Agglomeration, catch-up and the liability of foreignness in emerging economies

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Abstract
Given the importance of location choice for accessing knowledge, we examine the location choices of domestic and foreign firms in an emerging economy after market liberalization. In the literature, co-locating with other firms has been associated with agglomerative economies and knowledge spillovers that lower the liability of foreignness for foreign firms. However, as domestic firms are trying to upgrade their capabilities, or "catch up," they may also prefer locations with other firms, as these locations have knowledge spillover potential. We develop competing hypotheses to test the extent to which catch-up motivations affect location decisions. Examining the location choices of 501 domestic and 68 foreign firms for their R&D laboratories in India during 2005–2010, we find that domestic firms exhibit a stronger preference for cities with high agglomeration than foreign firms do. This shows that upgrading motivations dominate location choice during periods of accelerated catch-up in emerging economies.
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INTRODUCTION

Market liberalization in many developing and emerging economies has led to deregulation, increased competition and greater foreign investment in these economies. Foreign entry and participation have grown tremendously in the last decade, even though many market reforms occurred in the 1990s. For instance in India, foreign direct investment (FDI) inflows went from $2.6 billion in 1998 to $4.5 billion in 2003, and then jumped to $43.4 billion in 2008 (UNCTAD, 2000, 2006, 2012). The stock of FDI in India rose from $1.6 billion in 1990 to $16.3 billion in 2000, and then skyrocketed to $202 billion in 2011. These figures aptly illustrate how the pace of foreign entry in developing and emerging economies has dramatically accelerated in recent years, with these countries now accounting for nearly half of global FDI inflows (UNCTAD, 2012). As a result, local firms in these environments have begun to "re-orient themselves by making changes to their strategies, structures, technologies, systems and organizational practices/routines" (Kumaraswamy, Mudambi, Saranga, & Tripathy: 2012: 369). Facing formidable foreign rivals, and lacking traditional institutional protection, local firms have strong motivations to react (Meyer & Sinani, 2009). In particular, local firms try

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to upgrade their capabilities and potentially "catch up" to the technological and productivity frontier (Abramovitz, 1986). Catch-up refers to the processes by which emerging-market firms improve their technological know-how and develop competencies in high value-added activities (Kumaraswamy et al., 2012; Mudambi, 2008).

Critical to the catch-up process is to identify, acquire and use externally generated knowledge. Economic geography stresses that, in addition to formal arrangements, "firms might also seek external knowledge through indirect means of knowledge spillovers" (Alcácer & Chung, 2007: 760). Locating near others is an important way for firms to increase their exposure to potential spillovers (Feldman & Audretsch, 1999; Glaeser, Kallal, Scheinkman, & Shleifer, 1992). However, agglomeration economies attract firms even in the absence of catch-up motivations. To investigate whether catch-up processes influence location choice, we compare the location decisions of domestic firms with those of foreign firms. The international business literature has shown that foreign entrants prefer locations with similar firms, particularly other foreign firms, domestic firms from the same industry, or firms from different industries (Cantwell & Piscitello, 2005; Head, Ries, & Swenson, 1995; Lee, Hwang, & Lee, 2012; Smith & Florida, 1994; Tan & Meyer, 2011), with the motivation for this behavior being a liability of foreignness (Zaheer, 1995). In other words, in the absence of catch-up, we would expect to find that foreign firms, not domestic ones, are more likely to co-locate with other firms. However, if catch-up aspirations are indeed present, then we expect this dynamic to be reversed.

Given this, we take the liability of foreignness literature as a starting point, and propose that another compelling dynamic may influence location choice in emerging markets – catch-up. While the liability of foreignness research considers foreign entrants as being local-knowledge-seeking, meaning they locate near other firms to access local knowledge, we suggest that domestic firms are "competence driven"[1] while in catch-up mode. In such a mode, co-location may be particularly attractive for emerging-market firms, as they are often "superior in combining and integrating outside technologies with their own resource base" (Luo, Sun, & Wang, 2011: 41). Through co-location, domestic firms hope to gain detailed information about each other. In addition, co-location enables better environmental scanning, which in turn leads to observational learning, which "is often more efficient than experimental learning because it reduces errors typical in experimentation" (Uhlenbruck, Meyer, & Hitt, 2003: 271). Thus, in the context of catch-up, co-location offers an efficient way of investing in absorptive capacity to facilitate learning from others and accelerate capability building.

We contribute to the literature on location strategies of firms in emerging markets by simultaneously examining domestic and foreign entrants. In this manner, we account for the attraction of agglomeration economies, and establish a benchmark against which to compare the effect of catch-up. Both the liability of foreignness and catch-up concepts imply that location choices of foreign firms should be explicitly compared with those of domestic firms, and vice versa (Zaheer & Mosakowski, 1997). Our research question is thus: Does the liability of foreignness or catch-up dominate location decisions in emerging markets? We present competing hypotheses to illustrate the compelling arguments for both sides. In this manner, we acknowledge that although foreign firms' location choices may be influenced by a liability of foreignness, this effect may be masked in times when domestic firms are accelerating their catch-up attempts.

We select a context, India, where we expect to find both the liability of foreignness among foreign investors and catch-up processes among domestic firms. By situating our study in an emerging market, we choose an environment where foreign investors' need for local knowledge is particularly acute, as "institutions are often opaque and continuously changing" (Tan & Meyer, 2011: 505). Emerging markets also suffer from institutional voids, which "increase information asymmetries between insiders and foreign investors" (Santangelo & Meyer, 2011: 898), thereby increasing the likelihood that foreign investors will face a liability of foreignness. The Indian context is particularly appropriate for studying foreign entry, as multinational enterprises (MNEs) ranked it among the top three host countries for FDI, and in 2011 it was "the dominant FDI recipient in South Asia" (UNCTAD, 2012: 46). The increasing participation of foreign firms also makes India an appropriate context for examining catch-up. Researchers have documented various strategies that domestic firms employ to upgrade their capabilities (Awate, Larsen, & Mudambi, 2012; Kumaraswamy et al., 2012; McDermott & Corredoira, 2010). Recent work suggests that there has been an acceleration of the catch-up process in India, as witnessed by the

growing use of international acquisitions, starting in 2003 (Gubbi, Aulakh, Ray, Sarkar, & Chittoor, 2010). This acceleration also coincides with the transfer of increasingly high value-added activities to India (Lewin, Massini, & Peeters, 2009). As a result, in the past decade, domestic firms have begun to place new emphasis on knowledge-intensive activities in order to develop competencies in these crucial areas (Mudambi, 2008). Although location decisions are central to the literature on foreign entry and the liability of foreignness, the use of location choice as a strategy for catch-up has not been explored. Our research design enables us to demonstrate the extent to which catch-up may (or may not) influence location decisions of domestic firms, while explicitly accounting for the other important process at work – the liability of foreignness.

THEORY AND HYPOTHESES

Market liberalization in many emerging markets over the past two decades has led to lower entry barriers and easing of restrictions on foreign investors. As a result, "high-growth emerging markets have been attracting multinational enterprises (MNEs) in increasing numbers" (Gubbi et al., 2010: 399). The foreign entrants possess many advantages, including superior technology and know-how. However, they also are at a disadvantage, as they lack local knowledge *vis-à-vis* domestic competitors, and therefore face higher information and search costs. Nevertheless, the increasing entry of foreign firms – over the past decade in particular (Lewin et al., 2009; World Bank, 2007) – has put significant pressure on domestic firms in emerging economies to catch up, reconfigure their strategies, and upgrade their technological capabilities. Figure 1 illustrates the rapid rise of foreign participation in the Indian economy. "Catch-up" refers to the process by which

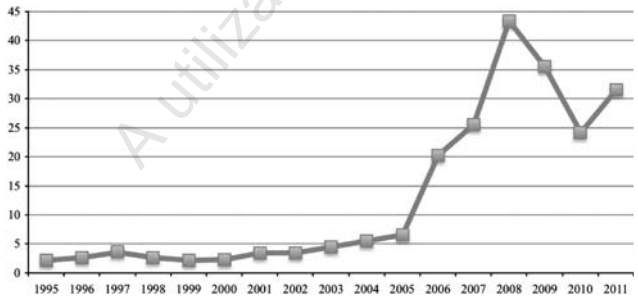

Figure 1 FDI inflows to India (in US$ billions).
Source: UNCTAD *World Investment Report*, various years.

emerging-market firms "are striving to develop competencies in high value-added activities" (Mudambi, 2008: 702) and to develop technological capabilities on a par with firms from developed economies (Awate et al., 2012). The emphasis on high-value-added activities is because "production and control of knowledge-based assets have crucial roles in value creation and appropriation" (Mudambi, 2008: 703). Furthermore, as MNEs are increasingly "offshore[ing] more complex and higher-value-adding activities" (Lewin et al., 2009: 902), this both provides the potential for domestic firms to benefit from spillovers (Meyer & Sinani, 2009) and confirms the location of key factor inputs. These dynamics have profound implications for the location choices of both foreign and domestic firms. Both sets of firms are drawn to certain locations, owing to agglomeration economies. By comparing foreign investors and domestic firms, we illustrate which process is dominant in emerging economies – either the liability of foreignness or catch-up – and to what extent that process dictates location choice. In other words, by accounting for both processes simultaneously we have the opportunity to identify the dominant process, and examine the strength it exerts in location decisions.

Research on multinational entry into foreign markets suggests that foreign firms suffer from a liability of foreignness due to a "foreign firm's unfamiliarity with the local culture and other aspects of the local market, a lack of information networks or political influence in the host country" (Zaheer & Mosakowski, 1997: 440). The liability of foreignness is defined as the competitive disadvantage that foreign firms face in a foreign market, arising from a lack of knowledge about the host environment, from a lack of embeddedness in the local environment, and from the possible exclusion of foreign firms from political processes (Eden & Miller, 2004; Zaheer, 1995). Accessing local knowledge is important in all countries, but may be particularly so in emerging markets, as laws and regulations can be subject to "interpretation" and haphazard application with limited recourse (Meyer, Wright, & Pruthi, 2009). Acquiring knowledge of a foreign market helps firms decrease uncertainties, misunderstandings and risks, allowing foreign firms to plan and achieve project expectations more accurately. As a result, when firms enter foreign markets, their location decisions are presumed to be partially driven by their need to access information that is locally relevant.

For foreign firms, one way to mitigate their higher information and search costs is to locate near other firms. As Figueiredo, Guimarães, and Woodward (2002: 344) argue, "high information costs of non-home investors lead to clustering." Higher information costs increase the attractiveness of agglomeration, as agglomeration alleviates some uncertainty. In addition, agglomeration or co-location creates opportunities for entrants to develop relationships with other firms "willing to share relevant local knowledge" (Tan & Meyer, 2011: 505). Thus foreign investors use the presence of other firms to guide their location decisions as a means of compensating for their unfamiliarity with the foreign market. In this sense, foreign investors' location decisions are significantly shaped by the liability of foreignness.

While the liability of foreignness affects the location decisions of foreign firms, a different dynamic influences the location choices of domestic firms. As many emerging markets have undergone a process of market liberalization, domestic firms face a home environment that is more competitive, and confront entry by foreign firms who "possess sophisticated technological and managerial capabilities that domestic incumbents lack" (Kumaraswamy et al., 2012: 369). As a result, domestic firms are undertaking efforts to catch up rapidly to technological leaders (Abramovitz, 1986). This requires them to develop and acquire new technological skills, often in a compressed time frame, owing to the vertiginous pace of change brought on by their country's rapid economic rise. However, these firms "face significant constraints on their development" (Awate et al., 2012: 207), as many factor markets in their home country are underdeveloped. Thus, as the need for technological improvement grows, ways to access complex knowledge become more critical. Within this context, location decisions of domestic firms can be seen as being "competence driven" or knowledge seeking, by their need to find and learn new technology and capabilities.

