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Organizational scaling: The role of knowledge spillovers in driving multinational enterprise persistent rapid growth

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A B S T R A C T

Based on insights from the spillover, international business, and knowledge management literatures, we study factors that enhance multinational enterprise (MNE) scaling and growth. Viewing MNEs and their employees as potentially rich knowledge sources, we draw attention to MNE-to-MNE knowledge spillover which fuel MNE scaling throughout organizations and employ panel data spanning 44,256 foreign and 21,246 domestic MNEs during 2004-2017. Our results show that (a) foreign MNEs benefit from depth and breadth of organizational knowledge spillover available in a geographic region, (b) domestic MNEs benefit from the depth of human capital knowledge spillover, and surprisingly, (c) domestic ownership hampers MNE scaling.

1. Introduction

Researchers in international business and strategic management have long viewed knowledge as a critical, idiosyncratic, firm-specific advantage that multinational enterprises (MNEs) leverage across their different geographical locations (Kogut & Zander, 1993). In economics, knowledge also represents one of the primary drivers of growth (Acs et al., 2013; Lucas, 1993; Romer, 1990). Yet the most frequently studied sources of knowledge inflows have been formal and contractual such as partnerships, alliances, and collaborations (e.g., Powell, Koput, & Smith-Doerr, 1996; Simonin, 2004), whereas knowledge outflows in the form of knowledge spillovers to peer MNEs have remained largely unexplored and centered on the effects to the local (or domestic) firms (Gupta & Govindarajan, 1991; 2000; Inkpen & Tsang, 2005). Moreover, recently scholarly emphasis has shifted from predicting a firm's *ability to grow* (i.e., in sales, employees, or geographically) to *persistent growth,* and/or the ability to continuously maintain a high or even increasing growth rate (Reuber et al., 2021).

Organizational scaling and growth are interrelated (DeSantola & Gulati, 2017), yet distinct concepts. Growth is typically defined as an increase in employment, market share or sales over a certain period of time (Delmar, 1997). Research into organizational growth has typically focused on increases in size, e.g., 'how much', without theoretically explaining 'how' an organization achieves these increases and deals with the problems associated with "more" (McKelvie & Wiklund, 2010; Shepherd & Patzelt, 2022). Organizational scaling captures the process of building and strengthening the internal capabilities, systems, and structures necessary to support and sustain growth and is defined by Shepherd and Patzelt (2022) as "spreading excellence within an organization as it grows" (p. 255) and that "excellence is manifest in knowledge in knowledge (such as schemas, routines, systems, and norms)…" (p. 256). In their review of the scaling literature, Palmié et al. (2023: 2) describe scaling as "*increase in the size of a focal subject that is accompanied by a larger-than-proportional increase in the performance resulting from the said subject*, with "subject" referring to what is being scaled (e.g., number of products sold, number of customers, or number of markets served)." As such, scaling is reflected in persistent rapid growth to deliver a viable business model (Tippmann et al., 2023), e.g., achieving a threshold of at least 20% growth per annum in revenue or employees over three consecutive years (OECD[1], 2007; Tippmann et al.,

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[1] The Organization for Economic Cooperation and Development (OECD) is an international organization in which governments work together to find solutions to common challenges, develop global standards, share experiences, and identify best practices to promote better policies for better lives.

2022).

Several studies have examined the factors that enable scaling, particularly in multinational enterprises (MNEs) beyond the intermediate stage of organizational development (Piaskowska et al., 2021; Sullivan, 2016). To this end, scholars and practitioners have begun to focus on the global scaling of multinational enterprises (MNEs) as "a logic of multinationalization that seeks rapid growth through the replication of global business models across foreign markets" (Reuber et al., 2021: 1031). Despite this recent attention, numerous theoretical and empirical gaps remain in our understanding of the internal and external mechanisms of MNE scaling and its distinction from MNE growth (Chliova & Ringov, 2017; DeSantola & Gulati, 2017; Reuber et al., 2021; Tippmann et al., 2022). As scaling involves the spreading of excellence as an organization grows, organizations rely on their capabilities of accumulating, communicating, relocating, and connecting internal and external knowledge to achieve a proliferation of excellence (Shepherd & Patzelt, 2022).

In this study, we bridge insights from the growing literature on MNE scaling (Reuber et al., 2021; Tippmann et al., 2023) with theoretical advances in the knowledge spillover (Audretsch & Belitski, 2020), knowledge management (KM) and international business (IB) literatures to answer the following research question: *How do external knowledge spillovers from peer MNEs and employees within a region affect MNE scaling compared to traditional growth?*

Knowledge spillovers play a crucial and largely overlooked role in MNE scaling. As organizational knowledge is not completely excludable from third parties (Audretsch & Keilbach, 2007). For example, Audretsch and Belitski (2020), in their study of external knowledge collaboration, found that knowledge inevitably *spills over* the boundaries of organizations. External knowledge spillovers are particularly relevant for organizational scaling as this knowledge may influence an organization's efforts to develop the internal capabilities, systems, and structures necessary to develop, adapt, and sustain a viable business model for persistent rapid growth (DeSantola & Gulati, 2017; Mihailova, 2023; Tippmann et al., 2023). We apply this perspective to regional MNEs to understand how regional knowledge spillovers may create new opportunities for scaling and an improvement in efficiencies of scaling for MNEs pursuing these opportunities. From a knowledge management perspective, MNEs are highly capable learning organizations (Meyer & Sinani, 2009), and have an organizational capacity due to their multi-level and transnational structures to actively internalize externally available knowledge in a geographic region and thereby create economic gains (Del Giudice et al., 2013).

Few studies have considered the role of external knowledge spillovers in MNE scaling. While we know that individual-level (i.e., human capital) knowledge flows can play an important role in shaping the business models of global multinationals (Hennart et al., 2021) and that knowledge flows are multidirectional (Rugman & Verbeke, 2003), the impact of knowledge spillovers on MNE scaling still remains unexplored in the literature. Thus, the primary aim of this study is to advance our understanding of MNE scaling as persistent rapid growth (Tippmann et al., 2023), as well as to theoretically and empirically scrutinize the role of external knowledge spillovers for MNEs. In this study, drawing on the definition of MNEs as "a group of geographically dispersed and goal-disparate organizations that include its headquarters [and] different national subsidiaries" (Ghoshal & Bartlett, 1990: 603), we define a **foreign MNE** as a group of geographically dispersed firms with headquarters abroad (outside the United Kingdom) and with at least one a subsidiary[2] in the United Kingdom. A foreign MNE can be either fully foreign-owned or co-owned by domestic firms in the UK. A **domestic MNE** is fully owned by a UK company with headquarters in the United

Kingdom and at least one subsidiary abroad. Our sample combines 248,990 firm-year observations of 44,256 foreign MNEs and 89,668 firm-year observations of 21,246 domestic MNEs during the period of 2004 to 2017.

We offer several contributions to the International Business (IB) literature on MNE scaling. First, we extend arguments from the knowledge spillover theory of entrepreneurship to explain the *mechanisms which enable organizational and human capital knowledge spillovers to enhance MNE scaling*. Although past studies have considered the potential for knowledge spillovers flowing from MNEs to local firms (e.g., Blomström & Kokko, 1998; Singh, 2007; Tzeng, 2018), they have largely ignored the critical bidirectional cross-pollination between MNEs operating in their region. Thereby, we raise scholarly awareness of the unintentional and non-contractual MNE-to-MNE knowledge transfer. We also examine the impact of knowledge spillovers from the foreign MNEs and employees hired by foreign MNEs in a region (both their density and number) which may also create opportunities for organizational scaling in co-located MNEs.

Second, we contribute to the knowledge management (KM) domain of the IB literature by utilizing two distinct measures of knowledge spillover: the breadth and the depth of knowledge spillover and the varying effects of knowledge quantity (number of knowledge agents) and intensity (density of the knowledge network). By assessing their ability to facilitate MNE scaling, we advance the concept of KM which captures the processes, practices, and artifacts designed by organizations to "derive value through the application and utilization of knowledge" (Barley et al., 2018: 280). In contrast to most prior studies which focus on the volume or frequency of interactions between firms (e.g., Saliola & Zanfei, 2009) or their employees (e.g., Collins & Smith, 2006), in this study we capture both potential sources of knowledge (for exceptions, see Easterby-Smith et al., 2008; Tsai, 2001).

Third, this study theoretically delineates and empirically compares MNE growth with MNE scaling (Monaghan & Tippmann, 2018; Reuber et al., 2021; Stallkamp et al., 2022; Tippmann et al., 2023) by testing the effects of external knowledge spillovers on both occasional (i.e., growth) and persistent rapid growth (i.e., scaling). By scrutinizing the effects from MNE-to-MNE knowledge spillovers, we establish the varying effects that context, ownership, and regional knowledge may play for scaling and growth in foreign and domestic MNEs.

In the next section we explore the literature on knowledge spillovers, international business, and organizational scaling and proceed to develop our research hypotheses. Our data and empirical methodology are then described in Section 3, with the results of our regression analysis and robustness checks subsequently presented within Section 4. Our discussion within Section 5 illuminates the implications of our study for the organizational scaling literature, as well as relevant policy and managerial implications. Finally, our study concludes with a discussion of limitations and future research directions.

2. Theoretical background and hypotheses

Scholarly interest in the drivers of MNE scaling has permeated the literature in international business (Mihailova, 2023; Reuber et al., 2021), knowledge management (Audretsch & Belitski, 2021; Dell'Anno et al., 2018; Natalicchio et al., 2019), knowledge spillovers (Cerver-Romero et al., 2020; Nicotra et al., 2014; Shepherd & Patzelt, 2022), dynamic capabilities and strategic agility (Bamel & Bamel, 2018; Shams, Vrontis, Belyaeva, Ferraris, & Czinkota, 2021), and regional development (Chliova & Ringov, 2017). Each of these streams has considered different aspects underlying high growth trajectories such as market and geographical expansion (e.g., Monaghan & Tippmann, 2018), formation of new firms and subsidiaries (e.g., Nordling, Thomas, Pugh, & Hermann, 2020), strategic management of knowledge (Ferraris, Santoro, & Scuotto, 2020; Gaur, Ma, & Ge, 2019), international resource reconfiguration(s) and dynamic capabilities (Eisenhardt & Martin, 2000; Mihailova, 2023; Schilke et al., 2018; Tasheva & Nielsen,
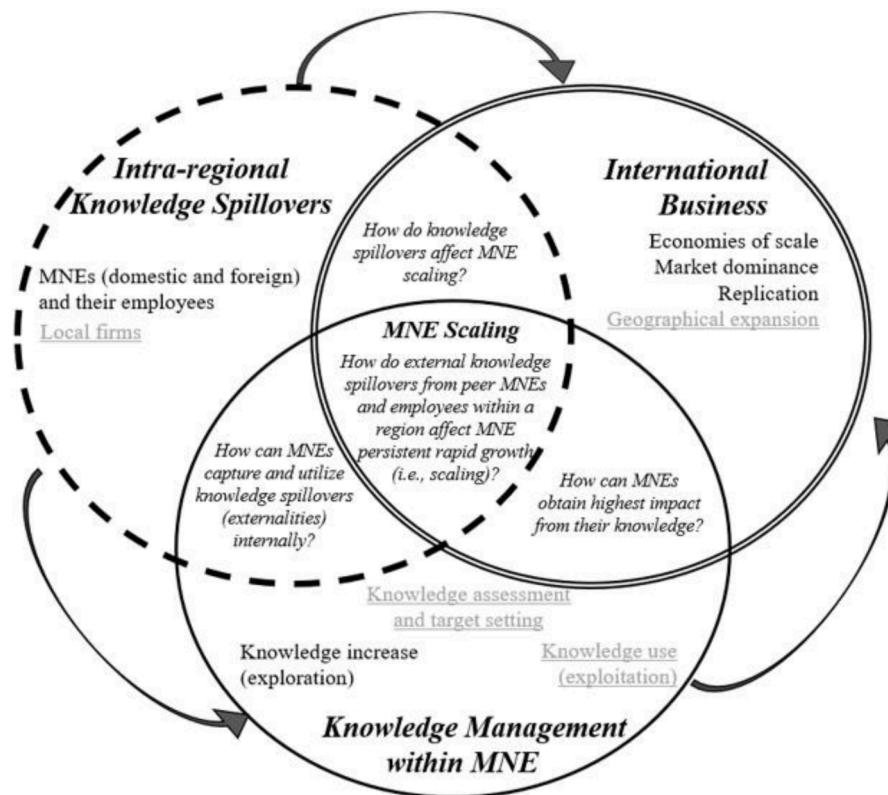
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[2] For a detailed overview refer to Appendix B: Summary of focal questions, domains, and definitions in three literature streams, and Appendix D: Study sample by (multinational) firm type.

