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Search Behavior and Catch-up of Firms in Emerging Markets*

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Abstract

This study investigates catch-up in the form of knowledge creation of firms in emerging markets by stressing two distinct types of search behaviors of an organization – horizontal search and vertical search. Based on an empirical analysis of 204 Chinese firms, this study provides new theoretical insights into and practical implications by emphasizing that in order to catch-up, firms in emerging markets should adopt idiosyncratic search strategies different from those of firms in more advanced countries. The regression results show that due to their under-developed absorptive capacity, firms in emerging markets should avoid searching in diverse knowledge fields, as established large firms in advanced countries are encouraged to do, in order to innovate successfully. Our findings also suggest that searching for recent and emerging knowledge helps firms in emerging markets overcome their learning curve disadvantage in the process of catch-up.

Keywords: catch-up, search behavior, China, innovation, patent, technology

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INTRODUCTION

In the knowledge-based economy, prominent scholars (e.g., Kogut and Zander 1992; Winter 1987) have often emphasized innovation and knowledge creation capabilities as key to sustained competitive advantage. Existing studies in organizational learning have suggested that organizations must value learning in order to survive and prosper in the knowledge-based economy (Argote 1999; Huber 1991; Levinthal and March 1993; Levitt and March 1988; March 1991). Drawing on the organizational learning perspective and the knowledge-based view, prior studies have investigated various sources of knowledge creation or innovation for organizations (e.g., Ahuja and Lampert 2001; Cohen and Levinthal 1990; Katila and Ahuja 2002; March 1991; Nerkar 2003; Rosenkopf and Nerkar 2001; Song, Almeida, and Wu 2003).

However, most existing studies examined the learning mechanism and knowledge creation in the context of established firms in advanced countries. Very few studies have investigated these constructs in the context of catch-up by laggard firms in emerging countries (e.g., Miao, Song, and Li 2014; Miao, Song, and Salomon 2014; Zhou and Li 2012). With the rapid economic growth of emerging economies, firms in these countries have recognized technology as the significant driver of organizational competitiveness in global markets. Thus, they have striven to improve their technological capabilities through learning and innovation (Chen 2005; Khanna, Song, and Lee 2011; Kriz 2010).

China, a typical emerging economy, has achieved great economic growth since its adoption of the open door policy and various economic reforms in the past three decades. In the wake of this rapid economic growth, an increasing number of Chinese firms have achieved remarkable success in terms of global competitiveness. Previous studies have suggested that a key factor in the success of Chinese firms is their organizational learning capabilities in the changing business environment (Chen 2005; Kriz 2010).

With the rise of Chinese firms in the world economy, it becomes more important to understand learning behaviors of Chinese firms and how these behaviors influence new knowledge creation in the process of catch-up, the source of sustainable competitive advantage. Organizational search behavior has been stressed as key

to organizational learning, promoting or hindering firms' efforts to solve problems and create new valuable knowledge (Huber 1991; Katila and Ahuja 2002; Rosenkopf and Nerkar 2001). In this study, we examine how organizational search behaviors of Chinese firms affect their creation of new knowledge. This study contributes to the existing research stream by classifying search behaviors into two distinct types: vertical search, which involves time-spanning search, and horizontal search, which focuses on the spanning of technological boundaries. While previous studies indicated that search patterns can affect knowledge creation (Ahuja and Lampert 2001; Katila and Ahuja 2002; Nerkar 2003; Rosenkopf and Nerkar 2001), few have distinguished and examined these two types of search behaviors simultaneously. Based on the organizational learning perspective and the theory of innovation, which highlights the importance of recombination, this study considers the impacts of both types of searches on knowledge creation, and investigates how vertical search and horizontal search interact in the process of knowledge creation.

