The Paradox of Technological Capabilities:

What Determines Knowledge Sourcing From Overseas R&D Operations?

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Abstract

We investigate the factors that influence the extent to which multinational corporations (MNCs) source knowledge from the host countries of their R&D labs. We propose that the technological capabilities held by MNCs and their home countries present a paradox. On the one hand, they enhance MNCs' absorptive capacity to learn. On the other hand, they reduce MNCs' motivations to outsource knowledge from host countries. We also argue that it is important to consider both relative and absolute levels of technological capabilities because relative levels can influence MNCs' motivations to source knowledge from host countries. Statistical findings generally support our arguments.

Key words: overseas R&D, knowledge sourcing, absorptive capacity, relative technological capabilities

Traditional theories of foreign direct investment (FDI) suggest that multinational corporations (MNCs) undertake FDI in order to transfer and exploit their home-country-based knowledge to foreign countries (Hymer, 1960; Caves, 1971). In recent decades, however, MNCs have set up R&D labs overseas to acquire and develop new technological capabilities (Patel & Pavitt, 1991; Shan & Song, 1997; Kuemmerle, 1999; Asakawa, 2001). The sharp increase in technology-seeking FDI stems from persistent country-level differences in technological paths (Cantwell, 1989). By conducting overseas R&D in multiple locations, MNCs have attempted to access and acquire knowledge complementary to that derived in their home-country operations.

Although several studies investigate MNCs' knowledge-sourcing behaviors, few examine how MNCs' overseas R&D influences the R&D they do in their home countries, which is where they concentrate this activity. Penner-Hahn and Shaver (2000) contend that, despite the burgeoning literature that enjoins firms to internationalize their R&D in order to access new technologies, we know little about the conditions that induce MNCs to do so. In addition, recent research on knowledge-seeking FDIs has largely "missed the opportunity for theoretical advancement that might arise from drawing upon more general theories of innovation and technological progress in organizations (Frost, 2001: 101)." In this paper, we examine how the technological capabilities of MNCs and MNCs' home countries affect the level of knowledge that MNCs' headquarters source from the host countries of their overseas R&D labs. Drawing on the absorptive capacity view and evolutionary economics, we advance theory about knowledge-seeking FDIs by developing a framework of the "paradox of technological capabilities." The technological capabilities of MNCs, as well as those of MNCs' home countries, contribute to MNCs' *absorptive capacities* to source knowledge from host countries. Yet they can also affect MNCs' *motivations* to source knowledge from host countries.

Specifically, we propose that MNCs with strong technological capabilities are likely to have established their own technological trajectories, which constrain their search for new capabilities and make them less motivated to source new knowledge from host countries (Nelson and Winter, 1982; Stuart and Podolny, 1996).

We also propose that not only absolute but also relative levels of technological capabilities influence MNCs' motivations to outsource knowledge from host countries. We examine the effects of relative levels of technological capabilities in terms of (1) the ratio of MNCs' technological capabilities to those of their home countries, (2) the ratio of home countries' to host countries' technological capabilities, and (3) similarities in technological profiles between home countries and host countries. Specifically, we propose that MNCs are more likely to outsource knowledge from host countries with technological capabilities that are strong relative to those of their home countries. We also propose that when MNCs are technological leaders in their home countries, they are more motivated to learn from host countries because they have relatively little to learn in their home countries. Finally, we argue that an MNC's level of knowledge outsourcing from host countries will first increase and then decrease as the distance between the technological profile of its home country and that of its host country increases.

We investigate knowledge sourcing from host countries of overseas R&D labs in the global semiconductor industry. We use US patent data to trace knowledge flows from host countries to MNCs' R&D labs in their home countries. We then employ negative binomial regressions to investigate the factors influencing the level of knowledge sourced from host countries. Our results support our arguments regarding both the paradox of technological capability and the influence of relative capabilities.

LITERATURE REVIEW AND THEORY

Advances in Global R&D Activities and An Emerging View of MNCs

Recently, both the extent to which MNCs perform R&D outside their home countries and the types of foreign R&D they do have changed considerably. Kuemmerle (1999) has documented significant increases in the R&D that MNCs do abroad. Further, although MNCs originally focused most of their foreign R&D on adapting technologies they had developed at home to foreign production conditions, Dunning (1993) and Kuemmerle (1999) found that MNCs have recently accelerated their efforts to acquire and develop new technologies overseas. Leading MNCs have now established vast global networks that access technologies from various locations (Bartlett and Ghoshal, 1989; Hedlund, 1986).

