Managing Natural Disaster Risk at the Subnational Level in China

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ABSTRACT

We examine how foreign firms consider major discontinuous risk in subsequent investment decisions in a host country and whether different location portfolios can serve to mitigate investment risk. Our sample includes data on 437 Fortune Global 500 firms and their initial entry into Chinese provinces between 1955 and 2008. Using a conditional logit model of discrete time event history analysis, results show that geographic proximity to same MNC subsidiaries mitigates the negative effect of natural disasters on MNC entry into an affected province, while geographic proximity to other MNC subsidiaries does not. Thus the knowledge needed to respond to severe disasters appears to be highly context-specific and shared only between firms with a high degree of commonality and trust.

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INTRODUCTION

Our objective in this study is to examine how foreign firms consider major discontinuous risk in subsequent investment decisions in a host country and whether different location portfolios - defined as the set of available organizations with whom the focal firm might transact and coordinate – can serve to mitigate this risk. Discontinuous risks are defined as episodic occurrences that are often difficult to anticipate or predict and may have differential effects across firms and geographies (Lampel, Shamsie, & Shapira, 2009, Oetzel & Oh, 2014; Ramanujam, 2003). In comparison, continuous risk is considered to be more steady, ongoing and somewhat predictable, such as the level of corruption, governance, and infrastructure quality in a country.

While both types of risk affect firms and their location decisions, continuous risks have received much greater attention in the literature (Doh, Rodriguez, Uhlenbruck, Collins, & Eden, 2003; Henisz & Delios, 2001; Jandhyala, 2013; Kaufmann, Kraay, & Mastruzzi, 2008). One reason that discontinuous risks such as natural disasters or terrorist events are relatively less studied, is precisely because they are episodic and often difficult to anticipate (Oetzel & Oh, 2014). In addition, despite the potentially devastating effects of major discontinuities like natural disasters, day-to-day operations often take precedence, even when a firm is located in an unusually disaster prone part of the world.

Social psychologists suggest that the threat of natural disasters tends to receive far less attention, particularly in comparison to other crises such as terrorism or political violence, because individuals generally do not perceive natural disasters as manageable events. There is a common perception that natural disasters are unavoidable and unmanageable 'acts of God' that are outside the control of managers and their firms (Slovic, Fischhoff, & Lichtenstein, 2000a; 2000b). As a result, managers may be more likely to adopt *ad hoc* responses to natural disaster risk. Another important quality of discontinuous risks is that they may be widely reported at the national level but their impact is often highly localized making the sub-national level of analysis particularly appropriate for understanding firm response to these risks (Dai, Eden & Beamish, 2013). Of course, getting location-specific information about the resources and institutional dynamics at the sub-national level is often more challenging than getting the same

information on a country as a whole.

Another reason the distinction between continuous and discontinuous risks is highly salient is because research has shown that there are important differences in how continuous and discontinuous risks can be effectively managed. Generally speaking, since continuous risks may be more likely to affect all firms in a country, fine grained location specific knowledge may be less important. In fact, researchers have shown that for responding to continuous risks, knowledge from one market can be leveraged in others (Delios & Henisz, 2003; Holburn & Zelner, 2010). Thus experience with continuous risk is often, although not always, fungible across countries.

In contrast, the way in which organizations respond to different discontinuous risks is often idiosyncratic across risk types (Abadie & Dermisi, 2008; Davies, 1996; Oh & Oetzel, 2017). For natural disasters, the particular type of discontinuous risk we focus on in this study, there is reason to believe that context- and location-specific experiences, information, and other resources, may be more important for effectively responding and managing these risks. For instance, researchers have argued that informal cross-organizational collaborations in the same disaster affected area can be critical for "reducing the underlying risk factors that contribute to disasters" (Chen, Chen, Vertinsky, Yumagulova, & Park, 2013: 131). Such collaborations can also help firms to "mitigate or respond to emerging crises" and to "facilitate post-disaster recovery and learning" (Chen et al., 2013: 130). In addition, given that the public sector role in disaster response has tended to decrease rather than increase over the last two to three decades, and that responsibility for responding to natural disasters is often highly diffused across agencies and sectors, the ability to develop informal partnerships for responding to episodic events is an important firm capability (Chen et al., 2013; Christoplos, 2003; May & Williams, 1986).

The need to understand and manage disaster risk, including post-disaster response, is growing in importance. According to researchers, natural disasters are becoming more prevalent in certain parts of the world because of climate change, urbanization, and a corresponding increase in the number of high population density areas, as well as the inability of local and national governments to fully respond to all disasters (because of a lack of financial resources, organizational capabilities, and increasing severity of

the crises, among other reasons) (IPCC, 2012; Perrow, 2007). Since these trends show no sign of abating, unless something changes, the financial cost of natural disasters and the loss of life will only increase (PWC, 2013).

Insurers' are also increasingly reluctant to underwrite these costly risks forcing firms to look for alternative strategies for minimizing losses. For example, in 2012 the Federal Emergency Management Agency (FEMA) of the United States began phasing out flood insurance subsidies in many areas of the country (FEMA, 2013). In other countries it may not be possible to purchase adequate insurance coverage for natural hazards. In China, the context of our study, natural disasters are a particularly salient issue. In 2013 alone, natural disasters reportedly cost $69 billion in China; nearly double the cost from 2012 (Chen & Reklev, 2014). Between June and early July of 2016, floods and landslides in China affected 32 million people in 26 provinces in China killing at least 186 people and displacing over 1.4 million people (BBC News, 2016). Furthermore, as Figure 1 shows, natural disasters have been widespread across the country over the last three decades and appear to be increasing in scope and impact.

Given the importance of the challenge posed by disasters, we seek to extend the foreign investment strategy and disaster risk management research by investigating whether and how different types of sub-national location portfolios reduce natural disaster risk for MNC subsidiaries. Specifically, building on insights from the disaster management literature, we examine whether MNCs locate subsequent subsidiary level investments near established subsidiaries from the same MNC, same home country, or different home countries, in an effort to manage discontinuous risk. We also investigate whether some location portfolios are more valuable than others. In addition, we analyze how competitive threats change the desirability of a location portfolio (Chung & Alcácer, 2002; Narula & Santangelo, 2009). That is, in the face of natural disasters will MNCs locate their subsidiaries close to firms from the same industry or will the competitive concerns outweigh the risk concerns?

To test our research questions, we assembled a unique multi-source dataset on 437 Fortune Global 500 firms and their initial entry into Chinese provinces between 1955 and 2008 and used a conditional logit model of discrete time event history analysis (McFadden, 1974). Discrete time event

history analysis is appropriate because information about entry, firm, and location is available by year (Allison, 1982). We found that an intra-MNC location portfolio (weighted by geographic closeness between a target location and locations of the MNC's existing subsidiaries in China) mitigates the negative effect of natural disasters on MNC entry into the target location, while inter-MNC location portfolios (weighted by geographic and industry closeness between a MNC in a target location and other MNCs' existing subsidiaries in China) do not. Our results suggest that while severe natural disasters deter new investment into a disaster affected province, MNC subsidiary location portfolios can, in some cases, mitigate these risks and enable firms to take advantage of new investment opportunities. Specifically, subsidiaries that locate near other same MNC subsidiaries may benefit from preexisting communication channels, a high degree of commonality, and presumably a high degree of trust; factors that may be especially valuable when facing major discontinuous risk in a new location. We discuss our findings in more detail in the Discussion. In the next section we review the foreign direct investment (FDI) and natural disaster management literature to glean insights into how MNCs learn to manage such risks in foreign countries and which capabilities are needed to do so.

THEORIES AND HYPOTHESES

Foreign Direct Investment and Response to Disasters

A key factor in managing FDI risk is deciding where to locate. When considering various investment locations for new subsidiaries, managers must weigh a variety of factors that may affect the desirability of the location including potential agglomeration benefits, the development of firm-specific advantages, and the potential for risk to the firm (Anderson & Gatingnon, 1986; Buckley and Ghauri, 2004; Dunning, 1998; Rugman & Verbeke, 2001; Tan & Meyer, 2011). As managers weigh these various factors they must consider how the risk profile of locations under consideration might impact their firm, particularly given the firms' unique characteristics and needs. Increasingly, natural disasters are another set of risks managers much consider in their location and investment decisions (PWC, 2013).

While it is clear from the research on FDI that crises and negative discontinuities generally deter investment (Dai et al., 2013; Escaleras & Register, 2011; Li & Vashchilko, 2010), it is also well

established that in some cases experience and knowledge related to crisis management can mitigate the effects of disasters (e.g., natural disasters, terrorist events, or violent conflicts) (Branzei & Abdelnour, 2010; Chen et al., 2013; Darendeli & Hill, 2016; Oetzel & Oh, 2014; Oh & Oetzel, 2017; Smart & Vertinsky, 1984; Shepherd & Williams, 2014; Tierney, Lindell & Perry, 2001; Webb, Tierney & Dahlhamer, 2000). Although it is only in the last decade or two that management scholars have specifically studied firm response to natural disasters, this research has already yielded valuable insights. For example, there is case based evidence that firms are adapting to the threat of natural disasters by mitigating the risk through location strategies (Alcácer, 2012; Worthington, Collins & Hitt, 2009). There are also studies that look at firm response to natural disasters in different countries. These studies have examined the role of experiential learning around disaster management, the importance of cross-organizational collaborations, and community or regional characteristics that might mitigate the effects of disasters on firms and the communities in which they operate (Ballesteros, Useem, & Wry, 2016; Chen et al, 2013; Olcott & Oliver, 2014; Linnenluecke & McKnight, 2017; McKnight & Linnenluecke, 2016; Oetzel & Oh, 2014).

Although there is evidence that managers take their choice of locations seriously when deciding which countries to enter (Alcácer, 2012), there is less information about how foreign firms consider other sites for investment in the same country, and virtually no research on the role that natural disaster risk might play in subsequent expansion decisions in the same country. As Tilcsik and Marquis' (2013: 112) work suggests, this may be a significant oversight. In their study of natural disasters and philanthropy, the authors found that, "Because punctuating events are geographically distributed, community location matters by determining organizations' differential exposure to the dramatic impact of major events" (Tilcsik & Marquis, 2013: 112). In a country as large and varied as China, provincial differences can be substantial. Before we begin to assess whether different location portfolio strategies serve to mitigate subsidiary-level risk, however, we must first establish that natural disaster risk deters investment as one might expect from prior research. While it is widely recognized that major discontinuities can threaten firm survival and/or profitability and deter new market entry or investment into affected locations (Dai et

al., 2013; Escaleras & Register, 2011; Li & Vashchilko, 2010; Oetzel & Oh, 2014; Oh & Oetzel, 2017), it is important to establish that this also holds in our sample. Thus we suggest that:

Hypothesis 1: Natural disasters will have a negative effect on MNC subsidiary entry into a disaster affected province in China.

