Strategic Management Journal
Strat. Mgmt. J., **36**: 1105–1114 (2015)
Published online EarlyView 4 May 2014 in Wiley Online Library (wileyonlinelibrary.com) DOI: 10.1002/smj.2263
Received 1 June 2011; *Final revision received 26 January 2014*

THE EFFECTS OF GEOGRAPHIC AND NETWORK TIES ON EXPLOITATIVE AND EXPLORATORY PRODUCT INNOVATION

MUAMMER OZER[1]* and WEN ZHANG[2]
[1] *Department of Management, City University of Hong Kong, Kowloon, Hong Kong*
[2] *China CITIC Bank, Shanghai, China*

Addressing the inconsistent findings in the literature, we first distinguish the type of innovation and study the relationship of industrial clusters with exploitative and exploratory product innovation. Furthermore, we study how focal cluster firms' network ties with their suppliers and buyers in their clusters might moderate these relationships. Our empirical study showed that, while cluster membership enhanced firms' exploitative product innovation, it hindered their exploratory product innovation. Moreover, the results showed that focal cluster firms' network ties with their suppliers and buyers in their clusters strengthened the effects of cluster membership on exploitative product innovation. They also showed that focal cluster firms' network ties with their buyers but not suppliers in their clusters reduced the negative effects of cluster membership on exploratory product innovation. Copyright © 2014 John Wiley & Sons, Ltd.

INTRODUCTION

Although industrial clusters have been found to drive innovation (Bell, 2005), previous studies have also argued that there is either no (Simmie, 2004) or even a negative relationship between the two (Boschma, 2005; Pouder and St. John, 1996). Thus, there have been calls for further empirical research to better understand this relationship (McCann and Folta, 2011; Pouder and St. John, 1996). Addressing these calls, we first study the differential effects of industrial clusters on exploitative and exploratory innovation, which are likely to require different types of capabilities and to be influenced by industrial clusters differently.

Second, we study how firms' network ties with different firms in their clusters might moderate the relationship between industrial clusters and innovation. Past research has studied both intra- (Lahiri, 2010; Singh, 2005) and interfirm (Singh, 2005; Zhang and Li, 2010) network ties. However, the role of network ties in industrial clusters has not always been consistent. For instance, Bell (2005) found that managerial but not institutional network ties increased cluster firms' innovation. In addition, Bell and Zaheer (2007) showed that institutional but not organizational ties improved the knowledge flow among cluster firms. Moreover, McCann and Folta (2011) found that cluster firms' strategic alliances with other firms had no effect on the firms' patenting performance.

Our focal firms in this study are the manufacturers of finished products in an industrial cluster. Instead of studying their network ties with different firms in aggregate, we differentiate their network ties with different types of firms and study the moderating effects of how their network ties with their suppliers and buyers in their clusters might moderate the relationship between their cluster membership and innovation, given that vertical relationships have been known to play an important role in both

Keywords: industrial clusters; exploitative innovation; exploratory innovation; geographic proximity; network ties
*Correspondence to: Muammer Ozer, Department of Management, City University of Hong Kong, 83 Tat Chee Avenue, Kowloon, Hong Kong. E-mail: mgozer@cityu.edu.hk

strategic and innovation management (e.g., Kotabe, Martin, and Domoto, 2003; Mahmood, Zhu, and Zajac, 2011; McEvily and Marcus, 2005).

Finally, we study the moderating roles of different network ties across exploitative and exploratory innovation. This expands our current understanding of how industrial clusters work to influence innovation and addresses several calls for further empirical research on how to overcome the potential negative effects of industrial clusters on innovation (McCann and Folta, 2011; Pouder and St. John, 1996).

THEORY DEVELOPMENT

Innovation can be about new processes that are introduced into a firm's operations to enhance efficiencies or about new products and services that are introduced to the market to meet customer needs (Afuah, 2003). Innovation is also categorized as exploitative and exploratory innovation. Whereas exploitative innovation builds on the firm's existing knowledge base to improve its existing processes and products, exploratory innovation involves a shift to a different knowledge domain with the aim to adopt or create new processes and products (Benner and Tushman, 2002). Since different types of innovation will likely require different types of capabilities, the effect of industrial clusters on these types of innovation will likely vary. In this study, we focus mainly on how industrial clusters influence exploitative and exploratory product innovation, as we explain below.

Product innovation is generally defined as the extent to which a focal firm can successfully develop and introduce new products to the market (Zhang and Li, 2010). It is widely regarded as a knowledge-intensive activity, as firms need to know what product features to offer (Jansen, Van Den Bosch, and Volberda, 2006), how to design their products (Danneels, 2002), and how to commercialize them (Teece, 1992). However, given the multidisciplinary nature of this knowledge, firms will likely need external knowledge to successfully develop new products and introduce them to the market (Zhang and Li, 2010).

