Networking and R&D in domestic and FDI plants in Spanish electronics clusters

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Abstract. To fully understand foreign affiliates' behaviour in regional agglomerations (hereafter RAs), we argue it would be useful to analyze the networking patterns of such affiliates in reference to domestic firms within the local market environment. Consequently, we examined 184 electronics plants,

both domestic and foreign, in three Spanish RAs. The FDI (Foreign Direct Investment) plants show patterns of cooperation similar to those of clustered domestic plants, involving joint R&D, outsourcing, and other types of inter-firm collaboration. FDI plants are, in some respects, less embedded in RAs than are domestic plants. Domestic market-seeking FDI's, probably as a strategy to adapt products to the domestic market, tend to collaborate more with regional partners than do export-seeking FDI's. FDI plants consider within-group subcontracting relationships as more important than do domestic multiplant companies. Nevertheless, the former apparently integrate both intra-firm and inter-firm subcontracting in their strategy. On the other hand, R&D-intensive FDI plants tend to stay away from collaboration with other companies, probably to avoid involuntary spillovers of their knowledge.

Key words: Business networks, cooperation, subcontracting, R&D, Innovativeness, multinational enterprises, affiliates and domestic firms, electronics sector, regional agglomerations.

1. Introduction

Policy-makers often seek to link regions and their industrial agglomerations to global markets by offering incentives to multinational enterprises (MNEs) willing to invest in local facilities. This is because such companies are seen as potential providers of skills and technology, able to complement the location-specific knowledge of domestic firms (Rugman and Verbeke 2001). However, as McCann and Mudambi, (2004) note, many Foreign Direct Investment (FDI) schemes are unlikely to fulfil all, or even most, of national and regional policy-makers' expectations with regard to the development of regional industrial capabilities.

It has been claimed that the positive effects of FDI on the host economy are greater when affiliates create linkages with local companies (Görg and Ruane 2001). Such business relationships may help to increase the expertise, employment, and output of domestic firms (UNCTAD 2001). Given the importance of geographical proximity in knowledge exchanges, some authors (Kearns and Görg 2002)maintain such linkages should also be created at the sub-national level.

These views are consistent with current economic theory. Over the last two decades firms have become increasingly perceived as part of networks of inter-linked businesses. Interest in networks as organisational forms which affect company performance (Dyer and Singh, 1998, Lechner and Dowling, 2003, Witt, 2004) and local economic competitiveness (Sornn-Friese and Sørensen, 2005) has increased. At the same time, many economic studies have increasingly recognised the role played by space, although the spatial pattern of inter-firm linkages remains poorly understood. Although numerous studies assume that spatial proximity between firms stimulates inter-firm linkages, they rarely test this relationship. Studies testing such relationships for specific types of firms, namely MNEs, are still rarer.

As stated above the expectations regarding the potential of MNEs for the creation of local linkages and, consequently, the stimulation of local R&D and economic development are often unrealistic. It is therefore crucial to identify

those situations in which affiliates are encouraged to develop local linkages.

We believe two factors are crucial for an improved understanding of specific affiliates' interactions with the local economy. First, we argue, consideration should be given to the affiliate's strategic objectives in the host-country. Secondly, analyzing clustered affiliates in isolation may not sufficiently explain their linkage patterns. We also need to understand the environment in which they operate, as well as the behaviour of other clustered companies. We argue in order to fully understand affiliates' behaviour the strategies of clustered domestic firms should be included in the analysis. The lack of readily available data for linkage patterns of co-located domestic firms has often restricted such comparisons in previous research (Crone and Watts 2000).

This article aims to answer two questions: 1) Are FDI plants able to create local networks similar to those of domestic firms? 2) Are the different strategies of FDI plants associated with different networking patterns?

We empirically compared the linkages created, respectively, by foreign and domestic electronics firms in three electronics centres in Spain including some of the world's most important companies in this industry in our sample. An additional contribution is our analysis of clustered FDI plants and their networks in Spain. Although the presence of MNEs in electronics agglomerations has attracted some attention from researchers (UNCTAD 2001), to date few analyses of Southern European countries have been performed. Some authors (Nachum and Keeble 2003) argued that research into the regional linkages of MNEs located in industrial agglomerations should now focus on different industries and sites, in order to broaden and deepen our understanding of this phenomenon.

In summary, we concluded that FDI plants and domestic plants display similar networking behaviour. Secondly, if we look at FDI plants, our research indicates that FDI plants adopt different strategies associated with different networking patterns. FDI plants which seek to exploit the domestic market are inclined to network with co-located firms, whereas export or R&D-intensive FDI plants are less motivated to network.