Fig. 1. Literature streams and focal research questions.

2022; Teece et al., 1997), and the accumulation of external knowledge (Qiu & Cantwell, 2018).

Defining organizational scaling and delineating it from growth is not a trivial task. On the one hand, these concepts are interrelated, since Tippmann et al. (2022); 2023) define scaling as persistent rapid growth to deliver a viable business model at scale. In addition to persistent rapid growth, scaling may involve the attainment of efficiencies (i.e., scaling efficiency) through rapid geographical expansion, as in the case of global scaling (Reuber et al., 2021). Because scaling also involves "spreading excellence" throughout an organization as it grows (Shepherd & Patzelt, 2022) and achieving outsized performance gains (Palmié et al., 2023), we therefore argue that organizational scaling is related to both the process of rapid and persistent growth and the outcome of the process of growth, and is dependent upon the knowledge and learning necessary to build a viable, scalable business model embraced throughout the organization (Blank, 2013; Mihailova, 2023; Shepherd & Patzelt, 2022).

Understanding the relationship between growth and scaling is theoretically intriguing as scaling is integral to growth, and is made more critical by rapid increases in size (Belitski, Stettler, Wales, & Martin, 2023). As organizational scaling is associated with growth (DeSantola & Gulati, 2017), it can be reflected in a rapid acceleration of internationalizing firms (Autio & Zander, 2016; Mihailova, 2023; Tippmann et al., 2022), such as MNEs. We draw on three theoretical perspectives to develop a deeper understanding of *why* and *how* MNEs scale up. The first stream of the literature is *firm-centric* and deals directly with scaling. Reuber et al. (2021) identify four *whys* of scaling for multinational companies: economies of scale (increased productivity), market dominance (increased market share), replication of the business model (increased sales), and geographic expansion ('globalness' or geographic reach) (see Fig. 1 and Appendix B for the summary of the focal questions, domains, and definitions).

Different insights into global scaling can be gained when viewed through different perspectives. From an economic perspective,

organizational scaling represents an increase in organizational productivity with an objective to internally reduce unit costs and reap economies of scale (or the cost advantages associated with greater output volume). From a market dominance perspective, organizational scaling represents persistent entrepreneurial pursuit of new growth opportunities and spreading the excellence (Shepherd & Patzelt, 2022). Finally, from an international business perspective, geographical expansion represents the pursuit of replicability of a successful business model. In line with these perspectives, the international business literature on scaling is illustrated by the double-lined circle on the right in Fig. 1.

The second stream of literature is based on knowledge spillovers is *location-centric* and relates to research on the economics of externalities. Drawing on the seminal works of Jaffe (1989) and Acs et al. (1992), knowledge emanating from R&D and human capital (e.g., knowledge, education, experience, and skills) not only spills over within an organization, but may also generate growth for other third-party firms. The main sources for such growth are spatially localized knowledge spillovers (Audretsch & Feldman, 1996) accessible to firms within close geographic proximity to the knowledge source, such as a firm or university. In line with these perspectives, the intra-regional knowledge spillovers in the international business literature is illustrated by the dashed line circle on the left of Fig. 1. The spatially-bounded nature of knowledge spillovers creates opportunities for organizational learning, knowledge transfer, and new knowledge creation (Argote & Miron-Spektor, 2011). The geographical context underlies the importance of localized tacit knowledge for exchanging experiences and explains why firms co-located with MNEs and investing in R&D and human capital may experience rapid growth. The mechanisms of knowledge spillovers are particularly relevant for organizational scaling and include product reverse engineering and imitation, labor market effects through employee exchange and movement, local linkage effects through MNE selection of suppliers and distributors, competition effects through rivalry (Spencer, 2008). Altogether these spillovers enable MNEs to effectively accumulate, communicate, relocate and connect

their knowledge with the external knowledge of localized MNEs and can aid in scaling.

Neves and Sequira (2018) extend Jaffe's (1986) work on knowledge externalities to reveal that spillover effects to knowledge production tend to be greater when estimated with foreign inputs. Location in an MNE-dense area and proximity to other foreign firms and their employees increases a firm's pool of knowledge and thereby raises its chances to identify scale-up opportunities. For example, a multi-unit MNE collocated in close geographical proximity to other MNEs may improve their learning about products and markets through spillovers from co-located MNEs and their employees (Darr et al., 1995). In doing so, a firm can build and maintain its capacity to effectively accumulate, communicate, relocate and connect their knowledge to external knowledge to facilitate a spreading of excellence (Reuber et al., 2021). Knowledge spillovers from MNEs-to-MNEs are particularly important for scaling and may include various channels such as labor movements, networks, demonstrations and imitation, R&D partnerships, and supply chains to enable a rapid knowledge transfer and adoption by MNEs. Knowledge generated by highly concentrated and localized, global knowledge sources can stem from two distinct types of spillovers: spillovers that occur based upon an increased number (e.g., breadth) and those due to density (e.g., depth) of foreign organizations[3] and their employees (human capital). Notably, the breadth of organizational knowledge spillovers can be considered as the number of different foreign MNEs operating within a region, and the depth of organizational knowledge spillovers as the share of foreign MNEs in the region.

The third stream of literature *combines firm-internal and external aspects* that relate to knowledge management and sourcing and is illustrated by the solid-line circle on the bottom of Fig. 1. The literature on knowledge management argues that organizational scaling relies on combining internal and external knowledge sources (Andersson et al., 2016; Ferraris, Santoro, & Scuotto, 2020; Ferraris, Santoro, & Dezi, 2017) to increase overall firm growth and speed of growth (Mihailova, 2023). To address the complexity of knowledge management in the process of innovation, Savino et al. (2017) propose knowledge search and recombination theory (Allen, 1977) and argue that firms combine internal and external knowledge to achieve organizational scaling by introducing new products enabled by the creation and borrowing of various technological solutions which allow them to spread excellence and achieve more rapid growth (e.g., Ahuja & Lampert, 2001; Capaldo et al., 2017).

Prior research in this domain suggests that organizations obtain a competitive advantage which we argue is a conduit for persistent and rapid growth if organizations know how to process, disseminate, reconfigure, and exploit organizational knowledge internally (Grant, 1996; Kogut & Zander, 1992), as well as how to develop the dynamic and operational (or ordinary) capabilities necessary to absorb external knowledge (Cohen & Levinthal, 1990) and to accomplish this in a reliable and repeatable manner (Cepeda & Vera, 2007; Eisenhardt & Martin, 2000; Helfat & Winter, 2011; Nicotra et al., 2014; Teece et al., 1997), thereby creating the foundation for persistent high growth. In the process of internationalization, resource reconfiguration takes place in varying degrees in all organizations (Uhlenbruck et al., 2003). However, only some organizations are able to reap benefits from resource reconfiguration, by developing capabilities and investing internally in R&D, or by externally accessing knowledge spillovers. Thus, MNEs with more advanced dynamic and operational capabilities compared to local firms will be better positioned to access and adapt knowledge spillovers while simultaneously reconfiguring existing resources and are correspondingly more likely to achieve a 'spreading of excellence' throughout their organization. Specifically, MNEs can scale if they develop superior

capabilities for knowledge sharing, flexibility, and adaptation to change (Del Giudice et al., 2013) and agility (Bamel & Bamel, 2018; Christofi et al., 2021) relative to their competitors.

In this study, we scrutinize two factors of organizational design that may affect a firm's propensity to scale up vis-à-vis growth: (a) *location effects* via distinct knowledge spillover sources (organizational and human capital) and (b) *ownership effects* by distinguishing between domestic and foreign MNEs. Thereby we explore whether the inflows of external knowledge originating from regional knowledge spillovers are conducive to persistent rapid growth in domestic and foreign MNEs.

2.1. The effects of the region's organizational knowledge spillovers

According to the network approach to internationalizing, firms successfully enter foreign markets by engaging in networks with foreign players and becoming insiders in these networks (Johanson & Vahlne, 2009; see also Haddoud et al., 2021 for a literature overview).

Whether through formal or informal relationships, networks provide access to valuable knowledge which MNEs need to expand their geographical reach.

Not surprisingly, prior studies have scrutinized the impact of the availability of knowledge externalities (Griliches, 1991), as well as knowledge sharing infrastructures, input and specialized labor pooling, supply and demand matching, legitimacy, and diversity on rapid firm growth (Bloom et al., 2013). While the international business literature has been largely silent on what drives MNE scaling, as well as contrasting it with MNE growth, a few important seminal works (Monaghan & Tippmann, 2018; Stallkamp et al., 2022; Tippmann et al., 2022, 2023; Reuber et al., 2021) also point to the role of localized organizational knowledge and investment in R&D and human capital by other MNEs.

Localization of diverse tacit knowledge is an important potential source of new knowledge, reassuring prompt competitive advantage, and enabling MNEs to achieve persistent rapid growth (Perri et al., 2017). In the industry context, this implies that knowledge spills over within industries (*intra-industry,* i.e., Marshall's externalities) and between industries (*inter-industry spillovers,* also known as Jacob's externalities) (Beaudry & Schiffauerova, 2009) with both origins of knowledge contributing to its diversity. In the MNE context, knowledge may spill over between subsidiaries and headquarters (*intra-firm spillovers,* e.g., Ge et al., 2019) and between domestic and foreign MNEs (*inter-firm spillovers*) (e.g., González-Masip et al., 2019). Scholars have used the concept of dual embeddedness to describe how MNEs integrate knowledge from external and internal sources. On one side, MNEs are engaged in an external business network (external embeddedness), while on the other side, they are integrated in their corporate network of subsidiaries (internal embeddedness) (Ferraris, Santoro, & Scuotto, 2020).

Oftentimes, knowledge spillovers generated as a result of knowledge creation and recombination foster "cross-fertilization of ideas" (Eisenhardt and Martin, 2000; Eden et al., 1997), which in turn create new knowledge that is both geographically localized and internationally valuable. This knowledge may spill over to other foreign and domestic firms as potential consumers of knowledge and ideas (Driffield et al., 2014). Spatially proximate MNEs create positive information externalities (Mariotti et al., 2010) and motivate other MNEs to co-locate in the region. This relationship is self-reinforcing. Knowledge spillovers positively impact MNE agglomeration (Mariotti et al., 2010), thereby increasing the number and density of foreign MNEs in a region and generating greater opportunities for exchange of knowledge and experience in a specific spatial context (Argote & Miron-Spektor, 2011).

Theoretical arguments and empirical evidence suggest that the tacit knowledge firms need for scaling is localized (Audretsch & Feldman, 1996) and spills over creating rapid growth opportunities for MNEs (De Clercq et al., 2008). Prior literature explained the mechanism of such vicarious learning, whereby firms observe and source knowledge from other firms through direct knowledge transfer or spillovers, changes in

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[3] For additional information regarding the differences between breadth and depth on firm, city, and regional levels, refer to Appendix C: Summary of conceptualizations and operationalizations of knowledge depth and breadth.

their routines, behaviors, and the way knowledge is created (Bingham & Davis, 2012; De Clercq et al., 2012). Localized organizational spillovers from foreign firms are seen as a source of new combinations of competencies and capabilities (Shepherd & Patzelt, 2022) for the existing domestic and foreign MNEs (Andersson et al., 2016) and as such, a potential source of dynamic capabilities (Bamel & Bamel, 2018; Nicotra et al., 2014) and increasing the speed and persistency of growth. Knowledge spillovers fuel new insights, best practices, and the spreading of excellence throughout an organization which depends upon the accumulating, communicating, relocating, and connecting of knowledge among organizational members (Shepherd & Patzelt, 2022). In this vein, knowledge spillovers foster the development of the critical dynamic capabilities necessary to build and adapt a viable, scalable business model (Blank, 2013; Mihailova, 2023), and to take advantage of new opportunities to achieve persistent, rapid growth (Tippmann et al., 2023).

We argue that spillovers which drive persistent rapid growth may stem from the breadth (the number of MNEs) and the depth (their concentration in a region) of organizational knowledge (Coad et al., 2014; Corsi & Prencipe, 2016; Hennart et al., 2021). From this perspective, we argue that MNE scaling vis-à-vis growth is the outcome of three combined forces. First, the larger the number of foreign MNEs present, the more diverse the breadth of possible knowledge sources available to provide co-located MNEs with potential inputs, insights, and opportunities to develop their organizational learning and capabilities to accelerate growth. Second, the greater the density of foreign MNEs, the higher the likelihood that a foreign MNE will take part in an inter-firm interactions among foreign and domestic MNEs, thus increasing the total depth or volume of novel foreign knowledge spillover to be combined with MNEs organizational schemas, routines, systems, and norms to generate new products and services. Third, the larger the number of foreign firms and their density in a region, the more rapidly MNEs could apply knowledge spillovers within and across organizational areas, leading to organizational scaling *vis-à-vis* a higher speed and persistence of growth. Thus, we hypothesize:

H1: MNE scaling is positively influenced by the localized organizational knowledge spillovers from peer MNEs. Specifically, MNEs located in regions with (a) higher number of foreign MNEs (knowledge spillover breadth) and (b) higher concentration of foreign MNEs (knowledge spillover depth), will scale faster.