Responding to Natural Disasters at the Subnational Level in China: The Role of Location Portfolios

Once an MNC's initial investment has been made in a country, the need to prepare for potential threats to the subsidiary is still there. In terms of preparing for and responding to natural disasters, firms may undertake a wide variety of activities including (but not limited to): conducting an assessment of firm vulnerability to natural disasters, establishing a natural disaster response plan, training employees about natural disaster preparedness, purchasing insurance for natural disasters and business discontinuity, and arranging to move business operations temporarily to another location, among others (Tierney, Lindell & Perry, 2001; Webb, Tierney & Dahlhamer, 2000). Once the disaster strikes, established evacuation and business continuity plans and employee preparedness may yield dividends. Appropriate disaster planning will be dependent on a variety of industry-, firm-, and location-specific factors that will, to some extent, be unique to every disaster.

As noted earlier, informal cross-organizational collaborations in the same disaster affected area can be critical for effective firm response since such efforts are generally too complex for a single organization to tackle in isolation (Chen et al., 2013). Given the organizational limitations of even the best public sector organizations to address problems of the scale and magnitude of natural disasters, informal partnerships are becoming increasingly important as a means to mitigate risk (Olcott & Oliver, 2014; Sobel & Leeson, 2007). In addition, the incentives to respond and the capabilities to do so vary substantially across sectors. Unlike the public sector, individual firms may face questions of survival. Coupled with their ability to coordinate decentralized market activities and share knowledge quickly and effectively, private sector firms are better positioned, some argue, to respond to crises like natural disasters (Sobel & Leeson, 2007). For these reasons, locating near other firms or potential partners can provide managers with valuable knowledge and information (Pe'er, Vertinsky, & Keil, 2016). Doing so is

also critical because the knowledge to respond to natural disaster risk tends to be highly localized so country-level knowledge or experience does not necessarily translate to the subnational level. In large countries such as China, regional differences can be particularly profound.

Knowing which organizations to reach out to, however, can be challenging. Of course this is easier to do in a firm's home country than in a foreign country. Researchers have noted that Japan may provide a best case example of how strong social trust among (primarily) domestic firms facilitated cross-organizational collaboration in response to the March 2011 earthquake, tsunami and subsequent disaster at the Daiichi nuclear power plant (Olcott and Oliver, 2014). In that historic disaster nearly 20,000 people were killed or went missing, 1.2 million buildings were damaged or destroyed, and in terms of collateral business damage, production in the assembly plants of Toyota, Honda, and Nissan dropped 62.7%, 62.9%, and 52.4% respectively in one month. Despite the mass devastation, the strong degree of social trust and deeply embedded nature of social relations resulted in an "easier exchange of resources, reduced monitoring costs, and more intensive exchange of information" than one might find in other countries (Olcott & Oliver, 2014: 7). The authors of this study on Japan go on to say that there was extensive direct inter-firm cooperation post disaster. This occurred between customers, suppliers, and competitors and is said to have been built on social bonds, trust and goodwill established before the disaster. Even direct competitors worked together to restore supply in the auto industry. Indeed, these efforts were considered so successful that by the end of August 2011, industrial production across Japan as a whole had reached 95.6% of pre-earthquake levels, and overall economic activity was at 98.8%.

In contrast to Japan, after the Wenchuan earthquake in China in 2008 there was reportedly less cross-organizational collaboration (Chen et al., 2013). Non-governmental organizations (NGOS) were not allowed to freely operate prior to the earthquake so they had not built up the social relationships or informal partnerships that could be leveraged post-disaster. Thus, even though the local governments in Wenchuan were willing to allow NGOs to act, the efforts were considered largely ineffective because local governments, NGOs, volunteers and others found it difficult to work together in the absence of preexisting relationships or prior experience collaborating together (Chen et al, 2013).

So assuming managers are looking for other private sector firms they can learn from and collaborate with, which firms make the best partners? Prior research has established that geographic proximity may facilitate intra- and inter-organizational knowledge transfer (Agarwal & Hauswald 2010; Mariotti, Piscitello & Elia, 2010; Porter, 1995). Focusing first on intra-organizational proximity, the presence of other subsidiaries from the same MNC may be desirable for a number of reasons. First, some MNCs actively share information across subsidiaries in a country (Chang & Park, 2005) and may even coordinate efforts around natural disaster response. Second, a MNCs' subsidiaries may be quite diversified from one another making their skills and competencies complementary rather than overlapping (Chang & Park, 2005).

For firms interested in expanding in China despite a natural disaster, managers may assess the knowledge resources and opportunities for collaboration in a given target location. For example, whether firms in the same MNC, from the same home country, or from other home countries are already present. This is because intra- and inter-organizational knowledge sharing can yield new insights and ultimately firm capabilities (Bruneel, Yli-Renko, & Clarysse, 2010: 168; Lane & Lubatkin, 2010). By interacting with other entities, managers can glean important information that they may not have been able to acquire operating alone.

Despite the potential value of knowledge sharing, we might anticipate that not all firms or organizations in the same geographic area are equally able to take advantage of knowledge of other organizations. As noted earlier, NGOs do not play the same role in China as they do in Japan. Their activities are highly restricted and therefore there is not the same potential for partnership as there is in other countries. Also, by definition MNCs looking to enter a new province do not have the same MNC firms already established in the immediate vicinity of the target investment. Thus proximity to the nearest same MNC subsidiary would be the critical factor. The more opportunities managers have to interact with people from other firms or organizations, the greater the possibility of knowledge sharing and learning and the greater the breadth of knowledge one can obtain.

When other firms have more experience and knowledge about local conditions and institutions,

geographic proximity can lower information costs and increase clustering or agglomeration benefits (Agarwal & Hauswald, 2010; Chang & Park, 2005; Chung & Song, 2004; Porter, 1995; Smith & Florida, 1994). Since disaster management requires the efficient gathering of information, which is by nature a decentralized process, it is important for managers to be able to tap into information across organizations to make effective and informed decisions (Hayek, 1945; Sobel & Leeson, 2007). Firms operating in or near the same disaster-affected area will have greater knowledge of the key regional/provincial players involved in disaster response, the quality and capacity of the local government to respond, local transportation and other emergency resources, etc. Managers of firms that are distant from the affected region may have much less understanding of the severity and nature of the disaster in question as well as who to work with and how 'things get done' in other localities. When geographic locations share similar disaster risks, individuals would be able to use nearby disasters to learn about their own disaster risks (Gallagher, 2014).

Assuming that Hypothesis 1 holds true, we turn to the relative advantages of different location portfolios to better understand whether and how the presence of other firms might serve to mitigate the effect of disaster risk. First, locating near same MNC subsidiaries may be particularly attractive to many firms. A key advantage of doing so is that managers may find interaction easier since presumably they share the same MNC resource pool and mission as well as the same language and a similar cultural background. Thus:

> Hypothesis 2: When expanding into a new province, locating near subsidiaries from the same MNC will positively moderate the relationship between natural disasters and subsidiary entry in the province.

When other subsidiaries from the same MNC are not geographically proximate, however, managers must consider other options in their location portfolio. Consistent with the literature on country-of-origin effects, we would expect that when same MNC subsidiaries are not present in a given location, managers may choose to locate near subsidiaries with which they share greater commonalities, like firms from the same home country (Williams & Grégoire, 2015). Commonalities between firms may reduce the

potential risk, cost, and uncertainty of MNC expansion (or internationalization) (Williams & Grégoire, 2015). There is evidence, for example, that South Korean multinationals seek to locate around affiliates of other South Korean multinationals in China (Chang & Park, 2005; Debaere, Lee, & Paik, 2008). In one study on the entry of Korean firms in China, Chang and Park (2005) found that the presence of Korean firms in a location increased the likelihood of entry by other Korean firms in the same business group. In another, researchers found that although industry characteristics and the presence of other firms were also relevant in location decisions, country-of-origin effects appear to play a distinct and significant role in leading South Korean firms' location choice in China (Debaere, Lee, & Paik, 2008).

As Williams and Grégoire (2015: 257) have argued, commonalities consist of elements present in two or more countries and form "potent indicators of closeness because they signal 'sameness'." Firms from the same home country, for example, are likely to share a common language, culture, and institutional environment facilitating information and knowledge sharing. However, it is not clear that the benefits of commonality extend to industry relatedness. In fact, there is ample evidence that the negative effect of industry relatedness will overshadow any other type of firm commonality. Researchers have shown that while locating near firms in one's own industry can be advantageous in some cases, in others it can pose a competitive threat (Chung & Alcácer, 2002; Narula & Santangelo, 2012; Rosenthal & Strange, 2003; Saxenian, 1994; Shaver & Flyer, 2000; Tallman, Jenkins, Henry, & Pinch, 2004). Some studies have found that large and technologically advanced firms may actually avoid locating near competitors due to unintended knowledge outflows (Cantwell & Santangelo, 2002; Chung & Alcácer, 2002; Shaver & Flyer, 2000). Valuable propriety knowledge may leak out to competitors. When knowledge is a source of competitive advantage, firms may only share knowledge through formal alliances or other formalized relationships (Narula & Santangelo, 2009).

Since research has suggested that experiential knowledge around managing major discontinuities can be a source of competitive advantage (Oetzel & Oh, 2014), firms in the same industry may not share knowledge about how to manage risk with one another. In the event of natural disasters, competitors may compete for receiving limited disaster recovery resources when they locate close each other. Thus

competitors are not likely to share disaster management information or knowhow about disasters. Also, for the same reason competitors may be less likely to have well established channels of communication between one another. Given competitive concerns, we expect location near subsidiaries from related industries will have a negative relationship between natural disasters and subsidiary entry in the province. Even if firms are from the same home country then, the fact that they are from different firms in related industries may reduce the likelihood that these organizations will collaborate. Thus, we suggest that:

> Hypothesis 3: When expanding into a new province, locating near subsidiaries from <u>different MNCs but the same home country and related industries</u>, will negatively moderate the relationship between natural disasters and subsidiary entry in the province.

Subsidiary-level managers are less likely to seek out other firms as informal partners as the commonalities between subsidiaries (and managers) decline. Subsidiaries from different MNCs and different home countries have multiple degrees of separation. As geographic distance between their home countries increases and managers consider sharing information across firms from different home countries, we would expect real or perceived differences to also increase (Williams & Grégoire, 2015). Conceptualizing distance in this way supports the growing body of research suggesting that it is not cultural distance that is the key difference between countries, but rather perceived and real differences in country context - country-of-origin effects - which encompasses the broader multidimensional nature of distance between national institutions, ways of thinking, etc. (Berry, Guillen, & Zhou, 2010; Harzing & Pudelko, 2016; Williams & Grégoire, 2015) that may best capture distance across countries.

