−0.827	−0.117	0.048	−0.041	R = 0.735	INV
	Size	0.045	−2.280 *	−0.193	−0.014	−0.012	R^2 = 0.540	
	BS	0.053	6.783 **	0.255	0.462	0.265	F = 98.240	
							p < 0.001	
M5	Industry	−0.041	0.031	−1.328	−0.102	0.02	R = 0.391	INV
	Size	−0.012	0.034	−0.364	−0.079	0.054	R^2 = 0.153	
	BS	0.265	0.039	6.719 ***	0.187	0.342	F = 20.216	
	NT	0.648	0.039	16.783 ***	0.572	0.724	p < 0.001	

Note: n = 340; LLCI, lower limit confidence interval; ULCI, Upper limit confidence interval; *** p < 0.001, ** p < 0.01, * p < 0.05.

Table 4. Total, direct, and indirect effects.

	Effect	SE	T	LLCI	ULCI
Total	0.358	0.053	6.783 ***	0.255	0.462
Direct	0.265	0.039	6.719 ***	0.187	0.342
Indirect:NT	0.094	0.043 (BootSE)		0.013 (BootLLCI)	0.178 (BootULCI)

Note: n = 340; *** p < 0.001.

The model data from Table 3 also show that network ties have a mediating effect between boundary-spanning search and innovation capability, which further confirms the regression analysis results of Table 2. Table 4 shows the data of total, direct, and indirect effects between boundary-spanning search → innovation capability. In terms of direct effects, the interval (LLCI =

0.187; ULCI = 0.342) does not include 0, $p < 0.001$, and direct effects exist. In terms of mediating effects, the interval (BootLLCI = 0.013; BootULCL = 0.178) does not include 0, $p < 0.001$, and mediating effects exist. Thus, Hypothesis 4 is validated. Although there are mediating effects between network ties and innovation capability, direct effects of boundary-spanning search on innovation capability exist. Therefore, absorptive capacity has a partial mediating effect.

4.5. Analysis of Moderating and Moderated Mediating Effects

In order to verify the moderating effects of absorptive capacity between network ties and innovation capability, we conducted a hierarchical regression analysis to test the relationship. First, the test results in Table 2 (M6, M7, M8) demonstrate the relationships among the variables. Second, we processed the interactions of absorptive capacity and network ties in centralization through process, Model 1, and select bootstrap = 5000, with a confidence interval of 95%, and then tested the mediating effect of absorption capacity, and the test results are shown in Tables 5 and 6.

Table 5. Bootstrap moderation analysis.

		Coeff	SE	T	LLCI	ULCI	Summary	Outcome
M8	Industry	−0.048	0.032	−1.503	−0.111	0.015		
	SIZE	−0.032	0.035	−0.908	−0.1	0.037	R = 0.718	
	AC	0.151	0.041	3.657 ***	0.07	0.232	R^2 = 0.515	INV
	NT	0.62	0.042	14.799 **	0.537	0.702	F = 70.901	
	AC*NT	−0.125	0.044	−2.832 **	−0.212	−0.038	$p < 0.001$	
ΔR^2 = 0.012 F = 8.022 $p < 0.01$								

Note: n = 340; *** $p < 0.001$; ** $p < 0.01$.

Table 6. Conditional effects of X on Y at values of moderators.

AC	Effect	SE	T	LLCI	ULCI
−0.717	0.709	0.051	13.780 ***	0.608	0.811
0	0.62	0.042	14.799 ***	0.537	0.702
0.717	0.53	0.054	9.899 ***	0.425	0.635

Note: n = 340; *** $p < 0.001$.

