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Innovation and Location in the Multinational Firm

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Abstract: This paper provides an overview of the relationship between multinational corporations (MNCs) and local economic systems. It examines the implications of a decentralisation of innovative activity within MNCs for their interaction with local networks. It is shown that this interaction depends upon the type of cluster, whether a general centre of excellence or a specialised centre. These two principal kinds of cluster are associated with different structures of local knowledge spillovers between firms. Localised science-technology linkages offer a further category of interaction. It is shown how locational hierarchies may affect the locational strategies of MNCs when they disperse innovative activity.

Keywords: multinational corporations; MNC; clusters; locational hierarchies; knowledge spillovers; science-technology linkages.

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1 Introduction

The current fascination in the international business field with the locational concentration or dispersion of activity owes much to the apparent paradox within globalisation between an apparent death of distance and yet a renewed significance of local clusters that are poles of attraction to innovation and entrepreneurship. In the former context, the world becomes flat (Friedman, 2005) and related activities may be spread out almost anywhere yet remain connected. This perspective is especially representative of some aspects of the software industry. Yet in the latter context, the world is spiky (Florida, 2005), in which selected poles of attraction become more globally interconnected with one another. This view perhaps better represents a wider range of innovative endeavour across industries.

Since the 1960s, when it was central to discussions such as those around the product cycle model (Vernon, 1966) and the role of US direct investment in Europe (Dunning, 1970), over the last 30 years, the interest in location as a critical factor in international business has experienced first, a decline and recently, a revival again. The lessening of interest in the 1970s was largely due to the shift in emphasis in the international business literature from macrolevel questions about countries and their trade and balance of payments positions, towards microlevel questions to do with the organisation of cross-border operations within firms. So, the focus of investigation shifted from the location to the firm.

However, the international company itself has gradually come to be perceived in a wider context. The revival of concern with location has been in part based on major changes in the economic environment, such as the increasing importance of intellectual capital as the key wealth creating asset, increasing globalisation in the form of a closer integration of activity between countries, but at the same time, an increasing concentration of some specialised knowledge-based functions within selected subnational regions and the rise of alliance capitalism (Dunning, 1998). Alliance capitalism involves both strategic alliances and acquisition exchange deals between leading firms, but it also incorporates extended local networks in many vicinities that entail new and often closer relationships not merely between firms themselves but between firms and other local actors (such as universities), in what have sometimes been referred to as regional and national systems of innovation.

The notion of the internationally networked multinational corporation (MNC) and its corollary, the geographical dispersal of sources of creativity within the MNC, has revived the interest in the location of competence-creating subsidiaries and the use of the location as a source of competitive advantage for the firm (Bartlett and Ghoshal, 1989; Nohria and Ghoshal, 1997; Porter, 2000; Cantwell and Mudambi, 2005; Nachum and Zaheer, 2005).

From the perspective of developing locations that wish to catch-up economically and technologically, the dispersion of knowledge creating functions within the MNC and to partner companies that form part of its international network (of suppliers, subcontractors, etc.), together with the fragmentation of production systems associated with a growth in outsourcing (Feenstra, 1998), have presented new opportunities. While knowledge spillovers between MNCs and indigenous firms in regions in Europe and North America most often involve foreign-owned subsidiaries operating locally, in countries such as Korea and Taiwan, the dispersion of the knowledge creating nodes of an international MNC system to suitably capable new centres have often relied on cross-border subcontracting and independent outsourcing linkages within global production networks (Hobday, 1995; Ernst and Kim, 2002).