For these reasons we would expect that geographic proximity near firms from different home countries may not be beneficial in disaster affected environments given the lack of established trust or common ways of operating. Of course, some firms can share information and knowledge about disasters with a philanthropic purpose, even with a lack of trust, but low commonalities make it unlikely that firms will share more than superficial information. Even if they did share more strategic information, the lack of commonality may make it difficult for firms to fully internalize the information and knowledge received. When firms from different home countries are also in the same or related industries, this may further

decrease the likelihood that firms will share know-how. High competitive pressures can make any firm uncooperative. Thus, we suggest that:

> Hypothesis 4: When expanding into a new province, locating near subsidiaries from different MNCs and different home countries but related industries will negatively moderate the relationship between natural disasters and subsidiary entry in the province.

Relative Effects of Different Location Portfolios

Since firms cannot always choose which subsidiaries will be present in a given location, managers may need to satisfice in their location portfolios. Following the theory that greater commonalities among firms is preferable, particularly for knowledge sharing, we may expect the benefits of locating near same MNC subsidiaries would be greater than the benefits of proximity to subsidiaries from other MNCs. On the other hand, according to the diversity literature (Beckman & Haunschild, 2002; Hoffmann, 2007; Koka & Prescott, 2008; Wuyts & Dutta, 2014), when we consider learning benefits from diverse knowledge sources (Huber, 1991), a MNC may prefer knowledge of subsidiaries from other MNCs.

This is because even when organizations experience the same risk event, how organizations learn from the disaster can vary given the idiosyncratic ways firms prepare, manage, and recover from disasters. Thus it is possible that a subsidiary would learn more from subsidiaries of different MNCs. Diverse sources might provide non-redundant knowledge and supplement a subsidiary's knowledge stock. This in turn would generate greater benefits to MNCs than potentially overlapping information from the same knowledge source (i.e., subsidiaries from the same MNCs). In fact, several studies show that high-level partner diversity can improve the problem solving capacity of an organization (Beckman & Haundschild, 2002; Hambrick, Cho & Chen, 1996). In addition, organizations may learn best practices from different MNCs in managing disasters. Thus organizations can improve their goals, strategies, structures, technologies, and practices to improve their overall functionality in post-disaster management (Kaklauskas, Amaratunga, & Haigh, 2009).

On the other hand, in the case of an emergency such as the occurrence of natural disasters, an organization cannot experiment with knowledge acquired from different MNCs because of the uncertainty in applicability and trustworthiness of that knowledge (Goerzen & Beamish, 2005). Thus it is likely that an organization will rely on trustworthy information sources such as their own subsidiaries. In addition, once organizations set up their processes through repeated ideas, actions, and processes, it is very difficult to quickly adopt other's knowledge and change these processes (e.g., Walsh & Ungson, 1991). Speedy adoption of knowledge and response to a disaster can be also critical since natural disasters occur suddenly, often requiring an emergency response (Waugh & Streib, 2006).

So how do managers identify which organizations will be trustworthy and make good partners for knowledge sharing? Research has long shown that when entering new markets, especially in the face of uncertainty, managers strongly consider the potential for learning when deciding where to enter (Johanson & Vahlne, 1977). As risk levels increase, such as in the case of natural disasters, the degree of commonalities - or distance-reducing factors - in a location become even more salient (Williams & Gregoire). In fact, it is not the degree of distance that may repel them from a location but the degree of commonalities that may pull them instead. In deciding whether to enter a province or not, having a sense of psychic closeness toward other firms in a region will carry even more weight than market based factors and estimates of investment return (Child, Rodrigues, & Frynas, 2009; Williams & Grégoire, 2015).

Commonalities in country-of-origin, language, and culture, for example, may make managers feel closer to another organization and therefore more willing to trust information gleaned from that source (Child et al., 2009; Håkanson & Ambos, 2010; Williams & Grégoire, 2015). Trust will increase mutual understanding and the accessibility of close partners' applicable knowledge (Inkpen, 1998). In particular, such knowledge will provide advantages to a focal subsidiary (Rugman & Verbeke, 2001), and the subsidiary will be able to manage and lower location-specific risks (Li & Meyer, 2009; Luo & Peng, 1999). Thus rather than focusing on differences and attempting to minimize them, managers may go through an iterative process where they first evaluate other subsidiaries and their managers on perceived closeness. Holding the effect of industry constant and solely comparing the relative benefits of locating

near same MNC subsidiaries versus different MNC subsidiaries, we therefore expect that the effect of locating near same MNC subsidiaries would be greater for moderating the relationship between natural disasters and subsidiary entry than the effect of locating near different MNCs from the same home country. Thus we suggest that:

> Hypothesis 5: When expanding into a new province, the effect of locating near subsidiaries from the same MNC will be significantly greater than locating near subsidiaries from different MNCs from the same home country for moderating the relationship between natural disasters and subsidiary entry.

Although we expect that a high degree of commonality between subsidiaries is important for mitigating risk, it is also important for managers to know if there are any opportunities to satisfice if the ideal location partner is not there. At times, there will not be another same MNC subsidiary near the target entry location. If there are only different MNCs but same home countries subsidiaries, and different MNCs and different home country subsubsidiaries in a location, does the greater degree of similarity in the former matter? Said differently, is there any residual benefit of locating near different MNCs from the same country? As the research tells us, firms from different MNCs but the same country will likely share a common language, cultural understanding, and knowledge about existing disaster management resources. If managers turn to the next best alternative in a crisis, we would expect that locating near firms from different MNCs but the same country-of-origin would be relatively better than locating near different MNCs from different home countries. Researchers who studied continuous risk mitigation strategies, for example, found that locating near firms from the same country-of-origin was sufficient to mitigate continuous risks like institutional voids (Tan & Meyer, 2011).

For these reasons, we argue that while the absolute benefits may be small, the relative benefits of locating near subsidiaries from different MNCs but the same home country will be greater than locating near different MNCs from different home countries. Thus we suggest that:

> Hypothesis 6: When expanding into a new province, the effect of locating near subsidiaries from different MNCs but the same home country will be greater than locating near subsidiaries

from different MNCs and from different home countries for moderating the relationship between natural disasters and subsidiary entry.

SAMPLE AND METHODS

A Natural Experiment: History of Foreign Firm Investment in China

Normally it would not be possible to test the relationships hypothesized here using a natural experiment. Not only is it difficult to examine complex decisions like firm response to disaster in a lab setting, but surveying managers about what they might do would likely yield significantly different results from what they actually do in practice. Using the history of foreign firm investment in China, we have the unique opportunity to study what firms actually did in response to different strategic challenges. This context offers a couple of additional advantages that we will detail here.

One advantage of studying these issues in China is its relatively recent open door policy and the tremendous growth in inward FDI that the country has experienced over the last several decades. This unique situation enables us to analyze the process of foreign investment by MNCs from the beginning. Indeed, our data show that, ITOCHU, a Japanese trading company, was the first foreign MNC to enter into China among Fortune Global 500 firms. ITOCHU established a production subsidiary in Liaoning province in 1955, and another production subsidiary in the same province in 1969. According to ITOCHU's website, the company has developed an extensive network of personal contacts, alliances with major companies, and numerous personnel with extensive knowledge of China. The second company was Nippon Steel (now Nippon Steel & Sumitomo Metal Corp.), a Japanese iron and steel company. Nippon Steel established a sales subsidiary in Shanghai in 1977 and five production subsidiaries in Beijing, Jiangsu province, and Shanghai afterward. According to Nippon Steel's annual report, the company improved its profitability due to high demand in China despite the domestic and worldwide economic downturn in the early 2000s. The first western company that entered China, according to our data, was Caterpillar, an American industrial and agricultural equipment producer. Caterpillar established a business services subsidiary in Beijing in 1978, and then established three production subsidiaries in 1994, one in Jiangsu province and two in Guangdong province.

With respect to initial investment in China, only six subsidiaries entered the country before China's economic reform in 1978. Most of the foreign MNCs did not have local ties in China or information about China until China opened their doors to FDI. For that reason, we are not concerned with differences in the initial conditions of our sample firms. The number of foreign subsidiaries has increased dramatically in the past 50 plus years. In the 1980s, only 177 subsidiaries of the world's largest 500 companies were established in China, while more than 2,500 subsidiaries were established by those 500 companies in 2000s. At the same time, as noted earlier, the incidents and frequency of natural disasters have significantly increased worldwide including China. China had about 180 incidents of natural disasters in the 1980s and more than 250 incidents of natural disasters in the 2000s. In Figure 1, we showed the snapshots for the average death toll of natural disasters per population in each province and the location of MNCs in China over time. Considering the increasing nature of these trends in China, natural disasters might not necessarily affect MNC investments in the country since MNCs needed to rush into China because of its economic size and increasing importance in the world economic system. However, China might have received even more MNC investments if it was not affected by such natural disasters. Thus natural disasters might have actually increased the opportunity costs of for MNCs, and for China.

[Insert Figure 1 around here]

Sample Source

To examine the effect of location portfolios on the relationship between natural disasters and firm entry and expansion in China at the province-level, we used a sample of Fortune Global 500 firms published in 2009, where the ranking was based on firm revenue in 2008, and their entry information into Chinese provinces between 1955 and 2008. Of these 500 firms, we excluded 43 firms originating from Mainland China, Hong Kong, and Taiwan. The entry information was collected from the *Report of Transnational Corporations in China* published by China Economic Publishing House. We defined Chinese provinces (provincial level administrative division) as 22 provinces, four municipalities, and five autonomous regions in Mainland China. We excluded two special administrative regions (Hong Kong and

Macau).

Our next step was to confirm and adjust the collected information based on individual MNC website and newspaper articles. Through these processes, we were able to find information about firm name, firm nationality, entry year, subsidiary name, and subsidiary location (province). Among these 457 large firms (excluding 43 firms from Greater China), 306 firms had entered into Mainland China by 2008. Among these 303 firms, we were able to collect information, such as entry year and location, for 281 firms from 26 countries. Of the 281 firms, 95 were from North America, 114 were from Europe, 68 were from the Asian Pacific, and four were from non-triad countries, such as Brazil, South Africa, and Saudi Arabia. The U.S. (87 firms) had the most firms in China, followed by Japan (51 firms), France (30 firms), and Germany (27 firms).