The paper is structured as follows: Section 2 and 3 discuss, respectively, the literature on i) the spatial patterns of inter-firm linkages and ii) the relationship between affiliates' strategies and their networking patterns. These two sections define both the theoretical background guiding our research as well as the hypotheses to be tested. Section 4 describes the key characteristics of the Spanish electronics industry and then discusses the sample data and methodology. Section 5 offers the results of statistical tests comparing the respective levels of embeddedness and the networking patterns of FDI plants and domestic plants. Section 6 displays the statistical test used to determine whether some specific strategic orientations of FDI plants tend to interact with local partners. For our analysis, we selected two features of FDI plants – highly intensive R&D and export activity. Policymakers often regard these aspects as especially desirable in linking the region to global markets and promoting regional development. Furthermore, domestic plant managers are often attracted by such features when they attempt to network with FDI plants. Section 6 also tests whether FDI plants having such characteristics tend to create local linkages. Finally, Section 7 offers our conclusions.

2. Spatial patterns of inter-firm linkages

There is no general theory of the spatial pattern of inter-firm linkages, nor do we attempt to formulate one here. The framework for our research is essentially drawn from network theory, International Business (IB) theory and agglomeration theory.

2.1. Business alliances, geographic clustering and externalities

Strategic alliances are inter-firm linkages which involve exchange, sharing or co-development (Gulati, 1995). The present article analyses alliances which do not involve an equity investment (e.g. outsourcing of production, joint-R&D or joint-marketing). We term such arrangements "business cooperation" or "business collaboration" (hereafter, cooperation or collaboration) and define outsourcing (subcontracting) as "the delivery of goods or services, which are specified by the contractor" (Andersen 1999, p. 626). The term "business

networks" (hereafter, networks) refers (Bianchi and Bellini,1991), to interrelated sets of companies based on an external division of labour not by a hierarchical command system. Networking implies the presence, among firms, of social and economic linkages that ensure an easier transmission of information (Casson 1997) and, probably, a reduction of duplicative R&D (DeBresson and Amesse 1991) -- an important consideration in high tech industries.

On the other hand, high-tech firms tend to cluster to take advantage of localised within-industry spillovers (Fagerberg 1995; Feldman and Audretsch 1996; Gertler 1995; Lundvall 1988; Paul and Siegel 1999), simple natural advantages (Ellison and Glaesser 1999), pools of skilled labour, or institutional-thick locales (Malmberg 1996). Over the last several years an extensive literature has shown the benefits, such as higher profitability, accruing to enterprises through spatial clustering (Becattini 1990; Brusco 1990; Gray, Golob and Markusen 1996; Keeble and Wilkinson 1999; Rama and Calatrava 2002; Signorini 1994; Suarez-Villa and Rama 1996). Multinational enterprises (MNEs) are frequently attracted by agglomerations (Dunning 1998; Head, Ries and Swenson 1995).

Inter-firm collaboration and clustering are often associated as geographic and cultural proximity are important for both business networking and the transmission of new knowledge (Feldman & Audretsch, 1996; Fagerberg, 1995). However, the importance of relationships that firms within RAs maintain with firms outside has been probably both underestimated and largely overlooked (see, for example, Henderson et al., 2002, Coe et al., 2004, Giuliani et al., 2005, Wai-chung et al., 2006).

2.2. Ownership and networking behaviour

McCann and colleagues (2002) claim that in order to understand the networking behaviour of MNEs, we must understand the structural characteristics of the different types of industrial agglomerations locations. This theory stresses the need to take into account the environment in which affiliates

operate, and not simply such companies in isolation.

Are FDI plants able to create local networks similar to those of domestic firms? Comparative research on this topic is scanty (Nachum and Keeble, 2001) and its results inconclusive. Some authors maintain that affiliates are unable to build networks similar to those of domestic firms because of their liability of foreignness (LOF) i.e. the additional costs of doing business abroad which is not incurred by domestic firms. This view suggests that the transaction costs of establishing external relationships may be higher for affiliates than for domestic firms. The alternative viewpoint maintains that affiliates are able to compensate for such costs in specific national or regional environments,

Empirical research has not yet provided a clear answer to this question. For instance, the study by Nachum and Keeble, (2001) of business service industries finds considerable differences between the networking patterns of affiliates and domestic firms in Central London. The LOF, the authors argue, may limit affiliates' ability to construct networks similar to those of indigenous firms. Another theory maintains that due to common externalities and similar competitive conditions in regional agglomerations (RAs), MNEs, despite their international nature, and domestic firms may have similar networking behaviour. "Trans-local" firms may embed some of their plants in both the economic and social relationships of local communities, leading them to adopt a new managerial culture, one closer to local practices (Bellandi 2003). In the case of Italian industrial districts large companies are able to develop social capital which my facilitate their interaction with local firms Bellandi, (2001). This argument is supported by various case studies of Spanish RAs (López 2003; Rama and Ferguson 2007). Nachum and Keeble, (2003) study the networking of foreign affiliates in the media cluster of Central London and find, some differences notwithstanding, considerable similarity with indigenous firms' behaviour. They believe this reflects a similar response to the common pressures upon (and opportunities available to) both types of companies. Comparing domestic firms and affiliates in the Toronto electronics cluster, Britton (2003) shows that neither group is strongly embedded in the region. These studies suggest, in our view, that the analysis of domestic firms is useful

for the understanding of affiliates' networking behaviour.