Though previous studies investigated the effects of organizational search behavior on innovation, most prior literature examined its effects on innovation or new knowledge creation in the context of established large firms in advanced Western countries (e.g., Katila 2002; Katila and Ahuja 2002; Nerkar 2003; Rosenkopf and Nerkar 2001). This paper investigates the effects of organizational search behaviors on catch-up in the form of knowledge creation of firms from China as a representative country with an emerging economy. We found that in order to innovate successfully, firms in emerging markets, which lack historical experience with past knowledge and sufficient absorptive capacity, should adopt distinct search strategies more appropriate to their under-developed state. Search strategies of firms in emerging economies should be different from those of established firms in advanced countries.

The results of this study suggest that firms in emerging economies can achieve greater success in innovation by focusing on recent knowledge than mature knowledge due to lack of historical experience with past knowledge and technologies. We also find that compared to established firms in advanced countries that are often encouraged to go beyond the local search, firms from emerging economies can create more knowledge through neighborhood search and combine knowledge from similar fields.

This paper is organized as follows. We first review the relevant literature and theories on organizational learning and knowledge creation process. Based on the literature review, we identify two search dimensions – horizontal search and vertical search – and put forth hypotheses about how these two types of search influence knowledge creations. Then, we empirically examine hypotheses based on patent data of 204 Chinese firms. Finally, we discuss the implications of our findings in light of the extant literature.

THEORY AND HYPOTHESES

Organizational Learning, Knowledge Recombination, and Search Behavior

The organizational learning perspective views an organization as a subject that searches for information and solutions from outside in order to solve problems (Huber 1991; Levitt and March 1988). Scholars have suggested that a firm should become a knowledge-creating company or a learning organization by enhancing its ability to generate, acquire, and integrate both internal and external sources of knowledge (Leonard-Barton 1995; Nonaka and Takeuchi 1995; Nonaka and Toyama 2003; Simonin 1997).

Following the seminal work of Shumpeter (1934), existing literature has defined knowledge creation as a process that involves recombining different streams of existing knowledge (Fleming 2001; Kogut and Zander 1992). This recombination process is undertaken through search, discovery, and use of existing knowledge both inside and outside of the organization (Henderson and Clark 1990; Huang 2009; Kogut and Zander 1992; Schumpeter 1934). Prior studies in this stream suggested that knowledge created through the recombination process can be a source of sustained competitive advantage because the capabilities required for recombination are usually tacit and complex (Kogut and Zander 1992; Winter 1987).

In order to create valuable new knowledge, a firm must search for relevant knowledge elements that are potentially useful for recombination. Knowledge search in an organization is an important organizational learning process through which a firm attempts to solve problems in an ambiguous world (Huber 1991). Organizational learning literature suggests that organizations engage in a variety of searches. In this study, we classify organizational search behaviors

according to two distinct dimensions – temporal (vertical searching) (Katila 2002; Nerkar 2003) and spatial (horizontal searching) (Levinthal and March 1993; Rosenkopf and Nerkar 2001). Vertical search highlights the temporal nature of knowledge. Firms can search for and learn both old, mature knowledge and recent, emerging knowledge. By contrast, a horizontal search spans different knowledge fields and reflects an organization's ability to recombine diverse knowledge elements to result in innovation (Rosenkopf and Nerkar 2001). Though prior studies have investigated the effects of search behaviors on innovation (e.g., Katila 2002; Katila and Ahuja 2002; Nerkar 2003; Rosenkopf and Nerkar 2001), to our knowledge, few have examined these two search dimensions simultaneously, especially in the context of firms in emerging economies. In the following section, we develop hypotheses about how vertical and horizontal searches influence knowledge creation of firms in emerging markets.

Vertical Search and Knowledge Creation

A vertical search considers a firm's search efforts across a certain time span to identify knowledge elements necessary for knowledge creation. In the knowledge pool which is available to a firm, some knowledge is mature and well developed, while other knowledge is emerging and less well exploited (Katila 2002; Nerkar 2003). Mature knowledge has been around for some time and is relatively well known, used and understood in the industry. In contrast, emerging or recent knowledge, by definition, is relatively new in chronological terms, and thus represents the leading edge of the knowledge frontier (Katila 2002; Nerkar 2003; Sorensen and Stuart 2000).

