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The Effects of Location and MNC Attributes on MNCs' Establishment of Foreign R&D Centers: Evidence from China

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This study examines factors affecting MNCs' establishment of R&D centers in China (i.e., China R&D centers). We argue that China offers not only location advantages (e.g., economic growth) that encourage MNCs to establish R&D centers there, but also location disadvantages (e.g., weak intellectual property protection) that discourage MNCs from doing so. Examining a sample of China R&D centers established by U.S. MNCs over fifteen years, we find that China's location advantages and location disadvantages have both independent and joint effects on MNCs' establishment of China R&D centers. We also find that MNC attributes moderate these effects.

Introduction

Because of its significance in the competitive landscape, scholars have paid increasing attention to the globalization of research and development (R&D) by multinational corporations (MNCs). With the continued integration of the global marketplace, many MNCs are diffusing headquarters functions geographically and moving R&D activities to locations abroad (Cantwell, 1995; Cheng and Bolon, 1993; Nobel and Birkinshaw, 1998; Zhang et al., 2007). As an important strategic option of cross-country capacity expansion, R&D globalization provides MNCs opportunities to exploit firm-specific technological capabilities in new markets, and to access new sources of knowledge that can be used to expand those capabilities (Kuemmerle, 1999). Options MNCs use for R&D globalization include merger and acquisition, technology licensing, and participating in an international R&D consortium. However, as Cheng and Rhee (2002, 3388–3389) noted, "none of these options would add to a firm's worldwide learning and innovation capabilities as effectively as establishing its own foreign R&D facilities."

During the first decade of the 21st century, MNCs have established more R&D centers in China (i.e., China R&D centers) than in any other country. According to Li et al. (2013), by 2012 there were more than 1,600 R&D centers founded by MNCs in China (Xinhua News, 2012). The MNCs' China R&D centers provide well-paying jobs for local workers and develop products and services sought by Chinese consumers (e.g., Gelb, 2000). Further, they bring advanced technologies into China, complementing its established strengths in manufacturing. In fact, research suggests knowledge spillover stemming from technologies introduced by foreign MNCs increases the productivity of local Chinese manufacturers (Zhang et al., 2010). Thus, MNCs' China R&D centers are not only critical for MNCs themselves, but are also important to China.

Although establishing R&D centers in China has become popular, it also presents significant challenges for MNCs. For example, institutional support such as intellectual property rights protection (IP protection) is lacking in China. Even when it exists, such support rarely meets the standards in developed economies, and enforcement of the laws and regulations often remains weak. As such, MNCs performing R&D activities in China take a risk that competitors (particularly local ones) and even local partners might expropriate core technologies with little or no legal consequences (Awokuse and Yin, 2010; Keupp et al., 2009; Zhang et al., 2007).

Thus, we ask the following two research questions. First, what characteristics of China tend to encourage and discourage MNCs' establishment of China R&D centers? Second, how do MNC attributes moderate the effects of China characteristics on MNCs' establishment of China R&D centers? Addressing these research questions helps to advance our knowledge of MNCs' strategies for competing in global markets. These questions are especially important because of China's increasingly important role in the global economy, its growing appeal as a location of foreign R&D centers, and the ongoing changes in its institutions and resources.

In this study, we focus attention not only on location advantages, but also on location disadvantages. *Location advantages* are conditions in host countries that attract MNCs to invest (Dunning, 1998). Scholars have argued that location advantages drive MNCs' foreign R&D activities (Dunning and Narula, 1995). With over 1.3 billion citizens, China is the world's most pop-

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ulous country, as well as the world's second-largest economy (World Bank, 2014). These characteristics of China represent location advantages that have helped to attract foreign direct investment, including foreign R&D centers, to China. However, China also has *location disadvantages* that may discourage MNCs from investing. Inadequate formal institutions, which reflect the codified rules that govern economic exchange (Holmes et al., 2013; North, 1990), are examples of location disadvantages. Weak IP protection in China (Li and Atuahene-Gima, 2001, 2002; Peng and Heath, 1996) is an important location disadvantage, especially for foreign R&D centers. Teece (1986a), for example, noted that foreign R&D has the potential to create value, but weak IP protection undermines such potential and reduces MNCs' abilities to capture the value. Although location disadvantages are important, they have received much less attention in international business and strategy research (including research on foreign R&D centers) than have location advantages.

We examine how location advantages, location disadvantages, and the evolution of these characteristics over time may affect China's attractiveness as a location for foreign R&D centers. We consider the following three characteristics of China: 1) growth in an MNC's industry in China; 2) IP protection in China; and 3) investment in innovation in an MNC's industry in China. We also address how MNC attributes shape the relationship between a country's location advantages, location disadvantages, and MNCs' establishment of foreign R&D centers in the country. Specifically, we consider how two MNC attributes—MNC R&D intensity and MNC experience in China—moderate the effect of China's location advantages and location disadvantages on MNCs' establishment of China R&D centers. MNC R&D intensity is important to consider, as it reflects the importance of advanced technology and innovation to that firm, thereby influencing the relative importance of the different location advantages and location disadvantages on a country's attractiveness as a location for foreign R&D centers. Further, we argue that MNC experience in a country is a source of knowledge and relationships that enable MNCs to harness the country's location advantages and to avoid or overcome its location disadvantages. As such, MNC experience may also influence the country's attractiveness as a location for the MNCs' foreign R&D centers.

Our study addresses the research questions above with a dataset that focuses on MNCs' R&D centers established in China over a 15-year period from 1998–2012. Before developing hypotheses about the effects of characteristics of China and of MNC attributes, we briefly examine the advantages and disadvantages that foreign R&D centers provide to MNCs.

Theory development and hypotheses

Foreign R&D centers are R&D facilities located outside of MNCs' home countries. Many of them are devoted to modifying existing product offerings, or creating entirely new products offerings.[1] Foreign R&D centers provide at least three benefits to MNCs: 1) they can develop product offerings for local markets; 2) they can develop product offerings for global markets; and 3) they allow access to local technology resources, such as knowledge and human capital (Cheng and Bolon, 1993; Kuemmerle, 1999; Nobel and Birkinshaw, 1998; Odagiri and Yasuda, 1996). The benefits MNCs receive from foreign R&D centers depend in part on the location advantages and location disadvantages present in the host country. The benefits also reflect the technology transferred to and developed in the R&D centers, MNC interaction with local stakeholders, management of the R&D centers and other factors. In this way, foreign R&D centers provide firm-specific resources and capabilities that reflect the idiosyncratic decisions and processes of individual MNCs. Thus, foreign R&D centers may influence the generation, continuation, and enrichment of MNCs' competitive advantages (Nobel and Birkinshaw, 1998).

MNCs also confront challenges with foreign R&D centers, including management and control difficulties and potential expropriation of proprietary knowledge and technology (Håkanson, 1987; Zhang et al., 2007). R&D is among the most difficult functional activities for firms to manage. The difficulties stem from its high costs, uncertainty about its returns, its long-term horizons, the role of tacit knowledge, and the need for isolating mechanisms to protect against technology expropriation (Teece, 1986a). More generally, MNCs must balance between coordination and control necessary to prevent knowledge spillovers, and local autonomy to enhance the productivity of the R&D centers (e.g., Cheng and Bolon, 1993; Zhang et al., 2007). In addition, managing foreign R&D centers can be especially difficult (Lall, 1979; Nobel and Birkinshaw, 1998) due to physical distance, liabilities of foreignness, cultural and institutional differences, etc. (e.g., Zaheer, 1995).

Because foreign R&D is important yet potentially expensive and difficult to manage, MNCs are sensitive to conditions in foreign countries that alter the balance between the benefits and costs of this activity. In particular, location advantages, location disadvantages and MNC attributes all influence the attractiveness of countries for MNCs' investments in foreign R&D centers. To develop our hypotheses about the factors influencing a country's attractiveness for MNCs' foreign R&D centers, we first consider the characteristics of China, and then examine MNC attributes as moderators of these relationships.

Country characteristics

A country's location advantages and location disadvantages influence the ability of MNCs to create and capture value through their foreign R&D centers in that country. We consider three characteristics of China that reflect its location advantages and location disadvantages: 1) industry growth; 2) formal IP protection; and 3) industry investment in innovation.

[1] Not all foreign R&D centers involve product modification and development. For example, some primarily perform basic research, recruit human capital, monitor host country technology developments, or support local production (e.g., Cheng and Rhee, 2002; Florida, 1997; Håkanson and Nobel, 1993; Nobel and Birkinshaw, 1998).

Industry growth

Economic growth is a location advantage that has attracted MNCs to China (Luo and Park, 2001). During the period of our study, China's gross domestic product (GDP) averaged 9.7% growth per year. By comparison, over the same time period, the average GDP growth of other major economies—such as Germany, the UK, Japan, and the U.S.—averaged 1.4%, 0.6%, 1.9%, and 2.3% per year, respectively (World Bank, 2014). MNCs likely need to investigate the growth situation in their particular industry within a country, which we term the *target industry*, before committing financial, managerial, and technological resources to locate foreign R&D centers in that country. Industry growth is an important indicator of industry structure and market attractiveness (Porter, 1980) and represents a location advantage that may encourage MNCs to establish foreign R&D centers in a country. There are two reasons.

First, foreign R&D centers help MNCs attract customers in the host country and respond to their changing needs with products tailored to satisfy those needs. When growth in the target industry is high, there are more opportunities for MNCs to profit by adapting existing product offerings to local demand or by developing new products specifically for the local market. In this way, target industry growth provides more incentives to establish China R&D centers (Kumar, 1996). Conversely, lack of growth can make it difficult to recoup the investment required to establish China R&D centers.