Scholars have responded to MNCs' globalization of R&D by focusing more extensively on how MNCs use FDI not only to "push" their existing advantages in exploiting foreign markets but also to "pull" new resources and capabilities from centers of innovation by acquiring or learning about complementary technologies (Shan and Song, 1997; Almeida, Song, and Grant, 2002). When knowledge is sticky and remains confined within narrow geographical boundaries (Jaffe, Trajtenberg, and Henderson, 1991), a manufacturing or R&D location serves as an important source of competitive advantage (Almeida, 1996). Firms located in innovative regions such as Silicon Valley have greater access to new technological knowledge than do their spatially distant counterparts. MNCs can develop competitive advantage by locating in overseas technological centers of excellence that offer differentiated streams of new knowledge, so long

as they can learn to identify, transfer, and integrate the knowledge they derive in host countries throughout their operations (Almeida, Song, and Grant, 2002).

Using industry-level data, empirical research supports the arguments that MNCs employ FDI to source knowledge. Cantwell (1989) found that MNCs are especially attracted to centers of innovation as a means of broadening their knowledge bases. He argues that the popularity of such centers is attributable to persistent country-level differences in technological capabilities. Kogut and Chang (1991) analyzed Japanese direct investments into the U.S. They found that many of these investments went to R&D-intensive industries, often in the form of joint ventures. This finding suggests that countries with technological advantages tend to attract FDI as well as generate outward FDI flows.

At the firm level, Almeida (1996) found that foreign MNCs' U.S. subsidiaries use knowledge derived from the regions where these subsidiaries are located significantly more than similar U.S. firms from the same region do. He suggests that MNCs in the semiconductor industry use FDI to access local information channels and source location-specific knowledge. Similarly, Shan and Song (1997) found that in the biotechnology industry, foreign MNCs invest in American biotechnology firms that patent frequently, thus sourcing country-specific, firm-embodied technological advantages. Almeida, Song, and Grant (2002) showed empirically that in the semiconductor industry, internal mechanisms within MNCs are more effective than are markets and alliances for transferring technology across borders.

The Paradox of MNCs' Technological Capabilities

MNCs spend much of their R&D in foreign countries to develop links to local scientific and technical communities in order to source complementary knowledge (Florida, 1997). Yet,

few studies have shown what factors affect how extensively MNCs source knowledge from these countries, even though such labs are apparently an excellent way for MNCs to outsource knowledge. In this paper, we focus on how the technological capabilities of major parties -- MNC headquarters' R&D labs, home countries, overseas R&D labs, and host countries of those overseas R&D labs -- influence the flow of knowledge from host countries to MNCs at home. We specifically examine (1) the MNC's headquarters' technological capabilities and (2) the relative and absolute levels of technological capabilities residing in the home country of the MNC's headquarters.

There is an apparent paradox in how firm-level technological capabilities influence the degree of knowledge flows from host countries to MNCs at home. Although an MNC can enhance its absorptive capacity by having strong technological capabilities (Cohen and Levinthal, 1990) and use this capacity to source more knowledge from others, these capabilities may reduce the MNC's motivation to learn from others. Drawing on evolutionary economics, which highlights the localized, path-dependent nature of search behaviors in firms (Nelson and Winter, 1982), Song, Almeida, and Wu (2001) suggest that by developing strong technological capabilities, firms establish idiosyncratic technological trajectories. They showed that firms with well-established technological paths are less likely to source knowledge from newly scouted engineers than are firms with less well-established technological paths. Similarly, Mitchell, Baum, Banaszak-Holl, Berta, and Bowman (2000) argue that although nursing home chains with strong capabilities may have more opportunities for knowledge transfer across units, a nursing home unit with a relatively high level of capabilities is less likely to transfer knowledge from other units in its nursing home chain. In this paper, we analyze this paradox by examining

empirically how the technological capabilities of both MNCs and their home countries influence an MNC's knowledge sourcing from countries where their R&D labs are located.