Although scholars have investigated the use of international acquisitions (Gubbi et al., 2010), joint ventures (Mahmood & Zheng, 2009) and buyer–supplier relationships (Kumaraswamy et al., 2012; McDermott & Corredoira, 2010) as a means for catch-up, location choice has not been investigated as a strategic tool that emerging-market firms can use to catch up. However, co-location is an important method for technological upgrading, not only because it provides a way of facilitating the sharing of complex tacit knowledge (McCann & Folta, 2008), but also because other methods of upgrading may hit a technological "glass ceiling" (McDermott & Corredoira, 2010: 311). For domestic firms, co-location within their home country can be particularly useful, as they can utilize their social capital to gain easier access to channels of information, knowledge and resources that they might not otherwise have. In addition, co-location offers an opportunity for *all firms* to access new information and complementary knowledge from many different sources, whereas joint ventures and international acquisitions may be available options for just a small subset of firms. Although some research suggests that only standardized knowledge flows freely in clusters (Mudambi & Swift, 2012), the literature on catch-up and spillovers points out that this is precisely the type of knowledge that can most benefit domestic firms in emerging markets (Meyer & Sinani, 2009). This technology may be more easily copied, but it can also provide the foundation for domestic firms to become more innovative imitators through "creative adaptation" (Luo et al., 2011: 38). What is certain is that co-location offers the *possibility* to domestic firms of accessing both standardized and complex knowledge.

Despite these arguments, we do not know to what extent firms in emerging markets rely on location choice as a means for catch-up. More importantly, we do not know how powerfully the desire to catch up influences location choice. In order to examine this, we compare the location choices of foreign investors and domestic firms. As foreign investors suffer from a liability of foreignness, they are attracted to locations with other firms (Tan & Meyer, 2011). Thus, in the absence of catch-up processes, foreign investors should value agglomeration economies more than domestic competitors do. However, if domestic firms are in a period of catch-up, then this may mask the liability of foreignness, such that domestic firms are drawn equally, if not more so, to agglomerations. We investigate these questions by developing competing hypotheses regarding the relative attractiveness of different types of agglomerations to foreign investors and domestic firms. The liability of foreignness argument necessitates examining domestic and foreign firms simultaneously, not independently (Zaheer & Mosakowski, 1997). Similarly, if the desire for technological upgrading strongly drives location choice among domestic firms, then a comparison with foreign entrants would convincingly illustrate this effect.

Agglomerations are typically divided into two broad categories – Marshallian and Jacobian. Similar or related-industry agglomerations give rise to what are often referred to as Marshall–Arrow–Romer externalities (Arrow, 1962; Marshall, 1898; Romer, 1986), while agglomerations of an array of diverse firms gives rise to Jacobian externalities (Jacobs, 1969). Both types of agglomerations can serve as sources of information to new entrants.

Same-Industry Externalities

Same-industry externalities are expected to originate from similar firms located in close proximity to each other. Marshall (1898) described four types of same-industry agglomeration externalities: access to specialized labor, access to specialized inputs, access to technology spillovers, and access to greater demand. The first three are considered supply-side externalities, as they provide unique or efficient access to a supply of necessary resources, while the last is a demand-side externality, as it increases demand for products or services (McCann & Folta, 2008). Because we are investigating research and development (R&D) laboratories, and not manufacturing or sales operations, we focus on supply-side externalities (Cantwell & Mudambi, 2005; Santangelo & Meyer, 2011). A critical input factor that R&D laboratories require is scientific and technical personnel. The agglomeration of same-industry firms indicates that an appropriate labor market exists. In addition, the quality of that labor market is higher with agglomeration (Black & Henderson, 1999; Hanson, 2000), as is the education level of the population (Qian, Acs, & Stough, 2013). In addition to labor, agglomeration also attracts specialized suppliers in large numbers, such as "specialized consulting, market research, [and] testing services" (McCann & Folta, 2008: 537). Firms wanting to tap into local innovation ecosystems must co-locate in order to develop the requisite local social capital (Mudambi & Swift, 2012; Stough & Nijkamp, 2009). Finally, agglomeration can lead to knowledge spillovers, where know-how from one organization leaks over to organizations located nearby, enabling the recipients to more readily generate new economic knowledge (Glaeser & Kerr, 2009). Thus agglomeration of same-industry firms leads to available pools of skilled labor, improved industry-specific infrastructure, higher presence of specialized suppliers and service providers, and potential knowledge spillovers.

Research on location choice suggests that an existing mass of relevant industry activity provides information to foreign entrants. Facing high search and information costs, foreign investors pay particular attention to examples that others set. Co-location with firms from the same industry can signal the presence of critical resources and knowledge, and thereby lower foreign firms' information and search costs, helping foreign entrants mitigate their liability of foreignness. Thus foreign entrants will make assessments about locating in a particular area based on existing same-industry activity. Moreover, this effect may be more pronounced in emerging markets, which are characterized by institutional voids, making critical information on specialized inputs more difficult to acquire and trust. Head et al. (1995) find that same-industry agglomeration plays an important role in directing Japanese investment in the US. Examining foreign investment in Portugal, Guimarães, Figueiredo, and Woodward (2000) find that the share of employment in the same industry attracts foreign investors to a region. Crozet, Mayer, and Mucchielli (2004) find that the presence of French firms from the same industry attracts foreign investment to French regions. Our first hypothesis tests for whether the liability of foreignness influences the location choices of foreign investors. To do so, we compare the location choices of foreign investors with those of domestic firms. More specifically, if foreign investors face higher information costs, then they will value agglomeration economies more than domestic competitors do. Put differently, as foreign investors suffer from a liability of foreignness, they will be more attracted to locations with Marshallian externalities than will their domestic counterparts.

> **Hypothesis 1a**: For foreign firms, the probability of locating in a city increases as the presence of same-industry firms increases, more so than for domestic firms.

While same-industry externalities exert an attraction for all firms, regardless of whether the firms are foreign or domestic, emerging economies are in the throws of trying to catch up, with domestic firms reconfiguring their resources dramatically, and expending significant effort to acquire and develop new resources (Uhlenbruck et al., 2003). Against this backdrop, domestic firms will be strongly attracted to areas with strong local innovation systems, as knowledge is widely distributed across various actors, and the "knowledge on which innovations depend is never entirely generated within the same firm, but draws upon a wider

structure of knowledge creation" (Cantwell & Mudambi, 2011: 209). These locations signal the possibility of learning through observation, through environmental scanning, or through establishing formal or informal relationships with industry peers (Uhlenbruck et al., 2003). Emerging-market firms have a "distinctive ability to obtain the necessary resources from outside institutions" (Luo et al., 2011: 43), including neighboring firms. The potential for process and product innovation is greatest for those firms that are behind the technological frontier (Kumaraswamy et al., 2012), as they can benefit from technology that is easily observable. And it is precisely these firms that "invest in absorptive capacity to facilitate learning from others and accelerate implementation" (Luo et al., 2011: 42). Thus, in the context of catch-up, a parallel process may be at work that draws domestic firms strongly to locations with same-industry firms. To observe the effect of catch-up on location choice, we compare domestic with foreign firms and thereby account for the attraction of Marshallian externalities on all firms. We propose a competing hypothesis, based on the idea that domestic firms are "competence driven" in the period of catch-up:

> **Hypothesis 1b**: For domestic firms, the probability of locating in a city increases as the presence of same-industry firms increases, more so than for foreign firms.

Cross-Industry Externalities

The benefits of agglomeration are not limited to occurring solely within the same industry. Externalities can also occur between industries. Inter-industry spillovers can, in fact, be important sources of information and knowledge (Jacobs, 1969). In addition, the presence of a diverse array of firms from different industries may also signal a business-friendly political and regulatory environment, and the presence of services critical for assuring efficient business operations. Business services and general political and bureaucratic friendliness towards businesses are important, as "a range of high-level services may help overcome the distance and other transaction barriers facing foreign firms" (Guimarães et al., 2000: 133). Thus foreign investors seek locations with more industry diversity, because such activity enables them to do business relatively easier than in other places.

This disadvantage is more pronounced in emerging markets, where institutional voids mean that many formal legal and regulatory frameworks that support business operations are opaque, and suffer from administrative inefficiency and corruption. In these contexts the information asymmetries between domestic and foreign firms are even greater (Santangelo & Meyer, 2011). This asymmetry, or liability of foreignness, implies that foreign investors will be drawn to industrially diverse locations more than domestic entrants are. Because the presence of industrial diversity suggests that a variety of predecessors, as opposed to a small clique of firms, were able to overcome information and negotiation costs, it thereby serves as an information signal to potential entrants. Empirical evidence generally supports the idea that foreign firms' location choices are influenced by the presence of cross-industry firms. Examining Korean firms' investment in China, Chang and Park (2005) find that provinces with a large number of local firms from different industries are more likely to attract new Korean entrants. More broadly, He (2002) finds that the overall number of industrial enterprises in a Chinese city positively influences the amount of FDI in that city. Similar results have been reported for Portugal (Guimarães et al., 2000) and the location of foreign R&D activities in Europe (Cantwell & Piscitello, 2005). Prior research examines only foreign entrants; however, the liability of foreignness suggests that, when comparing domestic firms with foreign entrants, the appeal of industrial diversity will be stronger for foreign entrants, who face greater information costs and uncertainty.

> **Hypothesis 2a**: For foreign firms, the probability of locating in a city increases as the presence of cross-industry firms increases, more so than for domestic firms.

Heterogeneous cities may also be uniquely attractive for domestic firms, as these city clusters can yield unique benefits in terms of knowledge. Widely diffused technologies in one industry can generate value when applied in different industries, either alone or when combined with other technologies (Rodan & Galunic, 2004). Emerging economies may in fact be prime grounds for these types of cross-industry – or Jacobian – externalities, as firms in these economies increasingly direct their innovation efforts towards redesigning products and processes to reach the billions of consumers who are just entering the marketplace (Luo et al., 2011), and as a result can benefit tremendously

from applying existing global knowledge in their R&D efforts. For instance, a 2006 World Bank Enterprise Survey found that applying existing technology in new settings is more likely to be associated with increases in productivity among Indian manufacturing firms than efforts to create new knowledge. As firms in emerging economies target the millions of consumers entering the middle class and those at the bottom of the pyramid, these firms stand to gain substantially by "using existing technology in imaginative new ways" (*The Economist*, 2010: 4). Cross-industry knowledge spillovers, then, can be seen as complementing or extending firms' existing knowledge stocks, providing technology that a firm would not necessarily develop on its own. This is particularly attractive for domestic firms eager both for modest product improvements and for serendipitous events that may produce innovative opportunities.

For firms eager to catch up and make technological improvements, knowledge from different industries can provide a cross-fertilization effect, as old problems can be addressed through new solutions, or by a combination of old and new approaches. Cross-fertilization of knowledge can also serve as the basis for absorbing additional stimuli, as cross-industry agglomeration can reduce search costs and increase the opportunity for unexpected events that may provide innovative opportunities (Feldman & Audretsch, 1999). Emerging-market firms have demonstrated a distinct type of "absorptive capability" – an ability to identify, assimilate and modify the knowledge imported to fit their market conditions (Luo et al., 2011). In addition, the increased "modularization for many products (e.g., household appliances and telecommunication products) has also simplified the process of imitation and utilizing combinative capability" (Luo et al., 2011: 42). In this manner, the presence of cross-industry firms can facilitate the combination of different ideas and their redeployment in new applications, enabling a swift path for emerging-market firms to upgrade their capabilities.