Industrial clusters can improve product innovation through several mechanisms. First, cluster firms will likely have the opportunity to observe their rivals in their clusters and learn more about alternative new product features, designs, and marketing efforts (Bell, 2005; Tallman *et al.*, 2004). Second, von Hippel (1987) has long noted that people from both rival and non-rival firms engage in informal information exchanges, which can enhance firms' product innovation through improvements in their product development and manufacturing processes. Since geographic proximity can facilitate such interactions through social and industry events in an industrial cluster, cluster firms will likely have ample opportunities to interact with other firms in their clusters and thus to learn from them (Bell and Zaheer, 2007). Third, from a "communities of practice" perspective, cluster firms will likely identify themselves with a joint cluster enterprise, engage in mutual industry events, and develop shared concepts, tools, language, and norms of business conduct. Hence, they will likely enjoy a sense of belonging, mutual trust, and reciprocity, which will further facilitate knowledge sharing among them and thus enhance their innovation (Wenger, 1998).

However, these cluster benefits will unlikely be uniform across different types of product innovation. In particular, while exploitative product innovations are incremental innovations that build on and reinforce current product knowledge to improve existing products, exploratory product innovations are radical innovations that require new knowledge or departures from existing knowledge to create new products (Jansen *et al.*, 2006). As noted above, industrial clusters will likely help focal cluster firms know more about alternative product features, designs, and marketing efforts. Since such knowledge is likely to help reinforce and improve their existing products (Jansen *et al.*, 2006), we propose the following hypothesis:

Hypothesis 1a: Cluster membership will be positively related to focal firms' exploitative product innovation.

Pouder and St. John (1996) argued that cluster firms tend to consider the rich competitive information available in the cluster to be amply important and engaging, leading them to focus more on their local rivals and thus to differentiate themselves within their clusters at the expense of scrutinizing competitors outside their clusters and learning from them. However, since cluster firms will be exposed to the same type of information, their competitive perceptions will likely become increasingly homogenous over time and hurt their exploratory

DOI: 10.1002/smj

product innovation, which requires heterogeneous and unique knowledge (Jansen *et al.*, 2006). Moreover, due to their enhanced cluster identity, cluster firms will likely utilize similar innovation routines and practices at the expense of using unique product innovation processes (Boschma, 2005). Such homogenous knowledge and practices will likely turn their clusters into "blind spots" and prevent them from utilizing new and diverse knowledge commensurate with market and technological changes outside their clusters (Pouder and St. John, 1996). Thus, cluster membership will likely hinder exploratory product innovation, which requires new knowledge or departures from existing knowledge to create new products (Jansen *et al.*, 2006). It follows that

Hypothesis 1b: Cluster membership will be negatively related to focal firms' exploratory product innovation.

The moderating roles of managerial network ties

Although cluster firms are exposed to general "knowledge in the air" in their clusters (Marshall, 1920), their unique and idiosyncratic network ties with different firms can lead them to have access to diverse knowledge from those firms and thus perform differently in product innovation (Bell, 2005; Zhang and Li, 2010). Given the importance of vertical ties (Kotabe *et al.*, 2003; Mahmood *et al.*, 2011; McEvily and Marcus, 2005), we study how focal cluster firms' network ties with their suppliers and buyers in their clusters might moderate the relationship between the focal firms' cluster membership and their exploitative and exploratory product innovation.

The moderating roles of managerial network ties with suppliers

From a knowledge-based view, suppliers can offer knowledge about viable design ideas (Takeishi, 2001), alternative parts, and raw materials, with their corresponding subsequent manufacturing processes (Kotabe *et al.*, 2003) and effective manufacturing practices (McEvily and Marcus, 2005). These sorts of knowledge usually lead to higher quality, efficiency, and speed in product improvements (i.e., exploitative product innovation) (Clark and Fujimoto, 1991). However, successful product innovation entails a careful integration and recombination of this interrelated knowledge (Takeishi, 2001). Zander and Kogut (1995) noted that firms cannot readily transfer complex knowledge with many critical and interacting features from other firms. Thus, although focal cluster firms might be exposed to this knowledge by observing their suppliers in their clusters, they may not easily incorporate it into their product innovation. However, because interfirm network ties tend to enhance trust and interpersonal relationships between the firms, which help the firms comprehend hard-to-understand tacit knowledge that they might receive from each other (Uzzi, 1996), focal cluster firms' network ties with their suppliers in their clusters will likely help the focal firms understand complex knowledge about alternative product designs and related manufacturing practices. This will in turn improve the quality, efficiency, and speed of their product modifications (i.e., exploitative product innovation) (Clark and Fujimoto, 1991). Thus,

Hypothesis 2a: Focal cluster firms' network ties with suppliers will strengthen the relationship between the focal firms' cluster membership and their exploitative product innovation.