Absolute Technological Capabilities vs. Relative Technological Capabilities

In assessing how MNCs' technological capabilities influence their knowledge sourcing, it is important to consider both relative and absolute levels of technological capabilities. Most studies of international R&D focus exclusively on absolute levels of technological capabilities held by firms, home countries, and host countries (Cantwell & Janne, 1999; Florida, 1997; Kuemmerle, 1999). Yet recent work contends that relative levels are also important (Lane & Lubatkin, 1998; Darr & Kurtzberg, 2000; Mitchell et al., 2000). Since learning occurs in a dyadic relationship between the learning unit and the teaching unit, knowledge-sourcing behaviors need to account for both the absolute and relative characteristics of these units. Lane and Lubatkin (1998) suggest that a firm's ability to learn depends on its relative absorptive capacity, which represents the similarity between the teaching unit and the learning unit. Accordingly, in addition to assessing absolute technological capabilities, we examine firms' and countries' relative capabilities in terms of (1) the relative technological capabilities of MNCs to those of their home countries, (2) the relative differences between the home and the host country, and (3) the similarity/dissimilarity between two countries in technological profiles. By focusing on relative capabilities, we are better able to capture motivational factors underlying knowledge sourcing and transfer that are ignored when only absolute levels of technological capabilities are examined.

Hypotheses

Technological capabilities of MNCs' headquarters in home countries. Among various firm-level factors that influence MNCs' propensity to source knowledge from overseas R&D labs, MNCs' technological capabilities seem to be most important. To identify, acquire, and assimilate valuable external knowledge, especially tacit knowledge, a firm must possess considerable absorptive capacity (Cohen and Levinthal, 1990) in related technological areas. Cumulative experience with a technology often determines the recipient's absorptive capacity to acquire such tacit knowledge. Therefore, a firm's prior knowledge base and cumulative investment in learning capabilities affect its absorptive capacity. Firms seek to acquire knowledge externally when there is a significant knowledge gap between them and industry leaders. Yet firms that develop substantial cumulative experiences and knowledge bases are better positioned to acquire target technologies (Leonard-Barton, 1995).

The absorptive capacity view suggests that MNCs with strong technological capabilities are superior in assimilating and extending knowledge sourced from overseas R&D labs. Penner-Hahn and Shaver's analysis of international R&D expansions by Japanese pharmaceutical firms (2000) found, for instance, that firms benefit from international R&D when they possess existing technological capabilities in underlying technologies. The absorptive capacity view implies that the level of knowledge sourced from host countries should be higher in MNCs with strong technological capabilities than it is in MNCs with weak technological capabilities. Hence we hypothesize:

Hypothesis 1a: Because they are more capable of sourcing knowledge from host countries, MNCs with strong technological capabilities at their headquarters are more likely to

source knowledge from host countries than are MNCs with weak technological capabilities at their headquarters.

Yet MNCs with strong technological capabilities may be less willing to source new or complementary knowledge from host countries because they may have already established distinct technological paths. A firm's innovative activities are often cumulative, path-dependent processes (Dosi, 1982), which constrain its future search behavior for new technologies and make it more likely to pursue R&D along its existing trajectories. Thus, in firms with established trajectories, learning or innovative search tends to be local -- in other words, home country-based, cumulative, and internal (Stuart and Podolny, 1996). Such firms may be less motivated to absorb and utilize new knowledge from host countries where they set up R&D labs. In contrast, MNCs that are still developing knowledge bases and have not yet established well-defined technological trajectories are more likely to search broadly by actively sourcing externally available knowledge from host countries where they have R&D labs and then combining this knowledge with their own internal capabilities. Therefore, we set forth the following alternative hypothesis:

Hypothesis 1b: Because they are less willing to source knowledge from their foreign R&D labs, MNCs with strong technological capabilities are less likely to source knowledge from host countries than are those with weak technological capabilities.

Technological capabilities of home countries. Cantwell and Janne (1999) argue that MNCs from countries with strong technological capabilities tend to have the highest degree of

technological competences. Other things being equal, these MNCs can access more human talent and more technological resources. Such access increases their absorptive capacity and enables them to identify, acquire, and absorb knowledge better than MNCs from technologically weaker countries can. Hence,

Hypothesis 2a: MNCs based in home countries with strong technological capabilities are more likely to source knowledge from host countries than are MNCs based in countries with weak technological capabilities.

