Internal versus external agglomeration advantages in investment location choice: the role of global cities' international connectivity

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Internal versus external agglomeration advantages in investment location choice: The role of global cities' international connectivity

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Abstract

Global location choices for foreign direct investments by MNCs aim to benefit both from the advantages of collocation with other activities of the firm (internal agglomeration) and the advantages of proximity to local industry clusters of similar activities (external agglomeration). We submit that there are important trade-offs between internal and external agglomeration because internal knowledge transfer associated with collocation of various value-chain activities of the MNC is confronted with greater risk of knowledge spillovers to rival firms if there is a substantial local cluster. Moreover, we argue that the international connectivity of a location reduces the importance of local agglomeration as a driver of investment location decisions because connectivity allows the MNC to reap benefits from agglomeration at a distance through the (temporary) transfer of people and knowledge. Connectivity changes the trade-offs between internal and external agglomeration because it enhances the spatial reach of internal agglomeration more than external agglomeration. The influence of connectivity is greater for service-related value-chain activities than for production-related activities. We find support for these hypotheses in an analysis of 38,873 greenfield cross-border investment decisions across diverse value-chain activities and industries in 71 global cities, 2008–2016.

Keywords Agglomeration · Cross-border investments · Global cities · Multinational corporations (MNCs) · Multinational enterprises (MNEs) · Value chain · Connectivity · Mixed logit

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Introduction

In recent decades, multinational corporations (MNCs) have been "fine slicing" the location of specific activities in places where they can enjoy the external agglomeration benefits of locating in industry clusters with other firms conducting similar activities (Kano, Tsang, & Yeung, 2020; Lorenzen, Mudambi, & Schotter, 2020). This has led to increasing geographic dispersion of value-chain activities (Acosta & Lyngemark, 2021), which in turn increases firms' spatial transaction costs related to coordinating, integrating, managing, and aligning these activities (Baaij & Slangen, 2013). MNCs can reduce these costs by collocating value-chain activities, such as R&D and manufacturing, in a single location (Castellani & Lavoratori, 2020; Defever, 2006; Ivarsson, Alvstam, & Vahlne, 2017). Hence, MNCs taking decisions on where to locate value-chain activities may face a trade-off between the internal agglomeration benefits of collocating different business activities owned by the same parent company in the same location and the external agglomeration benefits of locating in industry clusters with other firms

conducting similar activities (Alcácer & Delgado, 2016). MNCs have to orchestrate resources across locations taking into account both intra-firm and inter-firm relationships (Kano et al., 2020; Morandi Stagni, Santalo, & Giarratana, 2020). However, the circumstances under which these intra-firm and inter-firm relationships play a lesser or more prominent role have not received due attention in prior research. This is an important gap in our theoretical understanding, given the MNC's core advantage in the orchestration of value-chain activities across locations.

In this paper, we develop a fine-grained understanding of the location decisions of MNCs across different value-chain activities. We examine the relative importance of internal and external agglomeration benefits, their interrelationship, and how these benefits depend on the degree to which a location is globally connected. We argue that the benefits of internal agglomerations are at their greatest when external agglomeration is low and, conversely, when locations offer significant external agglomeration benefits, firms are better off if they refrain from increasing internal agglomeration in the same location. This occurs because collocation of multiple value-chain activities of the MNC in a location is likely to be associated with more intensive knowledge exchange, which increases the risks of unwanted knowledge spillovers to rival firms if the city is characterized by a strong agglomeration of establishments in the same industry. This leads to an asymmetry between knowledge outflows and knowledge inflows, reducing the net benefits of internal and external agglomeration. Moreover, we submit that the connectivity of a location can reduce the costs of coordinating geographically dispersed activities and can extend cluster benefits over longer distances (Belderbos, Du, & Goerzen, 2017; Castellani, Lavoratori, Perri, & Scalera, 2022). This reduces the advantages of spatial proximity to (collocation with) other firms (external agglomeration) and to other value-chain activities of the same firm (internal agglomeration). Distance entails spatial transaction costs because it makes it difficult to reap knowledge spillovers and other agglomeration benefits. International connectivity of a location reduces such spatial transaction costs and alters the influence of internal and external agglomeration forces in the optimal configuration of MNCs' investments.

We argue that connectivity reduces the advantages of internal agglomeration more strongly since, with good connectivity, relationships and coordination at a distance can be achieved through temporary proximity – with managers, sales representatives, researchers, and maintenance experts traveling (Lavoratori, Mariotti, & Piscitello, 2020; Torre, 2008). Finally, we submit that the role of connectivity in facilitating compensating advantages at a geographic distance is more relevant for service-related value-chain activities (such as sales and marketing, headquarters, business services, and logistics) (Muller & Zenker, 2001; Torre, 2008) than for production-related activities (such as manufacturing and R&D) because the latter require more intensive and durable interactions for collocation benefits to take shape.

We examine these conjectures in the context of MNCs' global investment location decisions across global cities. While previous literature has examined the roles of external agglomeration or internal collocation of investments in a single country or industry (e.g., Alcácer & Delgado, 2016; Rawley & Seamans, 2020; Stallkamp, Pinkham, Schotter, & Buchel, 2018), our paper examines location decisions globally at the level of urban areas – global cities. Indeed, global cities are among the world's most connected places and have received a disproportional share of multinational firms' investments (Chakravarty et al., 2021; Goerzen, Asmussen, & Nielsen, 2013), yet they are still strongly heterogeneous in their location traits and degree of connectivity (Lorenzen et al., 2020).

We examine 38,873 greenfield foreign direct investment decisions for various value-chain activities (headquarters, R&D, manufacturing, sales, logistics, and services) and 40 industries involving 19,208 multinational firms in the period 2008–2016 across 71 global cities. We find that both internal and external agglomeration advantages have a significantly positive impact on investment location choice, but internal and external agglomeration weaken each other's impact on the decision to invest in a particular global city. The international connectivity of global cities crucially determines the relative strength of the two drivers of investment location decisions, reducing the role of internal collocation advantages substantially more than the role of external agglomerations, and lessening agglomeration benefits for service-related activities but not for production-related activities.

Our paper contributes to the literature on location strategy (e.g., Alcácer & Delgado, 2016; and on global cities (Belderbos et al., 2017; Castellani & Lavoratori, 2020; Goerzen et al., 2013; Lorenzen et al., 2020; Sassen, 2001) by demonstrating the role of connectivity in the trade-offs between internal and external agglomeration benefits in the quest of MNCs to orchestrate activities across the value chain and locations. Compared to earlier work on global city-location decisions, we contribute a comprehensive analysis across industries, value-chain activities, cities, and investor countries of origin. Our research responds to calls for finer-grained analysis of MNCs' subnational location choices in international business research (Mudambi, Li, Ma, Makino, Qian, & Boschma, 2018), for in-depth research on the consequences of increasing global connectedness (Cano-Kollmann, Cantwell, Hannigan, Mudambi, & Song, 2016), and for critically assessing the (dis)advantages of geographic proximity in cities (Chakravarty et al., 2021).

Theoretical background

We first review the literature on internal agglomeration, external agglomeration, and connectivity, after which we formulate hypotheses on their interactive influence on the global location choices of MNCs across value-chain activities.

Internal Agglomeration

Internal agglomeration denotes the geographic collocation of business activities owned by the same parent company, and it has been recognized as a significant driver of MNCs' location strategy. Internal agglomeration benefits increase the likelihood of firms collocating different value-chain activities both at home and abroad (Alcácer & Delgado, 2016). Bringing together different activities of the same firm allows us to achieve economies of scale and scope from sharing facilities and the associated fixed costs, such as those related to procurement and branding, or sharing internal pools of labor. It makes it easier for firms to develop large-scale operations by sharing or redeploying specialized labor across activities. Fixed costs are shared from investments to attract, retain, and motivate workers. Likewise, geographic proximity enables the firm to increase efficiency by decreasing transportation costs of intermediate inputs as well as increasing the frequency of communication and knowledge sharing between the units (Gray, Siemsen, & Vasudeva, 2015; Rawley & Seamans, 2020).