As part of Hypothesis 2a, we argue that suppliers would likely offer product knowledge that can increase the quality, productivity, and speed of product improvement processes. On the other hand, because exploratory product innovations require new knowledge or departures from existing knowledge to create new products (Jansen *et al.*, 2006), mere process improvements will unlikely improve the focal cluster firms' exploratory product innovation. Thus, we propose that

Hypothesis 2b: Focal cluster firms' network ties with suppliers will not moderate the relationship between the focal firms' cluster membership and their exploratory product innovation.

The moderating roles of managerial network ties with buyers

In contrast to suppliers, who tend to provide operational knowledge, buyer firms usually offer product and output-related knowledge (McEvily and Marcus, 2005). Buyer firms can offer knowledge

DOI: 10.1002/smj

about alternative product ideas and emerging market trends (Mahmood *et al.*, 2011), current and future customer needs, and potential new product applications (von Hippel, 1986). This knowledge will likely enable focal cluster firms to change their product features and enhance their exploitative product innovation (Afuah, 2003). Focal cluster firms will likely be exposed to this knowledge through their social interactions with their buyers in their clusters. However, because this knowledge is interrelated and needs to be carefully integrated to develop successful new products (Danneels, 2002), it may not easily be transferred from one firm to another, as noted by Zander and Kogut (1995). Uzzi (1996) argued that interfirm network ties tend to enhance trust and interpersonal relationships between the firms and hence help the firms comprehend hard-to-understand tacit knowledge that they might receive from each other. Thus, focal cluster firms' network ties with their buyers in the cluster will likely help them comprehend this complex knowledge, which will, in turn, lead to higher quality, productivity, and speed in product modifications (i.e., exploitative product innovation) (Clark and Fujimoto, 1991).

Hypothesis 3a: Focal cluster firms' network ties with buyer firms will strengthen the relationship between the focal firms' cluster membership and their exploitative product innovation.

Hypothesis 1b posited a negative relationship between industrial clusters and exploratory product innovation. We expect that focal cluster firms' network ties with their buyers in their clusters can reverse this negative effect to the extent to which the knowledge that the buyer firms can provide is heterogeneous and conducive for exploratory product innovation. As we noted earlier, buyer firms can provide knowledge about alternative product ideas and emerging market trends (Mahmood *et al.*, 2011), current and future customer needs, and potential new product applications (von Hippel, 1986). This market knowledge is likely to be heterogeneous, as buyer firms in an industrial cluster tend to buy products within the cluster but resell them not only within the cluster, but also in national and global markets, exposing them to a variety of ideas from the worldwide markets (Altenburg, Schmitz, and Stamm, 2007). Global business theory argues that firms operating in global markets will have ample opportunities to acquire both market and technological knowledge, which are useful for new product ideas (Salomon and Shaver, 2005). Since buyer firms mainly compete in domestic and global markets, they will less likely be affected by the homogenous competitive knowledge within the cluster.

However, focal cluster firms may not readily incorporate the knowledge that they might receive from the buyer firms into their exploratory product innovation process, as this kind of knowledge tends to be complex (Danneels, 2002), and makes its transfer from one firm to another difficult (Zander and Kogut, 1995). On the other hand, since firms' network ties with each other will likely increase trust and interpersonal relationships between them (Uzzi, 1996), focal cluster firms' network ties with buyers in their clusters will likely enable the focal firms to comprehend this type of hard-to-understand tacit knowledge. As a result, such ties will likely help the focal firms improve their exploratory product innovation and overcome the potential negative effects of industrial clusters on exploratory product innovation. It follows that

Hypothesis 3b: Focal cluster firms' network ties with buyer firms will strengthen the relationship between the focal firms' cluster membership and their exploratory product innovation.

METHODOLOGY

We sampled firms located in the Greater Shanghai area in China, where the local authorities clearly define clusters and closely monitor them. With the help of local industry agencies, the second author (WZ) randomly contacted firms operating in manufacturing and technology zones in Shanghai and those that did not operate in any zone. We designed our questionnaire using existing scales and used its Chinese version after a back-translation process. WZ distributed two questionnaires in each firm and obtained the measures of independent and dependent variables from different people. While senior managers in each firm answered the items about network ties, mid-level manufacturing or marketing managers, who were knowledgeable about product innovation, answered the product innovation questions. The respondents were asked to attach their name cards to the surveys, similar to past research practice (Danneels, 2008). They were assured that

DOI: 10.1002/smj

the data would be kept confidential without identifying their names or firms. The surveys were collected in unmarked sealed envelopes, and the responses from each firm were matched using the firm names.