Hypothesis 2b: For domestic firms, the probability of locating in a city increases as the presence of cross-industry firms increases, more so than for foreign firms.

Co-location with Domestic Firms

The location choice literature stresses that new entrants, especially foreign investors, are eager to access local information and develop social capital in the local environment. Often, the best sources of local information are domestic firms, who are embedded in the host-country environment, and are adept at negotiating its rules, codes and norms. Tan and Meyer (2011) suggest that co-locating with firms is an alternative to forming joint venture partnerships, and may be an equally effective way of gaining market information: "foreign entrants can gain access to *local, industry-specific knowledge* such as industrial forecasts, and information on local customer and supplier behaviors" (2011: 506). As physical proximity enables firms to access localized knowledge, a co-location strategy can help firms gain the social and relational knowledge needed to overcome their liability of foreignness (Zaheer, 2002).

Gaining access to social institutions and relationships and becoming embedded in the local context are particularly important for foreign investors in emerging markets (Meyer, Mudambi, & Narula, 2011). Institutional voids in these markets mean that firms have "to rely to a larger extent on relational contracts rather than on formal (legal) contracts" (Santangelo & Meyer, 2011: 899), and it increases the difficulty of forecasting, inducing firms to rely on relational embeddedness to identify the trajectory of changes in the local environment. Thus in line with the concept of liability of foreignness, we predict that the pull of established domestic firms will be stronger for foreign entrants than for domestic ones.

Hypothesis 3a: For foreign firms, the probability of locating in a city increases as the presence of domestic firms increases, more so than for domestic firms.

Foreign firms may not be the only ones wanting to access localized knowledge. Domestic firms, eager to acquire new knowledge, also choose locations in search of new information. As established domestic firms possess localized knowledge and ties to local institutions, this is particularly relevant and more easily accessible to other domestic firms wanting to access duplicate information and resources. In addition, information about novel ideas flows more easily among similar agents located within the same area (Glaeser & Kerr, 2009). Therefore co-location with other domestic firms offers more innovation opportunities than scattered location. As a result, some scholars view ties and relationships to peers as being of equal if not

greater upgrading value, since these relations are imbued with greater levels of trust and collaboration (Giuliani, Pietrobelli, & Rabellotti, 2005). Glaeser and Kerr (2009) show that existing agglomerations of firms are a key determinant for locations of new manufacturing firms in the US, as these firms locate near others in hopes of gathering new information. And Rosenthal and Strange (2003) find a positive association between new-firm foundings and existing industry employment in five of the six industries they examine.

In attempting to upgrade their capabilities, domestic firms are more motivated to seek locations with greater amounts of knowledge-generating activity. "More activity means an increased likelihood that some of this activity spins off and sticks to proximate others" (Alcácer & Chung, 2007: 763). Domestic firms may be more drawn to domestic knowledge stocks, as this knowledge is more easily absorbed and integrated into their existing knowledge base. Although the knowledge-generating activity of domestic firms may not be enough to push firms to the technological frontier, it is more easily appropriated by other domestic firms, owing to its similarity (Chang & Xu, 2008). As domestic firms attempt to catch up, co-location with other domestic firms provides access to key strategic and knowledge resources that domestic firms can more easily appropriate and use, significantly enhancing the attractiveness of these locations. To examine whether a catch-up process is at play, we compare the location decisions of domestic firms with those of foreign firms, as domestic firms would be more attracted to locations with other domestic firms.

Hypothesis 3b: For domestic firms, the probability of locating in a city increases as the presence of other domestic firms increases, more so than for foreign firms.

Co-location with Foreign Firms

The liability of foreignness literature emphasizes that, although domestic firms may be the best sources of local knowledge, foreign entrants may find it more difficult to establish relationships with these firms than with other foreign firms. Managers of foreign firms are likely to be familiar with other foreign entrants, as these firms encounter each other in multiple markets, and therefore there is a history of social relations and established contacts across these companies (Cantwell & Mudambi, 2011). In addition, foreign entrants may look to other foreign firms to provide guidance on how to deal with simultaneous pressures from the parent firm as well as the host country (Kostova & Zaheer, 1999; Meyer et al., 2011). Forging connections to neighboring foreign firms may be more useful, because they "have different backgrounds and face different operational difficulties from domestic competitors" (Shaver, Mitchell, & Yeung, 1997: 813). Furthermore, similar firms are likely to be important referents for action. Managers of foreign firms may pay greater attention to peer firms and compare their actions with this limited group of actors (Belderbos, Olffen, & Zou, 2011). Foreign entrants may think that if other foreign firms can thrive in a location, then they can too, reducing their perceived risk of failure.

Empirical evidence strongly supports the idea that an existing foreign base in a location attracts additional foreign entry. Tan and Meyer (2011) find that foreign entrants into Vietnam are more likely to locate in provinces with higher levels of FDI from the same industry, or the same country, or a different industry, but that the presence of local firms does not exert a significant effect on location choice. He (2002) finds that the number of foreign enterprises in a Chinese province attracts more FDI to that location. Nunnenkamp and Mukim (2012) report similar results for India. Examining Korean firms' investment in China, Chang and Park (2005) find that provinces with a large number of existing Korean firms are more likely to attract new Korean entrants. Similarly, Belderbos et al. (2011) demonstrate that Japanese entrants into China strongly prefer locations with other foreign firms, particularly Japanese affiliates. And Cantwell and Piscitello (2005) show that MNEs locate their R&D activities in regions with more foreign-owned firms already located there. Other studies also show that foreign firms prefer locations with high levels of foreign agglomeration (Lee et al., 2012; Smith & Florida, 1994). A limitation of this work is that it examines only the location decisions of foreign firms. Nevertheless, this research suggests that locations with a larger presence of existing foreign firms will be more attractive to foreign entrants than to domestic ones, as foreign entrants perceive additional informational cues and advantages from established foreign firms.

Hypothesis 4a: For foreign firms, the probability of locating in a city increases as the presence of other foreign firms increases, more so than for domestic firms.

However, consistent with the catch-up perspective, the presence of foreign firms can also act to attract domestic firms. Domestic firms may expect that co-location with foreign firms will give them access to key strategic and knowledge resources that are unavailable among domestic peers, enhancing their capabilities and making them more competitive. For instance, Meyer and Sinani (2009) show that domestic firms are likely to benefit when foreign firms enter less developed economies, such as India, owing to knowledge spillovers. They state: "local firms may benefit from standardized knowledge that foreign investors do not prevent from diffusing" (2009: 1078). Mudambi (2008: 709) echoes this sentiment: "the high value-added local activities of such MNEs create knowledge spillovers into emerging market economies." Uhlenbruck et al. (2003) similarly contend that newly privatized firms in Central and Eastern Europe are likely to learn the most from foreign entrants. Thus domestic firms, intent on catching up to the technological frontier, have strong incentives to locate close to foreign firms. Kumaraswamy et al. (2012) show that a key aspect of domestic firms' catch-up strategy in the Indian auto components industry involved learning new technical and managerial competences from MNEs. They state that one way for domestic firms to appropriate advanced technologies from MNEs is "through unintentional spillovers due to labor mobility, leakage of intellectual property and imitation by domestic firms" (Kumaraswamy et al., 2012: 375). A key contribution in their paper is their demonstration that domestic firms are highly motivated to establish relationships with foreign firms, even at the expense of short-term profitability.

The desire, as well as the need, to acquire key strategic and knowledge resources from international sources is so high among emerging-market firms that this accounts for the positive abnormal returns these firms generate in international acquisitions (Gubbi et al., 2010). Domestic firms seek "exposure to a wide range of international best practices" because it provides them "with a valuable learning opportunity to transform their routines, repertoires, and outlook into that of a global company" (Gubbi et al., 2010: 401). Although the authors are referring to international acquisitions, co-location may be a very efficient way for emerging-market firms to tap into key knowledge resources from a variety of foreign sources.

Finally, the catch-up motivations of domestic firms may be particularly strong as MNEs enter emerging markets, as "foreign investment represents a high-profile form of entry, and local firms are thus normally aware of these entrants" (Meyer & Sinani, 2009: 1077). In such a context, domestic firms are spurred to reconfigure their activities, as they have "strong incentives to acquire the resources and competencies that will enable them to control higher value-added activities" (Mudambi, 2008: 708). By locating their activities near these MNE entrants, domestic firms may be hoping that this will enable them to learn advanced technology and managerial practices. If this is the case, then locations with foreign firms would be more attractive to domestic firms than to foreign investors.

Hypothesis 4b: For domestic firms, the probability of locating in a city increases as the presence of foreign firms increases, more so than for foreign firms.

DATA AND METHODOLOGY

We test our hypotheses using a comprehensive data set of domestic and foreign firms' R&D laboratory entries in different cities in India between 2005 and 2010. In using India, we have selected a context where we would expect to find a liability of foreignness, as institutions are weak, inefficient and in constant flux, leading to a need for local knowledge by foreign investors (Tan & Meyer, 2011). India also offers an ideal context for studying the catch-up or upgrading strategies of domestic firms as foreign firms began to enter the market at an increasing pace in the last decade, and foreign entry is one of the key drivers of catch-up. As Figure 1 illustrates, although FDI inflows averaged about $2.5 billion annually in the late 1990s, this average leaped to $30 billion annually post-2005, which is the period of our study. Indian firms' efforts to acquire critical assets for strategic renewal is one rationale offered for the rapid increase in international acquisitions seen starting in 2003 (Gubbi et al., 2010).

With respect to R&D laboratories, increasing numbers of foreign companies have entered India and set up R&D centers, with investment increasing from $1.3 billion between 1998 and 2003 to over $4.7 billion between 2003 and 2006 (World Bank, 2007), enabling us to compare the location decisions of foreign and domestic firms. In addition, firms began transferring high-value-added activities to India at an increasing pace only in the last decade (Lewin et al., 2009). Undoubtedly, many of

the foreign investors are attracted to India for reasons of low cost. However, given the variation across cities, country-level factors may only partially explain foreign investors' location decisions. A deeper analysis is needed, as subnational, location-specific characteristics are not only becoming increasingly important, but may be "replacing the nation state as the principal spatial economic entity" (Cantwell & Piscitello, 2005: 3). As Chang and Park argue, "the location decisions *within* a country … may be more important than the decision at the country level is" (2005: 595). For these reasons, India is an ideal context in which to situate our study.

Data on R&D laboratories come from the Department of Scientific and Industrial Research (DSIR), a unit within the Ministry of Science and Technology. There are over 1200 officially recognized R&D labs across India. We have collected data for 2003–2010, enabling us to identify new entrants starting in 2005 and onwards. Furthermore, we observe location entry by both foreign and domestic firms. Previous studies frequently used directories of FDI into a country, whose drawback is that they do not capture location entry by domestic firms. In addition, by using R&D labs we are able to examine entry by similar and therefore comparable organization forms.

Using DSIR's *Directory of recognised in-house R&D units*, we identify entry as those laboratories that are not listed in the *Directory* in a particular year but listed in subsequent years. In addition, we also use Internet searches for a random sample of firms to verify that firms had in fact established a new R&D facility in a particular location. Furthermore, we are able to distinguish between firms that establish their first and therefore new R&D laboratory and those that establish a second or subsequent R&D laboratory. Our sample includes 501 and 68 first entries by domestic and foreign firms, respectively. For robustness, we also evaluate 273 subsequent entries.