A particular advantage of MNCs is that they use hierarchical coordination and control to establish intra-firm linkages across their units to exploit unique resources from dispersed activities by coordinating learning processes to augment their capabilities. Collocation facilitates such coordination, monitoring, and control over value-chain activities under the same organizational hierarchy (Alcácer & Delgado, 2016). It facilitates the interactions and knowledge exchange between people from different divisions (Gray et al., 2015; Ivarsson et al., 2017). Interactions between sub-units allow the sharing of exclusive knowledge with other sub-units, positively contributing to problem solving and facilitating tacit knowledge transfer between different functions with strong coordination needs, such as between manufacturing and R&D (Hansen, 1999; Ivarsson et al., 2017). Prior literature has acknowledged that the spatial proximity of units positively affects their performance (Gray et al., 2015; Rawley & Seamans, 2020).

External agglomeration

Firms in the same industry collocate with each other in certain geographic areas to enjoy external agglomeration benefits stemming from pools of skilled labor, specialized suppliers, knowledge spillovers among collocated firms, and concentration of demand (Alcácer & Chung, 2014; Luo, Ma, Makino, & Shinkle, 2020; Marshall, 1890). Local knowledge can be more easily accessed if firms collocate with each other – for instance, because flows of knowledge among firms are facilitated by employee mobility (e.g., Narula et al., 2019; Rosenthal & Strange, 2020).

Recent contributions have highlighted that agglomeration benefits may be heterogeneous because weaker firms may benefit more from geographic clustering than market and technology leaders (Belderbos & Somers, 2015; Shaver & Flyer, 2000). The latter may fear that operating in highly agglomerated locations may dissipate their competitive advantages through the generation of externalities that benefit local competitors. Conversely, the balance between positive (learning from the local context) and negative (losing knowledge to local firms) externalities through agglomeration may be more positive for weaker firms (Mariotti, Mosconi, & Piscitello, 2019). In the hypothesis development below, we build on this logic of heterogeneous benefits from external agglomeration. In particular, we extend this theoretical notion by specifically considering whether the benefits that a firm can enjoy from external agglomeration in a given location may depend on the extent of internal agglomeration that the firm can leverage in that location.

The extant literature has provided ample evidence that the number of existing establishments in a given industry is a key driver for the location of new establishments in the same industry (e.g., Alcácer & Chung, 2014). Studies have also shown that both prior investments of the firm in a location (internal agglomeration) and clusters of firms in the same industry increase the attractiveness of a location for MNC investment (e.g., Nielsen, Asmussen, & Weatherall, 2017). In the current paper, we focus on conceptualizing and testing the nuanced roles of both internal and external agglomeration benefits. Our departure point is that cross-border investment location choices are driven by both agglomeration forces. We will build on this to develop a theoretical framework arguing that these forces interact with each other and are negatively moderated by international connectivity.

International connectivity

Prior literature has recognized the international connectivity of places as one of the most important locational drivers of MNCs (e.g., Bathelt, Malmberg, & Maskell, 2004; Belderbos et al., 2017; Castellani et al., 2022). Belderbos et al. (2017) conceptualize three approaches to understanding

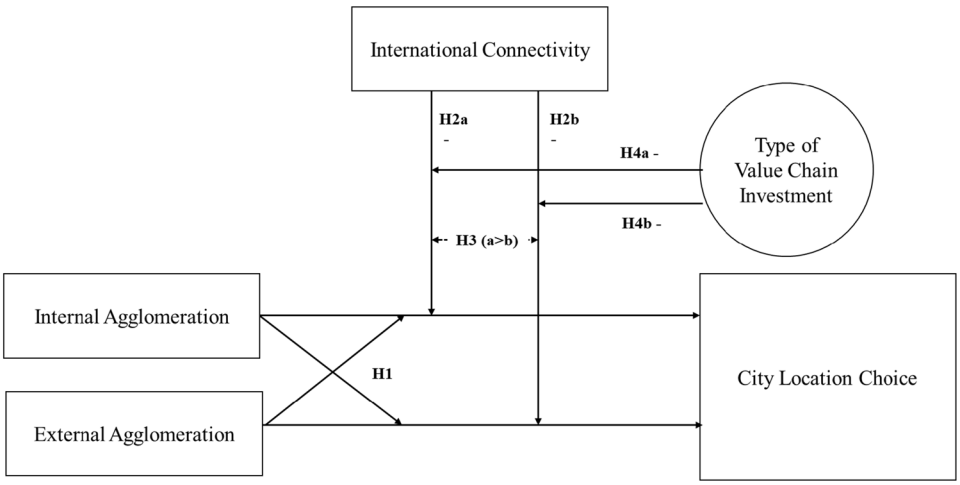

Fig. 1 Conceptual model. H1 suggests that internal and external agglomeration in a city are substitutes in attracting MNC investments. H2a and H2b suggest that a city's international connectivity negatively moderates the influences of agglomeration, while H3 posits that this moderation is stronger for internal agglomeration. H4 suggests that the moderation role of connectivity is weaker for production-related value-chain investments as compared with service-based value-chain investments

the connectivity: the infrastructure approach, the corporate organization approach, and the knowledge-centered approach. The infrastructure approach shows that cross-border urban networks are facilitated by the communication and transport infrastructure (e.g., air transport and telecommunication) supporting the flows of capital, knowledge, and labor (Derudder, Taylor, Ni, Vos De, Hoyler, Hanssens, & Yang, 2010; Mahutga, Ma, Smith, & Timberlake, 2010). The corporate organization approach focuses on global connections driven by the networks of corporate service firms, which enable intra- and inter-firm flows of information and knowledge (Taylor, 2001). Lastly, the knowledge-centered approach studies knowledge and information flows to define cross-border networks, and emphasizes the role of external knowledge inflows in enhancing the competitiveness of cities as local knowledge bases and hubs of international knowledge networks (Bathelt et al., 2004; Belderbos et al., 2017). Connectivity can be regarded as a multi-dimensional concept since flows of (tacit) knowledge, people, and capital all contribute to a location's connectivity in different ways (Belderbos et al., 2017). A recent contribution by Lorenzen et al. (2020) argues that while MNEs can create international connectedness by orchestrating activities across borders, this may create local disconnectedness, in particular between the city core and its catchment area. Our study focuses on a related issue and examines whether the international connectivity of a city alters the role of internal and external agglomeration forces in the city's attractiveness to new MNC investments in different value-chain activities.

Hypothesis development

MNCs have to orchestrate resources across locations, taking into account intra-firm as well as inter-firm relationships, and adopt a leading role in global value chains therewith (Kano et al., 2020; Mudambi et al., 2018). The successful MNC needs to leverage its internal coordination in order to develop the capabilities to orchestrate, transfer, source, and capture value from intangible resources to achieve profitability from fragmented, globally dispersed operations (Lorenzen et al., 2020; Pitelis, 2022). The spatial organization of the MNC's value-chain operations, as it aims to benefit from the agglomeration advantages and international connectivity of locations, becomes a key consideration.

In order to understand how the forces of internal and external agglomeration and international connectivity shape location decisions for the MNC's value-chain investments, we adopt a spatial transaction-cost perspective. Spatial transaction costs are defined as those expenses (e.g., communication, coordination, and monitoring) that relate to the governance and monitoring of actions in the alignment of geographically dispersed activities to achieve synergies or other competitive advantages (Baaij & Slangen, 2013; Mudambi et al., 2018). Such costs increase with distance between corporate functions and units and with the geographic dispersion of different value-chain activities (Alcácer & Delgado, 2016; Belderbos et al., 2017). Moreover, costs increase with distance from a cluster with external agglomeration because it renders it difficult to reap knowledge spillovers and other agglomeration benefits.[1]

The conceptual model of our theory development is illustrated in Fig. 1. We argue that the two agglomeration forces weaken each other's benefits in the same location (H1). Consequently, we submit that the influence of internal and external agglomeration in a location on the attractiveness

[1] We note that this perspective on transaction costs differs from the Coasian view. Rather than being a factor explaining firms' decisions over "make or buy" for certain activities, they contribute to the choice between geographical dispersion and concentration of value-chain activities.

of that location for investment is attenuated by the international connectivity of that location, since connectivity allows internal and external agglomeration benefits to be (at least partially) drawn at a distance (Hypothesis 2a–2b). However, there are important heterogeneities in the influence of connectivity: the consequences of connectivity for the spatial reach of agglomeration benefits are greater for internal than for external agglomeration (H3), and greater for service-related value-chain activities than for production-related value-chain activities (H4a–H4b).

Internal versus external agglomeration economies

A spatial transaction-cost perspective holds that the transaction and coordination costs to integrate and manage different value-chain activities of the firm are reduced if the value-chain activities are collocated because proximity facilitates knowledge sharing and interactions. At the same time, the proximity of a value-chain investment to other establishments in an industry cluster allows that activity to benefit from agglomeration externalities and facilitates knowledge spillovers. We argue that these two influences, while independently positive for a firm's investment choice, also lead to a substitutive relationship between internal and external agglomeration.