WZ delivered 400 questionnaires to 200 firms and collected 99 and 53 paired questionnaires from 99 cluster and 53 non-cluster firms, respectively. The senior managers had an average firm tenure of 5.38 years and an average job experience of 8.43 years. Among them, 87.5 percent were male, and 17.2, 60.3, and 18.5 percent held associate, bachelor, and graduate degrees, respectively. The mid-level managers had an average firm tenure of 3.72 years and an average job experience of 5.79 years. Of them, 78.3 percent were male, and 20.4, 67.8, and 9.2 percent had associate, bachelor, and graduate degrees, respectively.

Cluster and non-cluster firms did not significantly differ with respect to the means of our moderating variables, the type of clients, and the size of senior management team. Moreover, the respondents from these two groups of firms were statistically similar with regard to their gender, education, and years of experience in the firm and in the industry. Consistent with past research (Lu, 2010; McCann and Folta, 2011; Shaver and Flyer, 2000), compared to non-cluster firms, cluster firms were younger, smaller, and mostly non-state-owned firms ($p < 0.05$). As we explain later in the data analysis section, firm age, firm size, and firm ownership are instrumental variables in our analyses, and we test the hypotheses after controlling for these variables.

Measures

We assessed firms' cluster membership based on a dummy coding, with 1 = the firm is located in an industrial cluster and 0 = otherwise. We asked the respondents to indicate the extent to which their firms had managerial network ties with their suppliers and buyers within their clusters for cluster firms and in their regions for non-cluster firms over the last three years using a seven-point Likert-type scale ranging from *very little* (1) to *very much* (7) (Luo, 2003). We also created a composite score of managerial network ties with both suppliers and buyers by averaging the items in each category. We assessed firms' exploitative and exploratory product innovation by using the seven-item scales listed in Jansen *et al.* (2006: 1672). We asked the respondents to indicate the extent to which they agreed with the scale items on a seven-point Likert-type scale ranging from *strongly disagree* (1) to *strongly agree* (7). Finally, we asked several demographic questions. They were firm age (the number of years in operation) (Bell, 2005), firm size (natural log of the number of full-time employees in the firm) (Luo, 2003), the size of the senior management team (the number of people in the team) (Zhang and Li, 2010), firm ownership (coded as a dummy variable with 1 = state-owned and 0 = otherwise) (Park and Luo, 2001), and the client type (coded as a dummy variable with 0 = business client and 1 = otherwise) (Jansen *et al.*, 2006). Table 1 presents the means, standard deviations, and correlations among the variables.

Procedural and statistical measures to control for common methods biases

Podsakoff *et al.* (2003) suggested both procedural and statistical methods to control for common method biases including item priming and social desirability effects. Procedurally, as we noted

Table 1. Means, standard deviations, and correlations among variables*

Variable	M	*SD*	1	2	3	4	5	6	7	8	9	10
1. Exploitative product innovation	4.13	2.55										
2. Exploratory product innovation	4.22	2.62	0.00									
3. Cluster membership	0.67	0.47	0.20	−0.16								
4. Network ties with suppliers	4.28	2.40	0.28	0.15	0.12							
5. Network ties with buyers	3.66	2.59	0.16	0.20	0.13	0.36						
6. Network ties with multiple organizations	7.95	4.13	0.27	0.21	0.15	0.81	0.84					
7. Firm age	11.04	8.10	−0.13	0.13	−0.30	−0.08	−0.25	−0.20				
8. Firm size (natural log)	5.35	0.87	−0.14	0.03	−0.17	−0.36	−0.25	−0.36	−0.35			
9. Ownership	0.22	0.41	−0.16	−0.03	−0.24	−0.17	−0.22	−0.23	0.21	0.07		
10. Senior management team size	9.86	10.40	0.01	0.08	−0.05	−0.16	−0.07	−0.13	−0.08	0.26	−0.06	
11. Client type	1.61	0.49	0.15	0.09	0.07	0.19	0.06	0.15	0.03	−0.08	−0.03	0.06

*Correlations that are 0.16 and larger are significant at $p < 0.05$.