2.2. The effects of the region's human capital knowledge spillovers

The IB literature posits that external factors such as knowledge transfers between networks and employees across borders can help firms to innovate and grow (Fletcher & Harris, 2012). From this viewpoint, when firms are exposed to other internationally active firms, they may consider different strategies in acquiring external knowledge, such as collaborating with customers, suppliers, and competitors (Kogut & Zander, 1992) and then use the knowledge gained to fuel the accumulating, communicating, relocating, and connecting of knowledge necessary for organization scaling efforts (Reuber et al., 2021; Shepherd & Patzelt, 2022; Tippmann et al., 2022). For tacit knowledge to transfer to other organizations frequent face-to-face communication is required, e.g., employees of foreign firms interacting with employees from other firms co-located in a region.

Thus, in addition to the presence of foreign MNEs in a region, interactions between MNE workers promote knowledge transfer and human capital knowledge spillovers. If this is true, then in addition to organizational spillovers of knowledge, potential scaling of MNEs is conditional on human capital spillovers emanating from the number and share of employees in foreign MNEs living and working within a region. Thus, we adopt a finer grained lens, and examine a region's human capital spillover breadth and depth as a conduit of MNE scaling. The mechanism of the human capital knowledge spillover to MNE scaling is in managerial communication between employees working at different

MNEs in a region which may sprout new ideas and lead to novel solutions, securing persistent competitive advantage and resulting in rapid and persistent growth. Hence, it is individual knowledge and skills that is enriched by managerial ability in combining knowledge flows and the use knowledge embodied in individuals (i.e., human capital) in other organizations (Del Giudice et al., 2013; Helfat & Martin, 2015a; Straub & Del Giudice, 2012). Knowledge transfer between employees in MNEs and other organizations may better exploit their competencies and generate new knowledge structures and mental processes (e.g., managerial cognition) that are more impactful for efficiency and productivity (Helfat & Martin, 2015b; Petruzzelli et al., 2015).

This is critical for organizational efficiency to realize scaling (Mihailova, 2023). This is critical for organizational efficiency to realize scaling (Mihailova, 2023). Following this line of reasoning, we argue that MNE-to-MNE interactions serve as a springboard of new ideas, contributing to a spreading of excellence, new product creation, and new ways of knowledge application by organizations (Chuang et al., 2016; Fu, 2012; Shepherd & Patzelt, 2022). Thus, MNEs located in regions with more employees in foreign MNEs and a greater density of such employees will be more affected by diversity of localized international knowledge and will achieve higher scalability of their business models compared to MNEs located in regions with lower volume and diversity of employees in foreign MNEs. Mechanisms underlying knowledge spillovers to MNEs may include top managers' rotations across MNE subsidiaries globally, carrying intraorganizational knowledge which is then enriched with the local cultural and institutional contexts, and broader social interactions among individuals living and working in the same region. Therefore, an increase in the number and density of employees in foreign MNEs in a region fosters opportunities for firms' persistent and rapid growth. Taken together, we hypothesize:

H2: MNEs' scaling is positively influenced by the localized human capital knowledge spillovers from employees in foreign MNEs. Specifically, MNEs located in regions with (a) higher number of employees in foreign MNEs - human capital knowledge spillover breadth and (b) higher concentration of employees in foreign MNEs - human capital knowledge spillover depth, will scale faster.

2.3. The moderating role of domestic ownership in knowledge spillover - scaling relationship

To assess the effects of MNE ownership, we consider whether wholly owned domestic MNEs reap advantages from the breadth and depth of knowledge spillovers in comparison with their foreign MNE counterparts. Therefore, we build on prior literature that suggests that they benefit more from traditionally localized networks (Del Giudice & Maggioni, 2014). As noted by Tippmann et al. (2023), p. 2), "scaling is often associated with a considerable degree of internal transformation, and even innovation, as the organization needs to put in place new resources, processes and structures that provide for persistent rapid growth." In this vein, domestic MNEs are more familiar with the formal and informal institutions in a country (e.g., its regulatory and cultural environment) and well positioned to understand and channel knowledge spillovers in a manner which fosters organizational transformation and innovation (Shepherd & Patzelt, 2022). Domestic MNEs are likely to develop dynamic capabilities that are context specific (Tippmann et al., 2023) and thereby possess advantages when leveraging or reconfiguring the knowledge they receive via accessing regional human capital and organizational knowledge spillovers. Of note, while scaling in both domestic and foreign firms requires operational capabilities - capabilities that create efficiencies and thereby earn a living in the present (Helfat & Winter, 2011), they are the output of dynamic capabilities (Cepeda & Vera, 2007). Moreover, dynamic capabilities change operational capabilities in response to change in the environment. Thus, domestic MNEs that develop superior dynamic and operational capabilities are better informed about the markets and may have a superior capacity to leverage knowledge spillovers to sense potential market opportunities,
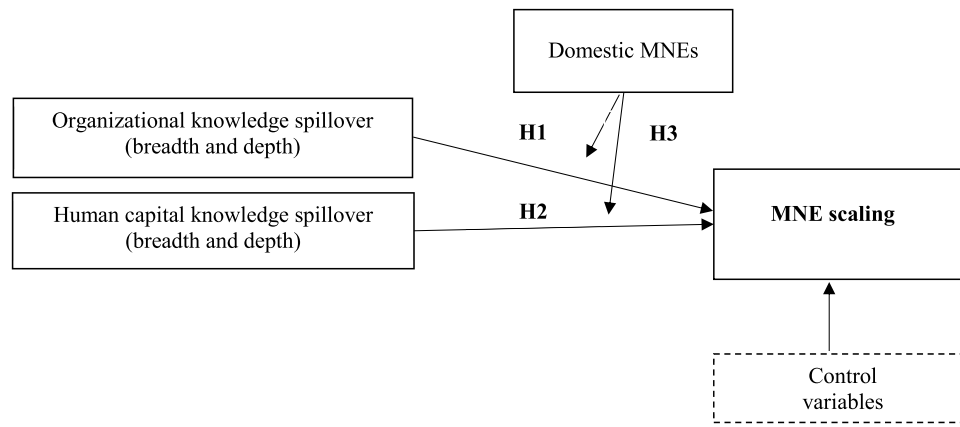
Fig. 2. Conceptual framework.

Table 1
Variables description and summary statistics.

Variable	Description	Mean	St. dev	Min	Max	Mean	St. dev	Min	Max
Sample by type of MNE		**Foreign MNE (248,990 obs.)**				**Domestic MNE (89,668 obs.)**			
Dependent variables									
Scaling	Binary variable = 1 if firm has experienced at least 20% growth per annum in revenue or employees over three consecutive years (OECD, 2007), 0 otherwise.	0.082	0.274	0	1	0.108	0.310	0	1
Scaling efficiency	Scaling variable weighted by the labor productivity (sales to employees ratio) annual growth rate to capture productivity gains.	0.101	0.374	0	2.360	0.144	0.538	0	2.360
MNE growth	Binary variable = 1 if firm's sales to average market sales (by 3 digit SIC) ratio has grown for at least 20% (annually) in absolute terms over the period of consecutive 3 years, 0 otherwise.	0.019	0.138	0	1	0.021	0.146	0	1
Explanatory variables									
Foreign employment share	Depth of human capital spillover: Share of employment in foreign MNEs in total employment in a region (t-1).	0.354	0.213	0.001	0.881	0.290	0.198	0.001	0.881
Foreign employment	Breadth of human capital spillover: Total employment (full-time employees) in foreign MNEs in a region (t-1) in logarithms.	11.297	1.207	0	13.632	11.044	1.261	2.564	13.632
Foreign firms share	Depth of organizational spillover: Share of foreign MNEs in total number of firms in a region (t-1).	0.051	0.045	0.001	0.331	0.041	0.040	0.001	0.331
Foreign firm	Breadth of organizational spillover: Total number of foreign MNEs in a region(t-1) in logarithms.	6.664	1.223	0.693	9.188	6.399	1.272	0.693	9.188
Control variables									
Employment	Number of full-time employees, in logs (t-1)	3.638	1.687	1.386	10.783	3.388	1.579	1.345	10.117
Subsidiaries	Number of firm's units (subsidiaries, plants, branches) within the country and abroad with an independent book-keeping and premises (t-1)	2.029	1.065	1	86	1.900	1.438	1	80
Age 4-7 years	Binary variable equals 1 if firm's age is 4-7 years since establishment, zero otherwise (t-1)	0.058	0.233	0	1	0.060	0.236	0	1
Age 8-15 years	Binary variable equals 1 if firm's age is 8-15 years since establishment, zero otherwise (t-1)	0.222	0.415	0	1	0.302	0.459	0	1
Age 16-30 years	Binary variable equals 1 if firm's age is 16-30 years since establishment, zero otherwise (t-1)	0.433	0.495	0	1	0.414	0.492	0	1
British	Binary variable = 1 if firm is partly owned by a British business, zero otherwise	0.341	0.474	0	1				
Switch Industry	Binary variable equals 1 if a firm changed its industry (two-digit SIC) in year t compared to year t-1, zero otherwise. Industry switch is considered if at least one number in 2-digits SIC industry code has changed (t-1).	0.143	0.350	0	1	0.079	0.270	0	14
HII sales	Herfindahl index based on sum of sales shares in a three digit SIC 2007 (0-perfect competition, 1 – monopoly) (t-1).	0.019	0.033	0.001	0.995	0.017	0.028	0.001	0.580
Pubs and hospitality	Share of employment in pubs and non-licensed restaurants (SIC 2007 = 56102, 56302, 56210) in total employment by 2 letter postcode (borough) (t-1).	0.040	0.033	0	0.278	0.041	0.032	0	0.278
Transport	Share of employment in transportation sector (SIC 2007 = 48, 49, 50, 51, 52, 522) in total employment by 2 letter postcode (borough) (t-1).	0.030	0.032	0.003	0.386	0.028	0.030	0.003	0.386
Arts and creative	Share of employment in arts and creativity sector (SIC 2007 = 90, 91, 92, 93) in total employment by 2 letter postcode (borough) (t-1).	0.020	0.012	0	0.106	0.022	0.013	0	0.106
KIBS	Share of employment in knowledge-intense business services sector (SIC 2007 = 41, 58, 61-66, 68-71, 73, 78, 85) in total employment by 2 letter postcode (borough) (t-1).	0.308	0.092	0.070	0.744	0.310	0.090	0.070	0.744

to decide whether or not to redirect resources allocated to operational capabilities to seize them, and to access and reconfigure internal and external knowledge to 'spread excellence' as the organization grows and create market-specific advantages (Shepherd & Patzelt, 2022). Therefore, it is important to consider the effect of both the breadth and the depth of MNE-to-MNE knowledge spillovers on increasing the capacity of firms to achieve a viable business model for persistent rapid growth (Tippmann et al., 2023).

When taken together, local embeddedness and knowledge of the market and context is likely to increase the dynamic capabilities driven by availability of knowledge spillovers such that domestic MNEs may be better equipped in recognizing opportunities for organizational scaling. Given the local embeddedness of domestic MNEs, we argue that both organizational and human capital knowledge spillovers in addition to an increasing volume growth may facilitate the persistence and speed of growth of domestic MNEs to a greater extent than foreign MNEs. Domestic MNEs are likely to have a lower cost of accessing and implementing knowledge spillovers for organizational scaling given their localized knowledge and dynamic capabilities related to their home country and market (Bamel & Bamel, 2018; Dunning, 1998; Nicotra et al., 2014). Thus, local market knowledge and inter-firm networks in a region (Del Giudice & Maggioni, 2014) help domestic MNEs to increase their ability to scale their business models. Thus, we hypothesize:

H3: Domestic ownership positively moderates the relationship between (localized human capital and organizational) knowledge spillovers and MNE scaling.

Our conceptual model is presented in Fig. 2.

3. Data and method

3.1. Sample description

We test our hypotheses on the data obtained from the United Kingdom's Business Registry during the period of 2004-2017. Specifically, we use the Business Structure Database (BSD) which provides an annual extract of the Inter-department Business Register (IDBR), a comprehensive database of all businesses in the U.K. and their main characteristics used by the government. Organizations that appear in this register either pay the government a value added tax (VAT) and/or employ at least one member of staff through the pay as you earn (PAYE) tax system. The main advantage of the data is that it constitutes the whole population of MNEs in the U.K. (see Appendix A) who are or have ever been active and who reported their employment size, legal status, ownership, industry, location and number of subsidiaries. Moreover, the inclusion of demographic variables (e.g., company start-up date and wind-down) provides insight into business cycles. The BSD data are divided into 'enterprises' and 'local units'. An enterprise is the overall business organization. A local unit is a 'plant', such as a factory, shop, branch, etc. In some cases, an enterprise will only have one local unit, and in other cases (such as a bank or supermarket), it will own many local units. (See Appendix D for study sample details by MNE type).