MNCs that operate several value-chain activities in a location exhibit a higher frequency of interactions and exchange of knowledge between these units (Castellani & Lavoratori, 2020). MNCs internalize knowledge and management routines by deploying knowledge-sharing mechanisms across local units (Alcácer & Zhao, 2012). Shared experience and the exchange of (tacit) knowledge allows improved coordination and specialization across local units and greater competitiveness in the locations. In this regard, Gray et al. (2015) observed that strong collocation benefits are associated with a high level of tacit process knowledge exchange within the firm.

However, such greater local internal knowledge exchange makes the MNC more vulnerable as a potential source of outgoing knowledge spillovers to rival firms in the local agglomeration (Mariotti et al., 2019; Shaver & Flyer, 2000). Prior research has observed that firms that generate more knowledge spillovers than they gain aim to prevent knowledge outflows to rivals and see industry clusters with rival firms as less attractive locations (Alcácer & Zhao, 2012; Belderbos & Somers, 2015). Firms benefiting from internal agglomeration advantages are likely to put more emphasis on preserving their knowledge that is generated and shared internally. MNCs need to retain control over core "bottleneck" knowledge assets within their global configuration of value-chain and innovation activities (Mudambi et al., 2018). As MNCs become a greater potential source of knowledge spillovers, they have relatively less to gain from incoming knowledge spillovers due to local agglomeration. Furthermore, the internal orientation may render these firms less open to benefit from agglomeration externalities.

This suggests that the more the MNC benefits from internal coordination and knowledge sharing associated with collocation of local value-chain activities, the less it is likely to see relatively strong benefits from external agglomeration. Conversely, if a location has a strong agglomeration, including rival firms, the MNC will find it less attractive to establish collocated value-chain activities to benefit from internal agglomeration. Although both collocation and proximity to industry agglomeration provide advantages by minimizing spatial transaction costs, their incompatibility renders local internal and external agglomeration forces substitutes in the MNC's location decisions.

Hypothesis 1 Internal and external agglomeration weaken each other's association with the probability that a location is chosen for investment by an MNC.

Agglomeration advantages and international connectivity

The literature on agglomeration benefits emphasizes the importance of spatial transaction costs. The benefits from agglomeration economies decrease with distance (Alcácer & Chung, 2014; Lavoratori et al., 2020) because the advantages take place mostly when firms (or sub-units of a firm) are geographically close to each other (Andersson, Larsson, & Wernberg, 2019). Distance from other units or from clusters of firms in the same industry engenders spatial transaction costs, which render benefiting from internal agglomeration more difficult and costly.

International connectivity determines the "ease with which people, goods, capital and knowledge flow across space" (Belderbos et al., 2017; p. 1275), hence reducing spatial transaction costs and allowing firms to relate to internal units more effectively and efficiently at a distance. In well-connected locations, intra-firm collocation of value-chain activities and geographic proximity may not be required, as temporary proximity may ensure sufficient knowledge exchange. Temporary proximity refers to the idea that actors need not be in constant geographic proximity when working together because periodic meetings and project teams may suffice to develop other forms of proximity. The mobility of managers, sales representatives, researchers, and maintenance experts through medium- and short-term visits at different units of the firm can facilitate face-to-face exchange of information and knowledge (Torre, 2008). Shared organizational proximity across units of the firm enhances the effectiveness of temporary proximity by establishing rules, resources, and capabilities for sharing knowledge in long-distance relationships (Gertler, 2008).

Lavoratori et al. (2020) show that intra-firm collocation of activities is less important if temporary mobility of professionals is facilitated. Coscia, Neffke, and Hausmann (2020) highlight the association between knowledge spillovers and temporary ("transient") mobility gauged by corporations' international credit-card usage. Temporary proximity and mobility are facilitated by the strong international connectivity of a city. Hence, if a location provides a firm with connectivity advantages, the firm is likely to weigh internal collocation advantages less in its location decision. This suggests the following hypothesis:

Hypothesis 2a The international connectivity of a location negatively moderates the association of internal agglomeration with the probability that the location is chosen for investment by an MNC.

Furthermore, international connectivity may ensure that knowledge exchanges *between* firms can more easily occur at greater distance. Knowledge flows due to external agglomeration will not remain purely local because cities with strong international linkages receive ample knowledge inflows from elsewhere. With international connectivity, epistemic communities outside the MNC enable flows of knowledge with limited face-to-face interactions (Bathelt et al., 2004). Ease of mobility reduces the costs of moving ideas, extending the spatial reach of knowledge spillovers and the diffusion of ideas. A strong international infrastructure enabling the mobility of people, capital, and resources (Mahutga et al., 2010) and the global supply of advanced producer services (Beaverstock, Doel, Hubbard, & Taylor, 2002; Goerzen et al., 2013) also facilitates access to services at a distance. This reduces the relative benefits of local agglomeration or extends these benefits beyond the narrowly defined location (Alcácer & Chung, 2014).

The arguments above suggest that the relative benefits from agglomeration economies in a certain location decrease when the location is characterized by greater international connectivity because the latter makes it easier to benefit from interactions with firms located elsewhere. We hypothesize:

Hypothesis 2b The international connectivity of a location negatively moderates the association of external agglomeration with the probability that the location is chosen for investment by an MNC.

We argue that international connectivity moderates the role of internal agglomeration more strongly than the role of external agglomeration because the organization of intra-firm relationships driven by organizational hierarchy (Alcácer & Delgado, 2016) can be more easily adapted in line with connectivity to mitigate spatial transaction costs. Temporary proximity is a relatively effective coordination mechanism to substitute for internal agglomeration because it builds on shared organizational proximity that establishes rules, resources, and capabilities for sharing knowledge in long-distance relationships (Gertler, 2008; Torre, 2008). In contrast, benefiting from external agglomeration factors at a distance cannot be managed and coordinated within the firm organization. It requires effort to establish relationships with other firms in these more distant locations. Temporary proximity is much less of a route toward benefiting from external agglomeration at a distance because no parallel coordination mechanisms exist through which firms can build on short-term postings to gain benefits from inter-firm relationships. Furthermore, while international connectivity can facilitate access to buyers and intermediate inputs (including services) at a distance, it has a limited impact on extending the labor-market catchment area and allowing the firm to draw on specialized labor from elsewhere. Whereas buyer and supplier linkage advantages may play out at some greater distance due to efficiency in transportation, the benefits of agglomeration through knowledge spillovers and labor mobility are more geographically confined (Alcácer & Chung, 2014). Hence, the weakening influence of connectivity will be less pronounced for external than for internal agglomeration. This suggests the following hypothesis:

Hypothesis 3 The negative moderating influence of international connectivity on the association between a firm's location choice and agglomeration is stronger for internal agglomeration than for external agglomeration.

MNCs are active in various value-chain activities that have different collocation propensities. We conjecture that their spatial organization is also differentially affected by the moderating influence of international connectivity on the benefits of agglomeration. In general, by facilitating temporary proximity, international connectivity reduces the benefits of internal and external agglomeration because it reduces spatial transaction costs and allows firms to relate to external parties and internal units more effectively and efficiently at a distance. However, it has been suggested that temporary proximity is more relevant in service-related activities (Mariotti, Mutinelli, Nicolini, & Piscitello, 2015; Muller & Zenker, 2001). Service-related activities (such as sales and marketing, headquarters, business services, and logistics) are largely immaterial, embodied in specialized professionals, and inherently more mobile. This reduces the need for permanent physical proximity because services can be supplied from a distance and occasional face-to-face meetings can be efficient means of coordination and a beneficial way to complement long-distance knowledge sharing (Lavoratori et al., 2020). Headquarters activities are a typical example where the advantages of temporary proximity have been discussed

(Castellani et al., 2022). Empirical evidence supports the importance of temporary assignments in the HQ's relations with both its internal and external stakeholders (O'Donnell, 2000). Such mobility of individuals from and to the headquarters' locations is crucial to facilitate effective decision-making and intra-MNC resource orchestration, foster knowledge transfer and sharing, and enable the emergence of organizational synergies (Belderbos et al., 2017; O'Donnell, 2000).