Disaster information was collected from Emergency Disasters Database (EM-DAT), which is managed by the Center for Research on the Epidemiology of Disasters (CRED), Université Catholique de Louvain at Brussels. EM-DAT is a global database on major disasters that contains essential core data on the occurrence and effects of more than 17,000 disasters in the world from 1900 to the present. EM-DAT provides information about individual disasters including disaster sub-type, location, year of incident, number of people killed, number of people affected, economic damage, and duration of the disaster. Information about economic damage and duration of the disasters, however, are not complete. EM-DAT defined a disaster as an event that meets at least one of four criteria: 1) ten or more people reported killed; 2) one hundred or more people reported to be affected by the disaster; 3) declaration of a state of emergency; and 4) calls for international assistance. Natural disasters include droughts, earthquakes, epidemics, extreme temperatures, floods, insect infestation, mass movement, storm, volcano, and wild fire. EM-DAT has been widely used in scientific research about disasters and its impact in various natural and social science fields (for several examples among many, Alcántara-Ayala, 2002; Guha-Sapir & Santos, 2013; IPCC, 2012; Jonkman, 2005; Slettebak, 2012; Strömberg, 2007).

The main source of geo-demographic information about Chinese provinces was China Data Online managed by the University of Michigan. The information was supplemented by various data

sources such as *China Statistical Yearbook*, *China City Statistical Yearbook*, *Yearbook of China Transportation and Communication*, and *China Statistical Yearbook on Science and Technology*. To control for the distance between MNC home country and China, we used geographic distance, political distance, and economic distance measured by Berry et al. (2010), and cultural distance measured by Kogut and Singh's method (1988) based on data provided by Hofstede, Hofstede and Minkov (2010).

Measures

Dependent variable. To measure MNC's subsequent entry and expansion in China at the province-level, we identified the entry of a MNC into each province after the first entry into China. We do not focus on a MNC's initial entry into China since ties with other subsidiaries could only have been established if the firm had already entered into China. In addition, about 77% of MNCs chose Shanghai (35%), Beijing (28%), or Guangdong province (14%; Guangzhou and Shenzhen cities are the most popular locations in Guangdong province) as their first subsidiary location in China. Thus analyzing sub-national differences would not be meaningful for the first entry into China due to such little variation. Also earlier research has examined the factors that influence MNCs' choice to invest in Shanghai versus Beijing (Ma, Delios & Lau, 2013). Our sample MNCs entered 5 provinces in Mainland China on average from 1955 to 2008. Forty-four companies entered more than 10 provinces, while 69 companies entered only one province. In the MNC-province-year observation, the dependent variable is 1 when a MNC first enters into a province after the first entry into China; 0 otherwise.

The MNC-province-year observation starts after the MNC's first entry into China and ends after its first entry into the target province. We excluded observations for the province that hosted the MNC's first subsidiary in China because the MNC should have better knowledge about that province, particularly as compared to other provinces where the MNC has not entered. This research design efficiently eliminates the problems of initial conditions and selection issues. First, all firms have only one (initial) subsidiary in China therefore their initial conditions, such as their knowledge about China, networks with governments and relationships with suppliers and customers, are about the same across the sample firms. Second, we excluded the province in which a firm initially entered because firms are more likely to

expand in that province. We also controlled for various characteristics of provinces to consider factors affecting their subsequent entry decision to Chinese provinces. As we will discuss below, when we measure the location portfolio and severity of natural disaster, we consider the province in which a firm initially entered.

A graphical illustration may help to understand our dependent variable (see Figure 2). For example, suppose Company A entered into China in 1999 and established subsidiaries in province 1 in year 2005, in province 2 in 2002, and in province 3 in 2007. In province 4 (and all the other provinces), Company A did not establish a subsidiary until 2008. All observations for Company A started in 2000, and observations for province 1 ended in 2005, for Province 2 in 2002 Province 2, for Province 3 in 2007, and for province 4 (and all the other provinces) in 2008.

[Insert Figure 2 around here]

Independent variables. We used two sets of independent variables in our study: severity of natural disasters, and subsidiary location portfolio. The first independent variable is the severity of natural disasters. In order to compute the severity of natural disasters at the province-level, we used the number of people killed in each incident. Because EM-DAT provides information about disaster events and many natural disasters affect more than one province, we first disaggregated the number of people killed in each affected province based on the population density (population divided by land size) of each province. Second, we aggregated the number of people killed by province and by year. Third, to compute the severity score in each province, we divided the number of people killed by the total population (per 10,000 people) of the province. Fourth, for a target province, we divided the severity score by geographic distance between a target province and each province, and then aggregate them for the target province. Fifth, we computed the three-year moving weighted average to measure the severity of natural disaster in year *t* for the target province. The rationale of using a three-year moving weighted average was to: 1) capture the direct and indirect damages of disasters that remain a few years after the event (Alcántara-Ayala, 2002); 2) recognize that disaster recovery takes a few years (Webb, Tierney, & Dahlhamer, 2002); and 3) account for the fact that managers do not only look at the year of entry and expansion, but they

also analyze disaster events that happened over the last few years as reference points (Alcácer, 2012). Through these steps, we were able to compute the contiguity spatial and temporal weight matrix of the severity of natural disaster, which considers both the spatial and temporal nature of natural disasters.

The second set of independent variables is for subsidiary location portfolio. First, based on the relevance of other subsidiaries to a focal subsidiary in a given location, we divided subsidiary location portfolio into three types: intra-firm location portfolio (i.e., location portfolio with subsidiaries from the same MNC), inter-firm location portfolio with subsidiaries from the same home country (i.e., location portfolio with subsidiaries of other MNCs from the same home country), and inter-firm location portfolio with subsidiaries from different home countries (i.e., location portfolio with subsidiaries of other MNCs from different home countries). To examine the characteristics of firms in a portfolio we adjusted 1) the geographic proximity from the target province in question to the province of another subsidiary's location (*geographic distance*), 2) the closeness of the industry sector from the focal subsidiary to another subsidiary (*industry closeness*), and 3) the distance from the home country of the focal subsidiary to the home country of another subsidiary (*home country closeness*). We graphically illustrate measures for the three types of location portfolio in Figure 3 and how they are related to our Hypotheses.

[Insert Figure 3 around here]

Mathematically, the location portfolio score of focal subsidiary *i* in province *k* at time *t* can be presented in Equation (1):

$$\text{Location Portfolio Score}_{i,j,k,t} = \sum_{j}^{n} \frac{Industry\ closness_{i,j,t} \times Home\ country\ closeness_{i,j,t}}{Geographic\ Distance_{i,j,t}} \quad \text{..... Equation (1)}$$

, where *j* is a subsidiary located in China. In order to compute *industry closeness*, we give an 8 when subsidiaries *i* and *j* share a 4-digit SIC; 6 when sharing a 3-digit SIC; 4 when sharing a 2-digit SIC; 2 when sharing a 1-digit SIC. For *geographic distance*, we used geographic distance between the target province of focal subsidiary *i,* and a province hosting subsidiary *j*. For home country closeness, we used the reverse geographic distance (the maximum geographic distance minus geographic distance) between the home countries of focal subsidiary *i* and subsidiary *j*. Geographic distance was measured using the log

of the great circle distance between the centers of two provinces (or countries). For all three types of location portfolios, we computed the three-year moving weighted average of their score in order to measure each subsidiary's location portfolio at time *t*. Through these steps we were able to employ the contiguity matrix of the subsidiary location portfolio to consider both spatial and temporal characteristics of subsidiary location (as we did with the severity of natural disaster score).

Control variables. We used the province-, dyadic- (China and MNC home country), and firm-level control variables known to influence MNCs' entry, expansion, or survival. We also included dummy variables for the 2-digit industry of the MNC.

At the province-level we included population (log of total population), education level (post-secondary enrollment per 100 capita), wage level (log of the average wage of staff and works), export intensity (total export value per GDP, %), openness to business (portion of gross output of non-state owned enterprise out to total output), local government effectiveness (portion of local government expenditures on innovation, culture, education, and science per total revenue), and infrastructure quality (number of health institutions per 10,000 capita). These variables are frequently noted in the literature analyzing firm location choice at the sub-national level (e.g., Chang & Park, 2005; Head & Mayer, 2004; Meyer & Nguyen, 2005). In China, MNCs are likely to choose a location that has a bigger market, workers that are productive and suited to low-skilled jobs, better quality infrastructure, effective government support, and export oriented policies and systems. We also controlled for the geographic distance (log) between MNC's first subsidiary and a target province. The literature shows that a MNC is more likely to cluster its own subsidiaries with one another (Chang & Park, 2005; Chung & Song, 2004; Head, Ries & Swenson, 1995; Smith & Florida, 1994).

At the dyadic-level, we controlled for geographic, economic, and political distance indexes provided by Berry et al. (2010). We also controlled for cultural distance using the same method proposed by Kogut and Singh (1988). We used five cultural dimensions (power distance, individualism vs. collectivism, masculinity vs. femininity, uncertainty avoidance, and indulgence vs. restraint) to compute the distance proposed by Hofstede et al. (2010). We did not use the long-term orientation dimension since

there was a significant amount of missing information for 14 MNC home countries (out of 26 countries). These dyadic-level control variables take into account the regional and semi-global nature of MNC businesses (Ghemawat, 2007; Rugman and Verbeke, 2004) as well as the liability of foreignness faced by foreign firms (Zaheer, 1995).

At the firm-level we controlled for the number of provinces in which a MNC has subsidiaries. This variable controls for the MNC's overall experience in different environments in China and how such experience affects the expansion decision of the firm at the province-level in the country. In addition, as we will discuss below, we also controlled for the MNC's age in China (i.e., age of the firm's first subsidiary in China), which is the time dependence of the entry in a discrete time event history analysis.

Finally, one may argue that how governments effectively respond to and prepare for natural disasters would be an important risk mitigation mechanism (Oh & Oetzel, 2011); more than how firms learn and communicate with each other. To control for this possible explanation, we included an interaction between local government effectiveness and severity of natural disasters in the interaction models. When we operationalize the interaction variable, we used mean-centered variables to reduce multicollinearity (the same reasoning applies to all other interaction variables).

Table 1 provides the variable names, definition of variables, and summary statistics. Table 2 shows the correlation matrix. No pair-wide correlations are noticeably high. The model variance inflation factor (VIF) is 2.69 and the highest individual VIF is 4.61 for wage level variable. Thus both the correlation matrix and VIFs do not show any symptoms of multicollinearity so we conclude that multicollinearity is not a concern in our analysis.