For each company, data are available on employment, turnover, foreign ownership, and industrial activity based on Standard Industrial Classification (SIC 92, SIC 2003 or SIC 2007). Year of 'birth' (company start-up date) and 'death' (termination date) are also included, as well as postal codes for both enterprises and their local units. These data additionally contain IDBR reference numbers, industry and postal codes where an enterprise is located. This information was used to calculate organizational and human capital knowledge spillovers.

Our data analyses proceeded as follows. First, we collected and matched eighteen consecutive waves of BSD data during 2000-2017. While we were able to collect data starting from year 2000, it takes 3 consecutive years to identify an MNE's status as an organization that has been able to scale up (or not). Specifically, organizations need to maintain a high level of growth (above 20%) in sales or employment over at least three consecutive years to be identified as a scale-up. While

the survey is conducted yearly by the Office of National Statistics (ONS) in the U.K., we constrained the observation window to 2017 to avoid potential lingering bias from the effects of Brexit on the strategies of the domestic and foreign MNEs operating within the U.K. Since Brexit introduced long-lasting market turbulence and increased environmental uncertainty, it may have the effect of reducing both the likelihood of MNEs to capitalize on regional knowledge spillovers and increased their likelihood to transfer ownership to local firms or investors, an extraordinary period which warrants separate study.

Pulling the data together, we created the variables of interest using the available company data, aggregating industry level data at the 2-digit SIC for 90 industries, creating identifiers for 175 geographical regions (using 1 to 2 letter postcode), calculating market share by 2-digit SIC, scaling characteristics and other explanatory variables. Although there are eighteen surveys covering 18 years with 33,807,849 observations, after cleaning for missing values and restricting our sample to foreign and domestic (local) MNEs, the number of observations dropped to 248,990 observations for foreign MNEs (44,256 uniquely identified firms) and 89,668 observations for domestic MNEs (21,246 uniquely identified firms). To be included in the sample, all questions related to the variables of interest must have been completed without missing values. We delineated between foreign and domestic MNEs using the location of their headquarters, coding ones located in the U.K. as domestic, while those abroad as foreign.

We excluded micro-MNEs with less than 5 employees as these extremely small firms (sole proprietorships, partnerships, very small teams, etc.) are most likely to exhibit incongruent growth aspirations with the rest of the sample (e.g., lifestyle businesses) and may respond to exogenous factors such as uncertainty and risk in different ways. Table 1 includes a list of variables and descriptive statistics.

Our samples of both foreign and domestic MNEs are evenly distributed over the period of 2004-2017, however there are two noteworthy patterns in the data. First, there has been a gradual increase in the number of domestic MNEs over 2004-2017 starting from 2881 domestic MNEs in 2004 (3.29% of the total sample) to 8255 domestic MNEs (9.21% of the sample) by the end of financial crises in 2012 and further rising up to 10623 domestic MNEs in 2017. Second, there has been a reverse trend in the number of foreign MNEs, including those co-owned by British companies from 18975 (7.62% of the sample) in 2004 to 13533 in 2017 (5.44%) (see Appendix A, Table A1).

Our sample includes all industries split into sections using the U.K. SIC 2007 classification of industries (Appendix A, Table A2). Most sampled MNEs operate within the 'Wholesale and retail trade' sector with 27.86% of foreign MNEs and 26.17% of domestic MNEs, followed by 'Professional, scientific and technical activities' with 16.78% of foreign MNEs and 13.27% of domestic MNEs. A substantial share of foreign (14.56%) and domestic (16.65%) MNEs also operate within the 'Information and communication, insurance, financial service activities, real estate' sector.

Most foreign (22.15%) and domestic (20.73%) MNEs are located in the Greater London area and 16.54% of foreign MNEs and 16.03% of domestic MNEs are located in the Southeast of England. At least 9% of both foreign and domestic MNEs are located in East England and the Northwest of England. Foreign MNEs from the Northeast of England constitute only 2.43% of the sample followed by Northern Ireland (1.36%) and Wales (2.75%). Regions where domestic MNEs are least present are the Northeast of England (2.48%) and the Northern Ireland (2.33%) (see Appendix A, Table A3).

In our final sample, most MNEs represent classically small firms from 10 to 49 full-time employees (FTEs). Small firms constitute 37.12% of the foreign MNEs sample and 43.67% of the domestic MNEs sample, which is notable given their limited representation within MNE research (Driffield et al., 2014). For comparison, micro MNEs (6-9 FTEs) still make up a quarter of the sample, with a similar distribution for domestic and foreign MNEs. The share of large firms (> 249 FTEs) in foreign MNEs is 14.32% and domestic MNEs is 9.5%. This is significantly larger

compared with the original BSD sample of UK firms where only 0.71% of all firms are large (see Appendix A, Table A4).

3.2. Data and measurements

3.2.1. Dependent variable

Following Reuber et al. (2021), we use information from annual reports to calculate our first and main dependent variable - scaling as a binary variable taking the value of one if a firm had at least 20% growth per annum in revenue or employees over three consecutive years (Chliova & Ringov, 2017; OECD, 2007), zero otherwise.

Besides scaling, we are interested in the MNE scaling efficiency, which akin to growth is related yet distinct from scaling. For example, a firm may become more efficient (i.e., exhibit an increase in productivity) without growing rapidly. We use data on productivity annual growth to operationalize the efficiency gains that scaling businesses attain over time, while closely following the operationalization of scaling (Monaghan & Tippmann, 2018; Stallkamp et al., 2022). To calculate our second dependent variable - MNE scaling efficiency we combine persistent rapid growth (scaling) by weighting it with the productivity gains measured as the annual growth in productivity. This variable varies between 0 and 2.3, where 0 indicates absence of scaling in the three consecutive years at any level of productivity and 2.3 means that a firm has scaled with a 2.3-times increase in its productivity in a very specific year.

Our third dependent variable is MNE growth which is different from scaling and indicates firm's rapid growth in relation to its baseline (OECD, 2007). We calculate MNE growth as a binary variable that equals one if a firm's sales to average market sales (by 3 digit SIC) ratio has grown for at least 20% (annually) in absolute terms over the period of 3 consecutive years, zero otherwise.

3.2.2. Explanatory variables

The resource-based view (RBV) focuses on firm resources in relationship to obtaining competitive advantage. However, firms are different in terms of their resource endowments, skills, and capabilities and thus the interplay between the internal and external resource allocation is different. Strategic management scholars have long researched the interplay between internal and external sources of knowledge for firm innovation and growth, reflecting the role of knowledge spillovers from MNEs as a source of external knowledge and competitive advantage for international and domestic firms (Audretsch & Belitski, 2020; Driffield et al., 2014). Knowledge spillovers add to a firm's capacity to develop effective dynamic capabilities, expanding their resources and gaining strategic agility to overcome challenges related to knowledge management in organizations (Eisenhardt & Martin, 2000; Nicotra et al., 2014; Teece et al., 1997).

Thus, our main explanatory variables focus on the breadth and depth of organizational and human capital knowledge spillovers from MNEs. First, the depth of organizational knowledge spillover is measured as the percentage share of foreign MNEs in the total number of firms (excluding the focal MNE) in a region. The breadth of organizational knowledge spillover is calculated as the number of foreign MNEs (excluding the focal MNE) in a region, taken as a logarithm. The mean share of foreign and domestic MNEs is 5.1% and 4.1% respectively and the difference is not statistically significant.

Second, at the employee-level, we calculated human capital spillover depth as the share of employment in foreign firms in a region relative to the total employment in a region excluding employment in the MNE. Human capital spillover breadth is measured as the number of employees in foreign MNEs in a region excluding employment in a focal MNE, taken as a logarithm (De Clercq et al., 2008).

To support the choice of the key factors that we hypothesized, we argue that MNE-to-MNE employee interactions are important to transfer knowledge and that an increase in the number of employees increases the probability of localized knowledge transfer through events participation, meetings, and community activity. Human capital flow across MNEs serves as a springboard of new ideas, leading to new product creation (Chuang et al., 2016; Driffield et al., 2014). Thus, MNEs that are located in regions with more employees in foreign MNEs that are either employed locally or have had an inter-MNE transfer from abroad, create a greater density of internationally exposed labor in the region and more diversity, where new ideas and talent could interact for knowledge creation, transfer and final commercialization, thus increasing firm scaling. Mechanisms underlying knowledge transfer may include top managers' rotations inter-MNE schemes, subsidiary collaboration within the enterprise groups, inter-unit collaborations, visiting positions in MNEs, carrying intra-organizational knowledge transfer and other means of communication which aim at embedding individuals into cultural and institutional contexts of particular regions. MNE employees embody its human capital, carry its culture and access and disseminate its knowledge. On average within regions the share of employment in foreign MNEs is larger (35.4%) than that of domestic MNEs. Foreign MNEs were at times located in regions with close to zero employees in foreign MNEs (see Table 1). This was not the case for domestic MNEs, which are located in regions with, on average, a higher number of employees in foreign MNEs (Driffield et al., 2014). To further differentiate the breadth and depth of knowledge spillover on the *regional level* from the breadth and depth of knowledge measured on firm or even city level we offer a comparative overview of these concepts in Appendix C.

Finally, we included a binary variable 'British', which equals one if an MNE is domestically co-owned, and zero otherwise (Liang, 2017). Of note, 34.1% of all foreign MNEs in the U.K. are co-owned by British businesses. *Host-country ownership* can play an important role in MNE scaling. MNE scaling may be constrained by a lack of knowledge about local markets, cultures, and institutions. Foreign MNEs often consider sharing ownership with local firms who are willing to bring their expertise, networks, supply chains and employees and exchange of industry and market knowledge to enhance performance (Tsai & Ghoshal, 1998). Given an increasing share of domestic MNEs in the UK over 2000-2017 (Appendix A), it is important to consider their effect on scaling. The international business literature (Zaheer & Nachum, 2011) suggests that MNEs vary in their ability to take advantage of local opportunities, and gaining local competitive advantage may not require a subsequent trading in ownership. For instance, Dunning (1998) argues that foreign MNEs can only increase their productivity when efforts are made to match localized R&D resources, knowledge, and networks with their internal R&D capabilities. While foreign MNEs are likely to benefit from increased access to local resources, knowledge and market-specific information when they are co-owned by domestic firms, this may take significant time and managerial effort, coordination and negotiations costs, including changing the organizational culture which is a long-term process. While a central advantage of host-country (co) ownership of a foreign MNE can be summarized in terms of (i) access to wider markets and broader business opportunities (Barkema et al., 1996; Chan & Makino, 2007), (ii) a reduction of business errors and relative costs due to greater tacit knowledge (Dell'Anno et al., 2018), change in the ownership increases coordination and transaction costs, creates managerial ambiguity on firm strategy and slows down scaling.

3.3. Control variables

Prior studies provide strong evidence that firm characteristics such as firm age and size (Coad et al., 2014) affect firm growth (Delmar et al., 2003) and scaling (Chliova & Ringov, 2017; Reuber et al., 2021). To control for the effect of *firm age,* we used binary variables within the following intervals (0-3 years; 4-7 years; 8-15 years; 16-30 years since establishment). Firms with 30 and more years since establishment is a reference category in our model. There is a higher share of local firms that are younger, with 30% between 8-15 years, while the share of foreign MNEs of 8-15 years old is 22%. There are no differences between foreign and domestic MNEs among the share of firms below 8 years old

Table 2
Logistic regression for MNE scaling and MNE growth (results reported in odd-ratios).