Mature and emerging knowledge differ in nature and therefore contribute differently to organizational learning and knowledge creation. Mature or old knowledge has been discussed with many merits. First, mature knowledge is usually well understood and offers greater reliability relative to more recently developed and less well tested approaches (Hutchins 1983; March 1991). Highly developed value networks and complementary, co-specialized organizational assets are built based on this type of knowledge (Christensen and Rosenbloom 1995). Additionally, mature knowledge which is well known in the industry offers the benefits of legitimacy (March 1991). For example, even if a new, unproven

technology holds the promise of superior performance, it may be difficult and expensive for a company to convince customers to trust it.

Although mature knowledge has several merits in terms of organizational learning, it has some inherent problems well. The theory of recombinant innovation says that inventions result from combining or recombining existing knowledge elements into new syntheses (Fleming 2001; Henderson and Clark 1990; Kogut and Zander 1992; Tushman and Rosenkopf 1992). As knowledge matures, the likelihood of a high-utility combination that has not yet been tried or exploited gradually declines (Fleming 2001; Nerkar 2003). Conversely, emerging knowledge whose constituent elements are relatively new, offers significantly higher potential for creative recombination (Katila 2002).

In addition, firms that gain recent knowledge are better able to predict the direction of future technological advances (Cohen and Levinthal 1989; Katila 2002; Miao, Song, and Li 2014). As a result, they are more likely to generate valuable new knowledge that meets current needs and emerging trends. Therefore, although mature knowledge is easier to utilize, more reliable, and more legitimate, its value in terms of knowledge recombination and prediction of future technological trajectories declines over time.

Scholars of organizational learning have emphasized that recent knowledge is relatively easily accessible for many firms, whereas older knowledge is often more difficult to access and build on (Argote 1999; March 1991). This is especially true for firms in emerging markets. Compared to established large firms that have built their capabilities on old knowledge and existing technological trajectories (Dosi 1982; Schumpeter 1939), firms in emerging markets are usually newcomers to innovations in an industry. Due to their lack of historical experience with existing knowledge, firms in emerging economies have more difficulty absorbing old/mature knowledge than established firms. Such firms can overcome the disadvantage of this learning curve by focusing on emerging technologies. As a result, for firms in emerging economies, the benefit of acquiring emerging knowledge is greater than the benefit of learning old or mature knowledge. Therefore, we hypothesize that searching recent knowledge is more likely to promote new knowledge creation for firms in emerging economies than searching for older knowledge.

H1: the degree to which a firm searches for recent/emerging knowledge is positively related to knowledge creation for firms in emerging economies.

Horizontal Search and Knowledge Creation

Horizontal searching in this study refers to the scope of the search across different knowledge fields. Prior studies have suggested a twofold impact of the search scope on new knowledge creation. On the one hand, a broad search can increase a firm's knowledge creation by providing more solutions to problems and enhancing recombination potentials (Fleming and Sorenson 2001; Nelson and Winter 1982). However, there is a limit to the number of new ideas that can be created using the same set of knowledge elements (Rosenkopf and Almeida 2003). An increase in search scope adds new elements to a firm's knowledge set, thereby improving the possibility of finding novel, useful combinations (Borzillo and Kaminska-Labbé 2011; Fleming 2001; Rosenkopf and Nerkar 2001). Established firms in advanced countries have been warned not to fall into the maturity trap of excessively pursuing local or exploitative searching with little broad or explorative searching if they want to continue creating valuable knowledge and sustain competitive advantages (Levinthal and March 1993; Rosenkopf and Almeida 2003; Rosenkopf and Nerkar 2001).