Alternatively, MNCs based in countries with strong technological capabilities may be less motivated to source knowledge from the host countries of their R&D labs. Almeida (1996) showed Korean semiconductor firms were more eager to source knowledge from their R&D labs in the U.S. than were their Japanese counterparts with U.S. R&D labs; Korea has weak country-level technological capabilities relative to Japan. Since countries with centers of innovation tend to develop technologies along well-established, specialized technological trajectories (Cantwell, 1989), they tend to attract investments by foreign MNCs that wish to access to this innovative capacity. At the same time, MNCs in countries with strong technological leadership build on and further refine their inherited national strengths to develop their own international competitiveness (Cantwell & Iammarino, 1998). The extensive investment in countries with centers of innovation may reinforce these countries' advantages and thereby solidify existing technological trajectories. Therefore, MNCs from such countries may be less willing to source knowledge from overseas locations and more likely to utilize and extend their home-country-based advantages, despite their superior absorptive capacity. Conversely, MNCs from

technologically less competent countries may have stronger incentives to outsource knowledge from other countries because they do not have well-established domestic capabilities to draw on. Hence, we suggest:

Hypothesis 2b: Because they are less willing to source knowledge from host countries where they set up R&D labs, MNCs based in countries with strong technological capabilities are less likely to source knowledge from host countries than are those based in countries with weak technological capabilities.

Relative technological capabilities of MNCs to their home countries. MNCs that are technological leaders in their home countries may be more motivated to outsource knowledge from host countries (Florida, 1997; Kuemmerle, 1999) because they may not have much left to learn within their home countries. In small countries, the level of technological capabilities in an industry frequently depends on only one or two firms. For example, Philips was a dominant innovator in the electrical equipment industry in the Netherlands (Cantwell & Janne, 1999). In such cases, these firms may be highly motivated to search for technological opportunities outside their home countries. On the other hand, if an MNC is not a technological leader in its home country or if there are many other innovators in its home country, it may find that searching for technological opportunities in its home country is more efficient than searching in foreign countries would be. Thus, we argue that MNCs with strong technological capabilities relative to those of their home countries are more motivated to outsource knowledge. Hence, we propose:

Hypothesis 3: The more dominant an MNC's technological capability is relative to the stock of capabilities in its home country, the more likely it is to source knowledge from host countries.

Relative technological capabilities of home countries to host countries. Kuemmerle (1999) found that when a host country spends more on R&D than a home country does, MNCs tend to source knowledge from the host country more actively by setting up "home-base augmenting" labs. Frost (2001) showed that overseas R&D labs are more likely to draw on knowledge from host countries in technical fields in which host countries have technological advantages. Thus, we propose that when a host country has stronger technological capabilities than a home country does, an MNC is more motivated to outsource knowledge from the host country because the technological trajectories in the home country are less rigid. Also, relative to the technologically strong host country, the home country has less knowledge to source from. Hence, we propose:

Hypothesis 4: MNCs are more likely to source knowledge from host countries when their host countries have stronger technological capabilities than their home countries do.

Similarities in technological profiles between home countries and host countries. Technological distance between a home country and a host country may also influence the level of knowledge sourcing from the host country. Lane and Lubatkin (1999), for instance, showed that firms with greater technological overlap have greater relative absorptive capacity and hence are more likely to learn from each other. In a study of the effects of the similarity between tasks on the transfer of knowledge among fast food stores, Darr and Kurtzberg (2000) showed that

similarities between stores' strategies and tasks positively affected transfer of knowledge among the stores. In our research setting, given that technological capabilities of home countries can enhance an MNC's absorptive capacity, similarities between the technological profiles of the home country and the host country is likely to make it easier for MNCs to learn from host countries.

Yet it is possible that when units are too similar, there is little these units can learn from each other (Mowery, Oxley, and Silverman, 1998; Hansen, 1999). There may be an optimal technological distance between the home country and the host country that influences both the motivation to learn (higher when these countries are technologically distant) and the ability to learn (higher when these countries are close). If two countries' technological profiles are too distant, then the level of knowledge an MNC sources from the host country might be lower because the MNC's capacity to absorb this knowledge would be weak. At the same time, if the home country's and host country's technological profiles are too similar, then the MNC would engage in a lower level of knowledge sourcing from the host country because it either has little to learn from the host country or the cost for it to learn from the host country is relatively high.

Hypothesis 5: The level of knowledge sourcing from the host country is likely to increase and then decrease as the distance between the technological profiles between the home country and the host country increases.