[Insert Tables 1 and 2 about here]

Method

To test our model, we used a conditional logit model of discrete time event history analysis (McFadden, 1974) that has been widely used in MNC location choice analysis (Chang & Park, 2005; Head et al., 1995; Henisz & Delios, 2001; Hahn, Bunyaratavej, & Doh, 2011; Jandhyala, 2013). Due to the existence of censoring and time-varying explanatory variables, applying standard methods to event histories can lead

to serious bias or loss of information (Allison, 1982). A firm's entry into a province can occur at any point in time, but available data are typically collected on a yearly basis thus it is inappropriate to treat such data as continuous. When a dependent variable is categorical, like the entry variable in our study, discrete-time models can be estimated by using log-linear methods with controlling the occurrence or nonoccurrence of the event as well as the length of time until an event occurs, called hazard rate (Allison, 1982).

The time dependence of the hazard (entry) is introduced in the model. The hazard of entry is computed by calculating the log of duration (age) between a MNC's first entry into China and the MNC's entry into a target province. For example, in Figure 2 durations are six, three, eight, and nine for Province 1, 2, 3, and 4 respectively. The conditional logit model requires all choices (provinces) to be selected at least once, and our analysis includes 30 Chinese provinces in Mainland China. Qinghai province was the only province in Mainland China where the companies in our sample did not enter until 2008. In total, 1,096 company-province entries were recorded in our sample, and 6,507 company-province entries were not recorded as entry until 2008. The total number of observations is 103,587.

Since we observed all sample MNCs' entries into China from the beginning, the model does not have left-censoring issues at all. Right censoring issues caused by truncating the observation period at 2008 is resolved by conventional adjustments in econometrics. To reduce the potential of endogeneity issues, we used 1-year lagged independent and control variables in the model. We also used heterosckedasticity robust standard error clustered by province.

RESULTS

The regression results from the conditional logit model appear in Table 3. In Column 1 of Table 3 we report the results from the control only model. The control only model results show that subsequent entry is more likely to occur in a province with low education-levels (β=-0.5145; p<0.001), high wage-levels (β=0.1887; p<0.001), and greater openness to businesses (β=0.9734; p<0.001). High degrees of government effectiveness (β=0.3021; p<0.05) improves the likelihood of entry into a province. Also, an

experienced MNC (having subsidiaries in other provinces than the target province in China) (β=0.2066; p<0.001) is more likely to establish its subsidiary in a new province in China. Finally, a MNC from a home country that has low political distance (β = -0.0295; p<0.001), low economic distance (β=-0.0175; p<0.001), and low geographic distance (β=-0.1273; p<0.05) with China is more likely to establish its subsequent entry into a new province in China.

[Insert Table 3 about here]

Column 2 of Table 3 shows the results with natural disaster severity. The results also show that a MNC is not likely to enter into a province that has severe natural disasters (β=-0.7876; p<0.05). For example, in Beijing the average disaster severity is 0.0968. If we increase the severity to 0.2180 (mean plus a standard deviation (SD) of natural disaster severity in Beijing), it will lower the likelihood of entry in Beijing by 0.2%, which is about 1% of its SD. Considering export intensity is one of the important determinants for entry into China at the province-level (Wei et al., 1999), we compared the effects of natural disaster severity and export intensity of the province. When we increase one SD of export intensity in Beijing from its mean value. The likelihood of entry in Beijing increases by 0.006%, which is about 0.03% of its SD. A comparison of these figures suggests that firms should not ignore the effect of natural disasters in making subsequent entry decision into provinces in China.

In Column 3 we included three types of subsidiary location portfolios. The results show that the effects of intra-firm location portfolio (β=3.3830; p<0.001) are positive and much more likely to affect the entry decision, while inter-firm location portfolio with subsidiaries from same home countries (β=0.0092; p=*n.s.*), and inter-firm location portfolio with subsidiaries and different home countries (β=0.0328; p= *n.s.*) are insignificant and less likely to affect the decision.

Although we did not hypothesize the direct effects of different types of co-located subsidiaries sets, we did test for these. We found insignificant direct effects for two types of inter-firm location portfolios and determined that these results deserved further investigation. Thus we added interactions between the three types of location portfolios in Column 4. Adding these interactions significantly

increases the model fit against the model in Column 3 (p<0.000) and provides very important post-hoc findings. The interaction between intra-firm location portfolio and inter-firm location portfolio with subsidiaries from the same home country (β=0.2580; p<0.001) is positive, indicating a complementarity effect between these two types of close location portfolio. Thus, taken together, these two types of subsidiary location portfolios improve the depth of knowledge available to managers. The interactions between intra-firm location portfolio and inter-firm location portfolio with subsidiaries from different home countries (β=-0.1402; p<0.001), and between the two types of inter-firm location portfolio (those from the same and different home countries) (β=-0.0729; p=0.001) are negative, indicating that there are substitution effects of inter-firm location portfolio with subsidiaries from different home countries. Thus MNCs establish inter-firm location portfolio with subsidiaries from different home countries only when the other two types of closer location portfolios are not available. Thus gaining a breadth of knowledge does not appear to be the primary objective of foreign subsidiaries in establishing a location portfolio. We will further discuss these post-hoc findings in the Discussion section.

After considering the complementarity and substitutability effects of our three types of location portfolios, we found that the direct effect of establishing an inter-firm location portfolio with subsidiaries from the same home country (β=0.1649; p<0.001) is more valuable than establishing an inter-firm location portfolio with subsidiaries form different home countries (β=-0.1380; p<0.05), yet less valuable than establishing an intra-firm location portfolio (β=3.4692; p<0.001) suggesting that same MNC subsidiaries are the main sources of knowledge and learning for foreign MNCs.

In Column 5 we added interactions between three types of location portfolios and natural disaster severity into the model in Column 3. We also controlled for the interaction between government effectiveness and natural disaster severity in the target province. The results show that the interaction between intra-firm location portfolio and natural disaster severity positively, but weakly, affect the entry decision (β=0.5880; p<0.1), while interactions of natural disaster severity with inter-firm location portfolio with subsidiaries from the same home country (β=-0.0313; p< p=*n.s.*) and with different home

countries (β=-0.0400; $p< p=n.s.$) are insignificant. In addition, the interaction between government effectiveness and natural disaster severity is insignificant (β=-1.929; $p=n.s.$). We presume that the primary concerns of local governments in China have been to implement the economic and political policies of the central government rather than to focus on natural disaster recovery and prevention (Ge, Gu & Deng, 2010).

In Column 6, we added interactions between three types of location portfolios into the model from Column 5. The results are very consistent with those in Columns 4 and 5: 1) the direct effect of intra-firm location portfolio and inter-firm location portfolio with subsidiaries from the same home country are positive and significant, while inter-firm location portfolio with subsidiaries from different home countries is negative and significant; 2) the interaction between intra-firm location portfolio and inter-firm location portfolio from the same home country is positive and significant, while the other two interactions of location portfolio variables are negative and significant; and 3) the interaction between intra-firm location portfolio and natural disaster severity is positive and significant (β=0.8169; $p<0.05$). In addition, the interactions between inter-firm location portfolio from the same home country and natural disaster severity (β=0.0011; $p< p=n.s.$) and between inter-firm location portfolio from different home countries and natural disaster severity (β=-0.0215; $p=n.s.$) are insignificant. Thus the results support Hypothesis 2, but not Hypotheses 3 and 4.

Regarding the magnitude of the interaction effects, when we increase the level of natural disaster severity by one SD from its mean, the net difference in the increase of the likelihood of entry between a firm with an average intra-firm location portfolio (i.e., the mean value) and a firm with a strong intra-firm location portfolio (i.e., the mean plus one SD) is 6% for Beijing. The resulting net difference is equivalent to 23% of the dependent variable's SD. We draw a graph for the marginal effect of natural disaster severity for intra-firm location portfolio in Figure 4. As the graph shows, the marginal effect is getting less negative when intra-firm location portfolio increases and is statistically different from most of the range of intra-firm location portfolio.

[Insert Figure 4 around here]

Likewise, the difference is 3.1% (equivalent to 11.8% of SD) for the case of the inter-firm location portfolio from the same home country and 0.9% (equivalent to -3.4% of SD) for the case of the inter-firm location portfolio from different home countries. Thus the effect (magnitude) of intra-firm location portfolio on MNC entry into a new province experiencing a natural disaster is statistically greater than the effects of the two types of inter-firm location portfolio on subsidiary entry in the same situation. However, the effect (magnitude) of establishing an inter-firm location portfolio with subsidiaries from the same home country is not statistically greater than that of establishing an inter-firm location portfolio with subsidiaries from different home countries (for MNC subsidiary entry into a new province experiencing a natural disaster). Thus the results support Hypothesis 5 but do not support Hypothesis 6.

Finally, it is known that when the number of observations in a sample is very large, which is the case with our study, the rare event problem is not a serious concern because the sample does not suffer from small sample bias (Allison, 2012). However, to make sure that our treatment of rare events is appropriate, we conducted a robustness check using a complementary log-log model (Buckley & Westerland, 2004). The results from the complementary log-log model are very consistent with our results in Table 3. We do not report the results here, but available upon request for readers.

POST-HOC ANALYSIS

First, scholars have been interested in the differences between intra-location (e.g., intra-province, intra-state, or intra-region) and inter-location in trade and investment patterns and knowledge spillovers (Audretsch & Feldman, 1996; Boschma, 2005; Fratianni & Oh, 2009; Nachum, 2000; Sun, Lee, & Hong, 2016) because of borders and other location-bound characteristics (Beugelsdijk & Mudambi, 2013). Therefore, we divided inter-firm location portfolios into inter-firm intra-province portfolios and inter-firm inter-province portfolios. We note that an intra-firm portfolio is always an inter-province portfolio since by our definition of subsequent investment, a firm has not entered the focal province before. The results show that the moderating effects of all inter-firm portfolios are not strongly significant while intra-firm portfolio remains statistically significant, supporting our findings. The moderating effect of inter-firm

intra-province location portfolio with other MNCs from different home countries is marginally significant, which may imply, yet weakly, that there is something a MNC can learn from very different others (e.g., learning from diversity), but the learning is confined to a limited geographic context. Thus the results support the findings that for tacit knowledge, spatial proximity is still required (Audretsch & Feldman, 1996; Howells, 2002). We do not report the results for all the post-hoc tests here due to the length of the paper, but they appear in the Supplementary Appendix for the reviewers.

Second, one may argue that the response to natural disasters can be industry-specific rather than firm-specific. To test whether the response to natural disasters is industry-specific and whether industry-specific characteristics affect our findings about the moderating effect of firm location portfolio, we added interactions between the severity of natural disaster and industry dummies. To define industries, we used the broadly defined classifications from the Fortune Global, because our sample firms operate in many different sub-industries (see Table A-2 in the Supplementary Appendix). The results show that most of the interactions are statistically insignificant, and our key findings remain the same. The effect of natural disasters might be industry-specific phenomena, but the response to such natural disasters would be firm-specific phenomena because preparedness and recovery capabilities are specific to a firm.