Second, target industry growth increases the availability of resources—such as supplier networks, distribution channels, etc.—to MNCs and their competitors. Thus, it enables stronger competition, increasing the pressure on firms in the industry to innovate as a means to attract local customers and to provide products responsive to their needs. Thus, target industry growth increases the importance of China for the establishment of R&D centers. The resources generated through industry growth may also increase the potential productivity of the China R&D centers. These arguments suggest target industry growth is a location advantage that facilitates MNCs' establishment of foreign R&D centers. Thus, we propose our first hypothesis.

Hypothesis 1. There is a positive relationship between target industry growth and MNCs' establishment of foreign R&D centers in the country.

Formal IP protection

Teece (1986b) argued that weak IP protection in a country reduces MNCs' incentives to develop technologies there. Weak IP protection increases expropriation risks (e.g., pirating and counterfeiting) for MNCs, potentially jeopardizing their competitive advantages. In turn, when IP protection is weak, MNCs may have to construct expensive and elaborate routines, processes, and structures to safeguard their technologies (e.g., Arruñada and Vázquez, 2006; Chen and Holmes, 2006). Microsoft, for example, pays hundreds of employees to monitor its IP and prevent expropriation (De Castro et al., 2008). Thus, the possibility of greater expropriation renders MNCs less able to recover their costs and earn adequate returns on their R&D investment. In support, Lee and Mansfield (1996, 184) found that weak IP protection leads MNCs to avoid investments in countries or to restrict investments "to sales and distribution outlets and rudimentary production and assembly facilities," rather than making investments in R&D. Likewise, Kumar (1996) found that a subjective measure of IP protection was positively related to the R&D intensity of MNC affiliates in developed countries.

A country's IP protection will be affected by the country's institutions, including formal institutions (e.g., economic institutions and laws), informal institutions (e.g., social norms and value), and enforcement mechanisms (e.g., North, 1990). In this study we focus on the IP protection embodied in a country's formal institutions, which we call *formal IP protection*.[2]

We focus on formal IP protection for two reasons. First, China's formal institutions are undergoing significant changes, especially because of its economic reforms. According to institutional theory, formal institutions reflect the society's changing goals and needs (DiMaggio, 1988; Holmes et al., 2013; Tolbert and Zucker, 1996). As China has emerged as an economic power, pressure from foreign governments, foreign firms, and (increasingly) local firms have led to improvements in the country's formal IP protection. Thus, many of China's efforts to provide substantive IP protection are recent and based on new laws. These new laws, which are among the first and strongest IP protection laws in China's history (He and Sappideen, 2009; Hu and Jefferson, 2009), are visible and codified "first steps" toward stronger IP protection. Second, although most observers agree that formal IP protection in China is weak by Western standards (which are among the strongest in the world), few consider the effects of the new laws. This issue is important, as China's government continues to adjust its formal institutions to establish an environment more supportive of international business.

The new IP protection laws recognize the importance of safeguarding IP, establishing basic IP protection regulations, defining administrative procedures for securing IP, and specifying remedies in the case of violations. Specifically, in December 2001, China joined the World Trade Organization (WTO). As a condition of entry, China created new laws to adhere to international standards for IP protection set forth in the Trade Related Intellectual Property Rights Agreement (TRIPs). TRIPs establishes international standards for several forms of IP protection, including copyrights, trademarks, and patents. It is "the most comprehensive multilateral agreement on intellectual property" (McGaughey, 2006, 267). China's adoption of TRIPs strengthened its formal IP protection by aligning its official standards with those of other WTO members.

[2] We consider informal institutions and enforcement mechanisms in the Discussion section.

Since joining the WTO, China has amended its formal IP protection to further comply with WTO requirements. Notably, in 2004, China passed the Foreign Trade Law (FTL), which is "seen as having vastly strengthened" IP protection in China (He and Sappideen, 2009, 861). Article 29 of the FTL (2004) specifies, "The State [i.e., China] protects trade-related intellectual property rights in accordance with the laws and administrative regulations concerning intellectual property rights." The law states, for example, that imported goods cannot infringe on local or foreign firms' IP that is protected in China. The law also empowers the investigation of IP violations and specifies penalties, including fines, confiscations, and suspension of trading privileges (FTL, 2004).

The steps China has taken to improve its formal IP protection may have made MNCs more willing to locate foreign R&D centers there. Greater IP protection provides incentives to invest in R&D in anticipation of future economic rewards that are both larger and more sustainable (Frame, 1987; Jones et al., 2000). Thus, we expect a positive relationship between formal IP protection and MNCs' establishment of foreign R&D centers.

Hypothesis 2. There is a positive relationship between formal IP protection in a country and MNCs' establishment of R&D centers in the country.

Industry investment in innovation

A country's supply of resources that facilitate innovation may also be important to MNCs. For example, China has invested in innovation by providing R&D subsidies to both local and foreign firms for decades (Godinho and Ferreira, 2012; Jin, 2010). High target industry investment in innovation enables MNCs to staff their R&D centers using local human capital with knowledge of the focal technologies, to launch and grow R&D centers more quickly, and to draw on local knowledge to enrich the R&D conducted at those centers. As a result, the literature on foreign R&D typically treats host country innovativeness as a location advantage that encourages MNCs to conduct R&D in the country (Belderbos, 2003; Florida, 1997; Granstrand et al., 1993; Håkanson and Nobel, 1993; Wortmann, 1990).

However, we argue target industry investment in innovation can be a location advantage or a location disadvantage, depending on the level of IP protection in the country. We predict that the effect of target industry investment in innovation is non-monotonic. That is, this effect is likely to be negative when formal IP protection is significantly lacking but may weaken and perhaps turn positive as formal IP protection strengthens. There are several reasons.

First, investment in innovation helps develop technological infrastructure in the target industry and enables local firms to build knowledge bases related to MNC technologies. These knowledge bases contribute to local firms' absorptive capacity, which reflects "organizational routines and processes by which firms acquire, assimilate, transform and exploit knowledge" (Zahra and George, 2002, 186). In other words, investment in innovation provides knowledge bases that help local firms identify, access, understand and utilize similar or complementary knowledge from other sources over time (Cohen and Levinthal, 1990).

Thus, target industry investment in innovation indicates that local firms are capable of learning about, replicating, and perhaps extending MNCs' proprietary knowledge. In this way, when IP protection is weak, expropriation hazards regarding MNCs' technologies increase with target industry investment in innovation. However, when formal IP protection is strong, MNCs may benefit from the presence of more technologically competent buyers, suppliers, and distributors along the supply chain, potentially increasing the returns generated by the foreign R&D centers (e.g., through knowledge sharing, support services, greater efficiency, etc.).

Second, target industry investment in innovation provides the physical structures and human capital necessary to facilitate certain kinds of expropriation. For example, investments in pharmaceutical innovation may provide the equipment to isolate certain chemical compounds, facilitating imitation of products with similar ingredients (Ostergard, 2000). Similarly, although local employees with knowledge of MNC technologies are potentially valuable resources, they have the potential to leave the MNCs for positions in rival firms or in new ventures they found. Their knowledge of MNC technologies, in turn, potentially enables their firms to develop product offerings that imitate or improve upon the MNCs' product offerings, perhaps eroding the MNCs' brand image (e.g., Keller, 1993) or generating greater competition for the MNCs over time (e.g., Givon et al., 1995). Thus, when IP protection is weak, knowledgeable employees also may be in better positions to bargain for higher compensation (to discourage their mobility), making foreign R&D centers more costly to the MNCs. In turn, MNCs might be less likely to establish foreign R&D centers in countries with weak IP protection and high target industry investment in innovation.

Third, high target industry investment in innovation suggests that advanced technologies underlie competitive advantage in the industry. In turn, the likelihood of expropriation might increase, because local firms in such industries have greater incentives to imitate MNC technologies. The negative consequences of expropriation for MNCs in such industries also are higher, due to the importance of innovation. Whereas strong formal IP protection is meant to create disincentives for expropriation to discourage it, weak formal IP protection increases the likelihood it will decrease the value MNCs can derive from their foreign R&D centers in the country.

In sum, target industry investment in innovation presents a tradeoff: MNCs must balance benefits stemming from more advanced knowledge and human capital, against the risk of expropriation, which can result in a loss of competitive advantages and lower returns. Thus, target industry investment in innovation can be a location advantage when IP protection is strong but can be a location disadvantage when IP protection is weak. By extension, the relationship between target indus-

try investment in innovation and MNCs' establishment of foreign R&D centers is likely to be non-monotonic depending on the level of formal IP protection.

Hypothesis 3. There is a non-monotonic relationship, which depends on the level of formal IP protection, between target industry investment in innovation and MNCs' establishment of foreign R&D centers in the country. This non-monotonic relationship is (H3a) negative when formal IP protection is low, (H3b) weakens as formal IP protection increases, and (H3c) turns positive at high levels of formal IP protection.

MNC attributes

MNC attributes may influence the effects of a country's location advantages and location disadvantages on MNC decisions to invest in the country. Rugman and Verbeke (2001), for example, argue that location factors vary in importance across MNCs. This view is consistent with Dunning's eclectic paradigm (e.g., Dunning, 1998), which emphasizes the role of both MNCs and country characteristics on MNCs' international expansion decisions. It is also consistent with theory that describes how firm and environmental variables interact to influence managers' decisions and to produce competitive advantage (e.g., Sirmon et al., 2007).

Drawing upon these insights, we posit that the importance of a country's specific location advantages and location disadvantages vary across MNCs. Specifically, MNC attributes moderate the effects of a country's location advantages and location disadvantages on its attractiveness as a location for MNCs' foreign R&D centers. We consider two MNC attributes of importance for this study: MNC R&D intensity and MNC experience in China.