We distinguish service-related activities from production-related activities. The latter include manufacturing activities – which are frequently associated with the territorial integration of material assets and dedicated human resources (Lavoratori et al., 2020) – and R&D activities. R&D laboratories, while being highly knowledge-intensive, are often linked to spatially bound material assets, such as research infrastructure and equipment. Moreover, it has been widely documented that R&D often strongly benefits from collocating with manufacturing activities due to their close relationship and in-depth interaction, leading to strong synergies (e.g., Castellani & Lavoratori, 2020; Defever, 2006; Gray et al., 2015; Ivarsson et al., 2017).

We conclude that whereas for service-related activities temporary proximity facilitated by international connectivity may provide an alternative to collocation benefits, for production-related activities the strong benefits of permanent geographic proximity – due to a continuous knowledge exchange and reliance on local material assets – reduce the potential for international connectivity to provide similar benefits. This suggests the following hypothesis:

Hypothesis 4a The negative moderating influence of international connectivity on the association between a firm's location choice with internal agglomeration is stronger for service-related value-chain investments than for production-related value-chain investments.

While international connectivity facilitates inter-firm knowledge transfer and access to intermediate inputs and services at a distance, thus reducing the importance of collocating with other firms to benefit from external agglomeration economies, this influence is also expected to differ across value-chain activities. In particular, while in the case of service-related activities – given the largely immaterial nature of these activities – international connectivity facilitates the transmission of agglomeration benefits at distance. In production-related activities, the higher reliance on spatially bound material assets increases the importance of being located close to clients, suppliers, and competitors (Gertler, 2008), and it reduces the role of international connectivity in extending these external agglomeration benefits beyond the narrowly defined location. We hypothesize:

Hypothesis 4b The negative moderating influence of international connectivity on the association between a firm's location choice with external agglomeration is stronger for service-related value-chain investments than for production-related value-chain investments.

Data, variables, and methods

Our analysis draws on an extensive database on cross-border greenfield investments compiled by the Financial Times Ltd (fDi Markets). The dataset records more than 190,000 cross-border investment projects covering value-chain activities, such as HQ, R&D, manufacturing, sales and marketing, business services, and logistics. The coverage of the fDi Markets database is seen as representative of FDI flows (Crescenzi, Pietrobelli, & Rabellotti, 2014). We analyze investments made over the period from 2008 to 2016 and operationalize the internal and external agglomeration variables by cumulating 5 years of prior investments.

Our location choice analysis is conducted at the level of cities. The location choice set includes 75 global cities that are ranked as having the most important "Global Power" by MasterCard (2008). Unavailability of data on independent variables reduces the number of cites that could be included to 71. During the period 2008 to 2016, we observed 38,873 greenfield investments located in these 71 cities by 19,208 multinational firms based in 97 different home countries. Our analysis focuses solely on greenfield investments in a value-chain activity and omits follow-up investments in a city by a focal firm in the same value chain. Such follow-up investments, focusing on the expansion of existing activities, are likely to be driven by different factors, such as the prior performance of the existing investment, compared to first-time investments for which the location choices are less constrained. Focusing on greenfield investment ensures a more appropriate testing ground for our hypotheses on the influence of internal and external agglomeration. Utilizing information on the type of investments in the fDi Markets dataset and following the value-chain activities framework of Porter (1985), we distinguish between six types of activities: R&D (research and development, design, development and testing, technical support centers), headquarters (including shared services centers), manufacturing (including recycling), services (business services, education and training), logistics (infrastructure and logistics, distribution and transportation) and sales (customer contact centers, maintenance and servicing, retail and sales, marketing and support). We note that human resource management, procurement, and legal, accounting, and finance support functions ("firm infrastructure"), originally considered in Porter's framework, are not individually distinguished but included in the headquarters category. Construction, electricity, and extraction, which

account for a minor 2.95% of cross-border investment projects observed in the fDi Markets database, are not easily classified, and are excluded from our sample. In line with our theoretical framework, we group the six activities into production-related (including manufacturing and R&D) and service-related (headquarters, services, logistics, and sales) activities.

Sales activities take the lion's share of investment (20,618; 53%), followed by business services (10,254; 26.4%) and HQ activity (2,791; 7.2%). Relatively low numbers of foreign investment projects are observed for manufacturing (1480; 3.8%) consistent with the notion that these investments are less likely to locate in urban areas due to space constraints and rent costs (Goerzen et al., 2013). Among the global cities, London received the largest share of investments (3028; 7.8%), followed by Singapore (2866; 7.4%), Dubai (2002; 5.2%), and Shanghai (1909; 4.9%) (see Table B1 and B2 in the online appendix).

Focal variables

The dependent variable in our analysis is the firm's choice to locate its value-chain activity in one of the 71 cities included in our sample. For each cross-border investment in our sample, it takes the value of 1 when the investment takes place in city *j* and zero for all other cities in the choice set. Among the focal variables, our measure of *international connectivity* is a composite of three items: cities' producer services connectivity, airport passenger traffic flows, and international knowledge connectivity. The composite approach follows from prior literature suggesting that international connectivity is a multi-dimensional concept because flows of (tacit) knowledge, people, and capital all contribute to a location's connectivity in different and complementary ways (Belderbos et al., 2017).

Data on international producer service connectivity of cities are obtained from Loughborough University's GaWC resources. Connectivity is calculated as the weighted number of linkages between a city and 314 other world cities created by the world's top 100 producer service firms through their global networks of offices (Taylor, 2001). The producer services connectivity index is based on the premise that flows of information between cities in the network are a function of the importance of the office (Derudder et al., 2010). The connectivity is taken as a relative index score of the city compared to the yearly maximum value in the sample (i.e., London).[2]

Airport connectivity is an indicator of the international flow of passengers to and from a city. We include the yearly number of passengers recorded at the global cities' airports, drawn from various data sources including Airports Council International (ACI), Centre for Aviation (CAPA), EUROSTAT, and airport and city websites. We normalize international airport passenger flows by expressing passenger numbers as an index relative to the yearly maximum value in the sample.

International knowledge connectivity is an indicator of the international co-invention activities emerging from a city. We define international co-invention linkage as a patent that has at least one co-inventor residing in a different country from a global city's country (Belderbos et al., 2017). International knowledge connectivity is calculated by the share of a city's patents with international co-invention linkage(s) in the total number of patents invented in the city, and it is normalized by taking the score relative to the yearly maximum value in the sample. Patent data are drawn from the PATSTAT statistical patent database and are identified at the patent family level. Patents are allocated to cities based on geocoding inventors' residences drawing on various sources such as De Rassenfosse et al. (2019) and PatentsView from USPTO.

We then calculate a composite measure of international connectivity by averaging the indexed scores across the three dimensions of connectivity. To do so, we adopt the "maximum-weight" approach to aggregation using for each city *j* the formula $Connectivity_{jt} = 100 \sum_{z=}^{3} \frac{1}{3}(X^{z}_{jt}/X^{z}_{max,t})$, with X^{z}_{jt} as the value for city *j* of the connectivity dimension *z* in year *t* and $X^{z}_{max,t}$ as the maximum for the same dimension across all cities in year *t*.[3] Cities with large shares of foreign investment tend to have a high degree of international connectedness. In particular, London (80.8) and Dubai (80.4) exhibit high international connectivity (see Table B2 and B3 in the online appendix).

Our focal variable *internal agglomeration* takes into account the specific collocation benefits of pairs of value-chain activities. For each investment project, made by focal firm *i* in value-chain activity *j* and city *c*, included in our sample, we measure internal agglomeration by the weighted sum of the focal firm's prior investments in the five value-chain activities other than the focal value-chain activity of investment, in the city during the 5 years prior to the investment year. The higher the number of previous investments of a firm in a city, the higher the internal agglomeration benefits. However, these benefits differ by pairs of collocated activities (e.g., Alcácer & Delgado, 2016; Defever, 2006). Therefore, we weigh these prior investments with a "collocation propensity" parameter, which reflects how often a pair

[2] We obtain yearly data on cities' producer services connectivity by interpolating values for the intermediate years.

[3] For illustration purposes, the international connectivity scores of the cities for the year 2015 are shown in the online appendix. In our regressions, the international connectivity refers to the year before the focal location decision.

Table 1 Collocation propensity parameters for the six value-chain activities

	HQ	Logistics	Manufacturing	R&D	Sales	Services
HQ	–	0.301	0.329	0.454	0.361	0.422
Logistics	0.177	–	0.320	0.241	0.249	0.254
Manufacturing	0.150	0.227	–	0.284	0.163	0.170
R&D	0.352	0.286	0.421	–	0.326	0.283
Sales	0.210	0.173	0.185	0.270	–	0.296
Services	0.256	0.229	0.249	0.325	0.314	–

of activities are collocated and serves as a revealed collocation advantage indicator.