In sum, the degree of MNCs' outsourcing knowledge from host countries depends on both MNCs' absorptive capacities and their motivations to outsource knowledge. On the one hand, MNCs' and home countries' technological capabilities enhance MNCs' absorptive

capacities, and are thus positively related to the extent an MNC outsources knowledge. On the other hand, both absolute and relative levels of technological capabilities influence MNCs' motivations to source knowledge from host countries.

METHOD

Data

We use patent data from the global semiconductor industry to test our hypotheses. Over the last decade, patents have become increasingly popular indicators of technological output and innovative capabilities (Hall, Jaffe, and Trajtenberg, 2000). Patent data have received so much attention because they are systematically compiled, have detailed information, and are available continuously across time. We use these data to shed light on knowledge flows from host countries to MNCs' headquarters in home countries.

For a variety of reasons, the semiconductor industry is a particularly appropriate arena for studying international technology flows. First, it is innovation-intensive. Second, although not all innovations are patented, the incentives for patenting are strong in the semiconductor industry; thus, patenting is commonly practiced (Almeida, 1996) and is considered vital to maintaining technological competitiveness. Third, the semiconductor industry is global, with major players from the US, Japan, Europe, Korea, Taiwan, and elsewhere. Moreover, private firms, national governments, and universities have all developed and patented semiconductor technologies (Podolny & Stuart, 1995). Finally, many semiconductor firms have set up R&D labs overseas to source knowledge from host countries.

Because a firm must patent in a specific country to gain intellectual property protection in that country, and because the U.S. is the world's largest technology market, non-U.S. firms routinely file patents in the U.S. (Albert, Avery, Narin, and McAllister, 1991). Thus, we use the

US patent data for more objective comparisons of patent counts of MNCs from various countries with different intellectual property regimes. Based on the advice of patent examiners in the U.S. Patent Office, we identified eleven patent (technology) classes at the three-digit level that constituted semiconductor-related technology. We considered patents with their primary technology classes that fell into one of these eleven classes as semiconductor patents.

For the empirical analysis, we identified MNCs that have at least one R&D lab in foreign countries. Because we counted patent citations made between 1995 and 1999 in our regression analysis reflecting a time lag in patent citations, we included overseas R&D labs set up before 1995 only in our samples. The total number of overseas R&D labs in our sample is 147. The total number of MNCs involved is 65.

Methods and Variables

We employ negative binomial regressions to investigate the factors influencing the level or the magnitude of knowledge sourced from host countries where overseas R&D labs were set up. The dependent variable is operationalized as the citation proportion ($P_{ij} = n_{ij} \Big/ \sum_j n_{ij}$) in which the numerator (n_{ij}) is the number of citations made by the home-country headquarter of MNC (*i*) from each host country (*j*) in which the MNC has overseas R&D labs and the denominator ($\sum_j n_{ij}$) is the total number of citations by the MNC. To reduce a potential bias from yearly fluctuations of patent citation counts, we summed up patent citation counts for the observation period that spans 1995 to 1999.

Likewise, independent variables are measured by summing up patent counts in the preceding five-year period that spans 1990 and 1994, reflecting a substantial time lag between

patents granted and those cited later. We standardized our independent variables so that different scales for these variables did not affect magnitudes of coefficients. Technological capabilities of MNCs (Hypothesis 1) are operationalized as the number of US patents granted to MNCs during the period between 1990 and 1994. We measured technological capabilities of home countries (Hypothesis 2) by the number of US patents granted to those countries during the same period.

An MNC's technological leadership in its home country (Hypothesis 3) is measured by the ratio of the number of patents granted to the MNC to the total number of patents granted to the home country between 1990 and 1994. As the ratio increases, the focal MNC is regarded as being more dominant in its home country. The relative difference in a home country's and a host country's technological capabilities (Hypothesis 4) is measured by the ratio of the number of US patents granted to the home country to that granted to the host country. Finally, each country's technological profile is defined as the shape of the distribution over 11 technological classes we chose. We measure two countries' similarity or dissimilarity of technological profiles (Hypothesis 5) by Euclidean distance as follows:

$$d_{ij} = \sqrt{\sum_{k=1}^{10} (P_{ik} - P_{jk})}$$

where P_{ik} *is the proportion of patents in class* k *in country* i *at time*

Again, Euclidean distance is measured based on the patents granted between 1990 and 1994.