Model

We employ a variation of McFadden's conditional logit model to test our hypotheses (McFadden, 1974). This model estimates the probability that a firm will choose a given city as a function of the attributes of that city, and has been widely used to examine location choice (e.g., Alcácer & Chung, 2007; Belderbos et al., 2011; Nachum, Zaheer, & Gross, 2008; Shaver & Flyer, 2000; Tan & Meyer, 2011). The main underlying assumption of this model is that firms select locations with the greatest expected value to the firm, and that this value is a function of observed city characteristics in the year prior to entry:

$$V_{ij,t} = \alpha' C_{ij,t-1} + \beta' X_{ij,t-1} + \gamma' Z_{ij,t-1} + \varepsilon_{ij,t} \qquad (1)$$

where $V_{ij,t}$ denotes the expected value for firm i in location j at time t; $C_{ij,t-1}$ are (control) characteristics of location j at time $t-1$; $X_{ij,t-1}$ are domestic firms' agglomeration measures in location j at time $t-1$; $Z_{ij,t-1}$ are foreign firms' agglomeration measures in location j at time $t-1$; and $\varepsilon_{ij,t}$ is an independent and randomly distributed residual that follows a Type I extreme value distribution, and is attributable to errors associated with imperfect information about the location by firm i. Under these conditions, the conditional probability that firm i will select location j, given the set of locations to select from, is given by

$$P_{ij,t} = P(Y_{i,t} = j) = \frac{\exp(\alpha' C_{ij,t-1} + \beta' X_{ij,t-1} + \gamma' Z_{ij,t-1})}{\sum_j \exp(\alpha' C_{ij,t-1} + \beta' X_{ij,t-1} + \gamma' Z_{ij,t-1})} \qquad (2)$$

The dependent variable ($P_{ij,t}$) gives the odds that firm i will enter location j rather than any other location at time t, or, in other words, the dependent variable takes the value 1 if a location j was selected by firm i and 0 for the locations that were not chosen. However, a handful of firms in our sample opened two labs in a single location in a given year. To account for this dependence among entry choices made by a single firm, we pooled all entry choices of the firm in a given location at time t into a single case, and assigned a weight equal to the number of labs the firm opened in that location. As in Nachum et al. (2008) and Lyn and Wei (1989), we utilize a "sandwich estimator" to account for the possible dependence among all entries made by a firm in a single location at time t, which leads to robust estimates. Further, excluding these multiple entries from our sample did not alter the results in the direction of the effects or their significance.

Estimation of Eq. (2) was performed using the maximum likelihood method. The sign and the significance of the estimated coefficients show the presence or absence of an independent variable's effect on location choice. For instance, if x denotes the measure of domestic firms' agglomeration in a particular location, then a positive and statistically significant coefficient of x will imply that the

probability of this location being selected by a new entrant increases as the agglomeration of domestic firms increases. However, the estimated coefficients cannot be interpreted as marginal effects, as in ordinary least squares. The marginal effects in this non-linear model depend on the values of all independent variables. Instead of calculating the marginal effect of an explanatory variable at the mean of all other independent variables (MEM), we calculated the average marginal effects (AME). That is, as in Tan and Meyer (2011), we first calculated the individual marginal effects at each observation in our sample, and then calculated their average. The justification for selecting AME over MEM is that the MEM represents the marginal effect at a point (mean or median) that might not be particularly informative. For instance, no firm may be likely to have the average values in every independent variable.

Since the main focus of the present analysis is whether the impact of agglomeration on location choice differs between domestic and foreign firms, we included interaction terms with the agglomeration variables (X, Z) in Eq. (2). Given that the estimated coefficients or marginal effects of these interaction terms may not capture the signs and magnitudes of the interaction effects (Ai & Norton, 2003; Hoetker, 2007), we also split the sample on the basis of firm origin (domestic vs foreign). We then compare the estimated coefficients in the subsamples and examine whether the results change from the full-sample model with interaction terms. Recent research suggests that a split-sample analysis may actually be superior to full-sample estimation with interaction terms, since it does not assume that the unexplained variance is identical between domestic and foreign R&D lab entries. At the same time, it allows for the impact of city characteristics on location choice to differ systematically between domestic and foreign entries, leading to consistent within-group estimates (Hoetker, 2007). To examine whether a liability of foreignness or catch-up process exists, we compare the marginal effects of the independent variables for the domestic entrants with the marginal effects of the independent variables for the foreign entrants. If the marginal effects for foreign entrants are larger than those of domestic entrants, then a liability of foreignness exists. If the reverse is true, then a catch-up process is at work. This interpretation is in line with previous studies on the liability of foreignness, which compare the decisions or performance of foreign firms with those of domestic firms (Zaheer, 1995).

Dependent Variable

The focus of the present analysis is on the first R&D lab entry into an Indian city, since entries in subsequent years are likely to be governed by firms' experiential learning. Although we do provide results for subsequent entries, we do not identify whether the entries were in the same city as the first entry. These considerations led to a comprehensive sample of 569 first entries (501 domestic and 68 foreign firms) and 273 subsequent entries into India cities during the period 2005–2010.

The focus of our analysis is on the city choice for the R&D lab entries. Specifically, in 2003 one or more R&D labs were present in 280 cities, representing 23 states or union territories. Of the 280 cities or urban agglomerations, 155 received at least one R&D lab entry during 2005–2010. We consider all 280 cities as the relevant choice set for the firms. While firms might not actively consider all 280 cities as alternative locations, Parsons and Hauber (1998) show that adding alternatives with a low likelihood of being chosen has almost no effect. They conclude that the results of conditional logit models are not sensitive to the inclusion of alternatives not actively considered by all firms. Further, a Hausman test (Hausman & McFadden, 1984) showed that the cities that did not attract R&D lab entry were equal substitutes for cities that did. Specifically, we estimated the conditional logit model with all 280 alternatives/cities, and used a Hausman test to compare the estimates with a restricted model that included only the 155 alternatives/cities that attracted entry. Results showed that the difference in coefficients was systematic, and so we included all 280 cities as the relevant choice set of the firm.

An R&D lab entry was assigned a value of 1 to the chosen city and 0 for the remaining 279 cities in the choice set of the firm. Table 1 presents the geographic dispersion of firms' entries in Indian cities between 2005 and 2010, and distinguishes between domestic-owned and foreign-owned firms, and between first and subsequent entries. We see that the first six cities (Hyderabad, Delhi, Bangalore, Mumbai, Pune, and Chennai) receive the majority of entries, accounting for about 69% of total first entries and for about 63% of the total subsequent entries.

The conditional logit model depends on the independence of irrelevant alternatives (IIA) assumption. That is, the relative probabilities between choices must be independent of other alternatives. To test for the validity of the IIA assumption,

Table 1 Geographical dispersion of R&D lab entries during 2005–2010 in India

Location	First entry			Subsequent entry		
	Domestic	Foreign	Total	Domestic	Foreign	Total
Hyderabad	76	5	81	20	6	26
Delhi	55	7	62	16	2	18
Bangalore	52	8	60	16	8	24
Mumbai	43	6	49	40	5	45
Pune	27	10	37	16	2	18
Chennai	27	6	33	11	2	13
Ahmedabad	12	1	13	6	0	6
Kolkata	10	1	11	2	1	3
Vadodara	10	1	11	11	0	11
Aurangabad	9	0	9	1	1	2
Chandigarh	8	1	9	3	0	3
Coimbatore	8	0	8	2	0	2
Mysore	5	1	6	1	0	1
Surat	6	0	6	0	0	0
Rest of cities	153	21	174	90	11	101
Total	501	68	569	235	38	273

we performed a Hausman-type specification test (Hausman & McFadden, 1984). This entails eliminating a subset of the choices from the choice set and re-estimating the model. If the parameters of the restricted model are not systematically different from the parameters of the full model, then the IIA holds. However, with 280 potential entry choices, the number of subset combinations to test is enormous. Nevertheless, we examined the IIA property by eliminating each of the 280 cities from the choice set, and compared the results with the full model. In none of the tests could we reject that the IIA property holds for the choice set. For instance, when Hyderabad is eliminated, the observed χ^2 test statistic is equal to 0.46, while the critical value for the χ^2 test statistic with nine degrees of freedom at the 5% level is 16.9. Although the IIA test has generally low power, these results do not offer evidence against the conditional logit approach.

Independent Variables

The primary independent variables are constructed from the population of all R&D laboratories in India in a given year, as reported in DSIR's *Directory of recognised in-house R&D units*. First, we classified the R&D labs in each city into their respective industry, based primarily on DSIR industry categories.[2] Then, using the Prowess database and Internet searches, we identified those labs owned by a foreign parent. Companies frequently disclose foreign ownership on their websites. In this manner, we construct measures that account for the presence of same-industry and cross-industry externalities in a location, as well as further deconstruct these measures to account separately for the presence of domestic and foreign labs.

Same-industry firms

To account for the presence of same-industry externalities, we employ a measure frequently used in agglomeration studies – a *location quotient* (LQ) (Glaeser et al., 1992; Feldman & Audretsch, 1999), which is based on a count of R&D labs (Delgado, Porter, & Stern, 2010). Specifically, our measure is defined as the share of the total number of labs in the city accounted for by the industry number of labs in the city, divided by the share of the total number of labs in India accounted for by the number of labs in that particular industry. More formally, if we define K_{jr} to denote the number of labs in industry r (r=1, …, 8) of city j, and K_r to denote the number of labs in industry r of India, then the share of labs in industry r of city j and of India are given by, respectively,

$$q_{jr} = \frac{K_{jr}}{\sum_{j=1}^{M} K_{jr}} \tag{3a}$$

and

$$q_r = \frac{K_r}{\sum_{r=1}^{8} K_r} \tag{3b}$$

Accordingly, the presence of same-industry labs (IS_{jr}) in city j in industry r is given by $IS_{jr}=q_{jr}/q$ or, equivalently,

$$IS_{jr} = \frac{\dfrac{\text{Number of labs in industry } r \text{ in city } j}{\text{Total number of labs in city } j}}{\dfrac{\text{Number of labs in industry } r \text{ in India}}{\text{Total number of labs in India}}} \tag{4}$$

This variable reflects the degree to which a city in the choice set of a firm is specialized in a particular industry, relative to the degree of research activity in that industry that would occur if labs in the industry were randomly distributed across India. A higher value of this measure indicates a greater

degree of specialization of the industry in a particular city.

To examine how the presence of domestic-owned vs foreign-owned labs in a city influences lab entry, we further decompose our LQ agglomeration measure to account for domestic (ISD_{jr}) and foreign labs (ISF_{jr}). We use these decomposed measures because we want to maintain mutual exclusivity between measures.

$$ISD_{jr} = \frac{\dfrac{\text{Number of domestic labs in industry } r \text{ in city } j}{\text{Total number of labs in city } j}}{\dfrac{\text{Number of labs in industry } r \text{ in India}}{\text{Total number of labs in India}}} \tag{5}$$

$$ISF_{jr} = \frac{\dfrac{\text{Number of foreign labs in industry } r \text{ in city } j}{\text{Total number of labs in city } j}}{\dfrac{\text{Number of labs in industry } r \text{ in India}}{\text{Total number of labs in India}}} \tag{6}$$

Cross-industry firms

To account for the presence of cross-industry externalities, we measure the presence of R&D labs from different industries in the same city (CS_{jr}). We use a LQ measure that is nearly identical to our previous measure of same-industry firms, but which counts the number of R&D labs from other industries ($-r$) in a city (j):

$$CS_{jr} = \frac{\dfrac{\text{Number of labs in industry } r \text{ in city } j}{\text{Total number of labs in city } j}}{\dfrac{\text{Number of labs in industry } r \text{ in India}}{\text{Total number of labs in India}}} \tag{7}$$

A higher value indicates a greater diversity across industries in a particular city. We also decompose the LQ measure in Eq. (7) to account separately for the presence of foreign (CSF_{jr}) and domestic (CSD_{jr}) R&D labs from different industries:

$$CSD_{jr} = \frac{\dfrac{\text{Number of domestic labs in industry } r \text{ in city } j}{\text{Total number of labs in city } j}}{\dfrac{\text{Number of labs in industry } r \text{ in India}}{\text{Total number of labs in India}}} \tag{8}$$

$$CSF_{jr} = \frac{\dfrac{\text{Number of foreign labs in industry } r \text{ in city } j}{\text{Total number of labs in city } j}}{\dfrac{\text{Number of labs in industry } r \text{ in India}}{\text{Total number of labs in India}}} \tag{9}$$

Control Variables

We include a number of relevant control variables that prior studies have indicated as important for location choice. In particular, we control for the "place" and "space" of a location, as both the geographic interdependence between units and the characteristics of the local environment can influence location choice (Beugelsdijk, 2007; Beugelsdijk, McCann, & Mudambi, 2010).