It has become clear that for an MNC to realise local knowledge spillovers relies on the building of suitable business relationships and not just on siting activities in a munificent location. In other words, a locally competence-creating type of MNC subsidiary strategy depends upon the embeddedness of the subsidiary within its own local network (Birkinshaw et al., 1998; Nobel and Birkinshaw, 1998; Andersson and Forsgren, 2000). However, some recent studies in this vein have recognised that individual firms contribute to the properties of local networks, as well as deriving spillovers from them, and so they have stressed that local competitive interaction may offset the attractions of knowledge spillovers (Shaver and Flyer, 2000; Alcacer and Chung, 2007; Aharonson et al., 2007). Thus, it has been argued that the clustering of firms in local networks may suffer from the problem of adverse selection, since laggards have more to gain from knowledge spillovers, but leaders have more to lose from knowledge leakages.

A related literature has revised the concept of the liabilities of foreignness for firms (Hymer, 1960; Zaheer, 1995; Zaheer and Mosakowski, 1997). Differences in local institutional contexts seem to be an especially important constraint on the organisation of business across national boundaries (Henisz, 2000, 2004; Henisz and Delios, 2002). An important instance of this can be found in the limited success of the recent efforts of Japanese MNCs to internationalise R&D and to interact with local host country technological networks, owing to their strong domestic home country inter-firm networks (Cantwell and Zhang, 2006). The especially strong nature of embedded home country network connections, has led Japanese MNCs to more centralised forms of organisational hierarchy that inhibit their capacity for international learning (Westney, 1993; Lam, 2003), associated with a tightness of knowledge sharing routines between central R&D facilities and subsidiaries located elsewhere (Collinson and Wilson, 2006).

This paper is intended to provide an overview of the relationship between MNCs and local economic systems, both from a theoretical and empirical point of view. The paper next discusses the origins of clusters as seen through theory and statistics, before turning to some empirical evidence on cluster origins and dynamics. Section 3 introduces the principal types of local knowledge spillovers and associated cluster types that have been observed and subsequently, Section 4 explores the science-technology linkages found in clusters. Section 5 considers the interaction between locational hierarchies and the investments of MNCs, and the effects of such hierarchies on the strategy of MNCs. The paper concludes with a short summary of the direction taken by recent literature in this field and a brief discussion of the issues that may be most in need of further research in the future.

2 Origins of clusters – theory, statistics and empirical evidence

A common location offers cultural similarities, which improve the ease and the speed of knowledge diffusion, providing the right environment for the development of a common language, shared codes of communication and interaction, collective values and institutions. Therefore, more recent approaches to the analysis of the benefits of agglomeration have shifted attention away from the traditional factors originally identified by Marshall (1891) – such as distance and the non-linearity of transport costs described by orthodox location theory (Hotelling, 1929; Lösch, 1954; Weber, 1929), or transfers of knowledge through the operation of local labour markets and through contacts associated with transactions in other markets – to the characteristics of localised social and institutional systems, supposing that they can provide a better understanding of the geographical concentration of economic and innovative activity, as well as of the dynamics of technological specialisation patterns. The conditions of the socioeconomic environment came to be stressed especially in discussions of the Italian industrial districts (Becattini, 1990; Amin and Robins, 1990; Paniccia, 2002) and in discussions of entrepreneurship in local areas (Sciascia et al., 2006; Studdard, 2006).

Thus, more recent research has examined the localised structural factors, which shape the innovation capacity of specific geographical contexts. Inter-organisational network relationships – between firms and science infrastructure, between producers and users at inter-firm level, between firms and the institutional environment – are strongly influenced by spatial proximity mechanisms that favour processes of polarisation and cumulativeness (Von Hippel, 1989; Lundvall, 1992; Kenney and Von Burg, 1999). Furthermore, the use of informal channels for knowledge diffusion (so-called tacit or uncodified knowledge) provides another argument for the tendency of knowledge-based activities to be geographically confined. Ellison and Glaeser (1997) offer some evidence on the geographic concentration of US manufacturing industry, which applies in a wide variety of industries. They suggest that the explanation for geographic concentration varies by industry and that natural advantage may often play a role as industries co-agglomerate both with upstream suppliers and with downstream customers. Developing the industry specificity of clustering further, Steinle and Schiele (2002) set out the conditions under which an industry is more likely to cluster. They distinguish between necessary conditions, which are divisibility of the process and transportability of the product, and sufficient conditions, which consist of a long value chain, multiple competencies, network innovation and volatility of the market.