Accelerator type Variables	DV: MNE scaling				DV: MNE growth			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
MNE ownership	Foreign MNE (248,990 obs.)		Domestic MNE (89,668 obs.)		Foreign MNE (248,990 obs.)		Domestic MNE (89,668 obs.)	
DV t-1	4.94***	6.52***	5.97***	6.22***	6.29***	6.26***	5.34***	5.33***
	(0.07)	(0.11)	(0.15)	(0.16)	(0.26)	(0.27)	(0.35)	(0.36)
Firm characteristics								
Employment	0.94***	0.93***	0.89***	0.90***	1.10***	1.10***	1.13***	1.14***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)	(0.02)
Subsidiaries	0.95***	0.95***	0.84***	0.89***	0.90***	0.92***	0.86	0.87
	(0.00)	(0.00)	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Age 4-7 years	4.31***	3.28***	4.17***	3.90***	1.02	1.06	1.04	1.15
	(0.12)	(0.10)	(0.20)	(0.20)	(0.08)	(0.09)	(0.13)	(0.13)
Age 8-15 years	2.41***	1.90***	2.31***	2.29***	1.11	1.07	1.07	1.10
	(0.05)	(0.04)	(0.09)	(0.09)	(0.05)	(0.09)	(0.07)	(0.07)
Age 16-30 years	1.56***	1.33***	1.40***	1.39***	1.01	1.00	1.03	1.04
	(0.03)	(0.03)	(0.04)	(0.05)	(0.03)	(0.0)	(0.06)	(0.06)
British (H3)	0.84***	0.88***			1.20***	1.16***		
	(0.01)	(0.03)			(0.04)	(0.07)		
Industry and Regional Dynamics								
Switch industry	1.50***	1.10***	0.94	0.91	1.06	0.82	0.98	0.88
	(0.01)	(0.03)	(0.03)	(0.03)	(0.03)	(0.05)	(0.07)	(0.11)
HHI sales	1.56***	2.17***	1.14	1.11	0.40	0.65	7.73**	10.52**
	(0.31)	(0.46)	(0.44)	(0.43)	(0.19)	(0.35)	(5.63)	(6.63)
Industry: Pubs and hospitality		0.61*		1.67		0.29*		0.82
		(0.14)		(0.59)		(0.16)		(0.66)
Industry: Transport		0.94		2.41		0.95		1.06
		(0.21)		(0.54)		(0.48)		(0.90)
Industry: Arts and creative		4.40**		2.44		1.80		3.45
		(2.51)		(2.20)		(2.40)		(6.60)
Industry: KIBS		1.03		1.14		1.08		1.19
		(0.08)		(0.17)		(0.17)		(0.38)
Organizational and human capital spillovers Other firm, industry and regional controls								
Foreign employment share (H2b)		1.04		1.14		0.83		0.48
		(0.12)		(0.23)		(0.21)		(0.20)
Foreign employment (H2a)		0.98		0.98		1.05***		1.03***
		(0.02)		(0.03)		(0.05)		(0.07)
Foreign firms share (H1b)		2.08**		1.48		1.07		5.22
		(0.71)		(0.75)		(0.91)		(7.41)
Foreign firm (H1a)		1.072**		1.03		0.96		0.95
		(0.02)		(0.03)		(0.04)		(0.07)
Constant	0.04***	0.02**	0.61***	0.07**	0.02***	0.01**	0.35***	0.06**
	(0.00)	(0.00)	(0.15)	(0.01)	(0.00)	(0.00)	(0.10)	(0.01)
Other industry, year and region fixed effects	Yes		Yes		Yes		Yes	
LR(chi2)	21512.36	26582.37	9496.69	9963.28	1630.93	1642.33	559.69	617.78
Pseudo R2	0.11	0.12	0.09	0.10	0.10	0.11	0.07	0.08

Note: standard errors robust for heteroskedasticity are in parenthesis. Reference groups: Age (31 and more years since establishment); legal ownership (listed company); year 2000; Industry (05-09).
2-digit SIC Industry, year and regional fixed effects are suppressed to save space. Significance level: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$". Number of foreign MNEs is 44,256 and number of domestic MNEs is 21,246.
Source: Business Structure Database, 1997-2017: Secure Access. UK Data Service.

(approximately 6 percent), with the rest of the sample of MNEs being 15 years old or greater.

To control for *firm size* we examine the number of employees in logarithm (Coad & Rao, 2008; Delmar et al., 2003;). Third, we use a continuous variable '*Subsidiaries*' which counts the number of reporting units (plants or enterprises within the enterprise group), as a proxy for firm's flexibility, size, technological and organizational diversity (Ambos et al., 2010), but also its transaction costs and speed (Sampson, 2007). There is no statistical difference between an average number of subsidiaries between domestic and foreign MNEs.

Relevant industry factors include an *industry's competition level* and a firm's experience of switching industries. In order to understand the role that context plays in growth scaling (Coad et al., 2018), we calculated the Herfindahl Index (HHI) by squaring the market share in sales for each firm by 3-digit SIC and then summing the squares. The use of HHI in sales is appealing as industry competitors are most likely to face similar conditions and experience common shocks to performance.

We measure *switching industry* as a binary variable equal to one if a firm has changed its industry (3-digit SIC code) in a current year compared to a previous year, zero otherwise. Switching industry is an indicator of a potential change in a firm's business model and how recent technological developments may have shaped the firms' industry (Belitski & Mariani, 2022; Ojala et al., 2018;).

Furthermore, to measure the effect of *regional specialization* on scaling we included measures of industry structure (Monaghan & Tippmann 2018) within a region of the share of employees in arts, pubs (restaurants and food industry), knowledge-intense business services (KIBS) and transport, including air, rail and road transport. The geographical concentrations of industries are limited by region and a combination of sectors. The motivation behind such controls is to account for the general level human capital distribution across industries by region. Firms located in regions with relatively higher proportions of knowledge-based sectors, such as KIBS are expected to experience increased knowledge flows and increased firm scaling.

In all models, we use one-year lags for our independent and control variables as well as the dependent variable. By including the lagged dependent variable, we examine the persistence of scaling, bearing in mind that firm scaling may be conditional on previous scaling. This is

important as the persistence of firms suggests that their capacity to scale is associated with a better 'fit' with changing environmental circumstances and that this capacity sustained over time.

We included 98 industry fixed effects (SIC code 2-digit) (mining and quarrying is a reference category) and seventeen-year dummies (2000 as a reference year) into our analyses. We did not control for regional fixed effects as industry shares by region are included to address concerns regarding unobserved regional heterogeneity.

3.4. Method

The MNE scaling and MNE growth models were estimated using a multivariate logit regression (Wooldridge, 2009), with the main covariates being the multi-level factors discussed in the theoretical framework.

The following econometric model is estimated to test H1-H4:

$$y_{it} = \beta_0 + \beta_1 y_{it-1} + \beta_2 x_{it-1} + \beta_3 m_{rt-1} + \beta_3 z_{it-1} + \lambda_t + \tau_s + u_{it} \quad (1)$$

Where y_i is the likelihood of scaling up of a firm i at time t. Additionally, x_{it-1} is a vector of explanatory variables (knowledge spillovers and foreign-domestic ownership) of a firm i in time t. All firm-level variables are one year lagged. y_{it-1} is the first lagged measure of firm's scaling up in $t-1$; m_{rt-1} is a vector of other control variables at the regional level such as employment by industry and industry-level competition (i.e., Herfindahl index); z_{it-1} is a set of control variables at the firm-level such as firm age, firm size, subsidiaries, switched industries. λ_t and τ_s are time and industry (2-digit SIC) fixed effects. All coefficients of the logit estimation are reported in odd ratios to ease the interpretation of results.

4. Results

4.1. Scaling and growth

Table 2 reports the results of the logistic regression for MNE scaling (specifications 1-4) compared to MNE growth (specifications 5-8). As mentioned, specifications 1 and 5 model relationships comprised of a random intercept, control variables and the lagged value of the dependent variable to control for the persistence of scaling. Additionally, we also control for industry and time-fixed effects. Our results indicate that there is a persistence in scaling and in growth of MNEs beyond the three-year time lag used to operationalize scaling. For example, foreign and domestic firms that scaled in the previous period (t-1) are 4-6 times more likely to scale-up in the next year as well as foreign and domestic firms that grew in t-1 are 5-6 times more likely to grow the next year (specification 5-8, Table 2).

Hypothesis 1 which states that a region's organizational knowledge spillovers increase foreign MNE scaling compared to foreign MNE growth is supported. An increase in foreign firms' share (organizational spillover depth) in a region by one percent is associated with greater odds of foreign MNE scaling by 2.08 times (spec. 2, Table 2) supporting H1b. An increase in the number of foreign firms in a region by one (organizational spillover breadth) is associated with an increase in the odds of foreign MNE scaling by 1.07 times (spec. 2, Table 2) supporting H1a. An increase in foreign firms' share (depth) and the number of foreign firms (breadth) is not associated with MNE growth in foreign MNEs (specification 6 and 8, Table 2).

Hypothesis 2 which states that MNEs' scaling vis-à-vis MNE growth is positively influenced by the localized human capital knowledge spillovers from employees in foreign MNEs is not supported. Foreign MNEs do not benefit in terms of scaling (spec. 2 and 4, Table 2) from human capital spillovers from other MNEs. However, the results of Table 2 demonstrate, that in regions where human capital spillover breadth is higher, foreign MNEs ($\beta = 1.05$, $p < 0.05$) (spec. 6, Table 2) and domestic MNEs ($\beta = 1.03$, $p < 0.05$) (spec. 8, Table 2) grow faster, but this does not extend to exhibiting a persistent individual growth. We

find the core differences in the role of human capital spillovers for MNE growth, rather than MNE scaling. It is the number of employees in foreign MNEs that create conditions for MNE growth rather than the share of such employees that matters for an increased diversity and creation of strong collaborative networks between workforce and knowledge exchange for a long-term growth (Rugman et al., 2011).

Hypothesis 3 which suggests domestic ownership of MNEs will positively moderate the relationship between knowledge spillovers and MNE scaling in relation to MNE growth was not supported neither localized human capital nor for the localized organizational knowledge spillovers. Increases in the breadth and depth of human capital and organizational knowledge spillovers did not result in significant increases in scaling in these firms. Note that increases in foreign employment did result in increases in foreign MNE growth, just as it did in domestic MNEs. Overall, our findings provide evidence that foreign MNEs benefit most in terms of propensity to scale from an increase in the presence and share of other foreign MNEs in a region.

The main argument of this finding is that foreign MNEs operating in more internationally open locations exhibit better scaling opportunities, because their dynamic capabilities enable them to achieve a progressive assimilation of international knowledge locally and development of a more advanced knowledge combinations for scaling vis-à-vis growth. Spillovers from foreign MNEs are conduits for other foreign MNEs in a region for external knowledge and for adoption of new technologies, leading to innovation, economic performance and scaling (Forslid et al., 2018). Regarding advantages related to co-location with foreign MNEs, we argue the foreign MNEs exposure to higher standards of technology and knowledge brought globally, higher requirement for cleaner production and use of new technologies drive MNE scaling vis-à-vis MNE growth for firms who are able to develop operational and dynamic capabilities that enable them to recognize and absorb this knowledge (cf. Cepeda & Vera, 2007; Helfat & Winter, 2011). MNE scaling is the outcome of the presence of diverse foreign MNEs in a region and it is related to a localized combination of MNEs, introducing different business models, technologies and perspectives (Mihailova, 2023). We argue, that specifically for foreign MNEs to enhance their propensity of scaling it is better to be located in a region with a higher presence of foreign MNEs but relatively lower employment, rather than in a region with a greater foreign employment, but smaller number of foreign firms. That is, the latter is more associated with a propensity to grow in both foreign and domestic MNEs, but not achieve scaling via persistent rapid growth.

It is interesting that organizational knowledge spillovers are associated with scaling in foreign firms and not associated with scaling for domestic firms as the firm specific advantages may not match with relatively 'distant' knowledge coming from foreign MNEs, which can make absorption of spillovers complicated. This may can be explained by the higher adaptation costs of organizational knowledge spillovers for domestic MNEs (Rugman & Verbeke, 2005), and in particular, at early stages of internationalization.

4.2. Other factors for MNE scaling and growth

Several additional key differences between MNE scaling vis-à-vis persistent rapid growth are observed to be associated with firm characteristics such as firm age, firm size, domestic co-ownership of foreign MNEs as well as MNE's strategy to remain or switch the industry. Firm age was an important predictor of scaling for foreign and domestic MNEs (spec. 1-4, Table 2), while it does not predict MNE growth for foreign or domestic MNEs (spec. 5-8, Table 2). Younger (4-7 years since the establishment) foreign and domestic MNEs were 3-4 times more likely to scale up compared to matured firms, while foreign and domestic MNEs between 8 and 30 years were between 1.3 to 2.2 times more likely to scale up compared to mature firms. Younger foreign and domestic MNEs as well as MNEs between 8 and 30 years were as likely to experience growth as mature firms (30 years and more).

Table 3
Tobit regression for MNE scaling efficiency with productivity weighting.