On the other hand, some researchers have suggested that a broad search scope can hurt innovativeness because of the high costs of knowledge integration (Grant 1996; Martin & Mitchell 1998). It has been argued that "the broader the scope of the knowledge to be integrated, the more complex are the tasks of creating and managing integration" (Grant 1996: 377). As the scope of the search increases, and consequently, the proportion of new knowledge to be integrated into a firm's knowledge base also increases, so do the technological and organizational challenges of integration (Grant 1996; Martin and Mitchell 1998; Rosenkopf and Nerkar 2001). In addition, these researchers have argued that an excessive increase in search scope can hinder innovation output by decreasing reliability (Martin and Mitchell 1998). A firm's reliability, defined as its ability to respond to new information correctly, is "a negative function of distance from an agent's immediate experience or from its local environment situation" (Heiner 1986: 84). Cyert and March (1963) suggested that

an innovation project in which the proportion of new knowledge is high is less likely to succeed than projects that search closely related, already existing knowledge.

These two possible results of a broad search scope suggest an alternative view of the inverted U relationship between search scope and innovation performance posited in previous research (e.g., Rosenkopf and Nerkar 2001). This view indicates that a firm should increase its search scope up to a certain threshold level to promote knowledge creation (Miao, Song, and Li 2014). Beyond this threshold level, increasing the search scope can be counterproductive. However, we argue that this curvilinear relationship argument is feasible only for established large firms who have developed their technological and learning capabilities to a certain level. We contend that logic of the inverted U relationship does not apply to firms from emerging markets. Instead, there is a different relationship between search scope and knowledge creation.

A firm's learning capability develops over time and accumulates based on its past experience (Nelson and Winter 1982; Song, Almeida, and Wu 2003). As latecomers, firms from emerging economies often have limited learning capabilities and substantial difficulty recombining and integrating diverse knowledge. If a firm's learning capability is weak, as is often the case for laggards from emerging economies, the negative effects of a broad or explorative search on innovation in terms of integration costs are increased rapidly, while the positive effects of a broad search in terms of recombination potential are diminished. Thus, the net effect of a wide search scope on innovation is negative. As a result, the optimal level of search breadth for laggards in emerging economies without strong learning or absorptive capacities would shift toward a narrow or exploitative search. In other words, in emerging economies, where firms do not have strong learning abilities, more narrow or exploitative (neighborhood) searching is optimal. Exploration (broad searching) is less important for successful knowledge creation.

Moreover, firms from emerging economies that pursue innovation usually have insufficient experience and much higher levels of perceived uncertainty about future innovation outcomes than experienced innovators in advanced countries (Miao, Song, and Li 2014; Miao, Song, and Salomon 2014). When knowledge is sufficiently similar in attributes and contexts, information about this knowledge has diagnostic values for the learner (Baum, Li,

and Usher 2000; Fiegenbaum and Thomas 1995; Xia, Tan, and Tan 2008). Learning and knowledge searching in familiar and/or similar technological fields therefore provides the most direct aid for beginners. More exploitative searching helps latecomers from emerging economies to interpret insufficient or ambiguous information. Thus, because of their weak absorptive capacity, firms from emerging economies learn more effectively from knowledge searching in similar technological fields than from searching more diversely.

In sum, for firms in emerging economies, the negative effects of broad or explorative searching (integration costs) are much stronger than the positive effects (creativity benefits) on knowledge creation. Consequently, these firms will achieve more success in knowledge creation when they narrow their spatial search boundaries.

> **H2:** the degree to which a firm searches for diverse knowledge is negatively related to knowledge creation for firms in emerging economies.

Interaction between Vertical Search and Horizontal Search on Knowledge Creation

Though some prior studies addressed how temporal and spatial searches affect organizational learning respectively, little attention has been paid to how the two distinct search dimensions interact with each other to influence knowledge creation. As a result, our understanding of the roles of various search behaviors in the creation of new knowledge is still limited. This study contributes to the existing literature by investigating the interactive effects of vertical and horizontal searches on knowledge creation.

As suggested in hypothesis 2, since firms in emerging markets as latecomers lack sufficient absorptive capacity, they fail to benefit from diverse knowledge searches due to high integration costs. Exploitative learning through neighborhood searching is more effective for these firms. Though organizations are often criticized for learning myopia and explorative searching is encouraged (March 1991; Levinthal and March 1993), exploitative learning through local searching is still important as the first step for firms with insufficient learning capabilities.