DOI: 10.1002/smj

above, we obtained the measures of the predictor and criterion variables from different people. Moreover, we assured the respondents that the data would be kept confidential without identifying their names or firms to urge them to express their true opinions rather than giving socially acceptable answers. Finally, we studied the moderating roles of network ties and tested our hypotheses using moderated regression models, which are less likely to be influenced by common method biases (Siemsen, Roth, and Oliveira, 2010).

Statistically, because common method biases such as item priming and social desirability imply that people might answer the potentially primed or socially sensitive items in a peculiar way (Podsakoff *et al.*, 2003), the answers to those questions should vary less compared to the answers for the other items. The variances of our focal variables ranged from 5.77 to 6.85 but did not differ significantly. Second, Herman's test showed that a single factor with all variables loaded into it could not explain the majority of the covariance among the measures. We also retested our hypotheses after controlling for a first-order factor with all measures as indicators to represent common method biases and found similar results (Podsakoff *et al.*, 2003). All these robustness tests showed that common method biases were not a major concern in the study.

Data analysis

Both cluster membership and network ties are likely to be endogenous in this study. We used a series of two-stage least squares models to address potential endogeneity issues associated with these variables (Bascle, 2008). The first-stage models had cluster membership and network ties as dependent variables; firm age, firm size, and firm ownership as instruments; and the size of the senior management team and the client type as control variables. We calculated the predicted values for cluster membership and network ties for each observation based on the first-stage models. Following Bascle (2008) and Kennedy (2008), the second-stage models had exploitative and exploratory product innovation as dependent variables and the predicted values for cluster membership and network ties and the interactions of these two predicted values as predictors, while using the size of the senior management team and the client type as control variables.

Instrumental variables should be both relevant and exogenous (Bascle, 2008). There are both theoretical and empirical reasons why our instrumental variables might be relevant. For instance, young firms are more likely than older firms to belong to an industrial cluster (McCann and Folta, 2011) and form network ties with other firms (Baum, Calabrese, and Silverman, 2000) to seek additional resources for product innovation. Similarly, compared to large firms, small firms are more likely to belong to industrial clusters (Shaver and Flyer, 2000) and form network ties with other firms (Park and Luo, 2001) to offset their resource and technical shortcomings. Finally, compared to non-state-owned firms, state-owned firms are less likely to belong to industrial clusters and to form network ties with other firms, as they tend to pursue such sociopolitical goals as regional development and job creation instead of generating revenues (Lu, 2010; Park and Luo, 2001). Significant F-statistics shown in Models 1–4 in Table 2(a) confirm the relevance of the instrumental variables for both cluster membership and network ties.

As for the exogeneity of these variables, there is no theoretical reason why they should relate to innovation. For instance, while older firms tend to have more resources, young firms tend to be more creative (Lahiri, 2010). Thus, it was found that firm age was related to neither exploitative nor exploratory product innovation (Zhou and Wu, 2010). Second, although larger firms might have a longer history and more resources, smaller firms tend to be more flexible and entrepreneurial (Park and Luo, 2001). Hence, it was found that firm size was related to neither exploitative nor exploratory product innovation (Zhou and Wu, 2010). Finally, although state-owned firms' institutional mandates might limit their urge to belong to industrial clusters or to form network ties with other firms, they still need to be innovative (Wade, 2003). Thus, no relationship was found between firm ownership and both exploitative (Li and Atuahene-Gima, 2002) and exploratory (Chen, Fu, and Zhao, 2010) innovation. The Hansen J-test, Sargan, and the difference-in-Sargan statistics reported in Models 1–4 in Table 2(a) and Models 8–11 in Table 3(a) are not significant, confirming the exogeneity of the variables for cluster membership and network ties for exploitative and exploratory product innovation, respectively.[1]

[1] The results of fully mediated models, which are available from the authors, also confirm these conclusions.

DOI: 10.1002/smj

Table 2. Results of regression analyses for exploitative product innovation

	Exploitative product innovation			
	Model 1 Cluster membership	Model 2 Network ties with supplier firms	Model 3 Network ties with buyer firms	Model 4 Network ties with supplier and buyer firms in aggregate
(a) First-stage models and robustness checks				
Senior management team size	−0.02	0.09	0.01	−0.06
Client type	−0.05	−0.17**	−0.04	−0.12*
Firm age	−0.37***	−0.20***	−0.35***	−0.34***
Firm size (natural log)	−0.28***	−0.38***	−0.35***	−0.45***
Ownership (state)	−0.16**	−0.12*	−0.13*	−0.13*
Instrument relevance: F-statistic (critical value)	16.04*** (9.48)	10.32*** (9.48)	11.60*** (9.48)	14.09*** (9.48)
Instrument exogeneity: Hansen J-test statistic (*p*-value)	0.40 (0.82)	0.97 (0.60)	0.24 (0.89)	0.31 (0.97)
Instrument exogeneity: Sargan statistic (*p*-value)	0.46 (0.79)	1.25 (0.54)	0.24 (0.89)	0.42 (0.81)
Exogeneity of firm age: the difference-in-Sargan statistic for firm age (*p*-value)	0.32 (0.57)	0.28 (0.60)	0.17 (0.68)	0.01 (0.97)
Exogeneity of firm size: the difference-in-Sargan statistic for firm size (*p*-value)	0.09 (0.77)	0.79 (0.39)	0.03 (0.87)	0.29 (0.59)
Exogeneity of ownership: the difference-in-Sargan statistic for ownership (*p*-value)	0.12 (0.72)	0.17 (0.68)	0.23 (0.63)	0.20 (0.66)