We assume that if firms collocate activities A and B more often than A and C, the expected benefit of collocating A and B is higher than for A and C. Alcácer and Delgado (2016) use the locational correlation of employment to demonstrate different levels of relatedness between pairs of value-chain activities and confirm that the weighted measure provides a more accurate estimate of the role of internal agglomeration in the context of the biopharmaceutical industry in the US. Internal agglomeration benefits vary by the kinds of collocated value-chain activities because of the requirements in coordination that motivate companies to integrate activities in proximity to each other (Alcácer & Delgado, 2016; Defever, 2006; Gray et al., 2015; Ivarsson et al., 2017).

We construct collocation propensity parameters, which we use as weights to calculate internal agglomeration advantages due to a firm's existing investment in a global city, specific to the focal value-chain investments for which a location choice is made. We establish the revealed collocation propensity weights for each pair of value-chain activities by examining the population of cross-border investment locations by firms that have investments in multiple value-chain activities in a host country between 2003 and 2016. We then calculate the share of investments in value-chain activity j that is collocated with value-chain activities k (in the same city), and vice versa.[4] The aggregated ratio of city collocation for each value-chain pair, as a share of the total number of investments for that value-chain pair in the country of the city, is the collocation propensity indicating the advantage of collocation for each value-chain pair.

The collocation propensities are presented in Table 1. These ratios show that the propensity to collocate is highest for R&D with respect to manufacturing (0.421) and HQ with respect to services (0.422). The collocation advantages and propensities are not necessarily symmetric. The propensity of manufacturing to be collocated with R&D is 0.284 and of service to be collocated with HQ is 0.256. Hence, manufacturing and services are less dependent on collocation with R&D and HQ than vice versa, attesting to the supporting function of R&D and HQ operations. The collocation propensity is lowest for manufacturing with respect to HQ (0.150), while the earlier collocation propensity of manufacturing with R&D is the highest among the collocation propensities for manufacturing activity. These results are consistent with the findings in prior research (Alcácer & Delgado, 2016; Defever, 2006; Ivarsson et al., 2017). We note that the collocation propensities are not necessarily symmetric. For example, many HQ activities may be located in places where the firm also has R&D operations (a collocation propensity of 0.454), but that does not mean that HQ activities are located with R&D activities to the same extent (a collocation parameter of 0.352). The variable internal agglomeration is then defined as follows:

$$Internal\ agglomeration_{i,j}^{v} = \sum_{k} w_{k}^{v} a_{i,k,j}, \quad v \neq k \tag{1}$$

where w_k^v is the collocation propensity of value-chain activity v given the presence of value-chain activity k and $a_{i,k,c}$ is focal firm i's sum of prior investments in the past 5 years in value-chain activity k in city j.

External agglomeration is an indicator of the number of establishments in a city in the focal value-chain activity and industry. Hence, it is an industry-, activity-, and location-based count. We derive the measure drawing on fDi Markets data using the detailed industry classification, which distinguishes 40 industries. External agglomeration is the sum of foreign firms' investments and domestic firm establishments in the city, industry, and value-chain activity in the 5 years prior to the focal investment. We measure domestic, local establishments in a city by identifying local firms based in the city that invest abroad. We count how many firms are present in a city in the focal industry and value-chain activity as evidenced by local firms' foreign investment activities in the prior 5 years. We test Hypotheses 1, 2, and 3 by including interaction terms between *internal agglomeration* and *external agglomeration*, between *international connectivity* and *internal agglomeration,* and between *connectivity* and *external agglomeration*. We mean-center the

[4] The collocation propensities are similar in concept to the locational correlation weights examined by Alcácer and Delgado, with the difference that their study used employment as a continuous measure while our study examines whether value-chain activities are collocated or not.

variables' connectivity, internal agglomeration, and external agglomeration before estimating interaction terms so that the coefficient of the main effects of connectivity and the two agglomeration variables represent their effects evaluated at mean connectivity and mean agglomeration, respectively.

To test Hypothesis 4, we distinguish value-chain activities related to production (manufacturing and R&D) and value-chain activities that are service-related (HQ, logistics, sales, and services), and we conduct sub-sample location choice analysis to compare the negative moderating effect of international connectivity on the effects of internal and external agglomeration between the two sub-samples.

Control variables

We control for the specific benefits in terms of reduction in informational uncertainty and increased legitimacy pertaining to foreign investment when peers from the same home country of firm *i* have invested in city *j* (e.g., Henisz & Delios, 2001; Stallkamp et al., 2018). We include the variable "home country investment share", representing the share of external agglomeration due to investors from the same home country.

The analysis controls for a city's GDP and GDP growth rate as proxies of a city's market size and economic potential, respectively. Data on GDP is drawn from the Oxford Economics database, which provides fine-grained city-level socio-economic indicators for more than 170 cities worldwide. We also include population density to control for the impact of urban agglomeration economies in a city, and we enter population density squared in order to account for potential congestion costs of agglomeration. In addition, we control for two cost-related factors: the corporate tax rate and the wage level, which are likely to have a negative effect on the attractiveness of cities for FDI. Data on corporate tax rates at the country level are obtained from KPMG, while data on wage levels of skilled employees at the city level are obtained from UBS's Price and Earnings reports.

Next, we control for three distance measures, which are main factors of liability of foreignness and spatial costs – thus, recognized as important determinants of FDI location decisions: language, geography, and culture (e.g., Asmussen & Goerzen, 2013; Belderbos et al., 2017; Cano-Kollmann et al., 2016; Kogut & Singh, 1988). Language distance between home and host countries is retrieved from the linguistic distance database established by Dow and Karunaratna (2006). Geographic distance between source and host city is measured by spherical distance using coordinates (i.e., latitude and longitude) of the cities. Geographic coordinates of the cities are retrieved from the GeoNames geographic database, which covers over 11 million locations worldwide (https://www.geonames.org). Cultural distance is the Kogut and Singh index of cultural differences based on Hofstede cultural dimensions, which is the most widely used cultural distance measure in international business research (Hofstede, 1980; Kogut & Singh, 1988). Hofstede's four dimensions of national culture (i.e., power distance, individualism, masculinity, and uncertainty avoidance) for both home and host countries are retrieved from Hofstede Insights (https://www.hofstede-insights.com).

We control for city-level patent intensity (i.e., the number of patents in city *j* divided by the city population) as a proxy of the extent to which a city is active in technological activities. Moreover, we include a measure of a city's academic strength, using the number of world top 500 universities located in city *j* as a proxy. We retrieved the measure from Academic Ranking of World Universities (ARWU) by the Shanghai Ranking Consultancy. In addition, we control for the attractiveness of a city for international labor by including the annual net migration rate in the city drawn from Oxford Economics. Finally, we control for country-level GDP, GDP growth, and population density with data taken from the World Bank Development Indicators.

All continuous variables are taken in logarithmic form and are 1-year-lagged with respect to the year of the focal cross-border investment project. Summary statistics of the explanatory variables and coefficients of correlation are given in Table 2. The correlation coefficients do not raise multicollinearity concerns. This is confirmed by a variance inflation factor (VIF) test, which indicates that all scores are less than 5, with the highest value indicated for top universities (2.44).

Methods

Our empirical analysis is based on the premise that each firm *i* has to make a location decision for a cross-border investment project, taking place in sector *s*, value-chain activity *v*, at time *t*. The firm has a choice set of J alternatives (global cities in our case).[5] For each location decision, firm *i* will choose the location providing the highest profit. This profit is modeled through a set of independent variables that have different sources of variation. McFadden (1974) has shown that such a discrete choice process can be modelled as a conditional logit model, which relates the probability that a location will be chosen over all others to their respective locational characteristics.

Among our three focal variables, internal agglomeration varies across firm, value chain, city, and year; external agglomeration varies across industry, value chain, city, and year; and international connectivity varies across city and year. Other independent variables are either measured at the

[5] Since the analysis focuses on cross-border investments only, the number of global cities in a location choice set is the number of cities minus the number of cities located in the home country of the focal firm.