Third, the role of a location portfolio in mitigating natural disasters may vary by type of natural disasters. Therefore, we divided natural disasters into eight types (earthquake, drought, epidemic, extreme weather, flood, slide, storm, and wildfire) defined by EM-DAT and tested our model. The results show that intra-firm location portfolio positively mitigates the negative effect of natural disasters on entry into provinces for earthquakes, floods, and storms, but actually exascerbates the negative effect of droughts, extreme temperatures, and wildfires. The moderating effect is insignificant for epidemics and slides. Overall, earthquakes, floods, and storms are more frequent and more severe than other types of natural disasters in China. Therefore, the results imply that firms can obtain benefits from a location portfolio in the face of natural disasters only when the disasters are frequent and severe. We assume then that firms in a location portfolio have better knowledge and information for frequent and severe disasters. If they are rare or trivial disasters, managers may not consider them important managerial concerns.

DISCUSSION

The objective of this study was to examine how foreign firms consider major discontinuous risk in subsequent investment decisions in a host country and whether different location portfolios - defined as the set of available organizations with whom the focal firm might transact and coordinate – can serve to mitigate this risk. The main contribution of our study is to show that while severe natural disasters deter new investment into a disaster affected province, MNC subsidiary location portfolios can, in some cases, mitigate these risks and enable firms to take advantage of new investment opportunities. Specifically, geographic proximity to a same MNC subsidiary serves to facilitate subsidiary entry into a disaster affected province (Almeida, Dokko, & Rosenkopf, 2003; Almeida & Kogut, 1999). For all other types of location portfolios, however, we found no advantages of geographic proximity for mitigating natural disaster risk.

The results of our study contribute to the literatures on FDI and post-disaster risk management in several respects. First, locating near a same MNC subsidiary can mitigate the deterrent effects of a disaster, even when a firm does not have first-hand experience operating in a province. In at least some cases then, discontinuous risks do not have to prevent firms from taking advantage of new investment opportunities. Furthermore, knowledge about post-disaster response does not have to be based on a MNC subsidiary's direct experience. This finding is important because while one can gain explicit knowledge of a host country's government prior to investment, knowledge about the capacity of local and regional governments to respond to a disaster, damage to infrastructure and potential disruptions to business, appears to be tacit in nature, especially when it comes to knowledge about the availability of resources needed to respond to discontinuous risk. Thus in the absence of direct subsidiary experience in a given location, geographic proximity to another subsidiary from the same MNC that has experience can help mitigate risk.

Another important finding is that the other location portfolios we examined do not mitigate risk for subsidiaries entering a new province that has been affected by a natural disaster. For instance, other subsidiaries in the same industry do not facilitate new subsidiary entry into a disaster-affected location.

The localized information that is so valuable for risk management may also provide competitive benefits for other aspects of a firm's business. Thus, firms from the same industry may be reluctant to share information if that knowledge can also be valuable competitive intelligence (Cantwell & Santangelo, 2002; Narula & Santangelo, 2009). This finding is consistent with the literature suggesting that same industry firms may only share knowledge through formal alliances or other legally structured relationships (Narula & Santangelo, 2009). In addition, firms from unrelated industries may share information, but the information is not readily useful or applicable due to the lack of commonality.

While research has shown that greater commonalities between firms can lead to lower information asymmetries and increased knowledge exchange (Malhotra & Gaur, 2014; Williams & Grégoire, 2015), our research suggests that for MNC subsidiaries facing discontinuous risk, the level of trust and similarity must be particularly high. One reason may be the country context. Due to media censorship, the underdevelopment of civil society, and the lack of trust and coordination between organizations from different sectors, first time entrants into a province are unlikely to obtain critical, detailed information about the local, regional, and central governments before they enter the country. Another reason concerns the type of risk involved. In a study of firm agglomeration and Vietnam, Tan and Meyer (2011) found that MNCs will locate or "agglomerate" around firms with the same country of origin in the face of institutional voids (e.g., weak property rights protection), defined here as continuous risks. Thus, the minimum necessary level of commonality between a subsidiary and a potential location portfolio increases as the risk moves from continuous to discontinuous. As the threat to the firm and its survival becomes more immediate, the resource must be highly trusted.

Our study also contributes to the growing body of research suggesting that sub-national (or regional) and community dynamics in a country are distinct from national level effects and can have a significant impact on a firm's vulnerability to risk and overall foreign subsidiary performance (Dai et al., 2013; Ma, Tong, & Fitza, 2013; Monaghan, Gunnigle, & Lavelle, 2014; Tilcsik & Marquis, 2013). Although natural disasters are often reported as national news, the impact of these events is often highly localized. In fact, organizational and community level factors are considered particularly important for

responding to natural disasters (Tilcsik & Marquis, 2013). Provinces in China vary substantially in their level of income, institutional development, and overall government capacity. In addition, studies have shown that geographic proximity to risk has a strong bearing on a firm's vulnerability to the disaster and to its strategic response (Dai et al, 2013). Thus for managers, building a location portfolio with firms that have context-specific knowledge about the disaster-affected province is highly desirable.

While the focus of our study was not on the relative roles of the private and public sectors in the response to natural disasters, our research has important implications for the literature on this topic and for practice more generally. Due to public sector resource constraints in most parts of the world and the increase in natural disasters, the private sector must take on an increasingly greater role in disaster planning and response. While the example of Japanese firms post-earthquake and tsunami in 2011 may be an exemplary case of post-disaster response (particularly since competitors in Japan shared resources with one another including employees and firm facilities), private sector firms around the world are by nature highly incentivized to anticipate disasters and respond immediately when they occur (Olcott & Oliver, 2014; Sobel & Leeson, 2007: 524). Not doing so threatens firm profitability and even survival.

Building on those arguments, the skills needed to effectively respond to disaster fit well within the existing repertoire of successful companies. Researchers have argued that the necessary coordination for post-disaster response requires, "information about a new constellation of market conditions to be acted upon, information that directs activities so that certain needs are economically satisfied, and finally information about whether the activities undertaken toward this end are succeeding. Without this information, coordination is impossible" (Sobel & Leeson, 2007: 529). Firms that leverage opportunities to collaborate with other firms, in this case same MNC subsidiaries, can develop risk management capabilities in-house that result in a new source of competitive advantage (Rugman & Verbeke, 1992).

Limitations and Future Directions

As with all empirical studies, our paper has several limitations that suggest opportunities for future research. One issue that we did not explore was the role of MNC's location portfolio with local Chinese firms, business associations, or government contacts. We did, however, discuss why it might be

more difficult for foreign firms in China to develop such contacts. Although, a lack of trust can deter foreign firms from developing knowledge linkages with local firms and other host country entities (Tan & Meyer, 2011; Tsui-Auch & Möllering, 2010), future research should look closely at MNCs' relationships with a variety of local stakeholders and potential partners.

Another limitation is that our econometric study could not tease out the mechanisms that generate benefits through building location portfolios. We theoretically argue that MNCs can gain knowledge and learning advantages through establishing a location portfolio with certain types of firms. However, it is possible that MNCs follow or imitate their own and other firms in order to gain other benefits. Thus some firms invest in risky locations with weak location specific knowledge and firm level resources and capabilities to avoid latecomer disadvantages (Chang & Rhee, 2011), while latecomers need to utilize the benefits of a location portfolio in order to avoid such disadvantages. Thus it is important to conduct follow-up studies through micro-level analysis such as qualitative interviews.

We also recognize another limitation: we are studying subsidiaries of large MNCs that stayed in China over the years and developed valuable local resources. Thus it is possible that there is some degree of survivor bias or advantage of size. Although we lower these concerns by only looking at the first entry into each province from the beginning, future studies may look at smaller and medium sized enterprises to examine the effect of size. Nevertheless, our sample firms of 437 Fortune Global 500 firms make up approximately 80% of FDI in the world so at least for large MNCs, our findings should be generalizable. Finally, building a location portfolio with same MNC subsidiaries and the subsidiaries from other firms is not the only source of knowledge and learning. Future research needs to look at other firm-level or subsidiary-level sources of knowledge and learning than location portfolios in determining sub-national-level entry and expansion in a country.

In addition, our data do not provide information about the size and performance of subsidiaries. Some firms will make smaller size investments in a natural disaster prone province or divest their investments in the case of disaster. Likewise, the size (and relative size) of a firm in a location portfolio is also important in measuring the strength of that location portfolio. Due to data limitations, we cannot

measure size or relative size. Also, in this paper we analyzed location choice under natural disaster risks rather than entry mode choice. Thus, it may be beneficial for future studies to analyze entry mode choice under discontinuous risks since foreign firms can at least partially lower their investment concerns through the information provided by their partners in joint ventures or alliances. Nevertheless, we do not think that this data limitation will change the results or implications of our study but future research using information on entry mode may provide more nuanced results regarding our findings.

Our research also has important implications for practice. First, firms need not be deterred by seemingly "unmanageable" discontinuities like natural disasters. Even one other subsidiary from the same MNC may be sufficient to mitigate risk and enable a firm to take advantage of a new investment opportunity. Second, preparing for and responding to discontinuities may be a source of competitive advantage. To the extent that some firms are better able to access information on risk response and effectively utilize that information, they can outperform the competition.

CONCLUSIONS

Our objective in this study was to examine how foreign firms consider major discontinuous risk in subsequent investment decisions in a host country and whether different location portfolios can mitigate this risk. Findings suggest that geographic proximity to same MNC subsidiaries mitigates the negative effect of natural disasters on MNC entry into an affected province, while geographic proximity to other MNC subsidiaries does not. Thus the knowledge needed to respond to severe disasters appears to be highly context-specific and shared only between firms with a high degree of commonality and trust. Given the projected increase in natural disasters over the coming decades and the subsequent need to develop subsidiary-level capabilities around responding to natural disasters, our findings will hopefully encourage more research on this topic.