Variables	DV: MNE scaling			
	(1)	(2)	(3)	(4)
MNE ownership	**Foreign MNE (248,990 obs.)**		**Domestic MNE (89,668 obs.)**	
DV t-1	1.24***	1.29***	1.15***	1.14***
	(0.01)	(0.01)	(0.02)	(0.02)
Firm characteristics				
Employment	-0.04***	-0.06***	-0.06***	-0.05***
	(0.00)	(0.00)	(0.00)	(0.00)
Subsidiaries	-0.05***	-0.06***	-0.04***	-0.03***
	(0.01)	(0.01)	(0.01)	(0.01)
Age 4-7 years	1.48***	1.45***	1.57***	1.51***
	(0.03)	(0. 03)	(0. 03)	(0. 03)
Age 8-15 years	0.76***	0.76***	0.92***	0.92***
	(0.03)	(0.02)	(0.03)	(0.03)
Age 16-30 years	0.28***	0.29***	0.34***	0.35***
	(0.02)	(0.02)	(0.03)	(0.03)
British (H3)	-0.01	-0.09***		
	(0.01)	(0.03)		
Industry and Regional Dynamics				
Switch industry	0.28***	0.23***	0.05	0.01
	(0.01)	(0.03)	(0.05)	(0.05)
HHI sales	0.48**	0.52**	0.10	0.11
	(0.23)	(0.25)	(0.39)	(0.39)
Industry: Pubs and hospitality		-0.28		0.54
		(0.26)		(0.35)
Industry: Transport		-0.09		1.02***
		(0.20)		(0.38)
Industry: Arts and creative		1.28		1.02
		(0.66)		(0.90)
Industry: KIBS		0.02		0.14
		(0.10)		(0.15)
Organizational and human capital spillovers				
Foreign employment share (H2b)		-0.01		0.21
		(0.13)		(0.19)
Foreign employment (H2a)		-0.01		-0.04
		(0.02)		(0.03)
Foreign firms share (H1b)		0.75**		0.07
		(0.35)		(0.64)
Foreign firm (H1a)		1.07***		0.05
		(0.02)		(0.03)
Constant	-3.94***	-4.92***	-3.23***	-3.89***
	(0.06)	(0.16)	(0.09)	(0.32)
Other industry, year and region fixed effects	Yes	Yes	Yes	Yes
left-censored	241343	241343	80504	80504
LR(chi2)	16936	16344	7285	7498
Pseudo R2	0.08	0.10	0.09	0.10
Log-likelihood	-98664.11	-90657.05	-38773.78	-37824.48

Note: standard errors robust for heteroskedasticity are in parenthesis. Reference groups: Age (31 and more years since establishment); legal ownership (listed company); year 2000; Industry (05-09).
2-digit SIC Industry, year and regional fixed effects are suppressed to save space. Significance level: * p < 0.05; ** p < 0.01; *** p < 0.001". Number of foreign MNEs is 44,256 and number of domestic MNEs is 21,246. Source: Business Structure Database, 1997-2017: Secure Access. UK Data Service.

Firm size, on the contrary, positively affects MNE growth and negatively MNE scaling. Specifically, a one percent increase in firm employment was associated with 6-7% decrease in MNE scaling for foreign MNEs (spec. 1-2, Table 2) and 10-11% decrease in scaling for domestic MNEs (spec. 3-4, Table 2). Interestingly, MNE growth effects were opposite for both foreign and domestic MNEs with the coefficients positive and significant. An increase in employment by 1 percent was associated with 1.10 times higher growth for foreign MNEs (spec. 5-6, Table 2) and 1.13 times higher growth for domestic firms (spec. 7-8, Table 2).

Domestically co-owned foreign MNEs were 12-16% less likely to scale than foreign MNEs (spec. 1-2, Table 2), while they are 1.16-1.20 times more likely to grow (spec. 5-6, Table 2). This finding demonstrates the clear-cut differences between MNE scaling for foreign MNEs with a share of domestic ownership. Domestic ownership facilitates

growth, though reduces the speed and persistence of growth.

Another important difference between MNE scaling vis-à-vis MNE growth is in changing industries. Foreign MNEs record 1.10-1.50 increase in MNE scaling if they switched the main industry where they operated last year (spec. 1-2, Table 2) with no effect on MNE growth (spec. 5-6, Table 2). In addition, there is no significant effect of switching industry for MNE scaling and growth for domestic firms (spec. 3-4 and 7-8, Table 2).

Interestingly, foreign MNEs operating in an industry with lower levels of competition are 2.17 times more likely to scale (spec. 2 Table 2), while domestic firms who operate in less competitive sectors do not (spec. 3-4, Table 2). In contrast domestic MNEs are 7-10 times more likely to grow if they are located in an industry with less competition (spec. 7-8, Table 2), while foreign MNEs who operate in less competitive sectors do not (spec. 5-6, Table 2). This implies that benefits of industry concentration for domestic MNE growth are much higher than the benefits from industry concentration for foreign MNE growth. A low level of competition is conducive for foreign MNE scaling and domestic MNE growth. Foreign firms that are located in regions with a greater concentration of arts and creative industries scale faster than firms located in other sectors and faster than domestic firms located in the same region.

4.3. Robustness check

Rapid growth for MNEs may be (but does not have to be) associated with gains in productivity. We tested for the likelihood of MNE efficient scaling as a robustness check. Table 3 illustrates the results for Tobit estimation for scaling weighted by the productivity gains for domestic (spec. 3-4, Table 3) and foreign MNEs (spec. 1-2, Table 3). The distribution of the dependent variable is between zero and 2.36 as most of firms do not scale, even though productivity gains could be achieved. We calculated how the productivity gains changed MNE scaling between foreign and domestic MNEs and compared the results with Table 2 (spec. 1-4) for MNE scaling without accounting for the productivity gains in scaling.

The estimates show that the proposed H1a and H1b which state that MNEs' scaling is positively influenced by the localized organizational knowledge spillovers from peer MNEs are supported for foreign firms both for the breadth (β = 1.07, p < 0.001) and the depth of organizational spillover (β = 0.75, p < 0.05) (spec. 2, Table 3). These results support our prior findings on the positive and persistent effect of organizational knowledge spillover for scaling in foreign MNEs. Our H2a and H2b which state that MNEs' scaling is positively influenced by the localized human capital knowledge spillovers from the number and share of foreign employees is not supported for foreign MNEs scaling (spec. 2 and 4, Table 3). Finally, our H3 is not supported as domestic MNEs do not positively moderate the relationship between two types of knowledge spillovers and MNE scaling, with the coefficients not being significant for domestic MNEs (spec. 2 and 4, Table 3).

Consistent with the prior findings in Table 2, our results confirm that there is a strong positive persistence in efficient scaling for MNEs who have already scaled in the previous year with the value 1.24-1.29 (β = 1.24-1.29, p < 0.01) for foreign MNEs (spec. 1-2, Table 3). and 1.14-1.15 (β = 1.14 -1.15, p < 0.01) for domestic MNEs (spec. 3-4, Table 3). Both foreign and domestic MNEs are less likely to perform efficient scaling when the number of employees is increased (β=-0.04-(-0.06), p < 0.01) (spec. 1-4, Table 3) supporting prior findings in Table 2 on MNE scaling vis-a-vis MNE growth. Foreign MNEs that are 4-7 years old since their establishment have on average 1.45-1.48 percent higher efficiency in scaling, while the value for domestic firms is 1.51-1.57 percent. The returns to scaling and productivity slowly dissipate for both foreign and domestic MNES after 8 years since their establishment compared to firms 30 and more years old. While older MNEs are still able to scale up, their ability to do so decreases rapidly.

Foreign MNEs that have switched to a different industry demonstrate

Table 4

Summary of main concepts, results, and implications.

Concept	Growth	Scaling	Scaling efficiency
Conceptual definition	Increase in size and/or sales	Persistent and rapid growth	Efficient and persistent growth, spreading the excellence
Focal organizational goal	Strategic (product-market) fit	Strategic momentum	Highly adaptive strategic momentum
Organizational capability	Resources are directly added to fuel growth, e.g., exploit product-market fit	Resource-bases are configured to sustain persistent rapid growth. Scaling relies on more dynamism on the part of the firm to support / deepen investment in the business model.	Resource expenditures are minimized to enhance profitability when scaling.
Study results pertaining to the underlying mechanisms			
Organizational knowledge spillovers (presence and share of foreign firms in the region)	no effect	Larger number and share of foreign MNEs increase *firm-level access to knowledge* and thereby positively affect scaling	Larger number and share of foreign MNEs increase *firm-level access to knowledge* and thereby positively affect scaling efficiency
Human capital knowledge spillovers (employees in foreign MNEs in the region)	Larger number of foreign MNE employees increase *employee-level access to knowledge* and thereby positively affect MNE growth	no effect	no effect
Implications from the study			
For theory	- Growth, scaling and scaling efficiency are closely related, but distinct concepts. - The mechanisms promoting each differ while finding product-market fit underlies firm growth, maintaining it and gaining efficiency – underlies scaling. - **MNE growth** is boosted by *human capital spillovers* (e.g., number and share of employees in foreign MNEs – possibly from few large firms), whereas **MNE scaling** relies on *organizational spillovers* (number and share of foreign firms – possibly smaller ones). While the growing organizations are likely to be production and service facilities, the latter – digital and tech development firms.		
For managers	To grow, locate in regions with large number of foreign firm employees or find ways to provide access to networks of foreign firm employees.	To scale, locate in regions with a large number and share of foreign MNEs.	To scale efficiently, capitalize on knowledge available in regions with a large number and share of foreign MNEs.
For policymakers	To promote firm growth, create physical, virtual, and social infrastructure that facilitates creation of dense networks of foreign firm employees.	To promote persistent firm growth, create conditions to attract foreign MNEs into the region.	To promote persistent and efficient firm growth, create conditions to attract foreign MNEs into the region.

Note: Only significant results are reported. Hypotheses are labeled in parenthesis.

Source: Authors

Table 5

Logistic regression for MNE scaling.

Variables	DV: MNE scaling			
	(1)	(2)	(3)	(4)
MNE ownership	**Foreign MNE (248,990 obs.)**		**Domestic MNE (89,668 obs.)**	
DV t-1	2.93***	3.04***	3.02***	3.03***
	(0.03)	(0.03)	(0.05)	(0.05)
Firm characteristics				
Employment	0.96***	0.96***	0.92***	0.93***
	(0.00)	(0.00)	(0.00)	(0.00)
Subsidiaries	0.93***	0.92***	0.85***	0.90***
	(0.02)	(0.02)	(0.02)	(0.02)
Age 4-7 years	4.10***	3.96***	4.90***	4.72***
	(0.12)	(0.12)	(0.24)	(0.24)
Age 8-15 years	2.12***	2.13***	2.62***	2.63***
	(0.05)	(0.05)	(0.10)	(0.10)
Age 16-30 years	1.33***	1.34***	1.45***	1.47***
	(0.03)	(0.03)	(0.05)	(0.05)
British	0.98***	0.90***		
	(0.01)	(0.01)		
Industry and Regional Dynamics				
Switch industry	1.28***	1.19***	1.03	0.97
	(0.02)	(0.03)	(0.03)	(0.04)
HHI sales	1.64**	1.74**	1.18	1.01
	(0.35)	(0.40)	(0.50)	(0.49)
Industry: Pubs and hospitality		0.78		1.93
		(0.19)		(0.45)
Industry: Transport		0.84		2.71***
		(0.22)		(0.11)
Industry: Arts and creative		3.15		3.18
		(2.20)		(2.10)
Industry: KIBS		1.03		1.17
		(0.10)		(0.13)
Organizational and human capital spillovers				
Foreign employment share (H2b)		1.05		1.19
		(0.13)		(0.23)
Foreign employment (H2a)		0.98		0.96
		(0.03)		(0.02)
Foreign firms share (H1b)		1.66*		1.42
		(0.50)		(0.92)
Foreign firm (H1a)		1.07***		1.04
		(0.02)		(0.04)
Constant	0.03***	0.01***	0.06***	0.03***
	(0.00)	(0.00)	(0.00)	(0.00)
Other industry, year and region fixed effects	Yes	Yes	Yes	Yes
LR(chi2)	17587	16839	7747	8009
Pseudo R2	0.10	0.12	0.12	0.13
Log-likelihood	-72626.31	-66036.51	-27720.70	-26947.68

Note: standard errors robust for heteroskedasticity are in parenthesis. Reference groups: Age (31 and more years since establishment); legal ownership (listed company); year 2000; Industry (05-09).

2-digit SIC Industry, year and regional fixed effects are suppressed to save space. Significance level: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$". Number of foreign MNEs is 44,256 and number of domestic MNEs is 21,246.

Source: Business Structure Database, 1997-2017: Secure Access. UK Data Service.

high efficiency in scaling ($\beta = 0.23$-0.28, $p < 0.001$) (spec. 1-2, Table 3), while domestic firms are less able to exploit the productivity gains for scaling, as the coefficients are not significant (spec. 3-4, Table 3). We also find similar results compared to Table 2 estimates for foreign MNEs that operate in less competitive markets. They are more likely to scale efficiently ($\beta = 0.48$-0.52, $p < 0.001$) (spec. 1-2, Table 3), while the competitiveness of the market does not affect efficient scaling for domestic MNEs (spec. 3-4, Table 3). Industry-wise, although we do not find that location in the industry-region has a direct effect on efficient scaling, domestic firms in transport sector exhibit highest efficiency in scaling (spec. 3, Table 3).