Consequently, we formulate the following hypothesis:

H1: The networking patterns of FDI plants and domestic plants are similar.

A limitation of previous studies is FDI and domestic plants have been compared using only one specific type of linkage, often outsourcing arrangements. In contrast, our comparative study includes different types of collaboration (e.g. manufacturing outsourcing, R&D collaboration, joint-marketing). We believe such distinctions could be useful because companies' networking patterns may vary according to different types of collaboration. Additionally, previous studies have rarely considered managers' perceptions regarding the relative importance of "internal" versus "external" linkages. These perceptions are important because they may influence the companies' networking patterns in agglomerations. In this article, such aspects are taken into consideration and compared in both types of companies.

Table 1 summarises some of the main contributions to research in this field.

[Insert Table 1 about here]

2.3. Sourcing patterns and cooperation in agglomerations

Co-location in agglomerations may occur without linkages being produced among proximate firms (Gordon and McCann, 2000, Torre and Rallet, 2005, Wai-chung et al., 2006). Companies, whether domestic or foreign, may prefer to source inputs chiefly outside the region (Britton, 2003) because their national and international linkages may be more important than their regional connections (Arita and McCann 2002; Hendry, Brown and Defillippi 2000). MNEs are no exception. The localisation of foreign facilities in a region does not necessarily imply strong linkages between subsidiaries and regional firms. Compared to other companies, multiplant firms, and specifically multinational

enterprises, may maintain stronger intra-corporate linkages that encompass greater distances (Arita and McCann, 2002). Empirical analyses of the electronics industries in different regions show two different patterns. Some subsidiaries pursue a vertical integration strategy, having few linkages with local firms in spite of co-location, while others prefer an embeddedness strategy (Clarke and Beaney 1993; Hendry, Brown and Defillippi 2000; Kearns and Görg 2002; McCann, Arita and Gordon 2002; Morris 1992; Turok 1993). The extent of MNEs' local linkages depends on a variety of reasons, such as the costs and quality of local supplies, the reliability and proximity of suppliers, etc. (UNCTAD 2001). Foreign linkages may also be more important for FDI plants than for domestic plants. In the Spanish electronics industries, for instance, Holl and Rama, (2008) find that over one-third of FDI plants' network partners are located abroad, compared to 14% in the case of domestic firms.

Thus, we test the following hypothesis:

H2: FDI plants are less regionally embedded than domestic plants

The nature of the activity involved in the network relation may also influence the relative importance of local versus cross-locality linkages. Where face-to-face contacts are required and where contracts and linkages must be renegotiated frequently, network partners will have a greater need for proximity. For instance, in the Spanish electronics industries, Holl and Rama, (2008) find that subcontracting networks tend to be highly localised while other networks span over broader geographic areas. We therefore explore whether cooperation in general and, more specifically, subcontracting relationships involve different spatial patterns of networking. Once again, we compare affiliates to domestic plants.

3. Strategic objectives of the MNE

In this section we discuss theories relating the strategies of affiliates to specific patterns of networking, formulating four additional hypotheses.

3.1. Market-seeking affiliates and networking

Firms utilize different types of alliances to implement specific business strategies, such as new market penetration (Yasuda and Iijma 2005). A review of the empirical literature (UNCTAD, (2001)) suggests that MNEs which need to adapt their products to domestic demand are more likely to network with local partners. Such collaboration is necessary in order to design products adequately adapted to the local market. In other words, market-seeking affiliates are more involved in local networking. In contrast, Britton, (2003) finds that market-seeking affiliates in the Toronto electronics cluster are not particularly involved in networking.

Thus, we test the following hypothesis:

H3: Affiliates pursuing a domestic market-seeking strategy tend to collaborate with regional partners.

3.2. Internal versus external networks

The specific structure of the company may also influence its propensity to network with other firms. IB theory holds that affiliates are embedded in various networks (some internal and others external)[1]. The importance of some types of internal exchanges has recently increased, as MNEs have increasingly developed within-company outsourcing and off-shoring (Sako 2005). One explanation for MNEs' preference to outsource from their affiliates rather than from external companies is their need to protect business procedures and intellectual property rights, an important consideration in the electronics sector. Does the growing importance of such intra-firm linkages imply a potential reduction in the affiliate's external interactions?