(b) Second-stage models and hypotheses testing

	Exploitative product innovation		
	Model 5 Network ties with supplier firms	Model 6 Network ties with buyer firms	Model 7 Network ties with supplier and buyer firms in aggregate
Senior management team size	0.05	0.07	0.06
Client type	0.01	−0.04	−0.02
Cluster membership (CM)	0.31***	0.26**	0.29***
Network ties (NT)	0.24**	0.26**	0.25**
CM × NT	0.17**	0.16**	0.16**
R^2	0.30	0.29	0.29
Adjusted R^2	0.27	0.27	0.27
F	12.19***	12.17***	12.19***
ΔR^2	0.02	0.02	0.02
F	4.46**	3.80**	4.15**

***$p < 0.01$; **$p < 0.05$; *$p < 0.10$

RESULTS

Tables 2 and 3 show the results for exploitative and exploratory product innovation, respectively. Models 5–7 in Table 2(b) show that the relationship between focal firms' cluster membership and their exploitative product innovation was positive ($p < 0.05$). Similarly, Models 12–14 in Table 3(b) show that the relationship between focal firms' cluster membership and their exploratory product innovation was negative ($p < 0.05$). These results support both Hypotheses 1a and 1b.

Model 5 in Table 2(b) shows that focal firms' network ties with suppliers had a positive ($p < 0.05$)

DOI: 10.1002/smj

Table 3. Results of regression analyses for exploratory product innovation

	Exploratory product innovation			
	Model 8 Cluster membership	Model 9 Network ties with supplier firms	Model 10 Network ties with buyer firms	Model 11 Network ties with supplier and buyer firms in aggregate
(a) First-stage models and robustness checks				
Senior management team size	−0.02	0.09	0.01	−0.06
Client type	−0.05	−0.17**	−0.04	−0.12*
Firm age	−0.37***	−0.20***	−0.35***	−0.34***
Firm size (natural log)	−0.28***	−0.38***	−0.35***	−0.45***
Ownership (state)	−0.16**	−0.12*	−0.13*	−0.13*
Instrument relevance: F-statistic (critical value)	16.04*** (9.48)	10.32*** (9.48)	11.60*** (9.48)	14.09*** (9.48)
Instrument exogeneity: Hansen J-test statistic (*p*-value)	2.52 (0.28)	2.86 (0.24)	1.87 (0.39)	2.28 (0.32)
Instrument exogeneity: Sargan statistic (*p*-value)	2.01 (0.37)	2.73 (0.26)	1.75 (0.42)	2.19 (0.33)
Exogeneity of firm age: the difference-in-Sargan statistic for firm age (*p*-value)	2.41 (0.12)	2.75* (0.10)	1.76 (0.18)	2.17 (0.14)
Exogeneity of firm size: the difference-in-Sargan statistic for firm size (*p*-value)	0.08 (0.78)	0.08 (0.78)	0.01 (0.92)	0.01 (0.94)
Exogeneity of ownership: the difference-in-Sargan statistic for ownership (*p*-value)	2.31 (0.13)	1.31 (0.25)	1.41 (0.24)	1.39 (0.24)

(b) Second-stage models and hypotheses testing

	Exploratory product innovation		
	Model 12 Network ties with supplier firms	Model 13 Network ties with buyer firms	Model 14 Network ties with supplier and buyer firms in aggregate
Senior management team size	−0.08	−0.05	−0.07
Client type	0.01	−0.08	−0.05
Cluster membership (CM)	−0.28***	−0.30**	−0.29***
Network ties (NT)	0.38***	0.36***	0.37***
CM × NT	0.14	0.20**	0.17**
R^2	0.15	0.17	0.16
Adjusted R^2	0.12	0.14	0.13
F	5.24***	5.79***	5.51***
ΔR^2	0.02	0.03	0.02
F	2.64	4.94**	3.76**