A useful distinction is usually made between two different types of agglomeration forces, which shape spatial organisation, pushing related firms and industries to cluster spatially in one of two ways that may lead to patterns of uneven regional development, i.e., the emergence of centres and peripheries at the global and national level. There has been a debate as to which type of clustering predominates in a given setting and how the reasons for clustering have changed over time (Porter, 2000). On the one hand, there are general external economies and spillover effects – so-called 'urbanisation economies' – which attract all kinds of economic activities into certain areas. This leads to the emergence of all-round centres of excellence or higher order centres, which have a wide breadth of sectoral specialisation.

On the other hand, 'localisation economies' are fostered in spatial clusters of firms undertaking similar or related activities. These kinds of forces are likely to be industry-specific and to produce cumulative mechanisms, which enable host locations to

increase their production, technological and organisational competence over time (Dicken and Lloyd, 1990). These might be termed specialised centres or intermediate centres (by comparison with lower order sites that lack locational attractiveness to most MNCs). As shown by Baptista and Swann (1998), agglomeration spillovers may operate for intra-industry clustering, whilst instead congestion effects may tend to dominate, offsetting positive spillovers in the inter-industry case. For this reason, general centres of excellence tend to be more geographically dispersed (to spread out over larger areas) than are specialised centres.

Audretsch and Feldman (1996a) compare the clustering of innovative activity in the USA with the agglomeration of production. Their results indicate that the agglomeration of production remains constant over an industry life cycle and is more concentrated where new technology is important. Innovative activity, however, tends to cluster more when tacit knowledge plays an important role, which is greatest in the early stages of the life cycle. In addition, the locational concentration of production has a bigger influence on the agglomeration of innovation in the mature and declining life cycle stages. In a similar vein, Breschi and Lissoni (2001) raise questions about the recent tendency to emphasise the role of localised knowledge spillovers in clustering as opposed to other localisation factors and draw attention to the variety of potential transmission mechanisms that may be associated with localised knowledge spillovers.

Other studies have placed emphasis on dynamic aspects such as the entry of firms into the cluster and firm growth or performance in clusters (Appold, 1995; Baptista and Swann, 1999; Feldman, 2001; Maggioni, 2002; Pandit et al., 2001; Prevezer, 1997; Stuart and Sorenson, 2002). In this area, Swann and Pervezer (1996) began a series of research investigations into cluster dynamics, specifically the impact of cluster strength and the strength of the science base on entry into the cluster and firm growth. They show that the factors attracting entry into a cluster are different for the biotech and computing industries, and that there is also a difference between entrants and incumbents in absorbing different kinds of spillovers.

Taking a narrower focus on cluster dynamics, Malmberg et al. (1996) examine the impact of geographical location on the innovation process, firm competitiveness and the impact of MNC presence in the clusters on the knowledge accumulation process. In drawing on a variety of empirical studies as well as the relevant theoretical work on the process of local knowledge accumulation and the different agglomeration forces that lead to spatial clustering, it provides a very comprehensive overview of the topic.

3 Types of spillovers and clusters

The literature usually distinguishes between three different categories of location-specific knowledge spillovers:

1 intra-industry spillovers and specialisation externalities (classical clustering), which can be offset by gravitational pull and congestion effects

2 inter-industry spillovers and diversity externalities (urbanisation economies in all-round centres)

3 external sources of knowledge, and science-technology spillovers.