To reveal the moderating role of absorptive capacity between network ties and innovation capability, the results in Table 2 (M8) and Table 5 (M8) indicate the interaction coefficients of absorptive capacity and network ties as follows: −2.832 ($p < 0.001$), region value of interactions (−0.221, −0.038) does not contain 0, and $\Delta r^2 = 0.012$, $p < 0.01$, thus moderating effects exist. Our results suggest that the effects of network ties and innovation capability are fully moderated by absorptive capacity. Table 6 presents the interval values of absorptive capacity at different levels: low (0.608, 0.811), medium (0.537, 0.702), and high (0.425, 0.635). A critical look at the table indicates that the values do not contain 0. We then drew a mediating effect graph of absorptive capacity on network ties and innovation capability based on mean value and standard deviation of mean value ±1 (Figure 2). The results reveal that boundary-spanning search has a positive effect on moderating effects between absorptive capacity and innovation capability at low, medium, and high levels. Therefore, boundary-spanning search has a positive moderating effect on absorptive capacity and innovation capability and Hypothesis 5 is supported.

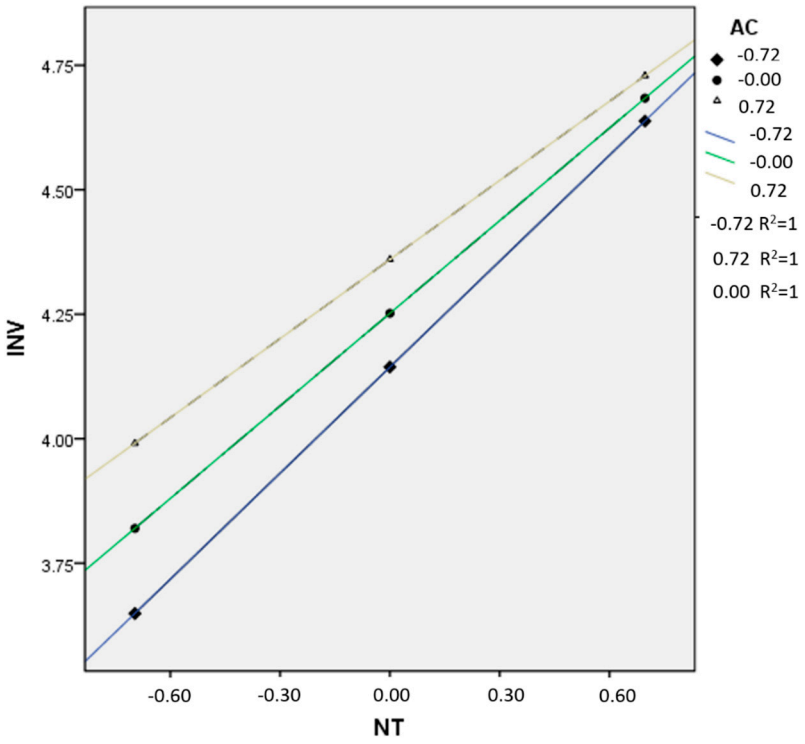

Figure 2. Graph/scatterplot = NT with INV by AC. * Estimates are based on setting covariates to their sample means.

Test of Moderated Mediating Effects

The theoretical research model formed in Figure 1 represents a second-stage moderated mediation. From the regression analysis, moderation analysis, and mediation analysis, this study demonstrates the following significant outcomes. First, we established a relationship between boundary-spanning search and network ties. Second, we verified the existence of a significant relationship between network ties and innovation capability. Third, the results of the study suggest that the effect of network ties and innovation capability is fully moderated by absorptive capacity. Fourth, the above-mentioned conditions constitute second-stage moderated moderation. Boundary-spanning search (X) has an indirect influence on innovation capability (Y) through network ties (M), and the strength of the indirect effect depends on absorptive capacity.

This study compared moderating variables at different levels, that is, how low, medium, and high values of absorptive capacity change mediating effects, and analyzed whether the indirect influence of boundary-spanning search on innovation capability through network ties would change with the moderating role of absorptive capability. We selected bootstrap = 5000 and a confidence interval of 95% through process and Model 14, and examined the mediating effects of network ties by absorptive capability. Tables 7 and 8 show the results.