Business and IB literature maintain that there currently exist possible trade-offs between the two (see, for instance Berggren and Bengtsson 2004). Yamin and Forsgren, (2006) used specific case studies in concluding that, in order to maintain control, company headquarters may prefer their subsidiaries to be only superficially embedded in the local environment.

In their study on businesses service firms in Central London, Nachum and Keeble, (2001) find that MNE internal networks partially replace the advantages provided by external networks. In contrast, a study of representative New Zealand companies found that affiliates complement the resources obtained from the parent company with local resources obtained from network partners (Scott-Kennel and Enderwick 2004).

We therefore test the following hypotheses:

H4: FDI plants consider within-company outsourcing to be more important than do domestic multiplant firms.

H5: FDI plants perceive a trade-off between intra- company outsourcing and outsourcing relationships with external firms.

3.3. Innovators and networking

Innovation is increasingly perceived as the outcome of interactions among multiple actors (von Hippel, 1988; Powell et al., 1996; Harris et al., 2000, Chiaromonte, 2002). Inter-company cooperation, via networks, has therefore attracted greater attention. Theories of agglomeration economies and industrial districts suggest that networking among local firms in agglomerations facilitates knowledge exchange and subsequently the innovation process. Another strand of theory suggests that highly innovative firms might seek geographic isolation from other companies to avoid unintended spillovers of knowledge (Kearns and Görg 2002; Nachum and Wymbs 2002; Suárez-Villa 2002). R&D intensity could discourage inter-firm linkages, as high-tech companies attempt to protect specific know-how and intellectual property rights (Teece, 1986; Acemoglu et al., 2004).[2] Ahuja, (2000) shows that the most innovative firms are sometimes reluctant to cooperate with other companies, as knowledge-sharing often implies risks, such as opportunism by partners., Contracts have more difficulty specifying where exchange is technologically more intensive. Such relationships often imply greater relationship-specific investment compared to the outsourcing of standardised inputs or processes, increasing the danger of opportunistic behaviour by the supplier. The present study compares the

innovativeness of domestic plants and FDI plants from a variety of angles.

We consequently test the following hypothesis:

H6: R&D-intensive FDI plants are less likely than other FDI plants to interact with co-located companies.

4. The Spanish Electronics Industries

According to data provided by the INE (National Institute of Statistics) three regions (Madrid, Catalonia and the Basque country) housed 77.3% of all Spanish electronics establishments and accounted for over 84% of Spanish electronics production by the end of the 1990s. The remaining production in Spain was geographically dispersed among many other regions,[3] the 17 Spanish Autonomous Communities. Previous research supports the idea that the three regions encompass agglomerations of electronics firms (Conejos et al. 1997; Rama and Calatrava 2002; Suarez-Villa and Rama 1996). In each of the three regions, the electronics plants are co-located with auxiliary industries and clients (defence in Madrid, automobiles in Catalonia and machine-tools in the Basque Country).

Subcontracting and other forms of collaboration, such as R&D cooperation, are common among Spanish electronics firms, which have a long and chequered history of inter-firm collaboration (Benton 1990; Estevan 1988; European-Commission 1992; European-Commission 1997; Holl and Rama 2009 forthcoming). For instance, electronics firms located in Madrid are apparently more willing to collaborate than similar companies in other European or American agglomerations (Suárez-Villa 2002; Suarez-Villa and Fischer 1995; Suarez-Villa and Rama 1996). The reasons for this are still an open question since no systematic international comparison has yet been undertaken.

4.1. A plant-based survey of the electronics industries

The data used in the statistical analyses were obtained from a plant-based survey conducted in 1999 which focused on electronics establishments, both domestic and foreign, involved primarily in manufacturing. From the 322

questionnaires sent to establishments (plants) in the regions of Madrid, Catalonia and the Basque Country, we obtained 184 responses suitable for use in the present analysis.

The sample is representative of Spanish electronics plants with over 20 employees[4] and includes various subsidiaries of some of the world's most important MNEs in this industry, such as Alcatel, Ericsson, Hewlett-Packard, Pioneer and Siemens. We define subsidiaries (affiliates) as companies with at least 50% of foreign capital, joint-ventures as companies with less than 50% of foreign capital and national (domestic) firms as enterprises with no foreign capital. FDI plants encompass both subsidiaries and joint ventures.