MNC R&D intensity and industry growth

MNC R&D intensity reflects the importance a firm places on innovation and advanced technologies for competitive advantage. We expect MNC R&D intensity to strengthen the positive relationship between target industry growth and the MNC's establishment of foreign R&D centers in the country.

MNCs often use their foreign R&D centers to complement or add to their firm-specific advantages by taking advantage of opportunities available in the target industry (Belderbos, 2003). Specifically, they may use R&D centers in a country to adapt technologically-advanced product offerings to local customers' needs and demands. More R&D-intensive MNCs often have significant experience identifying opportunities to leverage their technologies in this way. In addition, the profit-generating opportunities in high growth industries provide more R&D-intensive MNCs with greater incentives to establish foreign R&D centers for this purpose. Further, because they have more advanced technologies, the potential value of foreign R&D centers to identify and exploit these host country growth opportunities is also greater.

MNCs with greater R&D intensity may also be able to manage R&D processes more effectively, perhaps increasing the returns on their R&D investments (e.g., Cheng and Bolon, 1993). Through experiential learning, these firms develop routines, processes, and structures that facilitate the launch and operation of R&D centers. In other words, these firms are more likely to have the skills necessary to transfer, safeguard, and leverage their technologies successfully through foreign R&D centers. Thus, the establishment of China R&D centers to exploit target industry growth opportunities might be more attractive to more R&D-intensive MNCs. In turn, target industry growth may have a stronger effect on MNCs establishment of foreign R&D centers as MNC R&D intensity increases.

Hypothesis 4a. MNC R&D intensity positively moderates the relationship between target industry growth and the MNC's establishment of foreign R&D centers in the country. The positive effect of target industry growth is stronger with higher MNC R&D intensity.

MNC R&D intensity and formal IP protection

Because innovation and advanced technologies are critical to their competitive advantages, the negative consequences of imitation and technology expropriation are more severe to more R&D-intensive MNCs. Some of these MNCs (e.g., Google Inc.), for example, have scaled back their operations in China, partly because of expropriation risks (Vascellaro, 2010). Moreover, R&D creates uncertainty for managers and increases their information processing demands. Thus, managers in more R&D-intensive MNCs value formal institutions that reduce IP protection concerns and the associated uncertainty.

Thus, in general, because of the importance of IP protection to more R&D-intensive MNCs, they are likely to respond favorably to stronger formal IP protection. By extension, the positive relationship between formal IP protection and MNCs' establishment of foreign R&D centers may be stronger as MNC R&D intensity increases.

Hypothesis 4b. MNC R&D intensity positively moderates the relationship between formal IP protection in a country and the MNC's establishment of foreign R&D centers in the country. The positive effect of formal IP protection is stronger with higher MNC R&D intensity.

MNC experience and industry growth

MNC experience in a country enables managers to accumulate knowledge about local customs, local markets, and rival firms doing business in the country (both local firms and foreign MNCs), to learn about influential government units and officials, and to cultivate relationships with important stakeholders (Luo and Peng, 1999). The knowledge and relationships built through experience, in turn, help the MNCs to manage the institutional environment more effectively. Thus, such experience may help MNCs to create and capture more value through their foreign R&D centers in the country by improving their ability to generate, leverage, and appropriate innovations and other R&D outcomes locally.

In China, MNCs' experience enables MNC managers to develop *guanxi*, which reflects the personal relationships that govern exchange, help protect intellectual property, and provide access to resources (e.g., Park and Luo, 2001; Peng and Heath, 1996). Experience also helps MNC managers to understand and navigate China's unique environment, likely improving their ability to access resources both from local firms and from government units and officials (Hitt et al., 2004; Li and Atuahene-Gima, 2001). Through learning and *guanxi*, MNCs' experience in China helps MNC managers to gain the confidence that they can manage the challenges of China R&D centers, perhaps increasing their willingness to establish such centers.

Extending this reasoning, we expect MNC experience in China to strengthen the positive relationship between target industry growth and the MNC's establishment of China R&D centers. MNCs' experience in China facilitates their understanding of local customers and rivals. Thus, MNCs with more experience in China likely are able to build more valuable and more distinct positions in the local market (Luo and Peng, 1999). This experience, in turn, can improve their ability to leverage their R&D centers in the country to develop product offerings that appeal to local customers and are different from rivals' offerings (e.g., Belderbos, 2003). Therefore, MNCs with more experience in China are better able to exploit target industry growth opportunities through establishing China R&D centers.

Lastly, experience improves MNC managers' understanding of local workers and business practices, facilitating better relationships with local employees. Local employees commonly understand Chinese customers, suppliers, government processes, etc. better than foreign expatriates do. This knowledge, in turn, can reduce transaction costs and improve the value of exchange with local customers and suppliers. As MNCs acquire more experience in China, they also can interact more productively with other local stakeholders, perhaps increasing the productivity and value of their China R&D centers (e.g., von Zedtwitz, 2004). For these reasons, MNC experience in China increases the attractiveness of target industry growth opportunities, providing motivation for MNCs to establish China R&D centers to exploit such opportunities.

Hypothesis 5a. MNC experience in a country positively moderates the relationship between target industry growth and the MNC's establishment of foreign R&D centers in the country. The positive effect of industry growth is stronger with higher MNC experience in the country.

MNC experience and formal IP protection

Interestingly, MNC experience in China is likely to weaken the positive effects of formal IP protection on MNCs' establishment of China R&D centers. MNC experience in a country improves managers' ability to facilitate and safeguard technology transfers into and out of foreign R&D centers located in the country (Belderbos, 2003). Knowledge of local customers, licensors and distributors, for example, may enable MNCs to avoid working with firms most likely to expropriate (Keupp et al., 2009). Thus, through experiential learning, MNCs can develop, codify, and refine effective routines for protecting IP (e.g., Hitt et al., 2005; Levitt and March, 1988), perhaps reducing the salience of expropriation risks among MNCs with more experience in the country. These benefits of MNC experience are likely to reduce the importance of formal IP protection.

As formal institutions develop in China, differences between its institutional environment and the home institutional environments of Western MNCs might also diminish, perhaps reducing MNCs managers' uncertainty and the importance of MNC experience in the country (e.g., Luo and Peng, 1999; Peng et al., 2009). These arguments suggest the positive effect of formal IP protection on MNCs' establishment of foreign R&D centers is weaker with higher MNC experience in the country.

Hypothesis 5b. MNC experience in a country negatively moderates the relationship between formal IP protection in the country and the MNC's establishment of foreign R&D centers in the country. The positive effect of formal IP protection is weaker with higher MNC experience in the country.

Method

Sample and setting

To test the hypotheses, we collected data from 164 MNCs over the 15-year period 1998–2012. The sample was drawn from the 2003 BusinessWeek Global 1000 and the 2003 Forbes Fortune 500. The sampled MNCs were independent, publicly traded, technology-oriented U.S. firms with operations in China. This sample of firms is appropriate for at least four reasons. First, using U.S. publicly traded firms provides adequate and reliable firm-level data to test hypotheses. Second, using MNCs already operating in China allows us to separate decisions to invest in the country from decisions to establish

R&D facilities there. None of the MNCs in our dataset used an R&D center as their initial means of expanding into the country. Third, U.S. firms account for a large share of foreign R&D in general (Demirbag and Glaister, 2010) and of the foreign R&D in China specifically. von Zedtwitz (2004), for example, found that U.S. firms own more foreign R&D centers in China than do firms from any other country. Likewise, Hu (2010) found that U.S. firms are second only to Japanese firms in the number of foreign invention patents held in China. Fourth, China is a strategically important location for U.S. firms' foreign R&D activities. Recent surveys conducted by the Battelle Memorial Institute (2011), a global nonprofit R&D organization, suggest that U.S. firms conduct about 35% of their foreign R&D activity in China and about 30% of the surveyed firms planned to increase their China-based R&D activity. Thus, it is important to understand the factors that may affect U.S. MNCs' establishment of China R&D centers.

Analyzing China R&D centers established through 2012 enabled us to capture recent changes in China's economy, formal institutions, and attractiveness to MNCs. We selected 1998 as the starting point for three reasons. First, industry-level data used to test several hypotheses was obtained from the China Statistical Abstract, which was made publicly available by the Chinese government starting in 1996. Thus, three-year growth metrics (described below) used to test the industry growth hypotheses become available in 1998. Second, MNCs' establishment of China R&D centers surged in the late 1990s and grew exponentially thereafter (von Zedtwitz, 2011). Third, China began to strengthen its IP protection substantively when it entered the WTO in late 2001. Thus, starting the analysis in 1998 allowed us to evaluate the period immediately preceding formal institutional changes stemming from China's entry into the WTO.

China R&D centers

Given the sensitive and proprietary nature of R&D, information about individual R&D centers often is not publicly available, especially in China, where IP protection concerns and a lack of corporate disclosure requirements combine to encourage and enable more secrecy. In this section, we discuss the R&D activities performed by several China R&D centers in our dataset.[3]

In an earlier section, we identified three benefits that foreign R&D centers can provide to MNCs. We found evidence of all three in our sample. First, some of the China R&D centers targeted local markets. Caterpillar, for example, established a China R&D center to "support [its] growing Chinese customer base" (Caterpillar Press Release, 2009). Second, due to China's growing emergence as an innovation hub, MNCs are increasingly building advanced R&D centers in the country, many of which house R&D activities for regional or global markets (Li et al., 2013; The Economist, 2010). For example, Motorola developed its finger-writing technology—which had global applications—in a China R&D center (von Zedtwitz, 2011).