Distance to registered office

Recognizing that firms operate with multiple nodes (Mudambi & Swift, 2011), and that the geographic distance, or "space," between these nodes can affect location decisions (Beugelsdijk et al., 2010), we control for the geographic space of an R&D laboratory by accounting for the distance between a firm's registered office[3] and its R&D lab. We calculate the number of miles between the R&D lab and the city in which the firm's registered office is located by assigning the latitude and longitude at the center of the city in which the R&D lab and firm's registered office are located. Using spherical geometry, we calculate the distance (d_{gh}) between the two points g and h, as

$$d_{gh} = C\{\arccos[\sin(lat_g)\sin(lat_h) + \cos(lat_g)\cos(lat_h)\cos(|long_g - long_h|)]\} \tag{10}$$

where latitude (lat) and longitude ($long$) are measured in radians, and C represents a constant based on the radius of the sphere that converts the result into linear units of measure. To convert the result to miles on the surface of the earth, we use C=3963.19.

Population accessibility

We also take into account the "place" of a location – the environment of the city (Beugelsdijk et al., 2010). Although place is often thought of in terms of a single urban location (McCann & Mudambi, 2005), our measure takes into account not just the population of the focal city but also its proximity to other major urban centers. Thus our measure accounts for cities that may not have very large populations, but are close to major urban centers, increasing their attractiveness for firms. For instance, part of Pune's attractiveness for companies is its proximity to Mumbai. By measuring population and proximity to large populations, this variable also captures potential market demand in a location. We use the 2001 Census of India to obtain the population for each city. In this sense, our measure

integrates "space" with other locations into our assessment of "place" (McCann & Mudambi, 2005). To compute each city's accessibility to population centers, we define A be the accessibility of city j, P to be the population in city j, and d_{jk} to be a matrix of spherical distances between cities j and k, obtained from Eq. (10). Then, following O'Kelly and Horner (2003), our accessibility index (A_j) is given by

$$A_j = P_j d_{jj}^{-1} + \sum_{k,k\neq j} P_k d_{jk}^{-1} \tag{11}$$

where d_{jj}=1 (i.e., the own city is set to 1), to avoid division by zero. We set a maximum d_{jk} equal to 100 miles: thus cities located more than 100 miles away are not taken into account. For robustness, we also used different cutoff points (e.g., 50 and 150 miles) but did not find significant differences in results.

We use population accessibility as a proxy for the overall business attractiveness of a city, its amenities and infrastructure, as we find that city population is highly correlated with nearly all other city attractiveness measures. For instance, the Institute of Competitiveness, India,[4] published the *India City Competitiveness Report 2009*, ranking 37 major Indian cities along several dimensions, including physical infrastructure, communication infrastructure, financial infrastructure, competition intensity, innovation, and human capacity. Each of these scores is highly correlated with population, with correlation coefficients ranging from 0.85 to 0.98, and all statistically significant ($p<0.05$).[5] Thus population accessibility nicely captures the overall competiveness of a city and its infrastructure, as well as potential market demand conditions.

Enrollment diversification

We control for the availability of specialized labor within each location by using the total enrollment in professional education in each state by year, from the *Statistical Abstract of India*, as published by the Ministry of Statistics and Programme Implementation. Using data on student enrollment in engineering and technical, medicine, veterinary science, agricultural science, law, education, and all other colleges on a state-by-state basis, we construct an entropy measure of state-level diversification in student enrollments. Specifically, letting E_{lR} denote student enrollment in one of the previously mentioned fields (l=1, …, 7) in state R, then the entropy index of student enrollments (Edu_R) is formally defined as

$$Edu_R = \sum_{l=1}^{7} TE_{lR} \ln\left(\frac{1}{TE_{lR}}\right) \tag{12}$$

where

$$TE_{lR} = \frac{E_{lR}}{\sum_{l=1}^{7} E_{lR}}$$

Higher values of this measure mean that the labor pool in a state is more diverse.

Patent applications

To control for the overall innovativeness and general knowledge spillover potential of a particular location, we obtain the count of patent applications filed from the Annual Report of the Office of the Controller General of Patents, Designs, Trademarks and Geographical Indications. Although it would be ideal if this measure were available for each city in the choice set, data are only available by state.

State dummies

We recognize that local contexts are themselves embedded in broader regional contexts (Meyer et al., 2011). As in Nachum et al. (2008), we incorporate state-level dummies to account for other state-level differences that affect location choice. These dummies capture time-invariant location characteristics that might affect firm entry, such as geographic factors and differences in state regulations in each year. Given that the choice of the firm spans 280 cities, representing 23 states, we added 22 dummies and used the state of West Bengal as the benchmark.

State-specific time trends

Following Chung and Song (2004) and Tan and Meyer (2011) we included state-specific time trends to capture location-specific characteristics that are time variant, such as economic and demographic indicators. However, we did not find that these trends were statistically significant in any of the models, and we therefore dropped them from our final analyses.

Firm-specific variables

Recent studies have shown that firm heterogeneity should be accounted for in locational models, as firms may have different locational preferences, depending on their own characteristics (Alcácer & Chung, 2007; Shaver & Flyer, 2000). In other words, assuming firm homogeneity implies that all firms

have the same utility function and location preferences. To account for firm heterogeneity, we introduce the firm's R&D expenditures (at the firm level and lagged by one year) as a general measure of firms' intention for R&D lab entry. Given that the conditional logit model does not allow for the inclusion of firm main effects (constant within each case), we modeled them through interaction with city-level variables.

RESULTS

Tables 2 and 3 provide the descriptive statistics and correlations for the variables, with a distinction between first and subsequent entry. The correlation matrix reveals that the measure of same-industry agglomeration is, as expected, highly correlated with its components. Similarly, the aggregate measure of cross-industry agglomeration is highly correlated with its components, and both results are consistent between first and subsequent entry. There is also moderate correlation between our population accessibility index and the measures of cross-industry agglomeration, but our results are robust to the inclusion or exclusion of the population accessibility index. Results from the estimation of the conditional logit regression model in Eq. (2) with robust standard errors are presented in Table 4 for first R&D lab entry and in Table 5 for subsequent R&D lab entry.

Models 1 and 2 of Table 4 show that the coefficient measuring the presence of same-industry labs is positive and significant for both the domestic and foreign firms' subsamples (model 1: β=0.126, $p<0.01$; model 2: β=0.176, $p<0.01$), implying that the stronger the presence of same-industry labs in a city, the higher the probability that a domestic or a foreign firm will locate an R&D lab in that location. In addition, the coefficients for the presence of cross-industry labs in both samples are also positive and statistically significant (model 1: β=1.242, $p<0.01$; model 2: β=1.499, $p<0.01$). Although the coefficients show that an effect is present and significant, they do not represent the magnitude of the effect. To estimate the magnitude of each variable, we calculate AME, which show the impact of an increase in 1% of an independent variable on the probability of a location being chosen. We see in these models that domestic

Table 2 Descriptive statistics for (a) first R&D lab entry and (b) subsequent R&D lab entry

Characteristic	Mean	Standard deviation	Minimum	Maximum	Number of observations
(a)					
Same-industry firms	0.765	1.867	0.000	45.645	159,040
Same-industry domestic firms	0.698	1.813	0.000	45.645	159,040
Same-industry foreign firms	0.067	0.478	0.000	28.064	159,040
Cross-industry firms	0.137	0.329	0.000	1.552	159,040
Cross-industry domestic firms	0.124	0.305	0.000	1.490	159,040
Cross-industry foreign firms	0.012	0.064	0.000	0.912	159,040
Distance to registered office	594.10	329.52	0.000	1,748	159,040
Population accessibility (log)	12.649	0.980	10.137	16.308	159,040
Enrollment diversification (state level)	1.072	0.590	0.000	1.715	159,040
Patent applications (state level)	479.92	630.30	0.000	2,443	159,040
Firm R&D expenditure (Rs – crore)	1.029	5.826	0	107.29	37,800
(b)					
Same-industry firms	0.791	1.893	0.000	42.548	57,401
Same-industry domestic firms	0.719	1.837	0.000	42.548	57,401
Same-industry foreign firms	0.072	0.500	0.000	27.739	57,401
Cross-industry firms	0.144	0.339	0.000	1.552	57,401
Cross-industry domestic firms	0.131	0.315	0.000	1.490	57,401
Cross-industry foreign firms	0.013	0.066	0.000	0.912	57,401
Distance to registered office	587.82	321.20	0.000	1729	57,401
Population accessibility (log)	12.649	0.980	10.137	16.308	57,401
Enrollment diversification (state level)	1.074	0.590	0.000	1.715	57,401
Patent applications (state level)	480.76	628.23	0.000	2443	57,401
Firm R&D expenditure (Rs – crore)	49.716	11.377	0	796.86	39,761

Notes: 1 crore = Rs. 10,000,000.