Both the number of US patents granted to the subsidiary R&D labs and the number of US patents that were granted to host countries between 1990 and 1994 were added as control variables.

The link function in the negative binomial regression is as follows:

$$\log\left(\frac{n_{ij}}{\sum_j n_{ij}}\right) = \alpha + \sum \beta_i X_i$$

$$\log(n_{ij}) - \log\left(\sum_j n_{ij}\right) = \alpha + \sum \beta_i X_i$$

Where X_i represents each independent variables such as the technological capabilities of lab, firm, *etc*

In the regressions, the coefficient of the denominator, which is the total number of citations made by an MNC, is fixed at one.

RESULTS

Table 1 presents descriptive statistics. The correlation matrix does not show any troubling collinearity among the variables. Table 2 summarizes the statistical findings from the negative binomial regressions. The base model is composed of control variables only. We ran nested equations by adding variables sequentially. We added absolute capabilities variables in equation 1. Equation 2 is a full model that includes relative capabilities.

Insert Tables 1 and 2 about here

The two absolute capabilities variables improved Equation 1's explanatory power significantly (p-value <0.001). In equation 1, the coefficient of the number of patents granted to MNCs was significant and negative. This result supports hypothesis 1b and suggests that MNCs outsource knowledge less as their technological capabilities increase. On the other hand, the

coefficient of the number of patents granted to the home country was significant and positive, supporting hypothesis 2a. This result shows that MNCs outsource knowledge more as the technological capabilities of their home countries increase.

In equation 2, we added relative capabilities variables. These variables improved the explanatory power significantly (p-value <0.001). The significant and positive coefficient for "the ratio of the number of patents granted to an MNC to the number of patents granted to the home country" demonstrates that MNCs with strong technological leadership within their home countries tend to outsource knowledge more, thus supporting hypothesis 3. Likewise, the coefficient of "the ratio of the number of patents granted to home countries to those granted to host countries" was highly significant and negative, supporting hypothesis 4. This result shows that when home countries have strong capabilities relative to host countries, innovative opportunities in home countries may increase, with an attendant decrease in the extent to which knowledge is outsourced. We did not, however, find any significant relationship for the similarity of the host country's and home country's technological profiles. Our two absolute capabilities variables remained significant in this equation.

As for control variables, the number of patents granted to host countries is significantly and positively related in all the equations. The relationship between the number of patents granted to the subsidiary R&D lab and the dependent variable is insignificant.

DISCUSSION AND CONCLUSIONS

Statistical findings from negative binomial regressions show (1) the negative motivational effects of existing technological capabilities in MNCs (hypothesis 1b) and (2) the

positive effect of home country-level capabilities (hypothesis 2a) on the level of knowledge outsourcing from host countries. We also find that MNCs' knowledge sourcing from host countries increases when (1) MNCs are technology leaders in their home countries (hypothesis 3) and (2) host countries are technologically superior to home countries (hypothesis 4).

In addition to addressing a previously unexplored empirical question, this paper advances the theory of how MNCs learn from technology-seeking FDI. Our finding that the negative motivational effects of existing technological capabilities at an MNC exceed the positive effects of absorptive capacity has implications for research in the management of innovation, which stresses the importance of external knowledge to innovation. Although absorptive capacity is viewed as a source of competitive advantage (Cohen and Levinthal, 1990), most research that advances this perspective downplays the potential negative consequences of such capabilities. Since a firm with a strong existing knowledge base is more likely to have established idiosyncratic technological trajectories and thus exhibit path-dependent search behavior, its knowledge base may reduce its receptivity to externally sourced knowledge. Firms fitting this description face the challenge of balancing and building exploitative and exploratory abilities (March, 1991). Our study indicates that by setting up overseas R&D labs, a firm can source knowledge from host countries more easily, but the degree to which it does so is still significantly influenced by its tendency to search locally along the existing technological trajectories that it has established at home. We believe the motivational factors that underlie learning and absorptive capacity are important even in domestic settings.