The participating companies were asked about the geographical origin of their purchases of inputs as well as their sales of outputs in arms'-length markets. They were asked about the geographical location of their partners regarding cooperation in general (i.e. all types of cooperation) including, in addition to joint production or subcontracting, other joint activities, such as inputs and machinery purchases, marketing, domestic commercialisation, exporting, after-sales services and R&D. In focusing on the subcontracting aspects, we questioned clients (contractors) on the geographical location of their suppliers (subcontractors). In a similar fashion, subcontractors were also requested to note the location of their clients as well [5]. In order to evaluate the importance of intra-firm versus inter-firm networks, respondents were also asked to rate the importance of subcontracting within the group and with "external" companies i.e. firms unrelated to the respondent by ownership ties. Other data collected by the survey at the establishment level list size, age, ownership, R&D intensity, innovation and prior cooperation. At the company level, the survey includes information on the location of headquarters as well as the number of both local and extra-regional plants owned by the company. The survey is not hampered by significant item non-response.

The regional dimension of company linkage patterns is important for policy makers. Spanish regions have a considerable degree of autonomy and fiscal prerogatives, and develop their own spatial programmes (Suárez-Villa

and Cuadrado Roura 1993)

Given that the literature on clustered FDI plants is still relatively scarce and has to date provided few stylised facts, we shall explore various research questions whose pertinence has been substantiated by previous studies.

4.2. Location and main characteristics of industrial plants: Importance of networking

Of the sampled establishments, 79 are located in Madrid, 82 in Catalonia and 23 in the Basque Country. By regional firms, we mean firms which operate an industrial plant in the region (i.e. not necessarily a company whose headquarters are in the region). 51% of establishments participate in networks. More specifically, 46% outsource some production, 31% perform subcontracted work on behalf of others and 21% participate in networks, but these categories are not mutually exclusive. Our results confirm those of earlier research concerning the importance of networking in this industry. Jonckheere-Terpstra tests (results not displayed)[6] show that firms in the three regions show comparable levels of regional embeddedness and similar spatial patterns of networking.

Table 2 shows the share of FDI plants and domestic plants, and some characteristics of the sample by type of ownership. FDI plants and domestic plants do not differ significantly in terms of age, specialisation or degree of product diversification. This consideration is important as such characteristics will not account for possible differences in network patterns between both types of companies. Secondly, the results indicate that the group of domestic plants and the group of FDI plants have been clustering for similar periods of time (see Table 2 for the analysis of three different periods). If FDI plants had been established longer than domestic plants, this would suggest that they had played a leading role in the creation and early development of the RAs. This, however, is not the present case.

[Insert Table 2 about here]

5. Domestic plants, FDI plants and their respective networks

This section presents the results of the statistical analyses performed for hypotheses H1 and H2.

5.1. Cooperation levels

The first step of the analysis is a comparison of cooperation levels between domestic and FDI plants. According to our results, subsidiaries and joint ventures show cooperation levels similar to those of domestic clustered electronics firms (see results of Chi-square tests on Table 3). This is true for every type of cooperation analysed in this study: outsourcing (joint production), joint purchases of inputs and equipment, joint marketing, joint commercialisation in Spain, joint exporting, joint post-sales services and joint R&D. In other words, H1 stating networking patterns of FDI plants and domestic plants are similar is confirmed by our empirical research.

[Insert Table 3 about here]

A further result confirms that networking plays an important strategic role in MNEs operating in the Spanish electronics agglomerations. The share of plants engaged in cooperation is significantly higher when we consider subsidiaries (76%) on the one hand and domestic plants with no foreign capital and joint ventures (48%) on the other (significant at the 1% level). Our results differ from those of Nachum and Keeble, (2001). Through analyzing business services industries located in Central London, they found that MNEs are significantly less reliant than domestic firms on external networks for the provision of resources. This is explained, in their view, by the higher transaction costs incurred by foreign firms when they interact with external companies.

The importance of networking for MNEs operating within the Spanish electronics centres is confirmed when outsourcing relationships are specifically examined. Subsidiaries are significantly more prone (68%) than domestic establishments (44%) to outsource part of their production (significant at 1%).

This result supports those of Girma and Görg, (2004) and Batra *et.al.,* (2003), who find that in the United Kingdom and Malaysia, respectively, foreign firms are more likely to outsource than domestic firms.