***$p < 0.01$; **$p < 0.05$; *$p < 0.10$

moderating role in the relationship between focal firms' cluster membership and their exploitative product innovation. In addition, Model 12 in Table 3(b) shows that focal firms' network ties with suppliers did not moderate the relationship between the focal firms' cluster membership and their exploratory product innovation ($p > 0.10$). These results support both Hypotheses 2a and 2b. Finally, as Model 6 in Table 2(b) and Model 13 in Table 3(b) respectively show, focal firms' network ties with buyers had a positive ($p < 0.05$) moderating role in the relationship between the focal firms' cluster membership and both their exploitative and exploratory product innovation,

DOI: 10.1002/smj

respectively. These results support both Hypotheses 3a and 3b.

DISCUSSION

The results showed that cluster membership was related positively to exploitative but negatively to exploratory product innovation. They also showed that network ties with both suppliers and buyers strengthened the effects of industrial clusters on exploitative product innovation. Moreover, network ties with buyers attenuated the negative effects of industrial clusters on exploratory product innovation. This result is important, as it shows how to reduce the potential negative influence of industrial clusters on exploratory product innovation, which has been recognized as a major future research area (McCann and Folta, 2011; Pouder and St. John, 1996).

The results based on aggregated and differentiated network ties did not vary in the case of exploitative product innovation. This is consistent with the findings of Zhang and Li (2010) who found that both aggregated and differentiated ties with different service providers improved focal firms' innovation. On the other hand, we found that aggregated network ties with suppliers and buyers (Model 14 in Table 3b) positively moderated the relationship between industrial clusters and exploratory product innovation. However, the results based on the differentiated network ties showed that network ties with suppliers (Model 12 in Table 3b) did not moderate this relationship, underlining the significance of differentiating network ties with different firms.

This study has several limitations. First, we studied product but not process innovation. Since industrial clusters and network ties might exert different effects on process innovation, future research can study such innovation. Second, we focused on firms' network ties with other firms in their clusters. Future research could study both intra- and cross-cluster network ties. Third, we primarily studied interfirm network ties. We urge further research to study both intra- and interfirm network ties. Finally, networked firms face the possible risk of leaking their proprietary knowledge to their partners. Singh (2005) urged firms to use complementary assets that make such knowledge more valuable when it is used inside the firm than when it is used by its rivals. Future research can also look into the potential implications of such leakage.

ACKNOWLEDGEMENTS

We thank Anita McGahan and two anonymous reviewers for their very insightful and constructive comments throughout the review process. The first author acknowledges the financial support from the City University of Hong Kong (Project No: CityU 7008021).

REFERENCES

Afuah A. 2003. *Innovation Management: Strategies, Implementation, and Profits*. Oxford University Press: New York.

Altenburg T, Schmitz H, Stamm A. 2007. Breakthrough? China's and India's transition from production to innovation. *World Development* **36**(2): 325–344.

Bascle G. 2008. Controlling for endogeneity with instrumental variables in strategic management research. *Strategic Organization* **6**: 285–327.

Baum JAC, Calabrese T, Silverman BS. 2000. Don't go it alone: alliance network composition and startups' performance in Canadian biotechnology. *Strategic Management Journal* **21**(3): 267–294.

Bell GG. 2005. Clusters, networks, and firm innovativeness. *Strategic Management Journal* **26**: 287–295.

Bell GG, Zaheer A. 2007. Geography, networks, and knowledge flow. *Organization Science* **18**: 955–972.

Benner MJ, Tushman ML. 2002. Process management and technological innovation: a longitudinal study of the photography and paint industries. *Administrative Science Quarterly* **47**(4): 676–706.

Boschma RA. 2005. Proximity and innovation: a critical assessment. *Regional Studies* **39**(1): 61–74.

Chen JX, Fu S, Zhao YQ. 2010. An empirical test of CEO transactional leadership on organizational performance in Chinese transitional economy context. In *IEEE 17th International Conference on Management Science & Engineering*, Melbourne, Australia. DOI: 10.1109/ICMSE.2010.5719838.

Clark KB, Fujimoto T. 1991. *Product Development Performance: Strategy, Organization, and Management in the World of Auto Industry*. Harvard Business School Press: Boston, MA.

Danneels E. 2002. The dynamics of product innovation and firm competences. *Strategic Management Journal* **23**(12): 1095–1121.

Danneels E. 2008. Organizational antecedents of second-order competences. *Strategic Management Journal* **28**(4): 519–543.

von Hippel E. 1986. Lead users: a source of novel product concepts. *Management Science* **32**: 791–805.

von Hippel E. 1987. Cooperation between rivals: informal know-how trading. *Research Policy* **16**: 291–302.