To deal with both direct and indirect mediating effects, the values depend on variable W, so +1SD and −1SD are usually selected as higher and lower values of moderating variables, and then the differences of mediating effects are examined. If the confidence interval of differences between mediation effects does not include 0 with different values, then the moderated mediation effect is significant. From Table 7, we can see the overall model M9 ($p < 0.001$). Also, as displayed in Table 8, the low, medium, and high levels of interval values of moderated mediation effects do not contain 0. In addition, the interval values of moderated mediating network ties (BOOTCCLI = −0.037; BOOTULCI = −0.001) also do not contain 0. Thus, moderated mediating effects exist. We conclude that the mediating effects of boundary-spanning search on innovation capability would increase as the moderating effects of absorptive capacity on network ties and innovation capability increase.

Table 7. Bootstrap moderated mediation analysis.

		Coeff	SE	T	LLCI	ULCI	Summary	Outcome
M2	Industry	0.01	0.044	0.226	−0.076	0.096	R = 0.232	NT
	SIZE	−0.141	0.047	−2.971 **	−0.234	−0.048	R^2 = 0.054	
	BS	0.145	0.055	2.623 **	0.036	0.253	F = 6.343	
							$p < 0.001$	
M9	Industry	−0.038	0.031	−1.242	−0.099	0.022		INV
	SIZE	−0.01	0.034	−0.287	−0.076	0.057	R = 0.743	
	NT	0.617	0.04	15.318 ***	0.538	0.696	R^2 = 0.553	
	BS	0.222	0.042	5.311 **	0.14	0.304	F = 68.598	
	AC	0.08	0.042	1.9	−0.003	0.162	$p < 0.001$	
	NT×AC	−0.095	0.043	−2.225 *	−0.18	−0.011		

Note: n = 340; *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

Table 8. Direct and indirect effects, index of moderated mediation.

Direct effect of X on Y	Effect	SE	T	LLCI	ULCI
	0.222	0.042	5.311 ***	0.14	0.304
Conditional indirect effect(s) of X on Y at values of the moderator(s)	Effect	Boot SE		BootLLCI	BootULCI
	0.099	0.045		0.013	0.186
	0.089	0.041		0.010	0.169
	0.079	0.038		0.010	0.157
INDEX OF MODERATED MEDIATION: NT					
Index = −0.014; SE(Boot) = 0.009; BootLLCI = −0.037; BootULCI = −0.001					

Note: n = 340; *** $p < 0.001$.

5. Conclusions and Implications

5.1. Discussion

Resources are vital for every firm to thrive in their development and survival in the international market arena. Lack of resources can starve a firm to premature collapse. For firms to position themselves well in the global market arena (Xie, Du, Boadu, and Shi, 2018) [67], they need to form strategic alliances and collaborate with industry partners to share resources to promote innovation capability. From the prevailing literature, not many studies have been conducted on the effects of boundary-spanning search on the innovation capability of enterprises in emerging economies and other facilitating factors impacting boundary-spanning search activity and subsequently innovation capability. In this paper, we constructed a theoretical model of an organization's boundary-spanning search and innovation capability. First, we explored the effects of boundary-spanning search on innovation capability. Specifically, we examined the mediating and moderating effects of network ties and absorptive capacity on boundary-spanning search and innovation in Chinese companies. Our research complements the literature in several ways: First, our results reveal that boundary-spanning search has a positive and significant impact on innovation capability. This finding demonstrates that resource sharing along alliance networks and beyond boundaries aids firms in their innovation strategies. This research supports Tushman's (1977) studies indicating that informational boundary-spanning influences innovation [23]. Second, our study demonstrates a strong relationship between boundary-spanning search and network ties. Scholars and practitioners regard boundary-spanning as a crucial tool to establish network ties. This finding is in line with studies conducted by other scholars (Van Meerkerk and Edelenbos 2014; Klijn, Steijn, and Edelenbos 2010) [41,42] that reveal a positive relationship between boundary-spanning and network performance. Third, the results of the study suggest that the effect of network ties and innovation capability is fully moderated and mediated by absorptive capacity. Absorptive capacity plays a strategic role in organizational development; it is usually an attribute of the organization's research and