However, the lack of creativity or exploration caused by limited

knowledge searching in the immediate neighborhood can be overcome and supplemented by searching for emerging knowledge to a certain degree. As stated above, recent and emerging knowledge provides fresh ideas and new elements for creative recombination with existing knowledge as a basis of valuable innovation. Thus, for emerging country firms, searching for emerging knowledge in familiar fields can promote knowledge creation.

> **H3:** the positive effects on knowledge creation of searching for similar knowledge by firms in emerging economies will be strengthened if a firm searches for more recent knowledge at the same time.

DATA AND METHDOLOGY

Sample and Data

The sample in this study includes all Chinese firms that registered patents at the U.S. Patent and Trademark Office (USPTO) from 1977 to 2004. Patent data have been widely used in organizational research in recent years to study firms' technological innovation and knowledge creation (e.g., Ahuja and Katila 2001; Benner and Tushman 2002; Rosenkopf and Nerkar 2001; Sorenson and Stuart 2000). As prior studies have found, patents can be an indicator of knowledge creation and innovation (Ahuja and Lampert 2001; Nerkar 2003; Song, Almeida, and Wu 2003). Thus, patent stock can be used to evaluate the performance of knowledge creation. The USPTO database has the advantages in the analysis of knowledge search behaviors, because each patent document contains detailed information on citations to previous patents. Patent citations indicate the prior knowledge that a patent builds upon, thereby providing opportunities to investigate the background knowledge used in knowledge creation.

We identified all Chinese firms that registered patents at USPTO from 1977 to 2004. Because firms can register their patents across different technological classes, the primary technological class for each firm was defined as the one ranked first in terms of the patent share among all of the firm's technological classes. All variables in this study were measured based on patent data in each firm's

primary technological class. The final sample was thus composed of 204 Chinese firms distributed across 123 3-digit primary U.S. classes.

Measures

Dependent Variable

The dependent variable in this study is the knowledge created by firms in an emerging market – China. Previous studies have used successful patent applications as a useful indicator of knowledge creation (Ahuja and Lampert 2001; Nerkar 2003; Song, Almeida, and Wu 2003). Thus, new knowledge creation in this study is measured as the number of successful patent applications for each Chinese firm. The more patents issued to a firm, the more successfully that firm creates new knowledge.

Independent Variables

Time span of vertical search is measured as the time lag between a firm's patent and its cited patents. Prior research suggested that if a firm cites recent patents, then it can be viewed as working on current technological domains rather than mature technological domains (Ahuja and Lampert 2001; Sorensen and Stuart 2000). A patent that cites outdated patents tends to generate less impact (Sorensen and Stuart 2000) and may signal the formation of a competence trap (Rosenkopf and Nerkar 2001). Thus the average citation lag between a firm's patents and their cited patents is used to evaluate the degree to which a firm searches for new knowledge. The citation lag of each cited patent is calculated as the time elapsed since it was issued until the application year of the citing patent. The shorter the time, the more indication that a firm searches for emerging/new knowledge rather than mature/old knowledge.

Field span of horizontal search is measured according to the degree of diversity of technological fields of patent citations. Previous literature suggests that if patents cite other patents from many different technological classes, they may be built upon different technological paradigms, combining many relatively disparate technologies successfully (Ahuja and Katila 2004; Rosenkopf and Nerkar 2001). Thus, following prior studies, the Blau index (1-Herfindahl) of patent classes cited by a firm's patents was used as a measure of the degree to which a firm combines diverse knowledge

in its patents (Hall, Jaffe, and Trajtenberg 2001). The formula for the Blau index is $1 - \sum_{j=1}^{n} q_{ij}^2$, where q_{ij} is the proportion of the cited patents in technological class j by each patent i, and n is the total number of technological classes cited. Thus, the larger the value of the Blau index, the broader the search scope, thereby suggesting that a firm searches for more diverse/disparate technologies.

Control Variables

We used the dummy variable *high_tech* to capture firms in high-tech industries, which account for 37.7 percent of the sample in total, including the electronics, machinery, professional and scientific instruments, and transportation industries. In addition, we added year dummies in order to control for time effects on patenting and innovation.