Table 3 Correlations for (a) first R&D lab entry and (b) subsequent R&D lab entry

Variable	1	2	3	4	5	6	7	8	9	10	11
(a)											
1 Same-industry firms	1.00										
2 Same-industry domestic firms	0.97	1.00									
3 Same-industry foreign firms	0.24	−0.02	1.00								
4 Cross-industry firms	0.17	0.15	0.09	1.00							
5 Cross-industry domestic firms	0.16	0.15	0.09	0.98	1.00						
6 Cross-industry foreign firms	0.07	0.07	0.03	0.46	0.29	1.00					
7 Distance to registered office	−0.02	−0.01	−0.01	−0.04	−0.04	−0.01	1.00				
8 Population accessibility log	0.04	0.04	0.01	0.44	0.44	0.20	−0.01	1.00			
9 Enrollment diversification (state level)	0.20	0.19	0.07	0.20	0.20	0.08	−0.02	0.15	1.00		
10 Patent applications (state level)	0.03	0.02	0.03	0.06	0.05	0.05	−0.24	0.09	0.09	1.00	
11 Firm R&D expenditure (Rs – crore)	0.31	0.29	0.09	0.07	0.07	0.03	−0.02	0.02	0.09	0.03	1.00
(b)											
1 Same-industry firms	1.00										
2 Same-industry domestic firms	0.96*	1.00									
3 Same-industry foreign firms	0.24*	−0.02*	1.00								
4 Cross-industry firms	0.15*	0.13*	0.07*	1.00							
5 Cross-industry domestic firms	0.14*	0.13*	0.07*	0.98*	1.00						
6 Cross-industry foreign firms	0.07*	0.06*	0.02*	0.44*	0.27*	1.00					
7 Distance to registered office	−0.01*	−0.01*	−0.01*	−0.04*	−0.04*	0.00	1.00				
8 Population accessibility log	0.04*	0.03*	0.01*	0.45*	0.44*	0.18*	−0.01*	1.00			
9 Enrollment diversification (state level)	0.21*	0.20*	0.07*	0.20*	0.20*	0.08*	−0.02*	0.15*	1.00		
10 Patent applications (state level)	0.03*	0.03*	0.03*	0.05*	0.05*	0.05*	−0.28*	0.09*	0.09*	1.00	
11 Firm R&D expenditure (Rs – crore)	−0.01*	−0.01*	−0.00	0.00	0.00	0.00	0.00	−0.00	0.00	0.01	1.00

N=159,040 except for firm R&D expenditure, where N=37,800. All coefficients are statistically significant at $p<0.05$.
N=57,401 except for firm R&D expenditure, where N=39,761.
*$p<0.05$.

entrants are more attracted to agglomerated firms than foreign entrants are. For example, a 1% increase in the presence of same-industry labs increases the probability of lab entry by domestic firms by 0.54% but only 0.07% for foreign firms, indicating support for Hypothesis 1b rather than Hypothesis 1a. Similarly, a 1% increase in the presence of labs from different industries increases the probability of lab entry by domestic firms by 5.27% but only 0.60% for foreign firms, indicating support for Hypothesis 2b rather than Hypothesis 2a. These results suggest that although both sets of entrants are attracted to agglomerations of other firms, domestic entrants appear to be more strongly attracted than foreign entrants. This holds for both agglomerations of same-industry and cross-industry firms, indicating consistent support for catch-up processes (Hypotheses 1b and 2b). In addition, the average marginal effect of the presence of cross-industry labs is higher than the effect of same-industry labs in each of the models (model 1: 0.0527>0.0054; model 2: 0.006>0.0007), indicating that both domestic and foreign firms prefer locations that have more industrial diversity.

The control variables in both models 1 and 2 of Table 4 provide similar results. As expected, the coefficient of distance to registered office is negative and statistically significant, indicating that both domestic and foreign firms prefer to locate closer to their registered offices (model 1: $\beta=-0.017$, $p<0.01$; model 2: $\beta=-0.007$, $p<0.01$). Further, both domestic and foreign firms prefer to locate in locations that are highly accessible to urban populations (model 1: $\beta=0.830$, p lt; 0.01; model 2: $\beta=0.893$, $p<0.01$). The coefficient of state-level patent applications is insignificant in both models, indicating that the overall innovativeness of a location is not a significant determinant of entry.

In models 3 and 4 of Table 4, we pool the domestic and foreign samples together using interaction terms. In particular, we can observe in model 3 that all coefficients have similar size and statistical significance as in those models 1 and 2. While these results confirm the results of

models 1 and 2, the advantage of subsample analysis becomes obvious. As Hoetker (2007) demonstrates, the effect of the interaction terms is a function not only of the coefficient for the interaction but also of the coefficients for each interacted variable and the values of all the variables. Thus the sign of the interaction coefficient may not indicate the direction of the interaction effect, while the significance of the interaction coefficient depends on the values of the variables. That is, there can be a significant interaction effect for some observations even if the interaction effect is not significant, and vice versa. Furthermore, in pooling all entrants together, we make the implicit assumption that the unobserved variation is the same between foreign and domestic firms, which may not be the case. As a result, our interpretations of the results rely on the separate equations for each group (e.g., models 1 and 2 in Table 4), as suggested by Hoetker (2007).

In model 4 of Table 4, we control for firm-specific heterogeneity by creating interaction terms of the firm-level R&D expenditures and same-industry or cross-industry labs in a city. Although none of these coefficients is statistically significant, potentially indicating that our results are not driven by technological differences across firms or the level of firm-level R&D commitment, subsample analysis is needed to further confirm this. It should be noted that firm-level R&D expenditures are available only for firms in the Prowess database, and as a result our sample is reduced

Table 4 Conditional logit regression results of location choice: first R&D laboratory entry

Dependent variable: City location choice	(1)	(2)	(3)	(4)
	Domestic	Foreign	Full sample	Full sample
Same-industry firms	0.126***	0.176***	0.130***	0.110***
	(0.0211)	(0.0601)	(0.0201)	(0.0340)
	0.00535	0.00071	0.00621	0.00341
Cross-industry firms	1.242***	1.499***	1.295***	0.878**
	(0.181)	(0.351)	(0.166)	(0.349)
	0.05274	0.00601	0.06179	0.02732
Same-industry firms × Foreign dummy			0.0293	−0.0183
			(0.0929)	(0.197)
			0.00139	−0.00057
Cross-industry firms × Foreign dummy			−0.0547	−0.341
			(0.328)	(0.672)
			−0.00261	−0.01061
Distance to registered office	−0.0170***	−0.00678***	−0.0145***	−0.0111***
	(0.00196)	(0.00185)	(0.00155)	(0.00254)
	−0.00072	−0.00003	−0.00069	−0.00034
Population accessibility (log)	0.830***	0.893***	0.844***	0.953***
	(0.0633)	(0.125)	(0.0572)	(0.126)
	0.03525	0.00358	0.04027	0.02964
Enrollment diversification (state level)	−0.657***	−0.743*	−0.670***	0.0294
	(0.131)	(0.387)	(0.124)	(0.290)
	−0.02791	−0.00297	−0.03198	0.00091
Patent applications (state level)	0.000375	−0.000472	1.21e−05	−0.000402
	(0.000506)	(0.000907)	(0.000428)	(0.000717)
	0.00002	0.00000	0.00000	−0.00001
Firm R&D expenditure (Rs – crore) × Same-industry firms				−0.0483
				(0.0376)
				−0.00150
Firm R&D expenditure (Rs – crore) × Cross-industry firms				0.0781
				(0.0619)
				0.00243
State dummy variables	Yes	Yes	Yes	Yes
McFadden pseudo R^2	0.658	0.508	0.627	0.612
Number of observations/events	140,000/503	19,040/68	159,040/571	37,800/135

Table 4 *Continued*

Dependent variable: City location choice	(5)	(6)	(7)	(8)
Same-industry domestic firms	0.122***	0.121*	0.128***	0.103***
	(0.0213)	(0.0700)	(0.0203)	(0.0345)
	0.00518	0.00025	0.00603	0.00306
Same-industry foreign firms	0.229***	0.429***	0.218***	0.248
	(0.0694)	(0.147)	(0.0685)	(0.155)
	0.00973	0.00089	0.01031	0.00735
Cross-industry domestic firms	1.177***	0.908**	1.196***	0.713**
	(0.188)	(0.410)	(0.174)	(0.359)
	0.04997	0.00188	0.05657	0.02117
Cross-industry foreign firms	1.920***	4.174***	1.884***	2.255*
	(0.546)	(1.016)	(0.508)	(1.234)
	0.08151	0.00866	0.08909	0.0669
Same-industry domestic firms × Foreign dummy			−0.0820	−0.119
			(0.111)	(0.264)
			−0.00388	−0.00354
Same-industry foreign firms × Foreign dummy			0.178	0.0732
			(0.160)	(0.215)
			0.00839	0.00217
Cross-industry domestic firms × Foreign dummy			−0.547	−0.748
			(0.381)	(0.868)
			−0.02588	−0.02221
Cross-industry foreign firms × Foreign dummy			3.255***	2.426
			(1.136)	(2.703)
			0.15397	0.07201
Distance to registered office	−0.0170***	−0.00670***	−0.0146***	−0.0111***
	(0.00197)	(0.00184)	(0.00155)	(0.00258)
	−0.00072	−0.00001	−0.00068	−0.000329
Population accessibility (log)	0.828***	0.974***	0.860***	0.964***
	(0.0632)	(0.125)	(0.0576)	(0.128)
	0.03517	0.00202	0.04067	0.02861
Enrollment diversification (State level)	−0.665***	−0.743*	−0.676***	0.0211
	(0.132)	(0.402)	(0.125)	(0.294)
	−0.02825	−0.00154	−0.040671	0.00062
Firm R&D expenditure (Rs – crore) × Same-industry firms				−0.0513
				(0.0380)
				−0.00152
Firm R&D expenditure (Rs – crore) × Cross-industry firms				0.0784
				(0.0629)
				0.00232
State dummy variables	Yes	Yes	Yes	Yes
McFadden pseudo R^2	0.658	0.519	0.629	0.615
Number of observations/events	140,000/503	19,040/68	159,040/571	37,800/135

Notes: Figures in cells are estimated coefficients/robust standard errors/average marginal effect.
***$p<0.01$; **$p<0.05$; *$p<0.1$.
The dependent variable is at time t, and all independent variables are at time $t-1$ (except for distance to registered office and log of accessibility index). Time trends are not statistically significant in any of the models and are dropped to conserve degrees of freedom, especially in the samples with a small number of events. Coefficient estimates and significance are similar if time trends are included.

considerably, to 37,800 observations with 135 first lab entries.

Models 5 and 6 decompose the measures of same-industry and cross-industry labs in a city to account for the presence of domestic and foreign R&D labs separately. In both models the measures of same-industry and cross-industry labs are positive and statistically significant. In particular, the stronger the presence of same-industry domestic labs in a city, the higher the probability that a domestic or a foreign firm will locate there (model 5: $\beta = 0.122$, $p<0.01$; model 6: $\beta = 0.121$, $p<0.10$). Similarly, the stronger the presence of cross-industry domestic labs in a city, the higher the

probability that a domestic or a foreign firm will locate its lab there (model 5: $\beta = 1.177$, $p<0.01$; model 6: $\beta = 0.908$, $p<0.05$).

Comparing the AME from models 5 and 6, we see that the domestic firms have a higher probability of locating in a city where the presence of same-industry or cross-industry domestic labs is high ($0.0052>0.0003$ and $0.0499>0.0018$, respectively). Therefore we find support for the catch-up perspective of Hypothesis 3b, but not for the liability of foreignness of Hypothesis 3a.