Intra-industry spillovers are associated with the presence of a wide range of technologically active firms within a given sector, all in the same geographical area, which encourages the further local accumulation of relevant knowledge. The link between knowledge spillovers and clustering has been well established empirically. Not only do industries in which new knowledge plays an important part in production tend to cluster more (Audretsch and Feldman, 1996b), but firms in clusters with strong ties between similar firms tend also to innovate more than firms outside these regions (Baptista and Swann, 1998). Intra-industry spillovers relate to specialisation externalities, as in Marshall's early contribution. They materialise as an appropriate agglomeration pattern that facilitates asset sharing. The firms of each country tend to embark on a path of technological accumulation that has certain unique characteristics and sustains a distinct profile of national technological specialisation (Rosenberg, 1976; Cantwell, 2000). The kinds of linkages that grow up between competitors, suppliers and customers in any region or country are also, to some extent, peculiar to that location and imbue the technology creation of its firms with distinctive features (Mariotti and Piscitello, 2001). For these reasons, other MNCs often need to be on-site with their own production and their innovatory capacity if they are to properly benefit from the latest advances in geographically localised technological development, to feed their innovation (Cantwell, 1989; Kogut and Chang, 1991). In addition to the more intangible effects of knowledge spillovers, Bernstein and Nadiri (1989) also find evidence for more quantifiable effects. In their empirical study of four industries, they find that costs decline for the knowledge-receiving firm while the rate of R&D investment and capital accumulation increases. Overall, the social rates of return to R&D exceed the private returns.

However, such beneficial local clustering effects require a sufficient initial cross-firm diversity of activity in a location to start the process. If a local innovative system is dominated by a single major player or strong leader company, then this leader may exercise a forceful gravitational pull of the best resources, implying a particular kind of congestion effect for any other entrant. There may also be a more active competitive deterrence and government policies that favour a local champion in such cases.

Diversity externalities or urbanisation economies can be related to general purpose technologies (GPTs) entailing inter-industry spillovers (Lipsey et al., 1998) associated with the existence of firms working in several different fields of productive and technological endeavour. Indeed, the more diverse the learning activities conducted in the region is, the wider the range of potential crossovers from which the firm could potentially benefit. Such spillovers relate to diversity externalities, which favour the creation of new ideas across sectors, as originally suggested by Jacobs (1961). The presence of local business service activities in common may facilitate the transmission of knowledge spillovers between otherwise unrelated industries (Mas-Verdú, 2007; McKee, 2008). Inter-industry spillovers are more likely to occur in an all-round 'higher order' centre of excellence, which attracts the research-based investments of a wide variety of foreign-owned MNCs and facilitates a more favourable interaction with indigenous firms. In the absence of strong competitive forces among the firms in the cluster, the milieu is particularly conducive to interaction between MNCs and local firms and thus offers greater opportunities for inter-company alliances for the purposes of technological collaboration and exchange (Cantwell et al., 2001; Cantwell and Mudambi, 2000). An analysis of data from 170 US cities focusing on industry growth through knowledge spillovers in cities by Glaeser et al. (1992) confirms Jacob's ideas empirically. It shows that growth is mostly supported by diversity of industry and competition (which partly

also supports Porter's view) and thus suggests that diversity may promote innovation and knowledge spillovers to a greater extent. Further empirical evidence of urbanisation economies are offered by Ciccone and Hall (1996), who develop a model to analyse the impact of employment density on labour productivity and subsequently, estimates the parameters using gross state product and employment data across US states for 1988. Their results indicate that a doubling of employment density increases average labour productivity by around 6%.

Rather than just asking why (or why not) MNCs may locate activity in local clusters, there has been a substantial international business literature which looks the other way round, at the local technological spillovers generated by foreign-owned firms (Kokko, 1994; Perez, 1997; Blomström et al., 2001; Cantwell and Piscitello, 2005). Allied to these efforts has been an increasing awareness of the importance of absorptive capacity on the part of indigenous recipient firms (Cohen and Levinthal, 1989), as a necessary condition for beneficial spillovers to occur (Griffith et al., 2004). Moreover, it has also become clear that the local evolution of subsidiaries towards competence-creating mandates (or the non-attainment of such status) matters to the capacity of subsidiaries and indigenous firms to interact in knowledge creating activities and hence for the presence or absence of local knowledge spillovers in either direction (Feinberg and Gupta, 2004; Marin, 2006; Cantwell and Piscitello, 2007).