development (R&D). R&D departments mostly conduct research to generate knowledge stock for organizational development. They also source technological opportunities that can arise outside the firm. This internal and external knowledge can significantly impact organizational activities [62,68]. Fourth, boundary-spanning search has a positive moderating effect on absorptive capacity and innovation capability. This finding adds to the literature and debates, as it tests the moderating effect of boundary-spanning on absorptive capacity and innovation capability, although previous studies conducted by Ebers and Manuer (2014) [69] tested only the impact of boundary-spanning on absorptive capability and Tushman (1977) [23] tested the influence of boundary-spanning on innovation.

This study presents a practical and policy guideline for managers and policy-makers. First, enterprises need to continuously focus on exploring opportunities for network ties in direct and indirect ways to get access to effective flow and diffusion of resources, which can in turn enhance innovation capability. Second, enterprises should focus on open innovation and regard gaining external knowledge as a critical management task toward growth and sustainability. Third, due to uncertainty and complications in the acquisition of diversified resources (e.g., technological innovation) across organizational boundaries, it is difficult for enterprises to maintain organizational consistency in the process of innovation and knowledge transfer, especially when dealing with external partners. Therefore, enterprises need to develop and implement a management system to maintain effective balance in their organization. Fourth, policy-makers should provide more effective policies to support corporate innovation. They can provide support for enterprises to learn and search knowledge related to innovation through the construction of innovation platforms. Fifth, policy-makers should develop relevant policies to guide and encourage knowledge sharing among enterprises to promote innovation efficiency.

5.2. Conclusions

As open innovation plays an increasingly important role in firm growth and sustained competitive advantage, many firms are engaged in multiple partnerships and improving the utilization of heterogeneous resources. Open innovation has been recognized by both scholars and business practitioners as a process that allows business organizations to access new knowledge resources within and beyond the organizational boundaries. Combinations and recombinations of knowledge resources can emerge from this access, which can lead to firm growth, sustained competitive advantage, and increased innovation performance. Indeed, external resources play a significant role in organizational development. With the tense, dynamic, competitive market environment, firms need to collaborate and form alliances to promote their innovative capability for sustainability. This study investigates the effects of boundary-spanning search on innovation capability. Specifically, it examines the mediating and moderating effects of network ties and absorptive capacity on boundary-spanning search and innovation in Chinese companies. Results from the study reveal that boundary-spanning search has a positive and significant impact on innovation capability as well as a positive moderating effect on absorptive capacity and innovation capability. The study also shows empirically that enterprises create multiple simultaneous relationships with various partners, which can help to reduce the uncertainty of the external environment. With well-established cordial relationships, more opportunities can be created for enterprises to obtain diversified and heterogeneous resources to promote open innovation. This study further enriches the theoretical and empirical research achievements in both boundary-spanning search and innovation capability of enterprises.

5.3. Limitations and Directions for Future Research

Besides the numerous beneficial results of this study, quite a few limitations suggest further inquiry. First, this study concentrates on a specific industry with upstream and downstream relations. Future researchers could consider other industries or sectors to fully validate the results. Second, the study adopts a questionnaire survey approach to collect data for the analysis. Future researchers could consider panel data for the analysis. Third, this study makes a unique contribution to the current

body of research on network ties by investigating their mediating effect on the relationship between boundary-spanning search and innovation capability. The study records a partial mediating effect. There are other possibilities for the selection of mediating variables. Future studies might gain insight by exploring other variables such as social capital, organizational settings, and other factors that influence innovation capability through multiple theoretical perspectives.

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