Third, some MNCs use their China R&D centers to access local technology resources, such as knowledge and human capital. China is advancing in solar energy technology, for example. In line with this advancement, Applied Materials established one of the world's largest (400,000 square feet) and most technologically advanced solar energy R&D facilities in Xi'an (Applied Materials Press Release, 2009; Quan, 2009). Likewise, China has an increasingly sophisticated R&D workforce in telecommunications. Reflecting this location advantage, Cisco Systems staffed its China R&D center in Shanghai with 100 Chinese engineers (China Daily, 2005).

Further, many MNCs in our dataset operate more than one China R&D center, and the different R&D centers have different functions. Microsoft, for example, has used one of its China R&D centers to adapt its product offerings to function in Mandarin, which has more complex and more numerous alphabetical characters than does English. Another Microsoft China R&D center, however, has focused on basic research on technologies five to ten years from commercialization (Gelb, 2000). Microsoft's website reported that the latter facility employs over 230 scientists and can support over 250 additional visitors (e.g., students).

In addition, the use of some China R&D centers evolves over time (e.g., Chen and Holmes, 2006; Ronstadt, 1978). MNCs may establish China R&D centers to meet local needs but eventually use the resulting technologies to exploit global opportunities. For example, the Cisco Systems R&D center described above was established to tap "surging demand from local customers" (China Daily, 2005), but now employs 2,200 engineers to develop "innovative networking technologies and products for use in Cisco products in China and around the world" (Cisco Press Release, 2010). Because China has been the largest telecommunications market in the world for over a decade (Ho, 2009) and is also the world's second largest economy overall, the boundary between serving the Chinese market and serving the global market is blurring for many MNCs. Lastly, as this Cisco example illustrates, some China R&D centers simultaneously demonstrate all three benefits for foreign R&D centers that we discussed above.

Dependent variable

We restricted the definition of China R&D centers to those facilities wholly owned by MNCs. We excluded R&D partnerships, such as alliances and university collaborations, for three reasons. First, in R&D partnerships, alliance partners have input into decisions concerning the R&D. For example, Cummins Inc.'s R&D partner—Dongfeng Motor—helped make several decisions related to the firms' R&D partnership, including its location within China (Engardio and Arendt, 2005). Many part-

[3] We thank our action editor, Daphne Yiu, and an anonymous reviewer for encouraging us to discuss the nature of the R&D performed at the sampled China R&D centers. We are unable to collect such data from each of China R&D centers, preventing us from modeling it empirically.

ners are local Chinese firms or non-U.S. foreign firms, limiting firm-level data availability and comparability to the U.S. data. Second, alliance partners may expropriate MNCs' technologies, creating IP protection concerns different from those of MNCs operating wholly owned facilities (Zhang et al., 2007). Third, partnerships enable MNCs to share the risks, costs and benefits of foreign R&D centers and to learn from partners (Penner-Hahn, 1998). For these reasons, R&D partnerships are fundamentally different from wholly owned R&D centers. Nonetheless, as described below, we control for the number of R&D partnerships the MNCs have in China.

To identify the China R&D centers of our sampled firms, multiple sources were consulted. The sources included academic reports and published articles, consulting organizations (e.g., Market Intelligence Center in Taiwan), Asian and American news services, government organizations, and company websites. Perusing these sources, our search and selection criteria included the presence of terms such as *R&D center*, *research and development center* and *technology center*.

Identifying the year in which the China R&D centers were established was important, because the hypotheses pertain to changing conditions in China. After an extensive search, we identified 131 China R&D centers for which we could also identify the year of establishment. These 131 R&D centers were founded by 77 of the 164 sampled MNCs (about 47%).

Independent variables and moderators

We have three independent variables that reflect the characteristics of China. *Target industry growth* was measured using the following four indicators from the China Statistical Abstract: 1) gross industrial output; 2) total assets; 3) sales revenue; and 4) total profits. For each variable, we calculated a three-year growth measure. All four growth measures were available for all but the first two years of the sample period. Using data for the thirteen years for which all four were available (i.e., 2000–2012), a single principal components analysis (PCA) factor explained 76% of the variance in the four variables. Thus, we used the PCA factor score for those years. We used the gross industrial output growth measure for the first year of analysis (1998), because it was the only variable available that year. The correlation between this measure and the PCA factor score in the years 2000–2012 was .99. Likewise, we used an index of the gross industrial output growth and total assets growth measures for the second year of analysis (1999), because only these two variables were available that year. Again, the correlation between this measure and the PCA factor score for 2000–2012 was .99. Thus, although the measurement varies slightly over time, the overall variable appears to capture the same construct, industry growth, throughout the sample period.

Formal IP protection captures legal safeguards against expropriation of MNCs' proprietary knowledge and technologies. We measured formal IP protection using two new laws stemming from China's entry into the WTO. First, China adopted TRIPs when it entered the WTO in December, 2001. In 2004, to further its compliance with WTO standards, China passed the FTL to further strengthen IP protection (He and Sappideen, 2009; Heng, 2005). To reflect these changes in China's formal institutions, we constructed a variable coded 0 prior to 2002; 1 from 2002–2004 (to reflect TRIPs); and 2 from 2005 onward (to reflect TRIPs and FTL). Increases in the variable reflect stronger formal IP protection.

We measured *target industry investment in innovation* using the reconstruction and technical transformation variable from the China Statistical Abstract. This variable refers to investments in innovation and technical transformation of old facilities and the establishment of new facilities to develop innovative technologies and products. To account for industry size differences, we weighted the measure by industry total assets, also collected from China Statistical Abstract. We considered other measures—including industry R&D personnel and new product development—but each was available for fewer than half of the years in the sample period. However, the variable we used is a reasonable measure of the hypothesized construct.

We have two moderator variables that reflect MNC attributes. Following prior work (Håkanson and Nobel, 1993), we measured *MNC R&D intensity* as a MNC's R&D spending divided by its total sales. Data for this measure came from the COMPUSTAT database. To measure *MNC experience in China*, we subtracted the focal year from the year the MNC entered China. Similar measures have been used previously (e.g., Erramilli, 1991; Luo and Peng, 1999). Data for this variable were collected from company websites and an internal report from the Ministry of Science and Technology of China.

Control variables

We included several control variables to account for firm-level and China-related factors that could also explain the MNCs' establishment of China R&D centers. Unless otherwise noted, we collected all the firm-level controls from COMPUSTAT.

Because large firms usually have the resources to conduct foreign R&D and are more likely than smaller firms to locate R&D abroad (Belderbos and Sleuwaegen, 1996), we included two measures of firm size: the number of *total employees* and *market value*, defined as the share price times the number of shares outstanding. Similarly, firms with an abundance of slack may have greater ability to invest in foreign R&D. We used two measures of firm slack: *current ratio* (i.e., current assets divided by current liabilities) and *interest coverage ratio* (i.e., earnings before interest and taxes divided by interest payments). When these two measures are high, firms have more slack. Because strong performance might also provide the resources necessary to establish foreign R&D centers, we controlled for return on assets, *ROA* (i.e., net income divided by total assets). We also controlled for *capital expenditures*. MNCs with high capital expenditures might be more prone to take risks and/or to fund large-scale investments, both of which may make these firms more likely to establish China R&D centers.

We also included a measure of *international diversification*. Through international operations, MNCs accumulate knowledge that could increase their capabilities to manage China R&D centers and, thus, their willingness to establish such centers (Belderbos, 2003). Following prior work, we measured this variable using an entropy calculation, which accounts for "the number of global market regions in which a firm operates and the relative importance of each global market region to total sales" (Hitt et al., 1997, 780; Hoskisson et al., 1993; Palepu, 1985). We grouped markets into three segments to compute the measure: the Americas; Europe, Africa, and the Middle East; and Asia Pacific. The measure was calculated as follows, where P_i represents the percentage of the MNC's reported sales in region i:

$$\text{International Diversification} = \Sigma_j[P_i \times \ln(1/P_i)]$$

In addition, we included a measure of *TMT incentive compensation*. Agency theory suggests that top management team (TMT) incentive pay can discourage risk aversion (Eisenhardt, 1989; Jensen and Meckling, 1976), perhaps facilitating investment in China R&D centers. Using EXECUCOMP, we measured this variable by subtracting TMT members' (including the CEO's) salary from TMT total pay and dividing the difference by TMT total pay (Sanders and Carpenter, 1998).

To account for the possibility that firms might establish China R&D centers to tailor product offerings to local consumers' tastes, we measured the MNC's market orientation using *advertising intensity*, measured as advertising expenditures divided by total sales.

We also controlled for country-related variables that might explain MNCs' establishment of China R&D centers. All of these controls came from the China Statistical Abstract. First, we measured *target industry fixed assets* using the original value of fixed assets variable for each industry. This measure reflects the existence of basic commercial infrastructure to support MNCs' activities. As it increases, MNCs might be more likely to establish China R&D centers (e.g., Walsh, 2007). We control for *high technology target industry* classification because China has sought to recruit high technology firms (Hitt et al., 2004; Li and Atuahene-Gima, 2001) and to incentivize them to establish China R&D centers (Sun and Wen, 2007), often by providing subsidies to high-technology foreign firms that conduct R&D in the country (Godinho and Ferreira, 2012; Jin, 2010). Firms in industries classified as high technology industries (e.g., information technology, biotechnology, etc.) by China's government are coded 1 (0 otherwise).

In addition, patenting may reflect the availability of formal IP protection and technology resources. Thus, we also controlled for *patenting* using the total number of patents issued in China in a given year, divided by China's GDP in that year (to account for economic development). Finally, as noted, we control for each MNC's *wholly owned China R&D centers* and its *China R&D partnerships*[4] that had been established before (i.e., up to the year before) each of the sampled R&D centers were established. We used a running count for each measure.