Model Specification

The measure of knowledge creation in this study is a count variable with non-negative integer values. A Poisson regression approach is usually used for such data. Poisson regression assumes that the response variable Y has a Poisson distribution, and that the logarithm of its expected value can be modeled by a linear combination of unknown parameters. However, another characteristic of the Poisson distribution is that its mean is equal to its variance. In this data setting, the observed variance of the dependent variable (number of patents) (SD=3.00) is greater than the mean (mean=1.67). The problem of overdispersion can be solved by use of the negative binomial distribution. Thus, negative binomial regression analysis was conducted to test the hypotheses on knowledge creation. The negative binomial regression model is specified as follows: $\Pr(Y = yj) = \frac{e^{-\lambda j}\lambda_j^{yj}}{Y_j!}$, where $\lambda_j = \exp(\sqrt{B_i X_{ij}}\exp(\mu_j)$ and $e^{\mu j} \sim \text{Gamma}(1/\alpha, 1/\alpha)$ for observed counts of patents successfully applied by each firm.

RESULTS

Table 1 shows descriptive statistics and correlations of all variables. Table 2 summarizes the results of the negative binomial regressions on knowledge creation. In Table 2, Model 1 contains

Table 1. Descriptive statistics and correlations

Variable	Mean	Std. Dev.	Min	Max	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1. Knowledge Creation	1.67	3.00	1	30	1.00																							
2. Time span of vertical search	6.42	4.37	0	26	-0.05	1.00																						
3. Field span of horizontal search	0.28	0.27	0	0.84	-0.06	0.05	1.00																					
4. Time span x Field span	1.83	2.36	0	12.06	-0.04	0.41	0.79	1.00																				
5. High-tech industry	0.38	0.49	0	1	-0.05	0.04	-0.01	0.00	1.00																			
6. year_1977	0.00	0.07	0	1	-0.02	-0.09	-0.07	-0.05	0.09	1.00																		
7. year_1985	0.01	0.12	0	1	-0.03	-0.12	-0.12	-0.10	-0.01	-0.01	1.00																	
8. year_1986	0.05	0.22	0	1	-0.04	-0.08	-0.10	-0.11	0.01	-0.02	-0.03	1.00																
9. year_1987	0.02	0.14	0	1	-0.03	-0.01	-0.01	-0.05	0.04	-0.01	-0.02	-0.03	1.00															
10. year_1988	0.02	0.16	0	1	-0.04	0.04	-0.13	-0.11	0.01	-0.01	-0.02	-0.04	-0.02	1.00														
11. year_1989	0.03	0.17	0	1	-0.04	-0.01	-0.01	-0.02	0.04	-0.01	-0.02	-0.04	-0.02	-0.03	1.00													
12. year_1990	0.02	0.14	0	1	-0.03	-0.07	-0.06	-0.04	-0.04	-0.01	-0.02	-0.03	-0.02	-0.02	-0.02	1.00												
13. year_1991	0.03	0.17	0	1	0.24	0.02	0.06	0.04	-0.02	-0.01	-0.02	-0.04	-0.02	-0.03	-0.03	-0.02	1.00											
14. year_1992	0.04	0.21	0	1	-0.05	0.02	0.03	0.02	-0.07	-0.02	-0.03	-0.05	-0.03	-0.03	-0.04	-0.03	-0.04	1.00										
15. year_1993	0.03	0.17	0	1	-0.04	-0.04	-0.09	-0.09	-0.02	-0.01	-0.02	-0.04	-0.02	-0.03	-0.03	-0.02	-0.03	-0.04	1.00									
16. year_1994	0.02	0.16	0	1	-0.04	-0.08	-0.06	-0.09	0.01	-0.01	-0.02	-0.04	-0.02	-0.03	-0.03	-0.02	-0.03	-0.03	-0.03	1.00								
17. year_1995	0.03	0.17	0	1	0.00	-0.01	0.05	0.09	-0.02	-0.01	-0.02	-0.04	-0.02	-0.03	-0.03	-0.02	-0.03	-0.04	-0.03	-0.03	1.00							
18. year_1996	0.03	0.17	0	1	-0.01	0.03	0.02	0.04	0.04	-0.01	-0.02	-0.04	-0.02	-0.03	-0.03	-0.02	-0.03	-0.04	-0.03	-0.03	-0.03	1.00						
19. year_1997	0.03	0.18	0	1	-0.03	0.05	-0.05	-0.03	0.02	-0.01	-0.02	-0.04	-0.03	-0.03	-0.03	-0.03	-0.03	-0.04	-0.03	-0.03	-0.03	-0.03	1.00					
20. year_1998	0.06	0.24	0	1	-0.05	-0.01	0.04	-0.01	0.09	-0.02	-0.03	-0.06	-0.04	-0.04	-0.05	-0.04	-0.05	-0.06	-0.05	-0.04	-0.05	-0.05	-0.05	1.00				
21. year_1999	0.05	0.23	0	1	0.06	0.03	0.03	0.05	-0.10	-0.02	-0.03	-0.05	-0.03	-0.04	-0.04	-0.03	-0.04	-0.05	-0.04	-0.04	-0.04	-0.04	-0.05	-0.06	1.00			
22. year_2000	0.12	0.32	0	1	0.11	-0.10	0.04	-0.01	0.00	-0.03	-0.04	-0.08	-0.05	-0.06	-0.06	-0.05	-0.06	-0.08	-0.06	-0.06	-0.06	-0.06	-0.07	-0.10	-0.09	1.00		
23. year_2001	0.17	0.38	0	1	0.02	0.10	0.20	0.21	0.10	-0.03	-0.06	-0.10	-0.06	-0.07	-0.08	-0.06	-0.08	-0.10	-0.08	-0.07	-0.08	-0.08	-0.09	-0.12	-0.11	-0.17	1.00	
24. year_2002	0.16	0.36	0	1	-0.04	0.09	-0.07	0.00	-0.09	-0.03	-0.05	-0.10	-0.06	-0.07	-0.08	-0.06	-0.08	-0.09	-0.08	-0.07	-0.08	-0.08	-0.08	-0.11	-0.10	-0.16	-0.20	1.00