Jansen JJP, Van Den Bosch FAJ, Volberda HW. 2006. Exploratory innovation, exploitative innovation, and performance: effects of organizational antecedents and environmental moderators. *Management Science* **52**(11): 1661–1674.

Kennedy P. 2008. *A Guide to Econometrics* (6th edn). Wiley-Blackwell: Malden, MA.

Kotabe M, Martin X, Domoto H. 2003. Gaining from vertical partnerships: knowledge transfer, relationship duration and supplier performance improvement in the U.S. and Japanese automotive industries. *Strategic Management Journal* **24**(4): 293–316.

Lahiri N. 2010. Geographic distribution of R&D activity: how does it affect innovation quality? *Academy of Management Journal* **53**(5): 1194–1209.

Li H, Atuahene-Gima K. 2002. The adoption of agency business activity, product innovation, and performance in Chinese technology ventures. *Strategic Management Journal* **23**: 469–490.

Lu J. 2010. Agglomeration of economic activities in China: evidence from establishment censuses. *Regional Studies* **44**(3): 281–297.

Luo Y. 2003. Industrial dynamics and managerial networking in an emerging market: the case of China. *Strategic Management Journal* **24**(13): 1315–1327.

Mahmood IP, Zhu H, Zajac EJ. 2011. Where can capabilities come from? Network ties and capability acquisition in business groups. *Strategic Management Journal* **32**(8): 820–848.

Marshall A. 1920. *Principles of Economics*. Macmillan: London, UK.

McCann BT, Folta TB. 2011. Performance differentials within geographic clusters. *Journal of Business Venturing* **26**(1): 104–123.

McEvily B, Marcus A. 2005. Embedded ties and the acquisition of competitive capabilities. *Strategic Management Journal* **26**(11): 1033–1055.

Park SH, Luo Y. 2001. Guanxi and organizational dynamics: organizational networking in Chinese firms. *Strategic Management Journal* **22**(5): 455–477.

Podsakoff PM, MacKenzie SB, Lee JY, Podsakoff NP. 2003. Common method biases in behavioral research: a critical review of the literature and recommended remedies. *Journal of Applied Psychology* **88**: 879–903.

Pouder R, St. John CH. 1996. Hot spots and blind spots: geographical clusters of firms and innovation. *Academy of Management Review* **21**(4): 1192–1225.

Salomon R, Shaver JM. 2005. Learning by exporting: new insights from examining firm innovation. *Journal of Economics and Management Strategy* **14**(2): 431–460.

Shaver JM, Flyer F. 2000. Agglomeration economies, firm heterogeneity, and foreign direct investment in the United States. *Strategic Management Journal* **21**: 1175–1193.

Siemsen E, Roth A, Oliveira P. 2010. Common method bias in regression models with linear, quadratic, and interaction effects. *Organizational Research Methods* **13**: 456–476.

Simmie J. 2004. Innovation and clustering in the globalized international economy. *Urban Studies* **41**: 1095–1112.

Singh J. 2005. Collaborative networks as determinants of knowledge diffusion patterns. *Management Science* **51**(5): 756–770.

Takeishi A. 2001. Bridging inter- and intra- firm boundaries: management of supplier involvement in automobile product development. *Strategic Management Journal* **22**(5): 403–433.

Tallman S, Jenkins M, Henry N, Pinch S. 2004. Knowledge, clusters, and competitive advantage. *Academy of Management Review* **29**(2): 258–271.

Teece DJ. 1992. Competition, cooperation, and innovation: organizational arrangements for regimes of rapid technological progress. *Journal of Economic Behavior and Organization* **18**(1): 1–25.

Uzzi B. 1996. The sources and consequences of embeddedness for the economic performance of organizations: the network effect. *American Sociological Review* **61**(4): 674–698.

Wade R. 2003. *Governing the Market: Economic Theory and the Role of Government in East Asian Industrialization*. Princeton University Press: Princeton, NJ.

Wenger E. 1998. *Communities of Practice: Learning, Meaning and Identity*. Cambridge University Press: Cambridge, UK.

Zander U, Kogut B. 1995. Knowledge and the speed of the transfer and imitation of organizational capabilities: an empirical test. *Organization Science* **6**: 76–92.

Zhang Y, Li H. 2010. Innovation search of new ventures in a technology cluster: the role of ties with service intermediaries. *Strategic Management Journal* **31**: 88–109.

Zhou KZ, Wu F. 2010. Technological capability, strategic flexibility, and product innovation. *Strategic Management Journal* **31**(5): 547–561.