In addition to these types of inter-firm spillovers, there are usually localised connections to outside sources of knowledge. This is especially likely to be true of foreign-owned firms in an economy, which tend to have a greater degree of locational mobility when siting their corporate research and so pay greater attention to being close to relevant public research facilities. These specific types of spillover are further discussed in the next section.

4 Science-technology linkages

Firms' efforts to advance technology do not generally proceed in isolation but are strongly supported by various external sources of knowledge: public research centres, universities, industry associations, an adequate educational system and science base (Nelson, 1993; Rosenberg and Nelson, 1996; Nelson and Rosenberg, 1999; Breschi, 2000). There is growing evidence so far mainly from the US that these science-technology or university-industry linkages tend to be geographically localised (Acs et al., 2000; Audretsch and Feldman, 1996b; Audretsch and Stephan, 1996; Jaffe, 1989; Jaffe et al., 1993). The national science and technology policy environment and intellectual property regime may also be critical to the involvement of small firms in local science-based linkages and inventive activity (Colombo and Grilli, 2006; Darroch et al., 2005).

Recent work summarised by Pavitt (1991) suggests that the main technological and economic benefits of basic research are not in the (easy) transfer of codified information, but in the (complex) support of a technological problem-solving capacity. Instead, basic research provides training for researchers that go on to work in industry and elsewhere. Background tacit knowledge and know-how is acquired through actively engaging in basic research and improves the effectiveness of technological search activities. Furthermore, basic research provides instrumentation that is developed into industrial applications, and it also enables membership of national and international networks of

professional scientists and engineers. These networks are useful, not so much for the transmission of received information and results as for interactions that improve the learning activities of each participant.

The common assumption in economics (and in many policy circles) is that the economic benefits of basic research are widely and freely available, because they take the form of easily reproducible and transmissible information. If so, globalisation would undermine the case for the national public subsidisation of basic research (for a critique view of which, see Cantwell, 1999). Instead, recent research suggests that the economic benefits of basic research take the form of a contribution to (and an interaction with) the tacit problem-solving capability of firms (Zucker et al., 1998). Hence, these benefits are for the most part geographically and linguistically localised, since they are embodied in institutions and individuals and transmitted principally through personal (face-to-face) contacts. Most interactions (and the more effective interactions) between the realms of science and technology – e.g., through the training of individuals or in the corporate development of scientific instruments – take place locally.

Recent work has focused on the form of the science-technology linkage, i.e., whether knowledge is transferred through market mechanisms or through spillover mechanisms or externalities. Initial empirical results were not conclusive as to whether market mechanisms show the same geographical mediation as spillovers. Audretsch and Stephan (1996) for example, find that the influence of proximity between researchers and firms is largest when establishing ties and when the exchanges are informal. It also depends on the role played by the scientist within the particular firm receiving the knowledge. When the exchange of knowledge is formalised, however, the location factor did not seem to matter. The opposite results were obtained by Zucker et al, (1998), who found that the local exchange between universities and firms is mostly a market exchange and the benefits on performance through knowledge transfer were not due to generalised spillovers. Mowery and Ziedonis (2001) bridge these two perspectives and compare the importance of location for market exchanges with that for generalised spillovers and thus offer an even more detailed picture of the actual science-technology interaction. They distinguish between different types of knowledge, i.e., whether their transfer requires complementary know-how or rather constitutes research tools and show that the formalised exchanges of the former are more localised that the latter because of required close interaction between the inventor and the receiving firms. The results of their study also suggest that the formalised exchanges are somewhat more geographically localised than spillovers. These three studies indicate that the science-technology linkage is not uniform and equally geographically mediated but rather depends on a variety of factors, such as the role of the scientist in the interaction, the type of knowledge transferred and to some extent also the industry under consideration.