As suggested by Markusen, (1996), the client's motivations for externalizing production provide some insight into the nature of subcontracting networks. The objectives sought by the client (contractor) can provide some indication of the possible complementarities offered by the supplier (subcontractor). Given that employee dismissal costs have traditionally been much higher in Spain than in most other European countries, many of Madrid's electronics firms externalized production in earlier decades mainly to meet temporary work overloads without having to hire new employees (Benton 1990). This situation changed in the early 1980s, when newly created establishments began fulfilling the needs of medium-sized and large firms seeking specialized knowledge and production (Suarez-Villa and Rama 1996). In our sample, the share of subcontracting with regard to sales and the motivations to outsource are not significantly different in domestic and FDI plants (the results are quite similar regardless of whether joint ventures among FDI plants are included). For both types of companies, the most important incentive for subcontracting is cost reduction, not to solve temporary work overloads (Table 3). This finding provides a counterpoint to the opinion of Goshal and Westney, (1993), who argue that foreign plants and domestic plants network for different reasons. Our result, by contrast, is in line with a study on UK establishments, which finds no differences behind outsourcing between foreign and domestic electronics plants (Girma and Görg, 2004). We ascertained that the importance of cost reduction as a general motive for outsourcing in this Spanish industry corroborates those of previous studies (López-Bayón, Ventura and González-Díaz 2002; Rama, Ferguson and Melero 2003) and are in line with Girma and Görg's, (2004) results for the British electronics industry.

Neither are there significant differences between FDI and domestic plants concerning the propensity to act as subcontractor (the results are again similar, regardless of the inclusion of joint ventures among FDI plants)[7].

Our results seem to confirm that, in general, the organization of FDI

plants is similar to that of domestic plants in terms of their networking practices. As suggested by Nachum and Keeble, (2003), both types of firms may respond to similar constraints and opportunities by adopting similar forms of governance (i.e. hybrids between hierarchies and markets) and levels of business cooperation.

We now examine to what degree the linkages of FDI plants are regional.

5.2. Embeddedness

Here, we compare levels of embeddedness in domestic and FDI plants. In our sample, FDI plants are less embedded in RAs than domestic plants. According to a mean comparison test, FDI plants, as compared to domestic plants, source a smaller average percentage of inputs within the region and a greater proportion in international markets, significant at 1% (Table 4). Our results are in line with those of Kearns and Görg, (2002) with regard to Irish electronics companies. As they indicate, foreign plants are more likely to source their inputs within their parent company abroad and probably have better access to international sources of supply.

[Insert Table 4 about here]

Similarly, compared to domestic plants, FDI plants sell less of their output within the region and export more (significant at 1%). With regard to cooperation, domestic plants are also more deeply embedded in their regions (significant at 5%). Firms were asked to state the main location of their subcontracting partners. We found, using a chi-square test, that as clients in subcontracting networks, FDI plants are more likely to report their subcontracting suppliers are principally located abroad. As subcontractors, FDI plants also tend to be involved in networks that are geographically more extensive. Here, it is important to bear in mind that FDI plants place greater importance upon intra-group subcontracting than domestic firms do, an issue we examine more closely below.

H2 stating FDI plants are less regionally embedded than domestic plants is confirmed by the statistical analysis.

6. Strategy and networking

This section presents and discusses the results of statistical analyses for H3 to H6.

6.1. *Cooperation with regional partners and market-seeking investment*

Now we explore the possible reasons behind the FDI plant's networking with regional partners. We performed a non-parametric correlation [8] between exports as a percentage of the FDI plants' total sales and the importance of their regional cooperation. We found a negative correlation coefficient (Spearman's rho = - 0.471, significant at the 5% level). In other words, the larger the share of plant output which is exported, the less that plant tends to cooperate with regional partners. Conversely, a greater share channelled to the domestic market entails greater cooperation with regional partners.

H3 stating FDI plants pursuing a market-seeking strategy tend to collaborate with regional partners is confirmed by our empirical analysis.

This result suggests that market-seeking foreign investors may exploit their relationships with regional partners to acquire specific local knowledge.

6.2. Intra-firm and inter-firm linkages

We explored the relative strategic importance of intra-firm and inter-firm linkages for domestic and FDI plants and ascertained that FDI plants have more experience in cooperation. A t-test of mean comparisons shows a mean number of 36.1 prior cooperation arrangements since 1993 for FDI plants, compared to 11.5 for domestic plants (significant at the 2% level). The former also display more stable relationships. Cross tabulations indicate that 93.3% of FDI plants rate their cooperation arrangements as stable, compared to 61.4% of domestic plants (chi-square significant at the 2% level). This may reflect the organisational structure of multinational corporations. In fact, the FDI plants in our sample consider within-group subcontracting relationships to be more important than do plants belonging to domestic multiplant companies (the difference significant at the 10% level, based on the chi-square test statistic).

H4 stating FDI plants consider within-company outsourcing to be more important than do domestic multiplant firms is confirmed by our analysis.

If we exclude those plants with important within-group relationships, domestic plants display no significant difference in the extent of inter-plant subcontracting among national plants or terms of experience, stability of relationships, or the spatial extent of relationships.