Regarding the presence of foreign firms, we observe in models 5 and 6 of Table 4 that the stronger the presence of same-industry foreign labs in a city, the higher the probability that either a domestic or a foreign firm will locate there (model 5: β=0.229, $p<0.01$; model 6: β=0.429, $p<0.01$). Similarly, the stronger the presence of cross-industry foreign labs in a city, the higher the probability that a domestic or a foreign firm will locate there (model 5: β=1.920, $p<0.01$; model 6: β=4.174, $p<0.01$). But when we compare the AME from models 5 and 6, we observe that the domestic firms have a higher probability of lab location in cities where the presence of same-industry or cross-industry foreign labs is high ($0.0097>0.0009$ and $0.081>0.0086$, respectively). That is, for domestic firms, the probability of locating in a city increases as the presence of foreign firms increases, and this probability is higher than the foreign firms' probability of entry. Thus we find support for Hypothesis 4b, but not for Hypothesis 4a. Taken together,

Table 5 Conditional logit regression results of location choice: subsequent R&D laboratory entry

Dependent variable: City location choice	(1)	(2)	(3)	(4)
	Domestic	Foreign	Full sample	Full sample
Same-industry firms	0.148***	0.142***	0.149***	0.162***
	(0.0208)	(0.0530)	(0.0206)	(0.0263)
	0.00025	0.00015	0.00023	0.00018
Cross-industry firms	1.214***	1.634***	1.226***	1.017***
	(0.186)	(0.544)	(0.185)	(0.214)
	0.00202	0.0018	0.00187	0.00115
Same-industry firms × Foreign dummy			−0.0224	0.0288
			(0.0584)	(0.108)
			−0.00003	0.00003
Cross-industry firms × Foreign dummy			0.315	0.455
			(0.310)	(0.343)
			0.00048	0.00052
Distance to registered office	−0.00483***	−0.00424***	−0.00472***	−0.00447***
	(0.000676)	(0.000868)	(0.000566)	(0.000627)
	−0.00000	−0.00000	−0.00000	−0.00000
Population accessibility (log)	0.916***	0.932***	0.918***	0.908***
	(0.0783)	(0.214)	(0.0728)	(0.0841)
	0.00152	0.00101	0.00140	0.00103
Enrollment diversification (state level)	−0.569***	−0.808*	−0.592***	−0.461***
	(0.159)	(0.457)	(0.151)	(0.169)
	−0.00099	−0.00087	−0.00091	−0.00052
Patent applications (state level)	−0.000214	−2.65e−05	−0.000186	−0.000224
	(0.000150)	(0.000222)	(0.000130)	(0.000166)
	−0.00000	−0.00000	−0.00000	−0.00000
Headquarters R&D expenses (Rs – crore) × Same-industry firms				0.0000625
				(0.000196)
				0.00000
Headquarters R&D expenses (Rs – crore) × Cross-industry firms				0.000931
				(0.000691)
				0.00000
McFadden pseudo R^2	0.345	0.391	0.351	0.323
Number of observations/events	48,161	9240	57,401	39,761

Table 5 *Continued*

Dependent variable: City location choice	(5)	(6)	(7)	(8)
Same-industry domestic firms	0.144***	0.0754	0.144***	0.152***
	(0.0207)	(0.0665)	(0.0206)	(0.0270)
	0.00027	0.00007	0.00024	0.00020
Same-industry foreign firms	0.292***	0.446***	0.291***	0.292***
	(0.0452)	(0.137)	(0.0447)	(0.0514)
	0.00055	0.00042	0.00048	0.00038
Cross-industry domestic firms	0.988***	1.349*	0.997***	0.795***
	(0.211)	(0.729)	(0.210)	(0.244)
	0.00186	0.00126	0.00166	0.00105
Cross-industry foreign firms	3.178***	4.125**	3.162***	2.939***
	(0.553)	(1.827)	(0.558)	(0.706)
	0.00598	0.00386	0.00526	0.00387
Same-industry domestic firms × Foreign dummy			−0.0933	−0.0672
			(0.0760)	(0.114)
			−0.00015	−0.00008
Same-industry foreign firms × Foreign dummy			0.125	0.117
			(0.141)	(0.175)
			0.00021	0.00015
Cross-industry domestic firms × Foreign dummy			0.261	0.270
			(0.409)	(0.485)
			0.00044	0.00036
Cross-industry foreign firms × Foreign dummy			1.049	2.432
			(1.870)	(1.960)
			0.00175	0.00321
Distance to registered office	−0.00487***	−0.00416***	−0.00474***	−0.00453***
	(0.000687)	(0.000830)	(0.000572)	(0.000641)
	−0.00000	−0.00000	−0.00000	−0.00000
Population accessibility (log)	0.907***	0.945***	0.912***	0.898***
	(0.0790)	(0.216)	(0.0734)	(0.0846)
	0.00171	0.00088	0.00152	0.00118
Enrollment diversification (state level)	−0.564***	−0.826*	−0.587***	−0.444**
	(0.162)	(0.475)	(0.153)	(0.173)
	−0.00106	−0.00077	−0.00097	−0.00058
Headquarters R&D expenses (Rs – crore) × Same-industry firms				0.0000975
				(0.000194)
				0.00000
Headquarters R&D expenses (Rs – crore) × Cross-industry firms				0.000950
				(0.000695)
				0.00000
McFadden pseudo R^2	0.349	0.402	0.356	0.328
Number of observations/events	48,161	9240	57,401	39,761

Notes: Figures in cells are estimated coefficients/robust standard errors/average marginal effect.
***$p<0.01$; **$p<0.05$; *$p<0.1$.
The dependent variable is at time t, and all independent variables are at time $t-1$ (except for distance to registered office and log of accessibility index).

our results consistently support the catch-up perspective. Control variables in models 5 and 6 have similar size and significance as in models 1 and 2 and the results in the full sample estimation (models 7 and 8) are largely consistent.

The results on subsequent entry are presented in Table 5, and are the same as the first-entry results in terms of statistical significance of the coefficients. The only difference is that the coefficient of same-industry domestic labs (Table 5, model 6) is not significant, indicating that subsequent lab entry by foreign investors is unaffected by the presence of domestic labs from the same industry.

Robustness

We perform a number of additional analyses to ensure the robustness of our results. Our aim is to

see how various factors may affect the attractiveness of different locations. As we found that the liability of foreignness effects were relatively weaker than the catch-up effects, we want to check whether different subpopulations of the foreign entrants suffer from a stronger liability of foreignness that may be masked in the full population of foreign entrants. First, we control for differences in the foreign investors' home contexts by including dummy variables for the region of origin of the parent. Out of the first entrants that are foreign, 30 are from the US, 25 are from Europe, and 13 are from Asia or other countries. This distribution is consistent with a World Bank (2007) report that found that US and Western European countries account for the vast majority of foreign investment in India. As we do not have a broad set of different countries among the entrants, but rather a narrow set mostly from developed countries, dummy variables would identify any variation. We use subsidiaries with US parent firms as the baseline, and include dummies for firms originating respectively in *European* or *Asia/other* countries, as in previous studies (Santangelo & Meyer, 2011). Because this is a firm characteristic, we interact these dummy variables with two key location characteristics – same-industry and cross-industry firms – for inclusion in the conditional logit model. The results are presented in Table 6, where we do not find that any of the region-of-origin variables are significant. This is consistent with other studies on liability of foreignness. For instance, Nachum (2003) uses a more nuanced measure of country of origin – cultural distance – and does not find that this has a significant effect on liability of foreignness in her analysis. Similarly, we also do not find that region of origin plays a significant role in explaining location decisions of foreign investors. Furthermore, the AME of foreign entrants in Table 6 are less than the marginal effect of domestic firms presented in Table 4 (Model 1).

Next, we test to see whether foreign entrants' location decisions are influenced by the regional linguistic and ethnic ties of their subsidiary heads. Nearly all of the foreign entrants in India have a person of Indian origin as their country head or managing director, which is similar to what has been found in other studies on foreign entrants in India (Zaheer, Lamin, & Subramani, 2009). We follow Zaheer et al. (2009) in coding the ethnic origin of the managing director for each foreign entrant – whether the person was from the northern, southern, eastern or western part of India.[6] We created four dummy variables – *Ethnic Ties North*, *Ethnic Ties South*, *Ethnic Ties East*, and *Ethnic Ties West* – which take a value of 1 for the geographic location the subsidiary head comes from, and 0 otherwise. We then multiplied each of these variables by the region of city location (North, South, East, and West). This created a variable that took a value of 1 when a subsidiary head from a geographic region matched a location in the same region, and 0 otherwise. In this manner, we are able to include the ethnic ties of the subsidiary head in the location model. The results are presented in Table 7. We find that only in the South did foreign firms take advantage of ethnic ties, a result also found in Zaheer et al. (2009), while firms that had subsidiary heads from the East actually displayed an aversion to locating in that region. More importantly, the significance and direction of the two main independent variables remain – the presence of same-industry and cross-industry firms in a city still act to attract foreign entrants. Thus, for the vast majority of the foreign entrants, it is a location's externalities, not ethnic ties, that play a role in attracting their investments, as only 27 of the foreign entrants had country heads from the South, which is less than 40% of the foreign entrants. Based on these results, it does not appear that the ethnic ties of the subsidiary head increase the likelihood that a foreign entrant will locate in that region, with the exception of Southern India. This result is consistent with Zaheer et al. (2009), who concluded that foreign entrants' location decisions are influenced more by city characteristics than by ethnic ties.

We also divide the foreign entrants into *Laggard* and *Leading* firms, as laggard firms may be more likely to suffer from a liability of foreignness than leader firms. Examining foreign entry in the US, Shaver and Flyer (2000) find that leading firms prefer not to locate in agglomerations composed of many similar firms. When comparing foreign *Laggard* and *Leading* firms with domestic entrants, we find that the AME of all of the main independent variables for domestic entrants are greater than those for either foreign laggards or leaders. Thus our findings are not driven by combining foreign laggards with leaders in one group, because we find that domestic entrants exhibit a stronger preference for locations with other firms than either foreign laggards or leaders. These results serve to reaffirm our main findings. Finally, we include a control for the relative wage level of the city. Higher wages in top-tier cities could deter

Table 6 Region-of-origin effect (ROO). Conditional logit regression results of location choice: first R&D laboratory entry

Dependent variable: City location choice	(1)	(2)
	Foreign	Foreign
Same-industry firms	0.106	0.0793
	(0.127)	(0.124)
	0.00042	0.00088
Cross-industry firms	1.552***	1.542***
	(0.501)	(0.490)
	0.00618	0.01723
Same-industry firms × ROO is Europe	0.223	0.227
	(0.172)	(0.166)
	0.00089	0.00253
Cross-industry firms × ROO is Europe	−0.387	−0.446
	(0.605)	(0.602)
	−0.00154	−0.00498
Same-industry firms × ROO is Asia/Other	0.0482	0.0629
	(0.186)	(0.185)
	0.00019	0.00073
Cross-industry firms × ROO is Asia/Other	0.867	0.954
	(0.881)	(0.913)
	0.00345	0.01066
Distance to registered office	−0.00675***	−0.00638***
	(0.00180)	(0.00139)
	−0.00003	−0.00007
Population accessibility (log)	0.905***	0.870***
	(0.128)	(0.121)
	0.00361	0.00972
Enrollment diversification (state level)	−0.810**	−0.703**
	(0.406)	(0.348)
	−0.00323	−0.007855
Patent applications (state level)	−0.000540	−0.0000714
	(0.000897)	(0.000211)
	−0.00000	−0.00000
State dummy variables	Yes	No
McFadden pseudo R^2	0.512	0.466
Number of observations/events	19,040/68	19,040/68

Notes: Figures in cells are estimated coefficients/robust standard errors/average marginal effect.
***$p<0.01$; **$p<0.05$; *$p<0.1$.
The dependent variable is at time t, and all independent variables are at time $t-1$ (except for distance to registered office and log of accessibility index).

entry, especially for foreign investors who may be seeking low-cost locations within India. To obtain data on relative wages on a city-by-city basis, we use information from the Sixth Central Pay Commission in India, which classifies cities into three categories and allocates a housing rent allowance on the basis of this classification. Workers in cities classified as X receive a 30% increase from the base pay scale, workers in Y cities receive a 20% increase, and workers in Z cities receive a 10% increase. Using this information, we construct a *relative city wage* variable using "Z" cities as the baseline equal to zero, "Y" cities equal to 10, and "X" cities equal to 20. Although this measure does not perfectly capture private sector wages, it does serve as a reliable proxy for relative wage rates across cities. We do not find that relative city wage is a significant predictor for location choice among foreign entrants. Furthermore, our results for the independent variables remain essentially the same as those presented in Table 4, in terms both of direction and of significance. This result is similar to that found in other studies. For instance, Belderbos et al. (2011) do not find that a province's manufacturing wage has a significant effect on location choices by Japanese firms in China. Similarly, Chang and Park (2005) do not find that the average wage has a significant effect on Korean

Table 7 Ethnic ties. Conditional logit regression results of location choice: first R&D laboratory entry