Analysis

Due to the nature of the hypotheses, we sought and identified a technique to examine the establishment of China R&D centers over time, accounting for time-varying covariates and allowing for the possibility that some MNCs establish multiple China R&D centers. Following Delios and Henisz (2003) and Henisz and Delios (2001), we used an exponential survival model with maximum likelihood estimation. The general form of the model is as follows:

$$\text{hr}_{jk} = \exp(\alpha_{jk0} + X_{jk1}(\alpha_{jk1}) + X_{jk2}(\alpha_{jk2}) + \ldots),$$

where hr_{jk} is the hazard rate representing the change from state j to k, the X_{jk}'s are the covariate vectors, the α_{jk}'s are the estimated parameters, and α_{jk0} is the constant. The transition from state j to state k reflects the addition of at least one China R&D center in the given year (Delios and Henisz, 2003; Henisz and Delios, 2001). Thus, this technique is a survival analysis in which "failure" is the establishment of a China R&D center; the MNCs are allowed to "fail" multiple times during the sample period; and the predictors vary over time.

To enable better inferences about causality and to allow time for MNCs to establish R&D centers that have been planned, we examined the control variables and independent variables at time t to predict China R&D centers at time $t+1$. There are separate observations for each period when "failure" was possible. Thus, the final sample size was 2,102 firm-year observations.[5]

Results

Table 1 contains sample means, standard deviations, bivariate correlations and the variable transformations we used (due to skewness). Although some of the bivariate correlations suggest possible multicollinearity concerns, variance inflation factors (VIFs)—which account for bivariate and multivariate multicollinearity—showed no significant concerns. The average of the

[4] Data for this measure was collected in much the same way as were data for the wholly owned China R&D centers. However, data sources for this measure also included research focused exclusively on R&D partnerships (e.g., Li and Zhong, 2003).

[5] We lost 164 firm-year (i.e., "one year of") observations due to the time lag. We also eliminated firm-years when the firm had not yet entered China, was not public, had failed, had been acquired, or had missing data.

Table 1
Variable means, standard deviations, and bivariate correlations

		Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	MNC Wholly owned R&D Centers	0.41	1.45																		
2	MNC R&D Partnerships	0.10	0.35	0.43																	
3	Total Employees[b]	3.36	1.18	0.12	0.01																
4	Market Value[b]	9.42	1.44	0.13	0.05	0.38															
5	Current Ratio	1.89	1.26	0.02	0.09	–0.52	–0.03														
6	Interest Coverage Ratio	0.14	1.12	–0.01	0.00	0.01	–0.03	–0.03													
7	ROA	0.06	0.15	0.00	–0.02	–0.01	0.24	0.05	–0.01												
8	Capital Expenditures[b]	5.89	1.43	0.10	0.03	0.67	0.56	–0.34	0.01	0.09											
9	International Diversification	0.54	0.37	0.11	0.13	–0.02	0.00	0.12	0.01	0.01	–0.04										
10	TMT Incentive Compensation	0.71	0.15	0.11	0.07	0.07	0.28	0.06	–0.06	0.13	0.15	0.09									
11	Advertising Intensity	0.02	0.04	0.00	–0.08	0.01	0.16	–0.03	–0.03	0.08	0.03	–0.06	0.03								
12	Industry Fixed Assets[b]	7.73	1.10	0.16	0.18	0.10	0.01	0.06	0.00	–0.03	0.20	0.14	0.26	–0.06							
13	High Technology Industry	0.52	0.50	0.16	0.12	–0.18	0.20	0.33	–0.03	0.03	–0.14	0.22	0.14	–0.13	0.08						
14	Patenting	1.02	0.29	0.13	0.18	0.04[a]	0.05	0.04[a]	0.00	0.04	0.05	0.10	0.33	–0.02	0.42	0.00					
15	Industry Investment in Innovation[b]	–4.15	0.98	0.03	0.09	0.15	0.05	–0.14	–0.03	0.05	0.15	0.06	0.33	0.02	0.32	–0.28	0.63				
16	MNC R&D Intensity	0.07	0.09	0.10	0.20	–0.46	0.09	0.48	–0.04[a]	–0.11	–0.25	0.18	0.07	–0.04	–0.07	0.52	–0.02	–0.14			
17	MNC Experience in China	11.56	6.17	0.30	0.22	0.36	0.34	–0.09	–0.04[a]	0.06	0.35	0.13	0.31	0.04[a]	0.37	0.00	0.51	0.49	–0.09		
18	Industry Growth[b]	–0.15	1.21	0.04[a]	0.06	–0.01	0.00	0.06	–0.01	–0.05	0.00	0.07	0.08	–0.03	0.23	0.05	–0.01	–0.05	0.01	0.14	
19	Formal IP Protection	1.22	0.85	0.14	0.16	0.07	0.06	0.02	–0.06	0.04[a]	0.09	0.16	0.45	–0.02	0.47	–0.01	0.55	0.75	–0.02	0.58	0.21

Correlations with absolute values greater than .05 and .06 are statistically significant at $p < .05$ and $p < .01$, respectively. Correlations listed as .04 or –.04 can be either statistically significant at $p < .10$ or not statistically significant, due to rounding. Those identified with the superscript [a] are statistically significant at $p < .10$.

[b] Variable was transformed with a natural log function.

Number of observations = 2102.

Table 2
Survival analysis results

	Model 1[a]	Model 2[a]	Model 3[a]	Model 4[b]	Model 5[c]	Model 6[a]	Model 7[a]
Constant	–5.66**	–6.58**	–8.19**	–43.09	–5.31**	–6.58**	–6.60**
MNC Wholly owned R&D Centers	0.01	0.01	0.02	–0.01	–0.15	0.01	0.01
MNC R&D Partnerships	0.26	0.26	0.23	1.57†	0.02	0.29†	0.26
Total Employees[d]	0.11	0.12	0.17	0.29	0.44*	0.11	0.11
Market Value[d]	–0.02	–0.02	–0.00	–0.11	0.07	–0.02	–0.03
Current Ratio	–0.03	–0.06	–0.05	0.24	–0.05	–0.06	–0.06
Interest Coverage Ratio	0.00	0.00	0.01	–0.44	0.09	0.01	0.01
ROA	0.19	0.39	0.47	4.97	0.69	0.47	0.49
Capital Expenditures[d]	0.16	0.21†	0.17	0.17	0.05	0.21†	0.21†
International Diversification	0.42†	0.38†	0.40†	1.15†	0.35	0.40†	0.35
TMT Incentive Compensation	0.09	–0.28	–0.35	1.28	–1.15	–0.26	–0.17
Advertising Intensity	4.07†	4.36†	4.15†	2.08	3.05	4.50*	4.31†
Industry Fixed Assets[d]	0.06	–0.04	0.02	–0.12	0.02	–0.05	–0.04
High Technology Industry	0.57*	0.50*	0.48*	17.00	0.13	0.53*	0.52*
Patenting	–0.40	–0.05	–0.33	10.68*	–0.01	–0.05	0.07
MNC R&D Intensity	1.82†	2.28†	2.53*	–1.77	3.92*	2.05†	2.25†
MNC Experience in China	0.04*	0.03†	0.03	0.05	0.01	0.03†	0.04*
Industry Growth[c]		0.24**	0.25**	0.78†	0.21	0.24**	0.22*
Formal IP Protection		0.40*	0.72**			0.43*	0.38†
Industry Investment in Innovation[c]		–0.24	–0.38*	–2.19*	–0.01	–0.25	–0.22
Formal IP x Industry Inv. in Innovation			0.55**				
MNC R&D Inten. x Ind. Growth						–0.00	
MNC R&D Inten. x Formal IP						–0.98	
MNC Experience x Ind. Growth							0.01
MNC Experience x Formal IP							–0.04*
Model Indices							
Log Likelihood	–185.10	–179.08	–175.90	–31.00	–78.12	–178.70	–177.43
Chi-square	52.54	64.56	70.93	56.14	23.63	65.34	67.87
Change in Chi-square		12.02[e]	6.37[f]			0.78[f]	3.31[f]
Number of observations	2102	2102	2102	587	1047	2102	2102

** P < .01; * P < .05; † P < .10; statistical significance levels based on one-tailed test. [a] Model includes all 2102 observations. [b] Model only includes observations for which Formal IP Protection = 0. [c] Model only includes observations for which Formal IP Protection = 2. [d] Variable was transformed with a natural log function. [e] vs. Model 1; [f] vs. Model 2.

VIFs was 1.90, and they were within conventional guidelines (Neter et al., 1989). Thus, we retained all variables. Also, we centered the main effect variables prior to calculating the two-way interactions to reduce multicollinearity. Table 2 contains the survival models and the results of the statistical tests that evaluated the hypotheses. Model 1 contains the control variables and the main effects of the moderators. Models 2–8 contain the primary statistical tests of the hypotheses.

Hypothesis 1 (H1) suggested that target industry growth is positively related to MNCs' establishment of foreign R&D centers. In Model 2, the coefficient for industry growth was positive and statistically significant ($b = .24$; $p < .01$). Thus, H1 received support. Hypothesis 2 (H2) suggested that formal IP protection is positively related to MNCs' establishment of foreign R&D centers. As Model 2 suggests, the coefficient for formal IP protection was positive and statistically significant ($b = .40$; $p < .05$). Thus, H2 also received support.

Hypothesis 3 posited that target industry investment in innovation is negatively related to MNCs' establishment of foreign R&D centers when formal IP protection is low (H3a), that this negative relationship weakens as formal IP protection increases (H3b), and the relationship is positive when formal IP protection is high (H3c). Models 3–5 contain statistical tests of these hypotheses. In Model 3, the main effect of industry investment in innovation was negative and statistically significant ($b = –.38$; $p < .05$), and the interaction term for formal IP protection and industry investment in innovation was positive and statistically significant ($b = .55$; $p < .01$). Thus, H3b was supported. In Models 4 and 5, we split the sample to examine observations in which formal IP protection was low (when the variable was coded 0) and high (when it was coded 2), respectively. Model 4 shows that the effect of industry investment in innovation was negative and statistically significant ($b = –2.19$; $p < .05$) when formal IP protection was low, supporting H3a. Model 5, however, shows that the effect of industry investment in innovation was not statistically significant ($b = –0.01$, *n.s.*) when formal IP protection was high, failing to support H3c.