Next, we explored whether FDI plants perceived a trade-off between intra-firm subcontracting and subcontracting with external firms which do not belong to the multinational group (extra-firm subcontracting). Here, FDI plants were asked to rate both types of subcontracting as very important, important or not important. If there were a trade-off between both forms (i.e. intra- and inter-firm subcontracting), we would expect to find a negative directional measure. Instead, we find a positive, but not significant, Sommer's d (Assymp = 0.136; Monte Carlo = 0.187, with a 99% confidence interval). To summarise, we detected no trade-off between intra-firm and inter-firm subcontracting among the FDI plants in our sample.

In other words, we found no support for H5 (FDI plants perceive a trade-off between within company outsourcing and outsourcing relationships with external firms).

6.3. R&D, innovation and collaboration

In Table 5 we compare the innovative activities of domestic plants and FDI plants collaborating with other companies.[9] First we must note that FDI plants engaged in networks and, more specifically, operating as clients or subcontractors in outsourcing networks, are significantly much larger than their domestic counterparts (whether measured by employees or sales). It is, therefore, noteworthy that the R&D resources per employee available to both types of firms do not vary significantly. Given the differences in size, this could imply that the relatively smaller domestic networkers located in RAs are more R&D intensive than the relatively larger foreign networkers. The latter may

obtain new knowledge from the multinational network rather than from in-house laboratories located in the host-country. Foreign subcontractors might be an exception, since they display higher levels of R&D per employee than domestic subcontractors (significant at 10%).

[Insert Table 5 about here]

FDI plants appear to place more importance upon human capital. Their costs per employee, possibly indicating a more highly-skilled workforce, and their average number of engineers are significantly higher than those of domestic plants. We found, however, no significant differences between the two with regard to outcomes. The percentage of establishments launching new products or processes, the average number of innovations and the average share of new products in total sales (which reflect the commercial success of innovation) are quite similar in FDI plants and domestic plants. This result suggests that domestic networked plants are more efficient than FDI plants in the *use* of the financial and human resources assigned to innovation.

A possible explanation is that interaction with regional partners is greater among domestic networked plants than FDI plants (significant at the 5% level). This may result in improved transmission of tacit knowledge (as opposed to codified knowledge, such as patents) among domestic firms. According to theories of technological change, geographic and cultural proximity among firms increase the speed and effectiveness of tacit knowledge diffusion. This interpretation of our results is consistent with previous analyses of the electronics industries of Madrid (Suárez-Villa and Rama, 1996).

We then tested whether R&D intensive FDI plants remain either isolated or network with other companies. A Mann-Whytney U test and a Kolmogorov-Smirnov Z test indicate statistically significant differences between the level of R&D per employee in collaborative and non collaborative FDI plants (Exact significance 2-tailed = 0.28 and the Monte Carlo significance 2-tailed = 0.22 and 0.75, respectively)[10]. On average, non collaborative FDI plants invest in R&D per employee three times more than collaborative FDI plants.

In summary the tests confirm H6 stating R&D-intensive FDI plants are

less likely than other FDI plants to interact with co-located companies.

These results seem to support the view that highly innovative firms prefer to remain isolated to avoid involuntary spillovers of knowledge (Ahuja 2000). In our sample, the R&D intensive FDI plant avoided not only R&D collaboration with other companies but also outsourcing linkages, remaining vertically integrated. Thus, this potential source of innovation could nevertheless remain isolated. Our results confirm those offered by previous research (McCann, Arita and Gordon 2002), namely that co-location in a RA does not necessarily entail collaboration with other companies.

7. Conclusions

We argue that in order to fully understand MNEs' networking in host countries and host regions, these firms should not be studied in isolation. Instead, the networking patterns of MNE affiliates should be analyzed in reference to domestic firms.

To support our hypothesis, we analysed the networking relationships of 184 electronics establishments, both foreign and national, located in three Spanish regions. We studied different types of cooperative arrangements, internal and external to a region.

In general, our results substantiate our initial hypothesis. According to the statistical tests, FDI plants show cooperation levels similar to those of domestic plants. This result confirms previous studies on FDI plants in other industries and locations (Nachum and Keeble 2003; Nachum and Wymbs 2002). In our sample, the similarity between FDI and domestic plants is observed for every type of cooperation analyzed: outsourcing (joint production), joint purchases of inputs and equipment, joint marketing, joint commercialization , joint exporting, joint after-sales services and joint R&D. Participating in outsourcing networks appears to be an important strategy for FDI plants. In conclusion, our results support the view that MNEs probably create networks similar to those of domestic firms (Bellandi 2001; Mol, van Tulder and Beije 2005; Nachum and Keeble 2003).