Dependent variable: City location choice	(1)	(2)
	Foreign	Foreign
Same-industry firms	0.196***	0.161***
	(0.0626)	(0.0607)
Cross-industry firms	1.473***	1.401***
	(0.355)	(0.350)
Ethnic ties north	0.225	−1.134
	(3.121)	(1.784)
Ethnic ties south	2.186*	1.748*
	(1.311)	(1.015)
Ethnic ties east	−13.73***	−9.259***
	(1.125)	(0.938)
Ethnic ties west	−1.040	−0.215
	(1.480)	(1.219)
Distance to registered office	−0.00650***	−0.00645***
	(0.00186)	(0.00166)
Population accessibility (log)	0.901***	0.875***
	(0.125)	(0.121)
Enrollment diversification (state level)	−0.778**	−0.599
	(0.385)	(0.372)
Patent applications (state level)	−0.000492	0.0000861
	(0.000909)	(0.000246)
State dummy variables	Yes	No
McFadden pseudo R^2	0.510	0.481
Number of observations/events	19,040/68	19,040/68

Notes: Figures in cells are estimated coefficients/robust standard errors/average marginal effect.
***$p < 0.01$; **$p < 0.05$; *$p < 0.1$.
The dependent variable is at time t, and all independent variables are at time $t-1$ (except for distance to registered office and log of accessibility index).

firms' location choices in China. Thus, while wage rates may influence the decision of which country to locate in, for foreign investors they do not appear to play a significant role on a subnational basis. Overall, these tests demonstrate that our main results are robust across different subgroups, and after accounting for additional location and firm characteristics. Taken together, when we compare foreign with domestic firms, it is domestic firms that exhibit a higher preference for locations with other firms, indicating that the catch-up motivations of these firms significantly and consistently influence location choice.

DISCUSSION AND CONCLUSION

We investigate the extent to which catch-up motivations of domestic firms influence location choice. In accordance with predictions from economic geography, we show that both domestic and foreign firms tend to agglomerate, preferring locations with a larger presence of same-industry and cross-industry firms. However, when we compare the magnitude of this preference, we find that domestic firms, not foreign entrants, exhibit a higher likelihood of agglomeration as the presence of other firms increases. Furthermore, the higher likelihood applies in the presence of same-industry or cross-industry firms as well as domestic and foreign firms in a location. In other words, domestic firms systematically display a higher likelihood of selecting a location as the presence of other firms in that location increases, more so than foreign entrants. While normally we would expect to find that foreign firms agglomerate to a greater extent than domestic firms, because foreign entrants suffer a liability of foreignness, which affects their location strategy (Tan & Meyer, 2011), we instead use this as our baseline to examine the extent to which catch-up affects location strategy. In this manner we illustrate how a dramatic acceleration in the catch-up processes in the Indian economy significantly influences location choice. Furthermore, the systematic manner in which domestic firms have a stronger tendency to

agglomerate with all types of firms indicates a learning motivation rather than just bandwagon mimicry (Belderbos et al., 2011). This finding highlights one aspect in which emerging economies are different from developed countries. While research in developed countries, such as the US, has shown that domestic investors pay less attention to location-specific activity than foreign investors do (e.g., Coombs, Mudambi, & Deeds, 2006), our findings demonstrate the importance of context. Although our results are complementary to the view that location choice is influenced by potential knowledge spillovers, we also show how dynamics in emerging markets can up-end established thought regarding the behavior of domestic firms *vis-à-vis* foreign firms.

While researchers have investigated how firms use formal mechanisms, such as acquisitions (Gubbi et al., 2010), joint ventures and licensing (Kumaraswamy et al., 2012) and supplier–customer relations (McDermott & Corredoira, 2010), to upgrade their capabilities, considerably less attention has been paid to informal mechanisms available through co-location. However, as Mahmood and Zheng (2009: 1490) note, "as the need for innovation grows, other forms of linkages become more relevant as conduits for the transfer of complex knowledge." Moreover, co-location is a strategy available to all firms, whereas only subsets of firms have the resources to participate in joint ventures or engage in cross-border acquisitions. In addition, co-location enables firms to access a diverse array of information from multiple sources. For emerging-market firms co-location is particularly attractive, as firms in these markets "are often inferior in creating a novel set of product offerings … but superior in combining and integrating outside technologies with their own resource base" (Luo et al., 2011: 41). According to the World Bank (2007: 36), this is precisely the type of activities that firms in catch-up mode should be engaging in, "for all others not at the [cutting edge of the global] frontier, competitiveness by absorbing existing but better production methods" is the preferred approach.

Beyond this, our paper makes two significant contributions to the literature on catch-up and location strategy. First, although it has been generally assumed that domestic firms look to foreign firms to upgrade their capabilities, our findings suggest that they also attempt to learn from their peers. Our results do show that the attraction to foreign firms is stronger than the attraction to other domestic firms, supporting the general idea that emerging-market firms look more to foreign firms for access to new capabilities. Nevertheless, the presence of other domestic firms also positively and significantly influences the location choices of domestic firms. The idea that domestic peers can be sources of knowledge has not generally been acknowledged in the literature. However, domestic firms may have an easier time of accessing localized information from other domestic firms than from foreign firms, given their similar backgrounds and strategies. Our contribution in this area opens additional research inquiries in this direction. For instance, it brings up the question of whether free-riding (Shaver & Flyer, 2000) is occurring, and whether it is more common among domestic firms. A World Bank report notes that "a number of enterprises that developed or upgraded product lines did not conduct R&D or acquire technology" (World Bank, 2007: 37), suggesting widespread free-riding. Second, it brings up questions of whether co-location with domestic or foreign firms provides firms with similar or different knowledge bases. As Awate et al. (2012) illustrate, emerging-market firms may be able to catch up along manufacturing or output capabilities through imitative strategies, but matching the innovation capabilities of developed-country firms is substantially more difficult. Thus domestic firms' location choices toward domestic peers compared with foreign entrants may be guided by a desire to catch up along two different dimensions.

Our second contribution is to focus attention on co-location as a way to partake in imitative catch-up. Inherently, catch-up processes involve a certain amount of imitation, as the goal is to match or mimic existing technologies and processes. Co-location enables firms to engage in observation and environmental scanning, and benefit from demonstration effects, which include "imperfect copying of advanced practices" (Meyer & Sinani, 2009: 1077) as well as imitation of "innovations in processes and organizational models" (World Bank, 2007: 6). The "copycat capabilities" of emerging-market firms may begin as pure duplication, but can then evolve into innovative imitation, and eventually into novel innovation (Luo et al., 2011). While some have suggested that knowledge flows in agglomerations are primarily of codified knowledge (Mudambi & Swift, 2012), or that only non-proprietary knowledge is allowed to spill over (Meyer & Sinani, 2009), this is precisely the type of knowledge that firms engaging in aggressive catch-up

initially require, and are skilled in absorbing. In other words, co-location is a strategy suitable for those aiming to imitate "technology that can be easily observed" (Meyer & Sinani, 2009: 1077), and not only are emerging-economy firms skilled in this type of imitation, but it is also one of the principal ways to close the technological gap, or catch up.

Finally, our findings do not mean that the liability of foreignness does not impact on location choice for foreign entrants. Our findings do, however, suggest that measuring the liability of foreignness is not straightforward in emerging economies, as the effect can be masked at certain times, particularly in the course of catch-up. This points to one of the reasons why international business scholars focus on emerging economies – these environments contain dynamics that are distinct from those of developed markets.

One of the limitations of this study is that although we distinguish between two types of externalities – Marshallian (same-industry) and Jacobian (cross-industry) – we do not explicitly consider Porter-type clusters (Porter, 1990). The Porter cluster argument has many similarities to Marshallian externalities: MNEs have much to gain from locating in a cluster, and therefore should locate their subsidiaries in locations where there are other similar firms. Beyond this, the Porter framework is ambiguous as to why foreign vs domestic firms would be attracted to a location. Indeed, the framework is designed for MNEs, and does not focus on the motivations of domestic firms. This, and other, issues have led some researchers to argue that "many of the Porter-type contentions become almost entirely untestable" (McCann & Mudambi, 2005: 1858). As a result, we do not explicitly consider how Porter-type clusters impact on location decisions; however, many of the variables from the Porter framework are already included in our analysis of Marshallian externalities and information learning.

Another limitation is that we focus our analysis on knowledge-seeking investments, and do not consider market-seeking investments. Market-seeking investments are influenced both by supply-side externalities and by demand-side externalities (McCann & Folta, 2008). In addition, if these investments involve manufacturing facilities, they will be affected by scale economies, transportation costs, and the relative size of the manufacturing in an economy (Krugman, 1991). From a theoretical standpoint there is little in the catch-up or liability of foreignness concepts that would imply that our results are not generalizable to other types of investments. However, we leave future researchers to investigate these types of investments.

In our discussion of same-industry agglomeration, we focus on supply-side externalities. We describe three types of externalities – labor market, specialized input suppliers and knowledge spillover – and our arguments imply that these three act jointly to attract entrants. One limitation of this approach is that neither our arguments nor our empirical analysis account for each of these separately.[7] Therefore we cannot be certain that the two sets of entrants – domestic and foreign – are attracted by each of these externalities equally. Do certain types of these externalities act on domestic firms, while others are more important for foreign investors? We know only how these mechanisms act as a group on both domestic and foreign firms, and although this approach is consistent with other studies of foreign entry, it limits how much we can say about how each specific supply-side externality operates individually.

While the presence of cross-industry firms signifies the industrial diversity of a location, there are other measures of diversity that are not captured in this variable. One of these is the ethnic, cultural and linguistic communities that reside in a city. As scholars note, many cities have seen influxes of both foreign and domestic migrants, which cause changes in population composition (de Graaff & de Groot, 2004; de Graaff & Nijkamp, 2010). How these population changes affect the attractiveness of cities to firms is an under-researched area. Future research could examine how these changes affect entry by foreign and domestic firms, and whether too much socio-economic fractionalization may deter the attractiveness of large cities, owing to the "Babylon" effect (Florax, de Graaff, & Waldorf, 2005).

In conclusion, we incorporate agglomeration research from economic geography with international business literature to enhance our understanding of the role that catch-up processes play in domestic firms' location decisions. We use a novel approach of comparing domestic firms' location strategies with those of foreign entrants, arguing that, in the absence of catch-up, foreign investors will be more attracted to agglomerations than will domestic firms, as foreign investors suffer from a liability of foreignness. We show that both types of entrants prefer locations with the presence of other firms. However, we find that it is domestic firms, not foreign ones, that exhibit a stronger preference for these agglomerations, suggesting

that emerging-market firms are competence driven in their location choices.

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NOTES

[1]We thank Special Issue editor Ram Mudambi for suggesting this term.

[2]More specifically, DSIR industry categories are the following: (1) chemical and allied industries; (2) electrical and electronics industries; (3) mechanical engineering industries; (4) agricultural and food processing industries; (5) processing industries (metallurgical, refractories, paper, cement, ceramics, and leather); (6) software; (7) mining and oil extraction; and (8) other.

[3]All firms in India must register and provide a registered office address.

[4]The Institute of Competitiveness, India, is a local Indian affiliate of the Institute for Strategy and Competitiveness at Harvard Business School.

[5]The India Competitiveness Report also ranked cities' administrative infrastructure, although the correlation for that measure was 0.34.

[6]This coding was done by a person of Indian origin who was also involved in the coding in Zaheer et al. (2009). Therefore this coding is entirely consistent with prior work in this area.

[7]We thank an anonymous reviewer for pointing this out to us.

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