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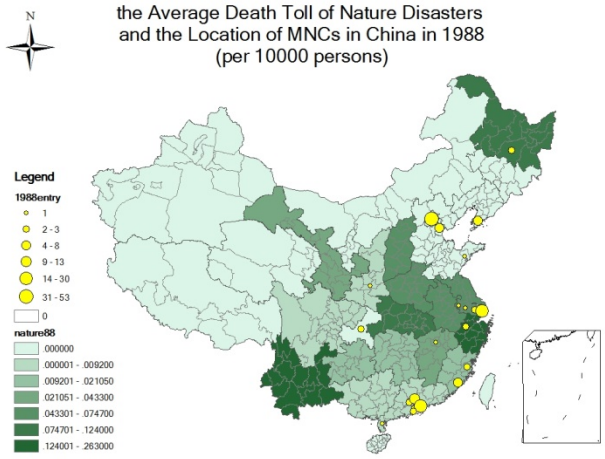
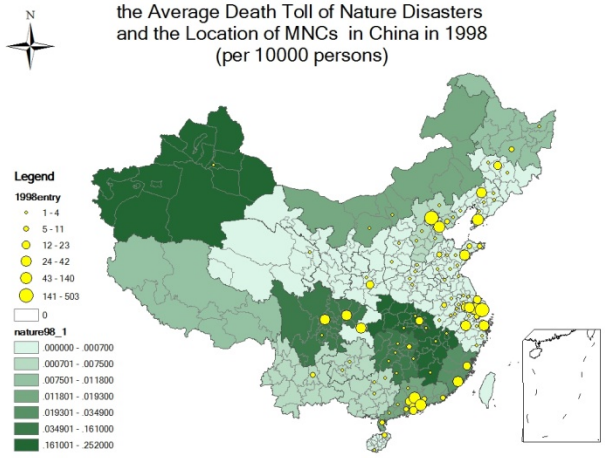
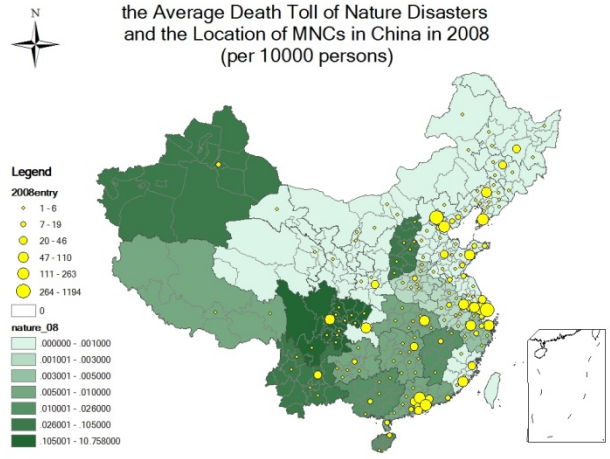
Figure 1. Natural disasters and MNC location in China



(a) Year 1988



(b) Year 1998



(c) Year 2008

Figure 2. Graphical illustration of sample composition and dependent variable

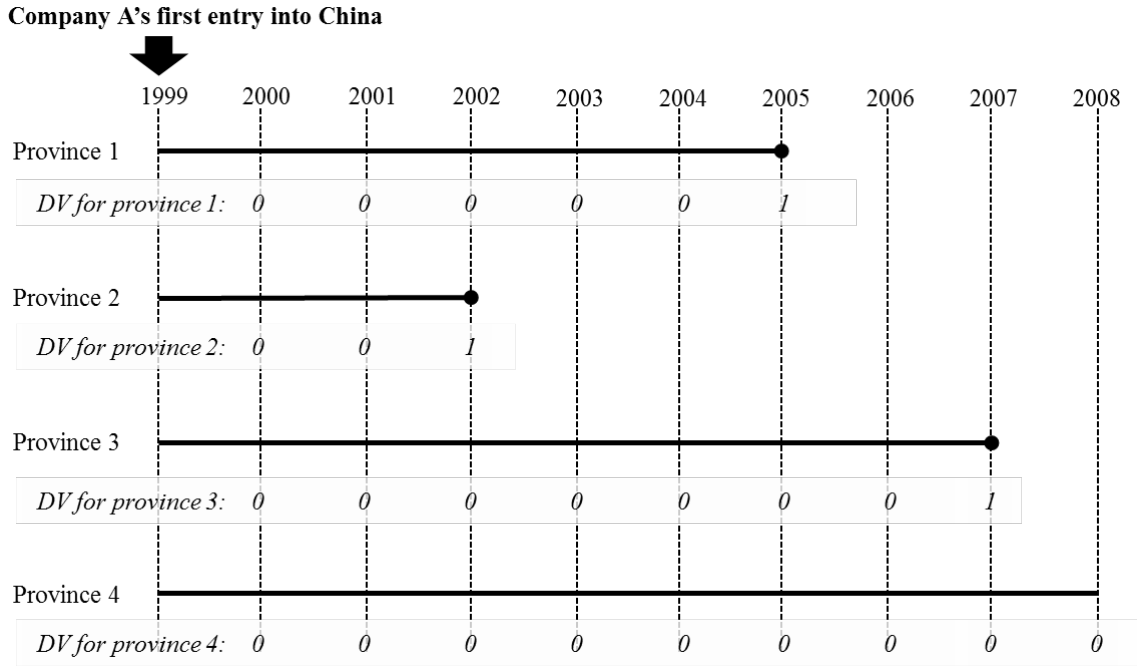


Figure 3. Graphical Illustration of three types of location portfolio

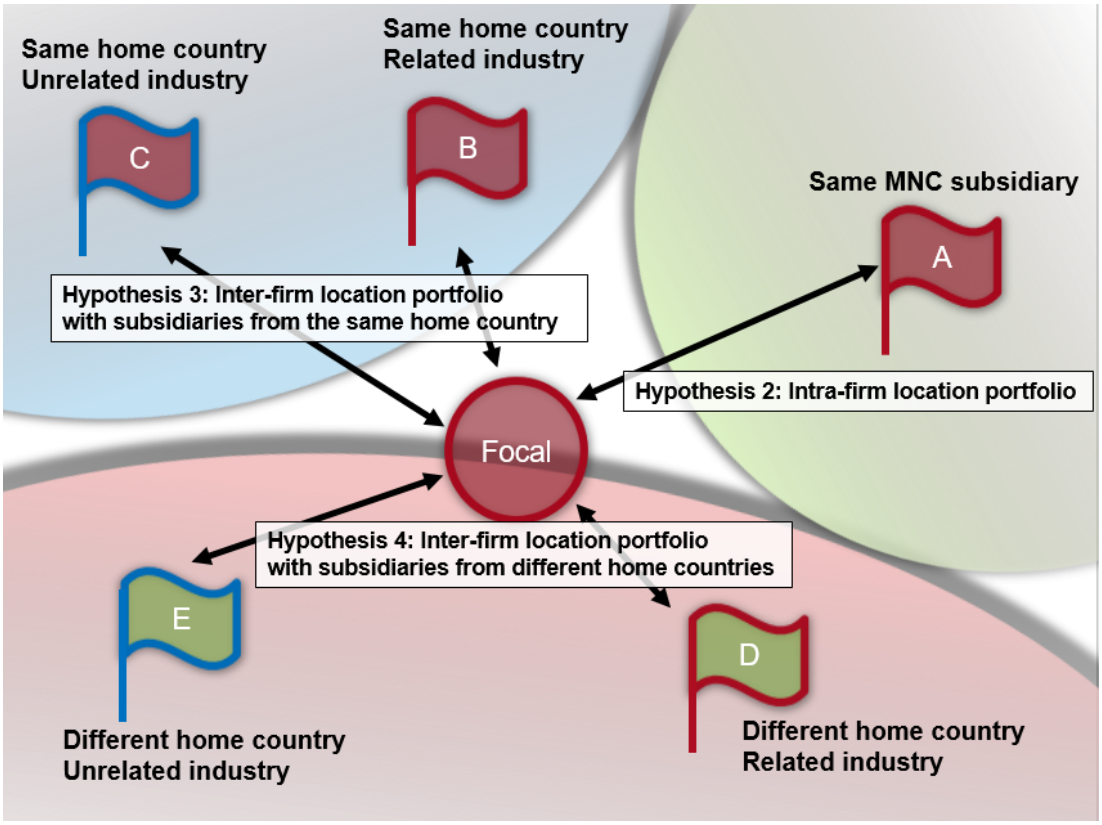


Figure 4. Marginal effect of natural disaster severity based on intra-firm location portfolio