We then graphed the effect of industry investment in innovation variable at each level of formal IP protection. Importantly, we constructed this graph and each graph below by a) rerunning Model 2 at three levels of the respective moderators (low, middle, and high), and b) plotting the slopes that emerged for the moderated variables (i.e., the main effects). In Figure 1, the effect of industry investment in innovation was negative when formal IP protection was low (see Model 4), was negative yet relatively flat (and not statistically significant) when formal IP protection was in the middle range, and was negligible when formal IP protection was high (see Model 5).

Hypothesis 4a (H4a) and Hypothesis 4b (H4b) posited that MNC R&D intensity positively moderates the effects of industry growth and formal IP protection, respectively, on MNCs' establishment of foreign R&D centers. In Model 6, neither

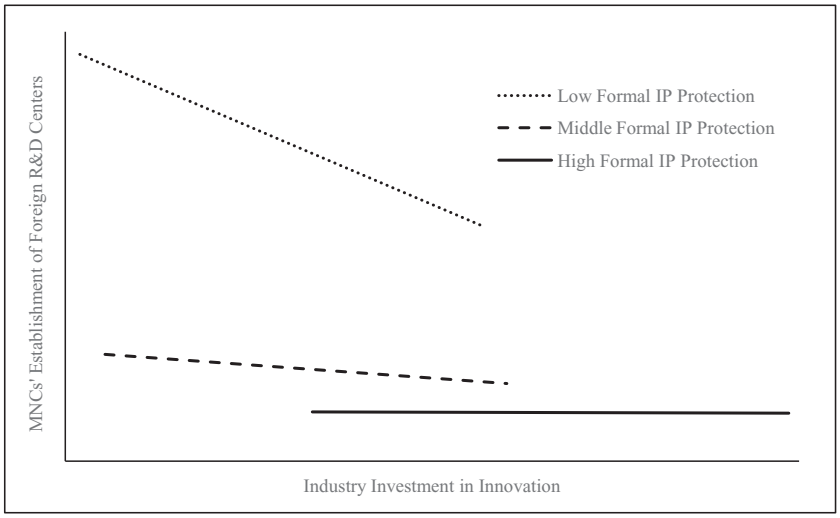

Figure 1. The relationship between formal IP protection, industry investment in innovation, and MNCs' establishment of foreign R&D centers

the interaction term for MNC R&D intensity and industry growth ($b = -.00$; *n.s.*) nor the interaction term for MNC R&D intensity and formal IP protection ($b = -.98$; *n.s.*) were statistically significant, supporting neither H4a nor H4b.

We then used the terciles for MNC R&D intensity to split the variable into three levels (low, middle, and high), and we graphed the effects of industry growth and formal IP protection at each of the three levels. In Figure 2, contrary to H4a, the positive effect of industry growth appears to weaken as MNC R&D intensity increases. Although we urge caution in interpreting this figure, because the overall interaction effect was not statistically significant, we note that the effect of industry growth was positive and statistically significant at both the low ($b = .60$; $p < .05$) and middle ($b = .34$; $p < .05$) levels of MNC R&D intensity. These results are evidence that the positive effect of industry growth weakens, not strengthens, as MNC R&D intensity increases.

In Figure 3, the positive effect of formal IP protection appears to strengthen as MNC R&D intensity increases. This pattern is consistent with H4b, but we again urge caution, because the overall interaction effect was not statistically significant. Nonetheless, we note that the positive effect of formal IP protection was statistically significant at the high level of MNC R&D intensity ($b = .77$; $p < .05$) and was moderately statistically significant at the middle level of MNC R&D intensity ($b = .62$; $p < .10$). These results are evidence that the positive effects of formal IP protection strengthen as MNC R&D intensity increases.

Hypothesis 5a (H5a) and Hypothesis 5b (H5b) posited that MNC experience in a country positively moderates the effect of industry growth and negatively moderates the effect of formal IP protection, respectively, on MNCs' establishment of foreign

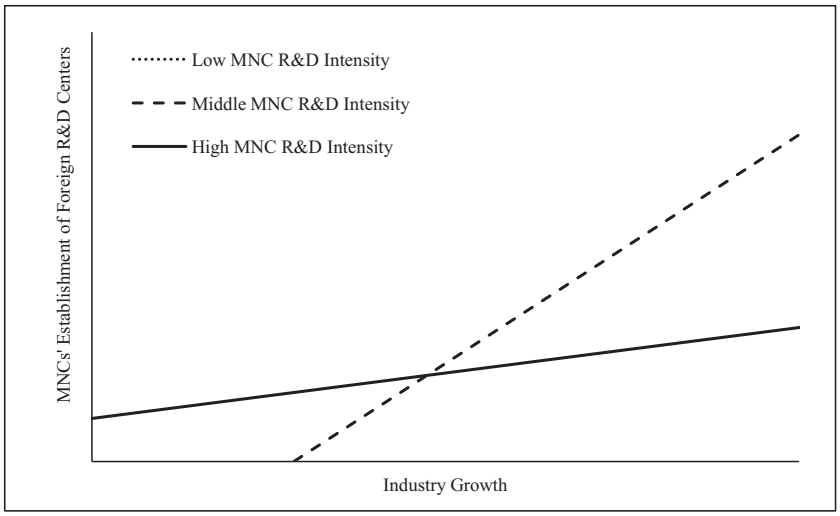

Figure 2. The relationship between MNC R&D intensity, industry growth, and MNCs' establishment of foreign R&D centers

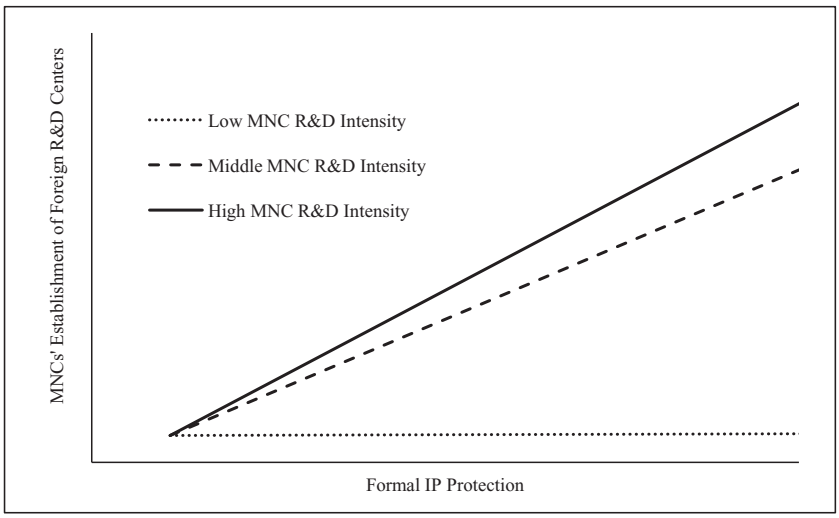

Figure 3. The relationship between MNC R&D intensity, formal IP protection, and MNCs' establishment of foreign R&D centers

R&D centers in that country. As Model 7 suggests, the interaction term for MNC experience in the country and industry growth was not statistically significant ($b = .01$; *n.s.*), failing to support H5a. However, the interaction term for MNC experience in the country and formal IP protection was negative and statistically significant ($b = –0.04$; $p < .05$), supporting H5b.

We then graphed the effects of industry growth and formal IP protection at three levels of the MNC experience variable (low, middle, and high; again using terciles). In Figure 4, consistent with H5a, the positive effect of industry growth appears to strengthen as MNC experience in the country increases. This pattern conforms to the prediction in H5a, although we again urge caution, because the overall interaction effect was not statistically significant. However, the effect of industry growth was positive and statistically significant at both the middle ($b = .27$; $p < .05$) and the high ($b = .41$; $p < .05$) levels of MNC experience in the country. Thus, there is some evidence that the positive effect of industry growth strengthens as MNC experience in the country increases.

Lastly, Figure 5 shows that MNC experience in a country negatively moderates the effect of formal IP protection in the country. When the MNC experience variable was at low and middle levels, formal IP protection appears to have a positive effect, but that effect weakens and appears to turn negative as MNC experience strengthens. Although none of the three slopes in Figure 5 are statistically significant, the overall pattern in the figure and the negative and statistically significant interaction effect reported in Model 7 provide support for H5b.