On the other hand, the significant and positive relationship between technological capabilities of home countries and the degree of MNCs' knowledge outsourcing seems to show the importance of absorptive capacity at the home country level. This somewhat conflicting

result may indicate the need to differentiate between firms' knowledge bases and those of their home countries. The results suggest that although the knowledge a firm can acquire in its home country but not own can be valuable, such knowledge restricts the firm's search behavior for innovation less than do the assets that this firm owns. For this reason, firms in the same home country may exhibit markedly different technological profiles and search behaviors.

This paper also proposes and empirically shows the importance of relative capabilities in determining the level of knowledge sourcing from host countries. Prior research in organizational learning, including studies in international contexts, mostly ignored how relative levels of technological capabilities influence MNCs' motivations to acquire external knowledge. Our results suggest that relative levels of capabilities may be as important as absolute levels of capabilities when MNCs source knowledge from host countries of their R&D labs. By examining the relative differences between home countries and host countries and between firms and their home countries in terms of technological capabilities, we highlighted largely unexplored, yet important dimensions of motivational factors associated with the technological capabilities that influence MNCs' learning decisions.

Empirically, we believe that this is the first attempt to investigate how overseas R&D activities of MNCs can influence R&D activities at home, where most MNCs still keep core innovative activities. Moreover, unlike most previous empirical studies of knowledge-seeking FDI, this paper attempted to measure the degree of knowledge sourcing from the host country more directly by tracing the level of knowledge flows captured by patent citation counts.

This paper has some limitations. Due to data constraints, we could not examine either the specific mechanisms that MNCs employ to facilitate knowledge transfer or the role of overseas subsidiary mandates in knowledge sourcing from host countries. We believe that future

research along these lines will enrich our understanding of how MNCs source knowledge from host countries and their overseas R&D operations.

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Table 1

Summary of Descriptive Statistics

Variable	Mean	Std. Dev	2	3	4	5	6	7	8	9	10
1. Number of citations made by MNCs in a host country	233.5	498.03	0.41	0.58	0.25	0.22	-0.04	0.56	-0.08	-0.07	-0.06
2. Total number of citations made by MNCs	1022.4	1100.7	-	-0.10	0.22	0.78	0.11	-0.06	-0.10	0.20	0.20
3. Dependent variable: Ratio of the two variables above (1/2)	0.265	0.328	-	-	0.10	-0.18	-0.11	0.92	-0.13	-0.13	-0.21
4. Number of patents granted to the overseas R&D lab	16.5	44.80	-	-	-	0.08	-0.19	0.17	0.08	-0.05	-0.10
5. Number of patents granted to the MNC	741.8	826.33	-	-	-	-	0.37	-0.23	-0.04	0.23	0.07
6. Number of patents granted to the home country	15032	10159	-	-	-	-	-	-0.28	-0.44	0.11	-0.27
7. Number of patents granted to the host country	7953.4	10008	-	-	-	-	-	-	-0.12	-0.13	-0.05
8. MNC/Home country (5/7)	0.48	0.441	-	-	-	-	-	-	-	-0.04	0.14
9. Home country / Host country (6/7)	157.3	970.3	-	-	-	-	-	-	-	-	0.38
10. Euclidean distance in technological profiles between the host cost country and the home country	0.25	0.15	-	-	-	-	-	-	-	-	-

Table 2

Results of negative binomial regressions

	Base Model	Equation 1 (absolute capabilities only)	Equation 2 (full model)
Number of patents granted to the overseas R&D lab (Control)	-0.0926 (0.0629)	0.0103 (0.0691)	-0.0063 (0.0591)
Number of patents granted to the host country (Control)	1.6550** (0.0728)	1.6834** (0.0682)	1.7216** (0.0682)
Number of patents granted to the MNC (Hypothesis 1)		-0.2141** (0.0674)	-0.1857** (0.0635)
Number of patents granted to the home country (Hypothesis 2)		0.3589** (0.0714)	0.4684** (0.0854)
MNC/Home country in terms of patent counts (Hypothesis 3)			0.2059** (0.0702)
Home country / Host country in terms of patent counts (Hypothesis 4)			-0.4221** (0.1291)
Euclidean distance in technological profiles between the host country and the home country (Hypothesis 5)			-0.1259 (0.1006)
(Euclidean distance in technological profiles)^2 (Hypothesis 5)			-0.0432 (0.0593)
Goodness of fit (log-likelihood)	199205.02	199217.58	199232.85

* significant at $p < 0.05$ level

** significant at $p < 0.01$ level

Numbers in ( ) are standard errors.