Our results for the main estimation of MNE scaling vis-à-vis MNE persistent rapid growth (Table 2) and the efficiency of MNE scaling (Table 3) are summarized in Table 4.

Finally, to estimate our study hypotheses for MNE scaling efficiency

Table A1
Sample distribution by survey year.

Sample	Foreign MNEs		Domestic MNEs	
Sector	# obs.	Share	# obs.	Share
2004	18975	7.62	2881	3.21
2005	19316	7.76	2645	2.95
2006	19659	7.90	2566	2.86
2007	20223	8.12	2590	2.89
2008	22148	8.91	3115	3.47
2009	20607	8.28	4938	5.51
2010	19397	7.79	6702	7.47
2011	18077	7.26	7221	8.05
2012	16891	6.78	8255	9.21
2013	15903	6.39	8720	9.72
2014	15360	6.17	9383	10.46
2015	14723	5.91	9851	10.99
2016	14178	5.69	10178	11.35
2017	13533	5.44	10623	11.85
Total	**248,990**	**100**	**89,668**	**100**

Table A2
Sample distribution by industry (SIC 2007).

Sample	Foreign MNEs		Domestic MNEs	
Section	# obs.	Share	# obs.	Share
Manufacture of food products, beverages, textiles, food and paper products, refined petroleum	10509	4.22	2333	2.60
Manufacture of chemicals, pharmaceutical, metals, computer, electronic and optical products, machinery, transport and electrical	22436	9.01	5046	5.63
Electricity, gas, steam, waste, water collection, treatment, civil engineering, construction	11159	4.48	2313	2.58
wholesale and retail trade	69375	27.86	23469	26.17
Accommodation and transport	21376	8.59	6807	7.59
Information and communication, insurance, financial service activities, real estate	36258	14.56	14934	16.65
Professional, scientific, and technical activities	41786	16.78	11895	13.27
Administrative and support activities, education, public administration, human health and social work	22559	9.06	15444	17.22
Art, entertainment and recreation	13532	5.43	7427	8.28
Total	**248,990**	**100**	**89,668**	**100**

Table A3
Sample distribution by the UK regions (states).

Sample	Foreign MNEs		Domestic MNEs	
Region	# obs.	Share	# obs.	Share
Northeast	6047	2.43	2227	2.48
Northwest	23109	9.28	8129	9.07
Yorkshire and The Humber	19473	7.82	6087	6.79
East Midlands	16349	6.57	5813	6.48
West Midlands	21386	8.59	7144	7.97
East England	24082	9.67	8776	9.79
London	55151	22.15	18584	20.73
Southeast	41186	16.54	14376	16.03
Southwest	16866	6.77	7472	8.33
Wales	6840	2.75	2897	3.23
Scotland	15112	6.07	6078	6.78
Northern Ireland	3389	1.36	2085	2.33
Total	**248,990**	**100**	**89,668**	**100**

we performed an additional robustness check and ran a logistic regression on productivity gains in scaling using Eq. (1) (Table 5). Our results in relation to the hypothesis one on the positive role of organizational knowledge spillovers on scaling for foreign firms are supported. However, the hypothesis two on the role of human capital knowledge

Table A4
Sample distribution by firm size.

Sample	Foreign MNEs		Domestic MNEs	
Firm size in FTEs	# obs.	Share	# obs.	Share
Micro 6-9	61095	24.54	23549	26.26
Small 10-49	92420	37.12	39157	43.67
Medium small 50-99	32079	12.88	10207	11.38
Medium large 100-249	27747	11.14	8240	9.19
Large >249	35649	14.32	8515	9.50
Total	**248,990**	**100**	**89,668**	**100**

Source: Business Structure Database, 1997-2017: Secure Access. UK Data Service.
Number of foreign MNEs is 44,256 and number of domestic MNEs is 21,246.

spillovers is not supported for foreign MNEs or for domestic MNEs. Again, this confirms the productivity gains results reported in Table 3. We did not find that domestic ownership positively moderates the relationship between knowledge spillovers and MNE scaling efficiency, again confirming our previous results. By using both target and logistic estimation we are able to demonstrate the robustness of our results, particularly the role that the number of MNEs and their share in the total firms in a region play in boosting the likelihood of foreign MNEs scaling.

5. Discussion and implications

This study develops and tests a theory of MNE scaling (compared to MNE growth) as a function of knowledge spillovers from peer MNEs. In doing so, we combine the international business and organizational scaling literature and draw scholarly attention to MNE-to-MNE knowledge spillovers and their role in MNE scaling in terms of persistent rapid growth.

5.1. Theoretical implications

A variety of drivers behind MNE scaling in relation to MNE persistent rapid growth have been considered in the literature (Chliova & Ringov, 2017; Gulati & DeSantola, 2016;). Nonetheless, our understanding of the role that external knowledge spillovers from MNEs may play in the organizational scaling of other, peer MNEs within a region has remained an open question. In this vein, our work follows a recent call in the IB literature (Buckley & Casson, 2020; Reuber et al., 2021; Tippmann et al., 2022) and organizational scaling literature (Palmié et al., 2023; Shepherd & Patzelt, 2022) to pay greater attention to the importance of the knowledge environment for organizational scaling and the differences between MNE scaling and MNE growth. In doing so, our study draws attention to the role which organizational and human capital knowledge spillovers within the external environment play in helping an organization to build and strengthen its capability to support and sustain rapid growth by providing new insights, best practices, and novel opportunities which organizations can use to drive a spreading of excellence throughout an organization as it grows, scales, and establishes a viable business model for persistent rapid growth (Blank, 2013; DeSantola & Gulati, 2017; Mihailova, 2023; Tippmann et al., 2023).

We distinguish between the breadth and depth of organizational and human capital knowledge spillovers, and examine their effects on MNE scaling vis-à-vis MNE persistent rapid growth. In doing so we directly address the call for research which explores factors, such as knowledge spillovers, which promote an accumulation of knowledge and learning within organizations as well as how these factors may impact incidences of organizational scaling and persistent rapid growth (Shepherd & Patzelt, 2022). While the knowledge management literature has largely focused on quantifiable knowledge stocks and knowledge flows (Del Giudice et al., 2013; Petruzzelli, 2011; Straub & Del Giudice, 2012), our findings underscore the importance of examining indirect inflows of knowledge in addition to collaborations (Bresciani, Ciampi, Meli, & Ferraris, 2021) with external knowledge partners and open innovation

Table B1
Summary of the focal questions, domains, and definitions in three literature streams.

Literature streams	Knowledge Management (KM) & International Business (IB)-Growth	Knowledge Management (KM) & Knowledge Spillovers (KS)	Knowledge Spillovers (KS) & International Business (IB)-Growth	Knowledge Management (KM) & Knowledge Spillovers (KS) International Business (IB)-Growth
Focal question	How can we design MNE (as a globally distributed learning network) to obtain highest impact from using and increasing firm's knowledge?	How can we capture and utilize knowledge spillovers (externalities) internally?	How do spillovers affect our expansion/growth strategy?	How do external knowledge spillovers from peer MNEs and employees within a region affect MNE scaling?
Context domain	Market/Industry/Regional context	(Strategic) Management context	Entrepreneurial context	Strategic growth context within market/regional boundaries
Core concepts	KM suggests that firms venture abroad for two distinctive reasons: (a) to **use** extant firm-specific knowledge (home base-exploiting (HBE activities like manufacturing), or (b) **to increase the** firm's stock of knowledge (home base-augmenting (HBA activities like R&D) (Kuemmerle, 2002). MNE is a "**network of transactions**" which consists of "capital, product, and knowledge transactions among units located in different countries" (Gupta & Govindarajan, 1991: 770, emphasis added).	Strategic knowledge management "relates to the processes and infrastructures organizations **use to attain, create and share** knowledge for formulating strategy and making strategic decisions (Zack, 2002)" (Ferreira, Mueller, & Papa, 2018: 121). Knowledge spillovers are "the **external benefits** from knowledge creation that is enjoyed by parties other than the party investing in the creation" (Agarwal, Audretsch, & Sarkar, 2010: 272, emphasis added).	Knowledge spillover theory of entrepreneurship (KSTE) suggests that entrepreneurs **generate opportunities** by utilizing commercially valuable but underexploited knowledge created by others (Audretsch & Feldman, 1996; Audretsch & Keilbach, 2007). MNE is "an interorganizational network that **is embedded in an external network** consisting of all other organizations such as customers, suppliers, regulators, and so on, with which the different units of the multinational must interact" (Bartlett & Ghoshal, 1989: 603, emphasis added).	**Creation and utilization of knowledge** is the most important task of companies, which enables them to transfer knowledge into value-creating activities, such as producing products or providing services "Growth is an inherently **endogenous process** based on the creation, dissemination, and commercial use of new technological knowledge." (Delmar, Wennberg, & Hellerstedt, 2011: 201, emphasis added). MNE is a globally distributed innovation network, whose "success linked to the capacity to **assimilate, generate, and integrate** knowledge on a worldwide basis (Bartlett & Ghoshal, 1989; Hedlund, 1994)" (Phene & Almeida, 2008: 901, emphasis added).

in established inter-firm networks (Ahuja, 2000; Ferraris, Santoro, & Dezi, 2017; Martin & Bachrach, 2018; Scuotto, Ferraris, & Bresciani, 2016). Thus, we provide a more nuanced and finer grained understanding to the IB literature concerning the relationships between organizational and human capital knowledge spillovers and MNE scaling in terms of persistent rapid growth.

Choosing to consider both foreign and domestic MNEs across a broad variety of industry sectors, instead of a homogeneous selection of multinationals, we expand prior insights into inter-organizational and inter-agentic learning within a global context, through the local-embeddedness of foreign MNEs. We help advance prior research on the differences among organizations concerning their "ability to transfer knowledge for organizational scaling" (Shepherd & Patzelt, 2022: 257). By unpacking these heterogeneities in incidences of scaling up between domestic and foreign MNEs, we address recent calls in the MNE scaling literature to delineate the drivers of scaling, e.g., persistent rapid growth (Ferraris, Santoro, & Dezi, 2017; Piaskowska et al., 2021; Reuber et al., 2021; Tippmann et al., 2023). Our findings add to recent advances in the literature of organizational scaling and knowledge transfer which describe the caveats and opportunities realized through interactions within knowledge-intensive industries (Del Giudice & Straub, 2011; Millar, Lockett, & Mahon, 2016).

Beyond considering the role of organizational and human capital spillovers for MNE scaling in relationship to persistent rapid growth, this study demonstrates the importance of the breadth and the depth of these knowledge spillovers stemming from an increase in the number and share of foreign firms and employees in a region. Specifically, our results indicate that foreign MNEs that remain fully foreign-owned are more likely to scale, and those foreign MNEs that switch industry or operate in the industry with a lower level of competition are also more likely to scale. In contrast domestic MNEs are more likely to grow if operating in low competition industries, while an industry switch does not affect their propensity to scale or grow. Interestingly, we observe younger MNEs are more likely to scale compared to older MNEs, while firm age is not associated with the likelihood of MNE growth. Firm employment reduces the propensity of MNEs to scale though increases the propensity of MNEs to grow, demonstrating distinct differences between organizational growth and scaling (Palmié et al., 2023; Shepherd & Patzelt, 2022).

Our results demonstrate how differences in organizational growth as an increase of a focal indicator, e.g., employment, sales, performance, and organizational scaling as persistent rapid growth, e.g., how growth unfolds and is supported over time (Palmié et al., 2023).

5.2. Policy implications

Policymakers play a central role in setting up conditions that create opportunities for MNEs to scale. Our data indicates that from a macro perspective, the number of foreign MNEs and their share in the U.K. population of firms along with the number of employees is steadily decreasing over time and is consequently limiting the degree of organizational and human capital knowledge spillovers. An implication for policymakers would be to consider the potential unintended consequences when incentivizing local firms to employ only local workers and balance this employment objective with that of increasing their organization's ability to compete and scale in a global marketplace. When taken to the extreme, such policies may dramatically reduce the size and share of foreign MNEs and their employees, diminishing access to international knowledge, and MNE scaling. Policy mechanisms that actively consider and balance the share of foreign MNEs and local firms will help ensure the richness of a region's knowledge environment.