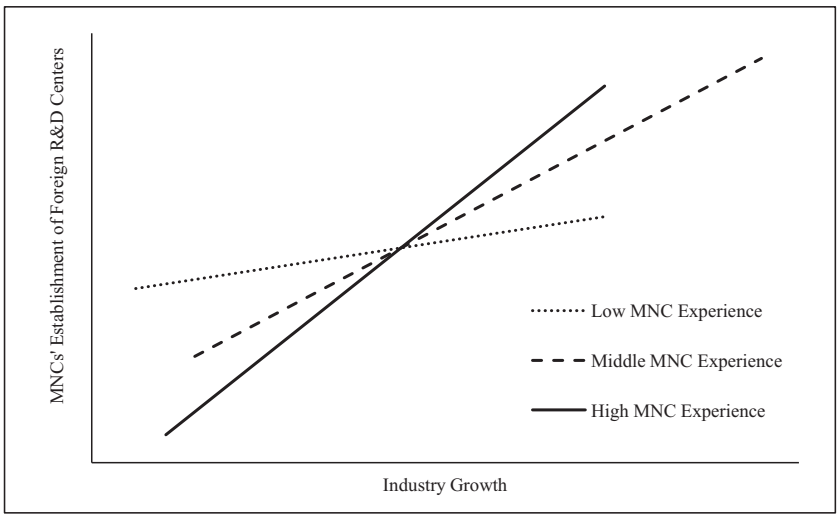

Figure 4. The relationship between MNC experience in a country, industry growth, and MNCs' establishment of foreign R&D centers

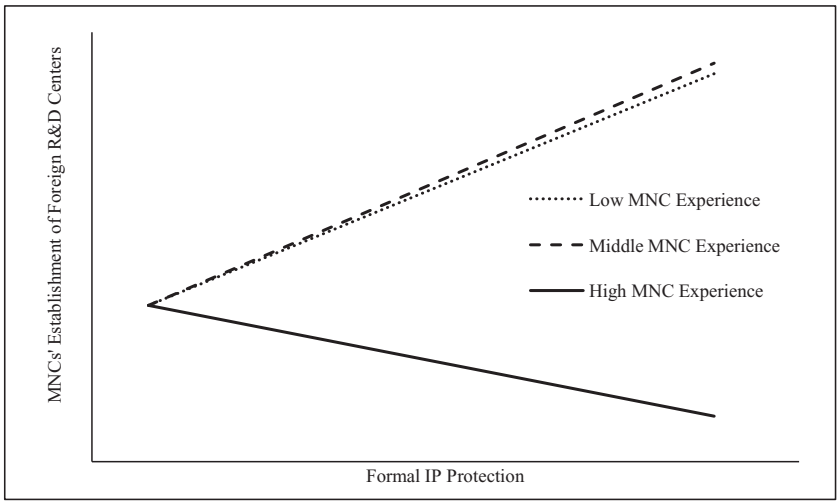

Figure 5. The relationship between MNC experience in a country, formal IP protection, and MNCs' establishment of foreign R&D centers

Supplemental analysis: regional differences in IP protection

To examine the robustness of the results, we examined an alternative measure of IP protection in China that reflects regional differences in the country. Decentralization of state authority enables differences in the nature and priorities of formal institutions across the provinces and municipalities in China (Boisot and Child, 1996). In particular, there is evidence that formal IP protection varies across China's twenty-seven provinces and four municipalities (i.e., Beijing, Shanghai, Tianjin, and Chongqing), perhaps affecting MNCs' location decisions within the country (Du et al., 2008). We capitalized on these regional differences in China to construct alternative measures of formal IP protection.

Specifically, we computed a regional dummy variable that proxies for differences in IP protection across China's provinces and municipalities. We coded this variable 1, if the China R&D center was in Beijing, Shanghai, or Jiangsu province (0 otherwise).[6] We chose these three locations for several reasons. Similar to prior research (Sun and Wen, 2007), our data revealed that the top destination of MNCs' China R&D centers is Shanghai, followed by Beijing. However, we found that China R&D centers established since 2002 (after TRIPs) are nearly as likely to be located in Jiangsu province as in Beijing. In the last five years, for example, our data show that the sampled MNCs established only one fewer China R&D center in Beijing than in Jiangsu province. Further, Beijing, Shanghai and Jiangsu provinces are in the top five of China's 31 provinces and municipalities in patenting (weighted by GDP). Greater patenting in a region indicates stronger IP protection, because firms lacking confidence in IP protection are probably less willing to expose their technologies in Chinese patent applications (Du et al., 2008; Hu and Jefferson, 2009). Thus, IP protection is thought to be stronger in Beijing, Shanghai, and Jiangsu province than in most of the other provinces and municipalities in China.

We sought to examine the robustness of our results by using this regional dummy variable to replace the other formal IP protection measure, which was based on changes in China's laws. In other words, we retested hypotheses that involved formal IP protection using this alternative measure.[7] The sample size decreased to 2,093, because we lacked location information for some China R&D enters. The results using this regional dummy variable supported our earlier conclusions regarding formal IP protection. Specifically, the positive main effect of the regional dummy variable ($b = 3.99$; $p < .01$), its interaction with target industry investment in innovation ($b = .75$; $p < .01$), and its interaction with MNC experience in China ($b = –.11$; $p < .01$) were all statistically significant. These results replicate the tests of H2, H3b and H5b, using a different measure of IP protection. Thus, in general, the results using this regional dummy variable provided evidence to support the interpretation of the results we presented above.

As a second robustness check, we computed an alternative regional dummy variable, which was coded 1 only when the China R&D center was in Beijing and Shanghai (omitting Jiangsu province) (otherwise 0). We conducted this second test because of the historical importance of these two municipalities as locations for MNCs' China R&D centers (Sun and Wen,

[6] We analyzed these provinces/municipalities using a single variable, due to the limited number of China R&D centers established in each individual province in a given year. In the period we analyzed empirically, Beijing and Jiangsu province each averaged fewer than two new China R&D centers per year, and Shanghai averaged about 4.5 per year. Thus, the data prevented us from interpreting results reliably from a survival analysis of China R&D centers in each individual region.

[7] We were unable to replicate the split sample analysis, because there were few China R&D centers established in the other 28 provinces (i.e., those with lower IP protection). There was only approximately one new China R&D center per year in these regions. And, only nine firms established a China R&D center in one of these regions. Thus, the data did not allow a reliable interpretation of the results from a survival analysis using split samples.

2007; Walsh, 2003). The results were generally the same as those using the other regional dummy variable, except that the interaction of this regional dummy variable with MNC R&D intensity was positive and moderately statistically significant ($p < .10$). This latter result provides some evidence that the strength of IP protection in Beijing and Shanghai might increase their attractiveness as locations for more R&D-intensive MNCs' China R&D centers.

Discussion

Summary and implications

The present study considered how growth in China's industries, its IP protection, and its capacity to innovate have altered the country's attractiveness for MNCs' foreign R&D centers. More generally, the study suggests that 1) location advantages and location disadvantages shape a country's attractiveness for MNCs' foreign R&D centers; 2) location advantages and location disadvantages vary across industries and may also interact to influence MNCs' decisions; and 3) MNC attributes can influence the effects of location advantages and location disadvantages on the establishment of foreign R&D centers.

Consistent with Hypotheses 1 and 2, our findings show that growth in an MNC's industry in a country and stronger formal IP protection in the country are location advantages that encourage the MNC to establish R&D centers there. Target industry investment in innovation, however, has a more complex effect on the MNC's establishment of R&D centers, as predicted by Hypothesis 3. When formal IP protection was low, the effect was negative; the effect weakened when formal IP protection increased; and the effect was nearly negligible when formal IP protection was strong. Thus, although target industry investment in innovation can provide location advantages in the form of knowledge and human capital, weak IP protection can undermine these location advantages. When there is weak IP protection, industries with high investment in innovation pose potentially significant expropriation hazards to MNCs. Local firms in such industries have greater ability and incentive to expropriate, and the consequences of the expropriation can be more severe for the affected MNCs.

In this regard, many observers agree that IP protection in China, although perhaps improving, remains weak (von Krogh and Haefliger, 2006). Some estimates, for example, suggest that counterfeiting accounts for up to 15% of China's GDP (Appaji, 2012). Likewise, De Castro et al. (2008) estimated that up to 90% of all software in China is pirated. Scholars have argued that such weak IP protection in China leads MNCs to invest less in R&D there than they might otherwise (e.g., Awokuse and Yin, 2010; Gelb, 2000; Hu and Jefferson, 2009). In support, we found that even at the highest levels of formal IP protection, target industry investment in innovation did not have a positive effect on MNCs' establishment of China R&D centers.

Although IP protection laws in China are not as strong as those found in more industrialized countries, partly due to the country's informal institutions and lax enforcement (Li, 2004), the new laws are an important first step. Recent evidence suggests, for example, that stronger formal IP protection may be facilitating enhanced China R&D activity by some MNCs. Li (2012), for example, reported that foreign firms' patenting in China is increasing at a faster rate than is their rate of patenting in their home countries. In addition, Hu and Jefferson's (2009) data suggests the growth of foreign firm patenting began to surge around the time China adopted TRIPs, and this growth accelerated exponentially afterwards. As noted, an increase in foreign firms' patenting suggests they are more confident in China's formal IP protection than they once were. Over time, continued improvements in formal IP protection may increase the attractiveness of China's location advantages to MNCs, perhaps increasing their willingness to establish China R&D centers to tap into these advantages (Cheng and Bolon, 1993; Kumar, 1996).

In addition, we found only limited support for the prediction that MNC R&D intensity moderates the effects of industry growth and formal IP protection, respectively, on MNCs' establishment of foreign R&D centers. A plausible explanation is that the importance of China's size or growth negates the importance of some factors that could influence MNC managers' decisions to establish China R&D centers. For example, the main effect of target industry growth was consistently positive and statistically significant in all models involving the full sample. The apparent importance of industry growth in MNC managers' decisions concerning China R&D centers is an area in need of additional research. For example, the oldest R&D centers in the dataset (captured in the controls) were founded in the early- to mid-90s, when China was averaging 12% annual growth but had not yet taken significant steps to strengthen formal IP protection. Nonetheless, during our sample period, formal IP protection appears important to all but the least R&D intensive MNCs, and it appears to matter more as MNC R&D intensity increases (see Figure 2 and explanation).