Table 2 Summary statistics and correlations

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
(1) Location choice																				
(2) Internal agglomeration	0.023																			
(3) External agglomeration	0.069	−0.016																		
(4) International connectivity	0.071	0.046	0.276																	
(5) Home-country investment share	0.031	0.026	0.354	0.051																
(6) City GDP	0.053	0.016	0.163	0.179	0.021															
(7) City GDP growth rate	0.019	0.039	0.053	−0.061	0.035	−0.142														
(8) Population density	0.004	0.009	0.004	0.168	−0.003	−0.187	0.219													
(9) Population density squared	−0.005	0.000	−0.032	0.146	−0.012	−0.156	0.142	0.937												
(10) Wage level	0.005	−0.029	−0.004	−0.025	−0.005	0.413	−0.452	−0.601	−0.482											
(11) Geographical distance (km)	−0.014	0.006	−0.008	−0.060	0.049	**0.120**	0.169	0.215	0.186	−0.229										
(12) Patent intensity	0.000	−0.014	0.022	−0.135	0.016	0.370	−0.059	−0.266	−0.252	0.440	−0.069									
(13) Top universities	0.034	0.007	0.080	0.097	0.017	0.639	−0.211	−0.429	−0.369	0.587	−0.054	0.472								
(14) Net migration rate	0.027	0.040	0.051	0.026	0.047	−0.180	0.248	−0.048	−0.055	−0.041	0.002	−0.095	−0.159							
(15) Corporate tax rate (%)	−0.036	−0.033	−0.146	−0.360	−0.018	0.289	−0.042	−0.048	−0.011	0.078	0.057	0.171	0.256	−0.340						
(16) Language distance	−0.008	0.016	−0.011	0.096	−0.151	0.061	0.120	0.154	0.055	−0.267	0.181	0.030	−0.057	0.028	−0.146					
(17) Cultural distance	−0.011	0.016	0.012	0.118	−0.087	−0.069	0.171	0.235	0.144	−0.331	0.205	−0.076	−0.145	0.026	−0.176	0.424				
(18) Country GDP	0.014	0.009	0.038	−0.309	−0.001	0.555	0.131	−0.225	−0.227	0.072	0.152	0.288	0.207	−0.065	0.443	0.019	−0.113			
(19) Country GDP growth rate	0.020	0.039	0.055	−0.010	0.034	−0.137	0.850	0.295	0.224	−0.473	0.196	−0.065	−0.225	0.190	−0.065	0.138	0.184	0.109		
(20) Country population density	0.039	0.034	0.122	0.282	0.038	−0.132	0.098	0.280	0.167	−0.200	−0.120	0.173	−0.012	−0.039	−0.144	0.144	0.155	−0.193	0.127	
Mean	0.015	0.006	20.992	32.230	0.093	233.507	0.030	3641.9	97.210	51.479	7349.6	0.601	2.242	0.006	27.620	−0.392	7.016	3864	0.026	342.21
Std. Dev.	0.122	0.057	43.342	12.228	0.153	258.662	0.041	9162.2	565.230	31.895	4368.8	1.173	2.136	0.011	7.969	1.268	5.289	5291	0.035	1135.9

Means and standard deviations are presented before taking the logarithm. GDP in billions of dollars. Density in persons per km^2

city level yearly (i.e., GDP, GDP growth, population density wage levels, patent intensity, top universities, net migration rate), at the country-year level (the corporate tax rate, language distance, cultural distance, GDP, GDP growth), or at the firm-city level (geographic distance from headquarters). In line with much literature on location choice (e.g., Belderbos & Somers, 2015; Castellani & Lavoratori, 2020; Defever, 2006), we estimate conditional logit and mixed (random parameter) logit models, with the latter allowing for general heterogeneity in investor preferences (Train, 2009).

We note that, in the conditional and mixed logit models, variables that do not vary across locations are unable to explain differential profits between locations and, hence, the probability of choosing a given location. Conditional on investment taking place, the model analyses the antecedents of location choice. Hence, variables such as firm size and firm or industry fixed effects cannot be included because they do not vary across location, but a firm's prior investments in a location can. Although coefficients estimated with nonlinear models, such as the conditional logit model, are generally not directly interpretable as elasticities, it has been shown that the average elasticity of the probability of location choice with respect to a logarithmic transformed independent variable can be calculated as (Z-1)/Z times the coefficient of the variable, where Z is the total number of choices (Greene, 2003, p. 723). In our model, the average number of choices (cities) in the choice set is 67 (as some cities are located in the home country of the investor and, hence, are not candidate cities for FDI). With a choice set of this size, the average elasticities approximate over 0.985 of the estimated coefficients of continuous variables in our models.

Empirical results

Table 3 reports the mean of parameters estimated via mixed logit models of the determinants of the choice of locating MNCs' activities across 71 global cities; details on the estimates of the random components are available in Table A1 of the online appendix.[6] Model 1 in Table 3 includes only the control variables, which behave largely as expected. The share of same home-country investments in the external agglomeration in the city has a positive and significant coefficient. This confirms prior findings on the positive role of same-country or co-ethnic prior investments (Henisz & Delios, 2001; Stallkamp et al., 2018). GDP, GDP growth rate, and population density, at the city and country level, have positive associations with the FDI location choice. The negative and significant coefficient of the squared term of population density implies that congestion costs lead to diminishing marginal benefits of density. Corporate tax and wage levels, as well as the three distance measures, have a negative association with MNCs' location choices. The presence of a top university in the city and net migration are positively associated with cross-border investments, while the patent intensity of a city appears to have a somewhat surprising negative association with MNCs' location choices. This is driven by investments in service-related activities, as revealed in the last two columns of Table 3.

Model 2 indicates positive effects of internal and external agglomeration and international connectivity, while Model 3 adds the interaction between internal and external agglomeration. Model 4 includes the interaction terms between connectivity and the agglomeration variables, and Model 5 shows the results of a fully specified model. Columns 6 and 7 show the results for producer-related and service-related value-chain activities separately.

Model 3 shows a negative and significant coefficient of the interaction term ($\beta = -0.921$, $p < 0.001$), and confirms Hypothesis 1. Model 4 suggests that Hypotheses 2a, 2b, and 3 are supported: the coefficients on the interaction terms of connectivity and internal and external agglomeration are negative and significant, and larger for internal agglomeration ($\beta = -1.486$, $p < 0.001$) than for external agglomeration ($\beta = -0.150$, $p < 0.001$). The difference between the coefficients is significant (chi-square = 30.44; $p < 0.001$). Incremental Wald Chi-square tests confirm that the goodness of fit of the model improves significantly as the hypotheses testing variables are added. Models 6 and 7 show that the negative moderating effect of international connectivity is strong in the sub-sample of service-related investments, for both internal ($\beta = -1.105$, $p < 0.001$) and external agglomeration ($\beta = -0.163$, $p < 0.001$), while, in the sub-sample of production-related value chain investments, no significant negative moderation is observed: ($\beta = 0.535$, $p = 0.216$ for internal agglomeration and $\beta = -0.026$, $p = 0.570$ for external agglomeration. The differences in the interaction effects between service-related and production-related investments are significant: $\Delta\beta = -1.640$, $p < 0.01$ for internal agglomeration, and $\Delta\beta = -0.137$, $p < 0.01$ for external agglomeration.[7] These results confirm Hypotheses 4a and 4b.

We note that the focal variables are demeaned, such that the effects implied by the coefficients apply to the situation in which the moderator variables are at the sample mean. The estimated coefficients in Model 2 suggest that a 10% increase in internal agglomeration and external agglomeration lead

[6] Since mixed logit commands restrict the number of coefficients that can be set as random to 20, we set the coefficients of control variables that did not have a significant random component in baseline models as fixed.

[7] The Wald tests were performed by estimating the two models jointly, using the SUEST command in STATA.