5 Locational hierarchies and MNCs

The decentralisation of innovative activity within MNCs has tended to occur as a result of the evolution of subsidiaries by gradually increasing their capabilities and their assigned charter responsibilities through drawing upon local networks subject to the constraints and opportunities of the locations in which they are sited (Birkinshaw and Hood, 1998). The consequent challenge for MNCs has been how to manage the independence and

simultaneous integration of the parts of its international network (Doz et al., 1981; Prahalad and Doz, 1987).

The notion that the geographical dispersion of technological development enhances innovation in the network of the MNC as a whole is founded on the belief that innovation is location-specific as well as firm-specific (Cantwell, 1989). The scientific and technological traditions of each country, the shared experience of its researchers and production engineers and the communication between them across companies, the nature of its educational system and its common business practices all contribute to the distinctiveness of the path of technology development undertaken in each location (Rosenberg, 1976; Pavitt, 1987; Cantwell, 2000). By drawing on innovations of various kinds, depending upon the conditions prevailing in the relevant local research centre, MNCs develop a more complex technological system and by accessing differentiated streams of knowledge have an important source of competitive advantage (Almeida, 1996; Dunning, 1996; Pearce, 1999).

The increased role of locationally dispersed sourcing of technology from the major centres of excellence through the international networks of more globally integrated MNCs (Cantwell, 1995) has led to a growing interest in the asset-acquiring motive for foreign direct investment (Cantwell, 1989; Cantwell and Janne, 1999; Cantwell and Piscitello, 2000) and in the greater decentralisation in the management of international R&D to capture 'home-base augmenting' benefits (Kümmerle, 1999a, 1999b). In his study of US patent data, Frost (2001) found that a subsidiary is most likely to source knowledge locally if it follows an exploration strategy, i.e., sourcing in a technical field in which the host country is relatively advantaged, an effect which is reinforced if the technological capabilities of the subsidiary are strong and if the firm has a wide overall presence in the host country and in its technical networks.

Internationalisation has supported corporate technological diversification since the form of technological development varies between locations as well as between firms (Cantwell and Janne, 1999; Cantwell and Piscitello, 2000; Zander, 1997). By locating production in an alternative centre of innovation in its industry, the MNC gains access to a new but complementary avenue of technological development, which it integrates with its existing lines. By increasing the overlap between the technological profiles of firms competition between MNCs is raised in each international industry, but so also are cooperative agreements as the numbers of knowledge spillovers between firms increases as well. Apart from the rise in technological interrelatedness, the potential opportunities for cross-border learning within MNCs have been enhanced by an increased take-up of information and communication technologies (ICT). ICT specialisation seems to amplify the firm's technological flexibility by enabling it to fuse together a wider range of formerly separate technologies.

A typical pattern of international specialisation in innovative activity within the MNC is for the development of technologies that are core to the firm's industry to be concentrated at home, while other fields of technological activity may be located abroad and in this sense, the internationalisation of research tends to be complementary to the home base (Cantwell and Kosmopoulou, 2002). The choice of foreign location for technological development in support of what is done in the home base of the MNC depends upon whether host regions within countries are either major centres for innovation or not. A differentiation between higher order regions, intermediate regions and lower order regions enables us to distinguish between the form of potential knowledge spillovers and technological networks in operation between foreign-owned

firms and their indigenous counterparts in different locations. Higher order regions have a diversity of expertise across industries and technological fields that are often rooted in GPTs – e.g., background engineering, mechanical methods, electronics and ICTs – and in these areas foreign-owned are more likely to move into the development of such GPTs (Cantwell and Iammarino, 2003). Especially through their activities in such regions, MNC subsidiaries account for an increasing share of all new technologies that are introduced in the multinational networks and they are associated with a significantly higher probability of entry into new and more distantly related fields of technology (especially GPTs), creating a long-term drift into new technological competence (Zander, 2002).