N=204

Table 2. Results of regressions on knowledge creation

Variables	Model 1	Model 2
Time span of vertical search		-1.68(0.02)*
Field span of horizontal search		-2.21(0.51)**
Time span x Field span		0.84(0.07)
High-tech industry	-1.79(0.15)*	-1.62(0.15)
year_1977	-0.09(1.20)	-0.46(1.19)
year_1985	-0.40(0.73)	-0.93(0.74)
year_1986	-0.39(0.47)	-0.74(0.47)
year_1987	-0.38(0.65)	-0.41(0.65)
year_1988	-0.46(0.60)	-0.73(0.60)
year_1989	-0.44(0.56)	-0.55(0.56)
year_1990	-0.48(0.65)	-0.80(0.66)
year_1991	3.68(0.43)***	3.90(0.42)***
year_1992	-0.66(0.49)	-0.63(0.49)
year_1993	-0.52(0.56)	-0.85(0.56)
year_1994	-0.46(0.60)	-0.70(0.60)
year_1995	0.41(0.50)	0.39(0.50)
year_1996	0.34(0.51)	0.32(0.51)
year_1997	-0.27(0.52)	-0.37(0.52)
year_1998	-0.23(0.43)	-0.21(0.43)
year_1999	1.27(0.41)	1.19(0.40)
year_2000	1.77(0.35)	1.54(0.35)
year_2001	0.96(0.35)	1.10(0.35)
year_2002	0.01(0.36)	-0.13(0.36)
_cons	1.22(0.31)	2.38(0.35)
N	204	204
Pseudo R-square	0.0633	0.0796
Likelihood-ratio test of alpha	90.33***	83.05***

Notes: * if $p < 0.10$, ** if $p < 0.05$; *** if $p < 0.01$; Standard errors are in parentheses.

the control variables only, serving as the baseline model. The evaluation of hypotheses is presented in Model 2, which includes all independent variables and control variables, as a full model. To assess the potential bias of collinearity, we calculated the variance inflation factors (VIF). The results showed that the highest value of the VIF is 7.60, which is below the recommended ceiling of 10 (Kleinbaum, Kupper, and Muller 1988). Thus, collinearity among explanatory variables does not appear to be a serious problem in this study.