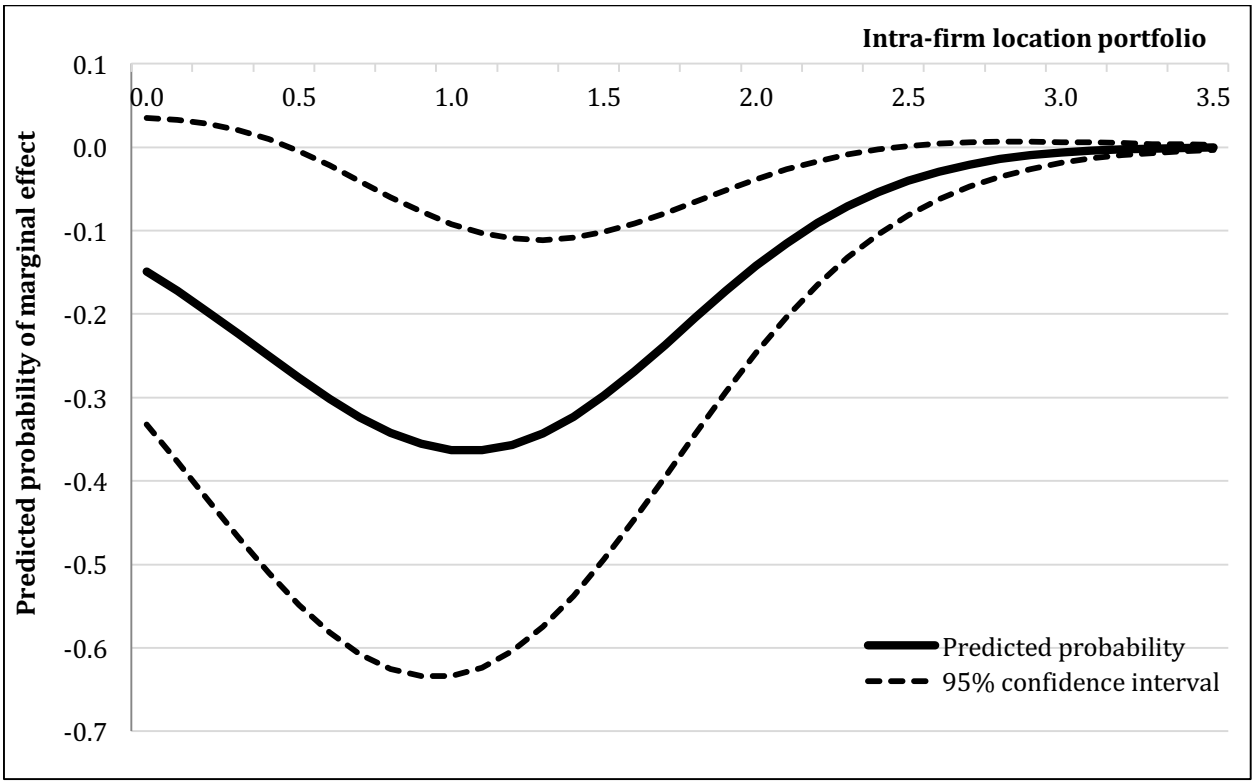


Table 1. Variable description and summary statistics

Variable name	Description	Mean	S.D.
Entry	Entry into a target province after initial entry into China (dependent variable)	0.011	0.107
Natural disaster severity score	The sum of number of killed per 10,000 capita in each province adjusted by geographic distance from the target province (3-year weighted moving average)	0.101	0.119
Intra_LP	Intra-firm location portfolio score for own MNC subsidiaries adjusted by geographic distance between the focal subsidiary and other subsidiaries (3-year weighted moving average)	0.568	0.507
Inter_SH_LP	Inter-firm location portfolio score for subsidiaries with other MNCs from the same home countries adjusted by industry closeness and geographic distance between the focal subsidiary and other subsidiaries (3-year weighted moving average)	2.715	1.704
Inter_DH_LP	Inter-firm location portfolio for subsidiaries with other MNCs from different home countries adjusted by home country closeness, industry closeness, and geographic distance between the focal subsidiary and other subsidiaries (3-year weighted moving average)	5.080	1.690
Distance from initial entry province	Distance between initial entry and the target provinces	6.988	0.657
Population	Population of the target province (logged; 10,000)	8.089	0.817
Education level	Post-secondary enrollment per capita of the target province	0.612	0.614
Export intensity	Total export per GDP of the target province (%)	12.623	15.166
Industrialization	Number of industrial companies in the target province	8.699	1.178
Wage level	Average wage of staff and workers in the target province (logged; Yuan)	8.827	0.890
Business openness	Portion of gross output of non-state owned enterprises	0.191	0.197
Infrastructure quality	Number of health institutions per 10,000 capita	2.637	1.780
Government quality	Local government expenditure in innovation, culture, education, and science per total revenue	0.411	4.259
Political distance	Political distance between China and MNC home country	9.057	4.037
Economic distance	Economic distance between China and MNC home country	12.890	6.334
Cultural distance	Cultural distance between China and MNC home country	2.995	0.531
Geographic distance	Geographic distance between China and MNC home country	8.280	0.693
Experience in China	Number of provinces in which a MNC has subsidiaries	3.689	2.816

Table 2. Correlation matrix

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1.Entry																		
2. Natural disaster severity score	-0.005																	
3. Intra_LP	0.089	0.047																
4. Inter_SH_LP	0.026	0.045	0.397															
5. Inter_DH_LP	0.014	0.068	0.244	0.446														
6.Distance from initial entry province	-0.017	0.005	0.030	0.018	-0.010													
7. Population	0.008	0.033	0.014	0.022	0.042	-0.270												
8. Education level	0.054	0.183	0.169	0.211	0.366	-0.134	-0.105											
9. Export intensity	0.095	0.051	-0.065	0.034	0.098	-0.151	-0.018	0.389										
10. Industrialization	0.056	0.074	-0.167	-0.113	-0.166	-0.368	0.705	-0.041	0.336									
11. Wage level	0.022	0.171	0.342	0.387	0.638	0.025	-0.075	0.644	0.233	-0.328								
12. Business openness	0.017	-0.007	-0.212	-0.189	-0.314	-0.175	0.169	-0.462	-0.010	0.531	-0.556							
13. Infrastructure quality	0.007	-0.053	0.060	0.060	0.097	0.177	-0.543	0.140	-0.001	-0.480	0.229	-0.236						
14. Government quality	0.001	-0.010	0.028	0.032	0.046	-0.011	0.046	0.009	0.003	0.044	0.050	-0.017	0.017					
15. Political distance	-0.004	0.008	0.097	-0.019	0.030	0.006	-0.007	0.001	-0.015	-0.013	-0.026	-0.018	0.004	0.005				
16. Economic distance	0.007	-0.012	0.149	0.490	-0.065	0.018	-0.001	-0.007	-0.009	-0.002	0.022	0.017	-0.002	0.011	-0.156			
17. Cultural distance	-0.002	-0.007	-0.015	0.056	0.051	-0.003	0.001	-0.033	-0.005	0.022	-0.043	0.037	-0.013	-0.002	0.118	0.137		
18. Geographic distance	-0.019	0.001	-0.183	-0.102	0.042	-0.019	0.013	0.039	0.031	0.005	0.050	-0.025	0.000	0.000	-0.111	-0.185	0.361	
19. Experience in China	0.046	0.060	0.890	0.392	0.282	0.073	-0.008	0.190	-0.075	-0.222	0.391	-0.266	0.089	0.030	0.090	0.105	0.003	-0.131

Note: N=103,587. Correlations above |0.005| are significant at $p<0.1$; Correlations above |0.006| are significant at $p<0.05$.

Table 3. Natural disasters, subsidiary network, MNC expansion into Chinese provinces

	Control only	Natural disaster	Subsidiary network	Interactions	Interactions	Interactions	Average elasticity
	(1)	(2)	(3)	(4)	(5)	(6)	of (6)
Independent variables							
Natural disaster severity of location		-0.7876*	-0.6215†	-0.7385*	-0.6905	-0.6282	-0.063
		(0.3657)	(0.3435)	(0.3750)	(0.6071)	(0.6335)	(0.063)
Intra-firm location portfolio (INTRA_LP)			3.3830***	3.4692***	3.3885***	3.4790***	1.939***
			(0.2358)	(0.2280)	(0.2331)	(0.2236)	(0.124)
Inter-firm location portfolio with other MNCs			0.0092	0.1649***	0.0087	0.1656***	0.444***
from the same home country (INTER_SH_LP)			(0.0387)	(0.0497)	(0.0386)	(0.0502)	(0.135)
Inter-firm location portfolio with other MNCs			0.0328	-0.1380*	0.0313	-0.1415*	-0.712*
from different home countries (INTER_DH_LP)			(0.0362)	(0.0635)	(0.0362)	(0.0637)	(0.320)
Interaction variables							
INTRA_LP × INTER_SH_LP				0.2580***		0.2599***	0.088***
				(0.0297)		(0.0302)	(0.010)
INTRA_LP × INTER_DH_LP				-0.1402***		-0.1428***	-0.030***
				(0.0409)		(0.0412)	(0.009)
INTER_SH_LP × INTER_DH_LP				-0.0729***		-0.0731***	-0.094***
				(0.0197)		(0.0199)	(0.025)
Natural disaster severity × INTRA_LP					0.5880†	0.8169*	0.002*
					(0.3300)	(0.3428)	(0.001)
Natural disaster severity × INTER_SH_LP					-0.0313	0.0011	0.000
					(0.1806)	(0.1827)	(0.002)
Natural disaster severity × INTER_DH_LP					-0.0400	-0.0215	-0.000
					(0.1137)	(0.1341)	(0.002)
Natural disaster severity × Government quality					-1.9294	-1.8526	0.010
					(1.7932)	(1.8836)	(0.010)
Target province characteristics							
Distance from initial entry province	0.0221	0.0219	0.0587	0.0638	0.0584	0.0639	0.442
	(0.0665)	(0.0665)	(0.0683)	(0.0697)	(0.0681)	(0.0696)	(0.482)
Population (log)	0.1573	0.2897	0.3708	0.2816	0.3460	0.2653	2.120
	(0.7052)	(0.7275)	(0.6403)	(0.6493)	(0.6132)	(0.6174)	(4.945)

Education level	-0.5145***	-0.4926***	-0.4303***	-0.4065**	-0.4285***	-0.4111**	-0.247**
	(0.1044)	(0.0964)	(0.1041)	(0.1311)	(0.1112)	(0.1389)	(0.084)
Export intensity	0.0082*	0.0074†	0.0108**	0.0107**	0.0106**	0.0106**	0.131**
	(0.0039)	(0.0038)	(0.0040)	(0.0039)	(0.0040)	(0.0038)	(0.047)
Industrialization	0.1901*	0.2380**	0.1127	0.1162	0.1308	0.1297	1.117
	(0.0829)	(0.0904)	(0.0934)	(0.0941)	(0.0948)	(0.0942)	(0.811)
Wage level	0.1887**	0.2154**	0.0149	0.0918	0.0080	0.0882	0.771
	(0.0723)	(0.0783)	(0.0727)	(0.1081)	(0.0748)	(0.1100)	(0.961)
Business openness	0.9734***	1.0083***	0.9789***	0.8992***	0.9961***	0.9121***	0.172***
	(0.2606)	(0.2581)	(0.2596)	(0.2680)	(0.2668)	(0.2735)	(0.052)
Infrastructure quality	0.0201	0.0193	0.0060	0.0097	0.0054	0.0079	0.021
	(0.0332)	(0.0341)	(0.0237)	(0.0230)	(0.0237)	(0.0232)	(0.060)
Government quality	0.3021*	0.2359*	0.1408	0.1139	0.1978	0.1560	0.063
	(0.1455)	(0.1052)	(0.1174)	(0.1365)	(0.1746)	(0.2066)	(0.084)
Experience in China	0.2066***	0.2076***	0.2799***	0.2614***	0.2807***	0.2627***	0.956***
	(0.0107)	(0.0109)	(0.0469)	(0.0423)	(0.0466)	(0.0419)	(0.153)
Dyadic (China-MNC home) characteristics							
Political distance from MNC home country	-0.0295***	-0.0293***	-0.0437***	-0.0219*	-0.0439***	-0.0218*	-0.195*
	(0.0077)	(0.0078)	(0.0107)	(0.0104)	(0.0107)	(0.0102)	(0.092)
Economic distance from MNC home country	-0.0175***	-0.0179***	-0.0193**	-0.0245**	-0.0193**	-0.0246**	-0.314**
	(0.0049)	(0.0050)	(0.0073)	(0.0079)	(0.0073)	(0.0079)	(0.101)
Cultural distance from MNC home country	0.1094*	0.1101*	0.0650	0.0153	0.0651	0.0147	0.044
	(0.0488)	(0.0490)	(0.0571)	(0.0674)	(0.0570)	(0.0678)	(0.201)
Geographic distance from MNC home country	-0.1273*	-0.1276*	0.0295	0.0078	0.0297	0.0075	0.061
	(0.0624)	(0.0625)	(0.0696)	(0.0703)	(0.0692)	(0.0697)	(0.572)
Log-likelihood	-4,978.1	-4,975.0	-4,592.4	-4,547.9	-4,590.7	-4,545.6	
Akaike Information Criteria	10,012.1	10,006.1	9,242.8	9,151.7	9,237.4	9,147.1	

Note: N=103,587. †$p < 0.10$; *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$. Two-tailed test. A conditional logit regression model (alternative is province) is used. Heteroskedasticity robust standard errors clustered by province are in parentheses. Constant and industry dummy variables are estimated but not reported here. The time dependence of the hazard is introduced as log of duration in all models.