Moreover, from a home country perspective, firms originating from higher order centres are more likely to establish a locationally specialised network of technological activity in support of corporate innovation than are firms that originate from lower order centres (Cantwell and Janne, 1999). Thus, at least until recently, patterns of technological specialisation within an industry seem to have been strengthened mainly by the networks of MNCs from the leading centres. This may also be partly attributable to gravitational pull and competitive deterrence effects when (local areas within) the leading centres are dominated by specific MNCs, thereby excluding these locations from the networks of other MNCs at least for diversification purposes.

In contrast, most regions are not major centres and tend to be highly specialised in their profile of technological development, and hence attract foreign-owned activity in the same narrow range of fields. Most localised knowledge flows in these areas are industry-specific or intra-industry. Instead, the need to develop GPTs is shared by the firms of all industries, and so the knowledge spillovers between MNCs and local firms in this case may be inter-industry in character, typically in higher order regions.

However, it should be noted that while the pattern of dispersion of innovative activity within the MNC tends to be conditioned by an external locational hierarchy, the capacity of the MNC to organise an internationally distributed network for innovation depends upon the evolution of a less uniform and centralised structure of hierarchy within the firm. As remarked earlier, Japanese firms have tended to retain such tightly centrally controlled internal hierarchies in their international operations, which has reduced the capacity of their foreign subsidiaries to evolve towards greater embeddedness in the local networks of the host locations in which they are sited (Lam, 2003; Cantwell and Zhang, 2006). In turn, a subsidiary's external business network is a crucial factor in explaining its own competence (Forsgren et al., 2005; Zaheer and Bell, 2005), since strong ties to other local actors allow it to better identify and absorb new technologies from its environment, and also to itself develop new technologies through close interaction with network partners.

6 Conclusions

The economic landscape has undergone many significant changes in the last few decades, the most extensive of which is globalisation. In its wake, certain kinds of economic activity have become more and more easily dispersed across space and distance matters less in the transfer of goods and people. However, at the same time 'sticky places within such slippery space' (Markusen, 1996) are emerging especially with respect to knowledge-intensive activities. Thus, the location decision is an increasingly important

issue for the multinational firm, and more and more closely interacts with and is inseparable from the analysis and strategic planning of internalisation and ownership specific advantages (Dunning, 1998, 2000), through the efficient management of cross-border transactions and the creative development of in-house corporate competence. With the rising awareness by MNCs of locational advantages as a competitiveness enhancing and sustaining factor, the understanding of the very specific processes and phenomena involved in a variety of locational types has become fundamental, and they are no longer just something that is 'in the air' as Marshall had once noted over 100 years ago.

In the newer context in which MNCs may seek to build a synergistic portfolio of location-specific knowledge-based assets, the continuing development of which depends upon connections with its own immediate locational environment, two issues especially arise that are likely to be the focal points of further research in this field. First, we need to better understand the conditions under which MNCs within the same industry tend to converge or to diverge in the geographical distribution of their innovative activity. A critical variable here may be the degree of competition between MNCs, or the extent to which they overlap in the composition of their major product markets, at a detailed level of disaggregation. It may be that strict competition for the same industry segments and more distant competition across different industry segments have opposite effects on the likelihood of the colocation of innovative activity. Strict competition may lead to mutual deterrence across locations, while with more distant competition; the benefits of positive knowledge spillovers may outweigh the negative competition effect.

Second, in earlier research, most attention has been given to knowledge flows that run predominantly in one direction rather than the other – such as flows from an MNC parent to its subsidiaries or knowledge spillovers from foreign-owned subsidiaries to indigenous firms, such as suppliers, customers or joint venture partners. Greater attention needs to be paid now to the complementarities that are created through two-way knowledge flows across locations within an MNC or between organisations within a location. It is particularly important that we gain a better understanding of the wider systems of innovation in or between locations that can sustain these kinds of bidirectional and interdependent knowledge flows.

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