Thus, our findings suggest that public policy directed towards supporting organizational scaling benefits from increasing the presence of foreign companies and their share in a specific region. Public policy directed towards supporting organizational growth benefits from *promoting an increase in foreign employment in specific regions* with a high

Table C1

Summary on conceptualizations and operationalizations of knowledge depth and breadth.

Concept and its operationalization	Knowledge depth		Knowledge breadth	
Knowledge flows on firm-level	Conceptualization	Operationalization	Conceptualization	Operationalization
Dual activities of exploration and exploitation (Xu & Cavusgil, 2019)	Exploitation-orientated activities focus on firm behaviors aimed at exploiting current competencies (Raisch, Birkinshaw, Probst, & Tushman, 2009).	Number of product classes in which a firm holds patents	Exploration-orientated activities focus on firm behaviors aimed at searching and developing fundamentally new competencies	Average number of approved patents per patent subclass for each firm up to year *t*.
Knowledge search strategy in process innovation (Terjesen & Patel, 2017)	Deep search strategy refers "to how intensively a firm draws from each external stakeholder"	Usage intensity of each of the 11 sources of innovation efforts	Broad knowledge search strategy seeks to access a wide range of external knowledge$$$ $$	Use of one or more of 11 information sources for innovation activities over the last 3 years
External knowledge breadth or depth (Laursen & Salter, 2006)	External knowledge depth represents the degree to which companies draw on different search channels as sources of knowledge that are intensively integrated into the firm's innovation processes.	(a) The extent of use for each information source (high, medium, low) – aggregated across all sources.$$$$$(b) collaboration with external partners	External search breadth captures the number of external sources or search channels that firms rely upon in their innovative activities	Usage of the 16 sources of knowledge or information for innovation (e.g., suppliers, customers, competitors, universities, conferences, technical standards, etc.)
Knowledge flows on the city level				
Knowledge depth and breadth of a city (Ye, 2021)	The depth of knowledge in the city develops when a city continuously applies for patents in a technical field.	Number of patents added to the existing technology categories from the previous year	The breadth of knowledge in cities develops when cities apply for patents in *new* technological fields.	Number of patents that cities apply for in new technology categories each year
Knowledge flows on the regional level				
Current study: organizational and human capital knowledge flows	Knowledge spillover depth is the *density* of international market players in the region that are likely to produce knowledge externalities.	Concentration of foreign firms (or employees of these firms) in the region (share of foreign firms in the total number of firms)	Knowledge spillover breadth is the *number* of international market players in the regions that are likely to produce surplus knowledge.	Total number of foreign firms (or employees of foreign firms)
Summary	*Knowledge depth captures information volume, where a larger share of foreign firms suggests higher quantity of knowledge.*	*Knowledge breadth captures information novelty and diversity, where more players provide more sources for potential inputs.*		

concentration of MNEs. As our study demonstrates how an increased breadth and depth of MNEs and their employees may boost MNE scaling vis-à-vis MNEs persistent rapid growth, policymakers may choose specific policy tool to encourage regional participation of MNEs and boost the attractiveness of a region. Professional conferences and trade fairs create platforms for showcasing a region and fostering knowledge exchange between MNEs and regional governments may play a central role in organizing and supporting knowledge spillovers in a regional context (Helfat & Martin, 2015a; Maskell, 2014). Policymakers may want to focus on younger firms that are relatively small to increase MNE scaling, while for MNE growth both younger and older firms could be targeted. With additional support, foreign MNEs may scale up rapidly within the sector or switch sectors, which again opens up opportunities for MNE scaling. Therefore, public interventions could be designed to (a) target specific young and small size foreign MNEs for MNEs scaling and (b) create knowledge ecosystems by attracting more foreign MNEs to come in a region and increase their share in total firms (Monaghan & Tippmann, 2018). As authors suggest, MNE often follow a "talent is most important in our industry"-thesis, choosing to locate their regional headquarters in areas where they can hire talent and curate talent networks from other high-growth technology firms. We demonstrate that for MNE spillovers this policy may work for MNE growth, but not for MNE scaling, for which entry by foreign MNEs and their increased relative presence in a region are important factors.

5.3. Practical implications

Framing a region's knowledge availability and richness from peer institutions as a conduit to MNE scaling, our study offers three implications for MNEs scaling and growth. Based on our analysis of the breadth and depth of external knowledge spillovers as drivers of scaling,

our first implication suggests that MNE scaling is linked to available peer MNE knowledge spillovers, and in particular for foreign MNEs. Domestic MNEs are not affected by peer MNE knowledge spillovers. Interpersonal knowledge embedded in human capital spillover is highly valuable for MNE growth, but is not associated with MNE scaling. A region requires MNE knowledge spillovers from the number of foreign MNEs and their share in a region to scale up. Therefore, to capitalize on the relational character of knowledge conversion, MNEs need to co-locate in places with a higher number of foreign MNEs. Those domestic and foreign MNEs interested in growth that is greater than the market average should co-locate in regions where the share of employees in foreign MNEs is the greatest. Foreign worker density plays an important role in MNE growth, but not MNE scaling. Our second practical implication is that *firm ownership* determines scaling. In the population of MNEs in the UK, foreign MNEs who benefit from knowledge spillovers from other foreign MNEs will have higher returns to scaling, unlike domestic MNEs. These findings suggest that while co-owned MNEs may capitalize on the 'local' brand image to gain legitimacy, distinctiveness, higher customer loyalty and ultimately, foreign MNEs are able to exploit their local advantages and their technology to scale up.

Third, our results suggest that a region's tacit knowledge spillover has *varying effects for foreign and domestic MNEs*. Domestic MNEs achieve greater returns to knowledge spillovers for MNE growth and not for scaling. Implications for the *managers of domestic MNEs'* suggest that co-location with foreign firms who hire more employees will result in benefits from interaction between their employees and the employees of foreign firms.

6. Limitations and future research

This study has several limitations that may be addressed in future

investigations. First, our analysis is limited to a population of firms within one country (U.K.), and during a specific time period (2000-2017). While our data allows us to make inferences, further studies are needed to establish the generalizability of our results. For instance, as a developed country with high levels of protection in intellectual property rights (IPR), the U.K. differs from the context of many developing countries with low levels of IPR, and therefore, internalization strategies and factors conducive to high growth may differ in these contexts (Oxley, 1999). Additionally, we chose to limit the observation window to 2018 to avoid potential bias emanating from the Brexit announcement on the strategies of the domestic and foreign MNEs operating within the U.K. Since Brexit introduced high market turbulence and increased environmental uncertainty (Moradlou, Reefke, Skipworth, & Roscoe, 2021), it may have the effect of reducing both the likelihood of MNEs to capitalize on regional knowledge spillovers and their likelihood to transfer ownership to local partners. Moreover, while our findings suggest that larger organizational knowledge spillovers create a fertile flow of knowledge to domestic MNEs, this effect may be time specific. In addition, digital technologies and platforms now facilitate data-driven innovation which is not localized using zoom and other platforms (Bresciani, Ciampi, Meli, & Ferraris, 2021). Future research may combine some of the ideas on how digital technologies can be implemented for knowledge transfer beyond the local boundaries and how this could be done most efficiently to facilitate firm performance improvements, related to MNE scaling as compared with MNEs persistent rapid growth. Future research could, therefore, consider the changes in MNE strategies given an increased data-driven innovation, global knowledge transfer with a goal of establishing potential effects on MNEs' ability to assimilate and utilize different types of knowledge spillovers locally and globally as MNE scaling depends upon accumulating, communicating, relocating, and connecting external and internal knowledge as articulated within prior research (Shepherd & Patzelt, 2022).

Subsequent research may also match data on MNEs registered in the UK and overseas on MNEs' international presence, ownership distribution and the level of ownership control. More fine-grained information on the number of subsidiaries abroad, the share of export and other trade-related characteristics, including employment of staff abroad in subsidiaries is needed to provide an even more nuanced picture how MNEs scale-up and what factors drive this process. Future research may also consider examining an MNE's capacity to acquire, assimilate, transfer and utilize external knowledge related to the absorptive capacity for MNE scaling (see Nicotra et al., 2014).

Future research is also needed to determine the processes by which dynamic and/or operational capabilities contribute to scaling. This would require more fine-grained information on the processes and extent to which knowledge spillovers contribute to existing operational capabilities to scale up in extant regional product markets or how knowledge spillovers enable MNEs scaling and MNE growth. Likewise, methodological innovations are needed that capture a two-step process to first trace the impact of knowledge spillovers on the reconfiguration of resources on strategic change and then assess the contribution of the resulting strategic changes in MNE performance. Such an empirical approach separates the intermediate effects of dynamic capabilities (e.g., the *quantity*) from subsequent MNE performance that results (e.g., the *quality*) (Helfat & Martin, 2015b; Martin, 2011). Such research would also have practical implications MNE managerial decision making.

Additionally, greater attention in future research could be paid to the distinction between explicit and tacit knowledge within MNEs spillovers. On the one hand, this approach will allow scholars to expand beyond characteristics of location richness in technological knowledge (R&D citations and patents) and better capture an important phenomenon - cross-industry knowledge abundance and richness. New proxies for the breadth and the depth of knowledge spillovers beyond the presence of firms and employees could be employed to further specify the intensity of regional interaction.

7. Conclusion

Organizational knowledge spillovers serve as an important conduit for MNEs scaling, whereas human capital spillovers contribute to MNE growth. Building on the knowledge spillover and international business literature our study develops insights into MNE scaling as persistent rapid growth compared to traditional growth (Palmié et al., 2023; Tippmann et al., 2023) as well as extends insights on the role of knowledge utilization in promoting organizational scaling (Shepherd & Patzelt, 2022). It demonstrates that the relationship between organizational and human capital mechanisms of knowledge spillovers and MNEs scaling is more nuanced than previously thought and depends on whether MNE growth versus scaling is examined along with the breadth and depth of spillover in a region. As such, MNE location, access to spillovers, and their breadth and depth have important implications for whether and how MNEs experience scaling.
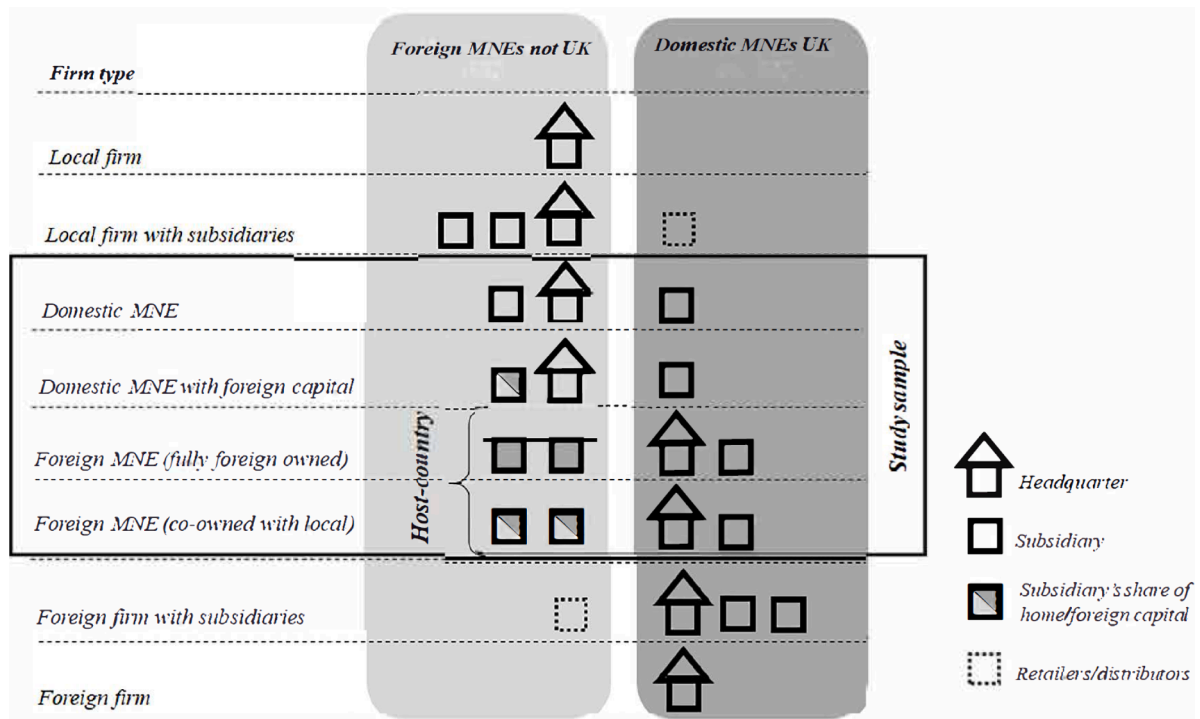
Appendix A1. Sample distribution.

Appendix A: Sample distribution

Appendix B

Appendix C

Appendix D: Study sample by foreign and domestic (UK) MNEs

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