The results support the importance of China R&D centers to more R&D-intensive MNCs in other ways as well. These firms may have more need for China R&D centers. R&D scientists can be among MNCs' most expensive employees, making relatively low-cost yet skilled R&D scientists in China (Demirbag and Glaister, 2010) more attractive. For example, China now produces nearly as many science and engineering graduates as do the U.S. and Europe combined (von Zedtwitz, 2011). Zhao (2006), in particular, suggested that China R&D centers could save MNCs up to 50% of their R&D costs. The opportunity to access valuable human capital while achieving cost savings simultaneously might weigh importantly in MNC decisions. The individual slopes in Figure 3 support this view: industry growth appears to decline in importance as MNC R&D intensity increases. Consistent with these arguments, the main effect of MNC R&D intensity was also positive and at least modestly statistically significant in all of the models that involved the full sample.

We also found some evidence that MNCs' experience in a country shapes the country's attractiveness as a location for foreign R&D centers. Specifically, the relationship between formal IP protection and MNCs' establishment of China R&D centers was weaker for MNCs with more experience in China. MNC experience in China provides opportunities to learn and to develop

guanxi. Learning how to do business in China is important, given its idiosyncrasies and complexities. In turn, *guanxi* is also important as it helps MNCs access resources, safeguard technologies, participate in exchanges in China, and learn from local stakeholders. These benefits, which help MNCs compete more effectively in China, may also explain why industry growth appears to be more attractive as MNC experience in the country increases (see Figure 4 and explanation). In particular, the knowledge and relationships developed through experience may help MNCs to protect their technologies in China, perhaps preventing expropriation and enabling the MNCs to pursue legal recourse more successfully if expropriation occurs. In turn, as they acquire experience in the country, technology expropriation risks stemming from weak formal IP protection may be less pertinent and high-growth industries may be more attractive.

Finally, our findings related to target industry investment in innovation are noteworthy. Our results suggest that, perhaps because it facilitates expropriation when IP protection is weak, target industry investment in innovation might be a location disadvantage in China currently. However, as formal IP protection has strengthened, its negative effects have weakened (and become negligible; see Models 3 and 5). It is important to note that China is in the early stages of strengthening its IP protection substantively. To the extent that China continues to strengthen its IP protection and expropriation risks decline, MNC managers are likely to hold more favorable views about the opportunities for China R&D centers in the industries where investment in innovation in China is high. Note also that range restriction on the formal IP protection variable may have prevented us from observing a positive effect of target industry investment in innovation (see Figure 1). Thus, we encourage future research to examine the potential non-monotonic effect of target industry investment in innovation on MNCs' establishment of foreign R&D centers in other countries (e.g., Japan and Korea) that have advanced through the institutional development similar to those now underway in China.

Limitations and future research

We hope this study serves as a catalyst for more research on foreign R&D centers in general and on China R&D centers in particular. For example, the insights from this research on location advantages and location disadvantages, their combined influence and evolution over time, and their differential importance across MNCs provide a basis for future research in this direction. In this section, we discuss the limitations of the current study, each of which suggests opportunities for future research.

First, there is a need for additional research on regional differences in China. China's transition has progressed unevenly across the country, with some regions (e.g., the eastern coastal region) more economically mature than other regions (e.g., western China). In supplemental analyses, we found that Beijing, Shanghai, and Jiangsu provinces are more attractive locations for MNCs' foreign R&D centers than other locations within China. We also found that target industry investment in innovation has weaker negative effects on MNCs' establishment of China R&D centers in these regions, and MNCs with less experience in China were more likely to locate their China R&D centers in these regions. Although we interpreted these effects as evidence that formal IP protection is stronger in these regions, these effects might also be associated with other factors, including local differences in income levels, education, the maturity of legal and judicial institutions, and economic growth (Hasan et al., 2009; Hitt et al., 2005). Thus, researchers should examine how other location advantages (such as knowledge and human capital) and location disadvantages (such as corruption) that likely vary across China's different provinces and municipalities influence the geographical location of MNCs' China R&D centers (e.g., Du et al., 2008). Likewise, the extent to which IP protection within a region supports the development of other region-specific location advantages is also worthy of study (Hasan et al., 2009).

Second, due to data availability, we primarily focused on China's formal laws related to IP protection. Scholars should examine informal institutions related to Chinese norms and customs concerning IP protection. We believe *guanxi* has a role in IP protection in China, because it may reduce other firms' willingness to expropriate MNC technology and may enable the MNCs to obtain greater restitution in the event of expropriation. However, we did not have access to a measure of this construct. MNC experience likely serves as a partial proxy for MNC *guanxi*, which is built over time through repeated interactions (Luo and Park, 2001). Therefore, we encourage scholars to study the role of *guanxi* in MNCs' establishment of China R&D centers in the future.

Additionally, Bird (2006) and He and Sappideen (2009) noted that Chinese government has recently launched initiatives (using television programs, newspapers, public rallies, etc.) to inform and persuade citizens about the importance of IP protection. Likewise, the Compendium of China's 2008 National Intellectual Property Strategy aims to strengthen IP laws and to increase the public's awareness about the problems of counterfeiting (Awokuse and Yin, 2010). As China's economy and innovativeness grow and the effects of IP violations become more salient and costly, Chinese citizens' views of IP might be more in line with those found in the West. Alternatively, collectivism and communal values in China might continue to support weaker IP protection than is found in Western countries. Future changes in China's formal IP protection laws will likely reflect the norms and values that ultimately emerge (e.g., Holmes et al., 2013).

MNC managers are also likely to be concerned about legal enforcement, because prosecuting IP violations can be time consuming and expensive and may not produce desired results, especially when enforcement mechanisms are weak. MNCs in China confront an unfamiliar, complex and potentially unfriendly legal system, which further hinders their efforts to prevent IP violations. In light of our findings concerning the negative effects of target industry investment in innovation, scholars should examine the enforcement mechanisms necessary to strengthen IP protection. Lee and Mansfield (1996, 186) argued,

for example, that countries may "accomplish little if they go through the motions of enacting a patent or copyright law but … do not convince firms that these laws will be fairly and effectively enforced."

Third, scholars should also extend our study by considering research settings other than U.S.-based MNCs investing in China R&D centers. It is likely that MNC managers consider multiple countries when deciding on the location of foreign R&D centers. Thus, considering other countries might highlight the comparative location advantages and location disadvantages China offers. Although they share some similarities, even emerging market economies—such as China and India—are a heterogeneous group (Hitt et al., 2005). Relative to China, for example, India has more Western-style legal institutions and a more developed banking system (e.g., Bailey et al., 2011; Engardio, 2005; Vig, 2013). Conversely, because the state is more important in China than in many other countries, MNCs may have less flexibility in China because they must regularly seek government approval and must take care to stay in good favor with government officials (Cheng and Kwan, 2000; Child and Rodrigues, 2011). Further, relative to India, China's economy is larger and is growing more rapidly, and many consider China's government to be more effective than India's government is (Khanna, 2009; Luo et al., 2011). Examining how these differences and others influence the location of MNCs' foreign R&D centers is an important area for future research. Researchers might consider the extent to which MNCs can leverage their experiences in China and the advantages gained from operating in China to compete more effectively in other countries both within and outside of the region.

Fourth, scholars should consider MNCs from countries other than the U.S. MNCs from the U.S. invest more in foreign R&D than do MNCs from other countries, and it is likely they value location advantages and location disadvantages differently as well. Israel (2007) estimates, for example, IP accounts for about one-third of the value of U.S. companies and about 40% of U.S. economic growth. As such, IP protection is likely to be highly salient for U.S. managers, perhaps more so than for managers in many other countries. Thus, scholars should expand our analyses to MNCs from other countries investing in both China and elsewhere.

Moreover, as our description of a few specific China R&D centers suggested, there are different types of foreign R&D centers. In addition to distinctions among R&D centers focused on local demand, global demand, and local technology resources that we highlighted, R&D activities also vary in their focus on basic research or on applied research (Florida, 1997; Lall, 1979). The consequences of expropriation of basic research are potentially more devastating than they are for applied research. Relative to the benefits of applied research, the benefits of basic research may also take longer to materialize. In turn, this distinction may have implications for foreign R&D in China. Secondary data that captured the distinction between basic and applied research were unavailable. Future research focusing on how China's location advantages and location disadvantages influence MNCs' establishment of different types of R&D centers might be a valuable contribution (e.g., Håkanson and Nobel, 1993; Nobel and Birkinshaw, 1998).

Finally, we used archival data and thus did not capture managers' specific motivations for establishing China R&D centers directly. China's evolving informal and formal institutions, growing middle class, and increasing involvement and strength in international economic and geopolitical matters, among other factors, likely shape MNC managers' choices to locate sensitive investments like R&D in China. Thus, we follow Cheng et al. (2009), by encouraging scholars to draw from sociology, economics, political science, law, and other disciplines to study these and other factors that may shape MNCs' establishment of China R&D centers.

Conclusion

This work demonstrates how evolving location advantages and location disadvantages influence a country's attractiveness for MNCs' foreign R&D centers. In general, we provided evidence that industry growth is a location advantage, weak IP protection is a location disadvantage, and target industry investment in innovation can be a location disadvantage when IP protection is weak. In addition, the effects of location advantages and location disadvantages on MNCs' establishment of foreign R&D centers depend on MNC attributes. In particular, MNC R&D intensity may influence how MNC managers react to industry growth and formal IP protection. Likewise, MNC experience in a country may provide knowledge and relationships that reduce the likelihood of unhindered expropriation, perhaps affecting managers' decisions about foreign R&D centers.

China's attractiveness to MNCs continues to evolve. Understanding the changes in China's institutional environment can help MNCs explore and exploit opportunities in China more successfully in the long term. Likewise, understanding factors that explain MNCs' establishment of China R&D centers, and how these factors interact and evolve, advances knowledge of China's economy, markets, and institutions, along with their implications for China and for MNCs. Finally, due to the ongoing importance and internationalization of R&D, knowledge about factors shaping MNCs' establishment of foreign R&D centers is an important area for organizational research.

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