Hypothesis 1 argues that firms that search for relatively new technologies can create more knowledge than firms that search for older and mature knowledge. The negative and significant coefficient ($p<0.1$) of this measure (citation lag) in model 2 supports hypothesis 1. Hypothesis 2 predicts that firms from emerging markets can generate more knowledge by searching for knowledge in similar fields, because for firms without sufficient learning capabilities, the integration cost of combining disparate knowledge would be much higher than the benefits of broad or explorative searching. Consistent with this argument, the negatively significant coefficient ($p<0.01$) of the Blau index in model 2 supports hypothesis 2 that firms from emerging economies should avoid explorative learning and narrow their search scopes for more exploitative learning.

Hypothesis 3 proposes that by searching for more recent knowledge, firms can overcome and complement the limitations of performing a neighborhood search in similar knowledge fields. Thus, the positive relationship between neighborhood searching and knowledge creation can be strengthened if a firm searches more for emerging knowledge. However, the coefficient for the term of interaction between vertical and horizontal searches is not significant. Thus, hypothesis 3 is not supported.

DISCUSSION AND CONCLUSION

This study contributes to the existing literature on knowledge creation and catch-up by classifying search behaviors of firms into two distinct dimensions (vertical and horizontal searches) and investigating their effects on catch-up in the form of knowledge creation in firms from China as a typical emerging country. Distinguishing these dimensions helps better understand the impact of these search behaviors on organizational knowledge creation. Prior studies of organizational searching, knowledge creation, and innovation offered theoretical and managerial implications in the context of established large firms in advanced countries. Rapid economic growth of emerging economies calls for a new research agenda on the learning behaviors of firms from these countries that are often different from those of established large firms in advanced countries. This study contributes to organizational learning literature by examining distinct search patterns for firms in

emerging countries.

Based on an empirical investigation of Chinese firms, this study suggests idiosyncratic search strategies for firms in emerging countries. Firms from emerging countries such as China can achieve more success in catch-up through knowledge creation by searching for more recent knowledge. This is because not only recent knowledge can bring fresh knowledge elements that contribute to higher recombination potential for knowledge creation, but also searching for recent knowledge helps firms from emerging economies overcome the learning curve disadvantages stemming from their insufficient historical experience with older and more mature knowledge.

The findings of this study also provide evidence that neighborhood or exploitative searching helps firms from emerging economies improve their knowledge creation capabilities. Existing literature has identified an inertia problem with established firms when they stick to established knowledge and do not attempt to adopt newer ideas (Dosi 1982; Nelson and Winter 1982; Stuart and Podolny 1996). Therefore, scholars often suggested that established large firms in advanced countries should go beyond the local search to avoid learning myopia and the competence trap. In contrast to this broad or explorative searching, the results of this study suggest that firms from emerging economies should focus on neighborhood searching and exploitative learning rather than explorative learning in order to innovate successfully. Due to their weak absorptive capacities, firms from emerging markets should not overestimate their learning capabilities and pursue exploration prematurely.

Despite theoretical insights and managerial implications about search behaviors for catch-up in the form of knowledge creation of firms from emerging markets in this study, this study has some limitations. Most notably, the study sample includes Chinese firms only. Though China is a typical emerging country, firms in other emerging countries (such as India) may involve different search patterns in the process of creating knowledge. Thus, to test the generalizability of our findings, we recommend that future studies should examine the effects of search behaviors on knowledge creation in different country settings. In addition, it would be interesting for future study to examine how other organizational factors could influence the process of knowledge creation differently for firms in emerging countries compared to firms in advanced

economies.

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