Table 3 The determinants of MNCs' location choices for value-chain investments across global cities: Results of mixed logit models

	Model 1	Model 2	Model 3	Model 4	Model 5	Production-related investments	Service-related investments
City-level variable							
Internal agglomeration		0.487	0.731	0.902	0.852	1.350	0.668
		(0.021)	(0.000)	(0.000)	(0.000)	(0.001)	(0.007)
External agglomeration		0.734	0.742	0.806	0.811	0.803	0.785
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Connectivity		0.128	0.129	0.156	0.156	0.0645	0.157
		(0.000)	(0.000)	(0.000)	(0.000)	(0.403)	(0.000)
Internal agglomeration * external agglomeration			−0.921		−0.874	−0.967	−0.937
			(0.000)		(0.000)	(0.000)	(0.000)
Connectivity *internal agglomeration				−1.486	−0.701	0.535	−1.105
				(0.000)	(0.002)	(0.216)	(0.000)
Connectivity *external agglomeration				−0.150	−0.148	−0.0255	−0.163
				(0.000)	(0.000)	(0.570)	(0.000)
Home-country investment share	1.879	0.835	0.833	0.738	0.750	0.371	0.766
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.034)	(0.000)
GDP	0.744	0.304	0.300	0.318	0.315	0.313	0.336
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
GDP growth	1.208	1.166	1.197	1.412	1.427	1.826	1.185
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.043)	(0.000)
Population density	0.790	0.221	0.232	0.267	0.251	0.397	0.240
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.008)	(0.000)
Population density squared	−0.379	−0.0760	−0.0788	−0.0892	−0.0809	−0.147	−0.0785
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.018)	(0.000)
Wage level	−0.206	−0.0506	−0.0550	−0.0404	−0.0446	−0.344	−0.00885
	(0.000)	(0.001)	(0.000)	(0.010)	(0.005)	(0.000)	(0.592)
Geographical distance	−0.264	−0.191	−0.183	−0.191	−0.192	−0.155	−0.197
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Patent intensity	−0.508	−0.112	−0.0591	−0.0902	−0.0546	0.0307	−0.108
	(0.000)	(0.001)	(0.121)	(0.015)	(0.151)	(0.846)	(0.006)
Top universities	0.0466	−0.0601	−0.0616	−0.0589	−0.0629	0.0289	−0.0734
	(0.002)	(0.000)	(0.000)	(0.000)	(0.000)	(0.586)	(0.000)
Net migration rate	4.689	2.792	2.650	1.832	1.746	3.324	1.706
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.021)	(0.000)
Country-level variable							
Corporate tax rate	−0.534	−0.184	−0.183	−0.211	−0.213	−0.323	−0.211
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Language distance	−1.083	−0.893	−0.894	−0.946	−0.925	−1.060	−0.926
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Cultural distance	−0.156	−0.124	−0.121	−0.122	−0.126	−0.0256	−0.128
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.466)	(0.000)
Country GDP	0.0802	0.0786	0.0744	0.0726	0.0746	0.0789	0.0685
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.002)	(0.000)
Country GDP growth	6.322	2.345	2.193	1.740	1.675	1.440	2.116
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.182)	(0.000)
Country population density	0.177	0.0458	0.0445	0.0477	0.0449	0.000546	0.0544
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.974)	(0.000)
Observation	2590706	2590706	2590706	2590706	2590706	244009	2346697
Number of projects	38873	38873	38873	38873	38873	3699	35174

Table 3 (continued)

	Model 1	Model 2	Model 3	Model 4	Model 5	Production-related investments	Service-related investments
Number of firms	19208	19208	19208	19208	19208	2327	17947
Wald chi^2	11578.0	17636.8	17464.6	14663.0	15038.2	3546.5	12791.0
(p value)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
	Reference	Model 1	Model 2	Model 2	Model 2		
Incremental Wald chi^2 (p value)		25.25	147.84	226.29	325.88		
		(0.000)	(0.000)	(0.000)	(0.000)		

p values in parentheses. Coefficients show the mean of parameter estimates. Estimates of the standard deviations of the random parameters are available in Table A1.

Table 4 Marginal effects: The elasticities of investment location choice with respect to internal and external agglomeration

Ext. agglomeration level	Elasticity w.r.t. Internal agglomeration	Int. agglomeration level	Elasticity w.r.t. External agglomeration
Mean - 2SD	3.561	Mean - 2SD	0.871
	(0.000)		(0.000)
Mean	0.840	Mean	0.800
	(0.000)		(0.000)
Mean + 2SD	− 1.554	Mean + 2SD	0.729
	(0.000)		(0.000)
International connectivity	Elasticity w.r.t. Internal agglomeration	Elasticity w.r.t. External agglomeration	Int./Ext. elasticity
Mean - 2SD	1.324	0.901	1.469
	(0.000)	(0.000)	(0.000)
Mean	0.840	0.800	1.05
	(0.000)	(0.000)	(0.000)
Mean + 2SD	0.342	0.702	0.487
	(0.089)	(0.000)	(0.090)

p values in parentheses. Elasticities are calculated based on the estimated coefficients reported in Table 3

to a 4.8% and 7.2% increase in the probability that a city is chosen as the location for FDI, respectively.

Table 4 shows the values of the elasticities for the internal (external) agglomeration variable at different levels of external (internal) agglomeration based on the estimated coefficients in the fully specified models of Table 3. If the elasticity of location choice with respect to agglomeration is β and the interaction effect of agglomeration and connectivity $\gamma * C$, then the elasticity with respect to agglomeration is $\beta + \gamma * C$. We calculate $\beta + \gamma * C$ for different levels of C (connectivity). The other elasticities in Table 4 are calculated analogously.

Table 4a illustrates the support for Hypothesis 1. The elasticity with respect to internal agglomeration declines strongly from 3.561 ($p < 0.001$) to – 1.554 ($p < 0.001$) as external agglomeration increases from two standard deviations below the mean to two standard deviations above the mean, while the elasticity with respect to external agglomeration declines, albeit to a more limited extent, from 0.871 ($p < 0.001$) to 0.729 ($p < 0.001$), if internal agglomeration increases by the same range. The elasticity with respect to internal agglomeration becomes significantly negative at high levels of external agglomeration.

Table 4b shows the values of the elasticities of location choice with respect to internal and external agglomeration at different levels of international connectivity (i.e., mean-2sd, mean, and mean+2sd). The coefficients on the agglomeration variables steadily decrease if connectivity increases from two standard deviations below the mean to two standard deviations above the mean. The elasticity with respect to internal agglomeration declines by 74.2% from 1.324 ($p < 0.001$) to 0.342 ($p = 0.089$) (74.2%),

while in the case of external agglomeration the elasticity declines by 22.1%, from 0.901 ($p < 0.001$) to 0.702 ($p < 0.001$). The ratio of the two elasticities declines from 1.469 ($p < 0.001$) to 0.487 ($p = 0.090$). This again demonstrates that the negative moderating effect of connectivity is much stronger in magnitude for internal than for external agglomeration, in further support of Hypothesis 3.

Supplementary analyses

We carried out several supplementary analyses to examine the robustness of our findings, results of which can be found in the online appendix. Since estimation of mixed logit models is computationally intensive with the number of observations that we have in our models, and prone to non-convergence of the maximum likelihood maximization algorithm, we conducted these additional analyses with conditional logit models. First, we show that conditional logit estimates are in line with those of the mixed logit (Table A2). Second, we allowed for non-linearity in the effect of agglomeration by including the squared terms of the agglomeration variables in the models (Table A3). The estimates for the focal variables also remained consistent. Third, we substituted the cumulative counts for the 5-year window agglomeration variable produced comparable results (Table A4). Fourth, we estimated separate models for each value-chain activity (Table A5). These results show positive coefficients for internal and external agglomeration and negative interactions between internal and external agglomeration across all activities. Interactions with international connectivity are significant for service-related activities (HQ, logistics, sales, and business services) but not for production-based activities, in line with Hypothesis 3. Fifth, using a different industrial classification to capture external agglomeration – either a more aggregate (18 industries) classification or a finer-grained NAICS-based industry definition (39 industries) – also showed consistent results (Table A6 and A7). Finally, including country fixed effects in the models did not alter support for the hypotheses (Table A8).

Discussion and conclusion

Discussion of findings

This paper investigates MNCs' investment location decisions in global cities. We examine 38,873 greenfield foreign direct investment decisions across 71 global cities for various value-chain activities (headquarters, R&D, manufacturing, sales, logistics, and services) and 40 industries by 19,208 multinational firms in the 2008–2016 period. While, on the one hand, our results confirm previous evidence that connectivity and both internal and external agglomeration advantages have a significantly positive impact on investment location choice, we find, on the other hand, that international connectivity negatively moderates the role of internal and external agglomeration. This moderating effect is weaker in the case of external agglomeration than internal agglomeration and in the case of production vs. service-related activities. In addition, our evidence suggests that internal and external agglomeration are substitutes; they weaken each other's impact on the decision to invest in a particular global city.

Contributions

The literature on the location strategy has long emphasized the importance of (internal and external) agglomeration and international connectivity as factors attracting MNCs to certain locations. Based on these previous conceptualizations and empirical findings, the suggestion is that locations combining high internal and external agglomeration and high connectivity may be more attractive to MNCs (Nielsen et al., 2017). In this paper, we contribute a conceptual framework that highlights the negative interrelationships between these location drivers.

First, our conceptualization builds on recent insights on the heterogeneous benefits from external agglomeration (Belderbos & Somers, 2015; Mariotti et al., 2019; Shaver & Flyer, 2000). In particular, we extend this theoretical notion by specifically considering whether the net benefits that an MNC can enjoy from external agglomeration in a given location may depend on the extent of internal agglomeration that the firm can leverage in that location. We suggest that internal and external agglomeration are substitutes, since the firm's need to preserve knowledge and limit outgoing spillovers through an internal orientation is not compatible with exchanging local knowledge related to external agglomeration. This new insight is grounded in a previously disregarded form of firm-level heterogeneity that changes the balance between outgoing and incoming knowledge spillovers related to intra-firm knowledge transfer and exploitation of a firm's value-chain activities. While the importance of performance-enhancing knowledge sharing between collocated activities has been well recognized (Gray et al., 2015; Ivarsson et al., 2017; Rawley & Seamans, 2020), the consequences of this for the net benefits of external agglomeration have not received attention. This new insight contributes to the body of literature on firm heterogeneity and the balance of learning and spillovers, which has considered market and

technological leadership rather than value-chain configurations as the source of firm heterogeneity (Belderbos & Somers, 2015; Mariotti et al., 2019; Shaver & Flyer, 2000).

Second, we argue that the benefits of agglomeration are lower in locations that offer good international connectivity. The connectivity of a location – which we conceive as multifaceted, including international flows of people, knowledge, and services – can reduce the spatial transaction costs of coordinating geographically dispersed activities (Belderbos et al., 2017) and can extend cluster benefits over longer distances (Castellani et al., 2022). This can reduce the advantages of spatial proximity both to other firms (external agglomeration) and to other value-chain activities within the same firm (internal agglomeration). Highly connected locations offer the opportunity to transfer people and knowledge over long distances with relative efficiency, thus lowering the benefits of close geographic proximity. Another way to think of this is that well-connected locations allow temporary proximity to be built, which in many circumstances may be a good substitute for long-term physical proximity.

Third, we provide a nuanced view of the moderating effect of international connectivity. We develop theoretical arguments to support the view that internal and external agglomeration advantages are differentially affected by the international connectivity of a location, with connectivity changing tradeoffs between the two forces in MNCs' orchestration of global value-chain activities. We argue that connectivity reduces the advantages of internal agglomeration more than external agglomeration. With good connectivity, relationships and coordination at a distance can be achieved when managers, sales representatives, researchers, and maintenance experts do the traveling, but this is more effectively organized within the firm and more difficult to arrange across firms.

In addition, we contend that the moderating effect of connectivity differs according to the type of activity that MNC conducts in host countries. This echoes the importance of bringing value-chain activity specificity into location strategy research (Alcácer & Delgado, 2016; Castellani et al., 2022; Crescenzi et al., 2014). In service-related activities, connectivity is more effective in reducing spatial transaction costs and allowing firms to relate to external parties and internal units at a distance. The largely immaterial nature of service-related activities and knowledge more easily enables transfer over distance and between firms. Moreover, it reduces the need for permanent physical proximity, so that firms can substitute internal agglomeration with temporary proximity through business visits. On the contrary, in production-related activities, the greater reliance on spatially bound material assets makes knowledge and intermediate inputs more costly to transfer over long distances and requires deeper and intensive knowledge exchange, thus reducing the potential role of temporary proximity and international connectivity in extending agglomeration benefits over distance.

Overall, our research responds to calls for finer-grained analyses of MNCs' location strategy and its local consequences, providing more nuanced conceptualization in international business research (Mudambi et al., 2018) for in-depth research on the consequences of increasing global connectedness (Cano-Kollmann et al., 2016; Lorenzen et al., 2020) and for critically assessing the (dis)advantages of geographic proximity in cities (Chakravarty et al., 2021, p. 11). While the literature has accepted the notion that locational innovation advantage is based on both local resources and global linkages as given (Bathelt et al., 2004; Belderbos et al., 2017; Mudambi et al., 2018), our study provides an important nuance by showing that connectivity and local agglomeration benefits are often substitutes. Lorenzen et al. (2020) argue that a focus by MNCs on international connectedness may come at the cost of local disconnectedness between the city core and its catchment area. Our findings based on a spatial transaction costs perspective support this notion, to the extent that the international connectivity of cities alters MNCs' location choices in giving less weight to the benefits of local interactions in the city. External interactions within the city agglomeration, however, are less affected than internal value-chain relationships, suggesting that "local spawning" effects of MNC activities in the global city are not primarily reduced by connectivity.

Managerial and policy implications

Our findings provide insights for managers seeking to define their firm's geographic portfolio of activities. In particular, they highlight the trade-off between seeking to achieve external agglomeration benefits by locating different activities in different geographic clusters or maximizing the benefits from internal agglomeration by concentrating investments in fewer locations in order to keep different value-chain activities close together. This strategy minimizes coordination costs from managing a geographically dispersed network. Implications for policymakers involved in designing policies for attracting MNCs to global cities can also be drawn. While improving connectivity and facilitating agglomeration are two policies that, taken in isolation, can boost city attractiveness, our findings reveal that policymakers do not need to invest resources to improve in both directions. On the one hand, interventions aimed at achieving better international connectivity are particularly suited to cities characterized by relatively low potential for creating external agglomeration. On the other hand, the more peripheral cities, or those where connectivity is particularly costly to build, may opt to foster agglomeration by investing more resources in targeted incentives to attract MNCs' activities to their location.

Limitations

Our paper is not without limitations. First, although we examine individual firms' location choices such that a location's characteristics can be taken as exogenous, this is not the case for internal agglomeration factors that derive from previous investment decisions and may relate to unobserved firm preferences for certain cities. Although we used weights of inter-value-chain collocation advantages that are exogenous to the firm (Alcácer & Delgado, 2016), and we allowed for unobserved firm heterogeneity in preferences by estimating random coefficients, this suggests caution in interpreting the results as causal effects and formulated hypotheses in terms of associations.

Second, our findings take agglomeration benefits across six value-chain activities into account, but the distribution of value-chain activities in our analysis shows a majority of investments in sales and services. The distinction between producer-related and service-related value-chain investments exhibits a different degree of relevance across industries, with producer-related value-chain activities better represented in manufacturing industries. Future work should seek to benefit from even richer data on cross-border investments to analyze a more balanced sample of investments across value-chain activities.

Third, although we included various distance measures as covariates in our analysis, future work can further examine the possible interrelationship between agglomeration and contextual distance. Contextual distance has been recognized by prior literature as a main source of liability of foreignness, and costs of global integration (Belderbos et al., 2020; Eden & Miller, 2004; Mudambi et al., 2018). The greater contextual distance to a host country may imply that firms need more managerial and operational experience in the location in order to decrease uncertainties and organizational costs involved in foreign operations (Kostova, Nell, & Hoenen, 2018). Hence, it may lead to a greater weight of internal agglomeration factors. To examine this proposition, the challenge is to obtain regional-level measures of contextual distance to capture variation across cities.

Fourth, we focused our analysis on global cities since the cities provide us with an ideal empirical framework with their distinctive locational drivers of FDI, such as their international connectedness and strength of agglomeration factors. Caution should be taken to generalize the findings to investment decisions in other types of cities, and future work could expand the scope of analysis to "non-core", smaller, and less connected cities. Fifth, our agglomeration measures could not take into account precise domestic firm agglomeration or specific measures of buyer and supplier presence as in Alcácer and Chung (2014). Although we could develop a measure of external agglomeration drawn from firms engaged in inward and outward investment in a city, a more precise agglomeration measure that includes domestic firms would constitute a next step in the analysis of external agglomeration effects as they are moderated by firm collocation and connectivity considerations. Sixth, due to a lack of systematic data, our analysis could not take into account the potential influence of local cluster policies (Luo et al., 2020) or city-specific subsidies for foreign investors.

Finally, in the interests of generality and parsimony, we used a comprehensive measure of international connectivity, but the different components of connectivity may have heterogeneous consequences across value-chain activities (Castellani et al., 2022). Future work could theorize and disentangle how different aspects of connectivity differentially moderate the influences of internal and external agglomeration on location choice.

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