One possible explanation for MNE affiliates' current behaviour is that MNEs tend to become isomorphic with their environment through adopting local organizational forms and practices (DiMaggio and Powell 1983; Goerzen 2005). Another plausible explanation is that MNEs interpret domestic firms' enthusiasm for networking as a sign of a thick market. The presence of a great number of contractors and subcontractors in a specific industry, as in the regions studied here, might have stimulated MNEs to build networks similar to those of domestic firms. This is because partnership choices are quite flexible in such situations (DePropris, 2001). Even firms whose social capital is small, as is allegedly the case of affiliates (Rugman and Verbeke 2001), may find suitable partners. Therefore, the networking activities of domestic firms may indicate market thickness i.e. the presence of many possible partners. Further research is clearly needed to analyze these arguments.

Despite such similarities, FDI plants display certain specific characteristics. In FDI plants, the relative levels of regional sourcing, sales and cooperation are lower than those of clustered domestic plants even though the levels of participation in regional outsourcing networks do not differ significantly between the two groups of companies. Moreover, clustered FDI plants place more importance on intra-firm linkages than domestic multiplant companies do. Our results indicate that FDI plants do not perceive a trade-off between intra-firm and inter-firm linkages, suggesting that, depending on the opportunities available, FDI plants could combine both types of relationships (Bellandi 2003; Scott-Kennel and Enderwick 2004). Notwithstanding the similarities between domestic and foreign plants, our results suggest that researchers may find it useful to take ownership into account when analyzing networks.

The present study maintains that the analysis of individual company strategy will also facilitate accurate prediction of the networking patterns of FDI plants. Those FDI plants, whose market is primarily domestic are more involved with regional partnerships, a result consistent with other studies (UNCTAD 2001). Accordingly, such plants are probably seeking regional collaboration to absorb local knowledge from their partners, thereby adapting their products to the domestic market. The technological endowment of FDI plants may limit,

paradoxically, their potential to transmit new knowledge to other companies co-located in the regions. In our sample, the most R&D-intensive FDI plants tend to remain isolated. They avoid not only R&D collaboration with other companies, but also outsourcing linkages (Ahuja 2000).

Our results also have some practical implications. Concerning policy-makers' expectations, we find that some of the potentially most attractive features of FDI plants - high R&D intensiveness and export activity - are rarely associated with the creation of local networks. For regions wishing to promote local linkages with foreign investors, those FDI plants which focus more on the domestic market and less on intense R&D may offer more potential. A general requirement for the development of FDI plants' local linkages is the existence of other networks in the agglomeration. To encourage foreign plants to network with local partners, policy-makers may find it useful to focus on complementary stimuli for domestic firms` linkages and national or regional systems of innovation. Our results suggest that domestic firms may find it useful to acquire a good working knowledge of the domestic market's specific characteristics in order to make cooperation agreements attractive for foreign partners. Conversely, the expectations of such companies to access new technology through collaboration with highly R&D-intensive foreign plants seem somewhat optimistic; as such FDI plants may choose to isolate themselves to a certain degree in the host country. As stated above, our results also indicate that the existence of local networks of domestic firms may point to a "market" for possible partners in an agglomeration. Managers of FDI plants may find it useful; therefore, to examine the behaviour of domestic firms before deciding how to most effectively organize the foreign firm in the host country (region). The absence of such networks may suggest that the FDI plant will need to obtain parts and inputs through vertical integration or in arm's length markets. In other words, potential foreign investors may find that the analysis of domestic firms' networking patterns provides useful signals in establishing the governance of the new foreign plant.

Due to data limitations, we were unable neither to ascertain the effects of age on FDI plant behaviour nor to distinguish, except in a few cases, wholly-

owned subsidiaries and international joint-ventures. Such specific information may help to shed more light on the local linkages established by FDI plants. Experience, for instance, may reduce the LOF of such companies and induce them to participate in more networking relationships. Future researchers may be able to investigate these points.

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Table 1. The linkages of FDI plants located in agglomerations: a review of the literature

Authors	Empirical base	Methodology	Main findings
Bellandi (2001)	Italian districts	Study case	Large “trans-local” companies, domestic and foreign, may develop social capital in industrial districts
Nachum and Keeble (2001)	Business services in Central London	Statistical analysis of a sample of 90 companies	FDI plants are not able to create local networks similar to those of domestic firms
McCann et al (2002)	The global semiconductor industry	Study case	FDI plants adopt different networking behaviour in different types of clusters
Bellandi (2003)	Italian districts	Study case	Large “trans-local” companies, domestic and foreign, may embed in social relationships of industrial districts
Britton (2003)	The electronics industries of Toronto metropolitan area	Statistical analysis of a sample of 66 companies with more than 100 employees	Both FDI plants and domestic plants display low levels of local embeddedness Domestic plants develop more local R&D linkages
López (2003)	The telecomm industries of Madrid	Study case	FDI plants are able to create local networks and develop social capital

Nachum and Keeble (2003)	The media cluster of Central London	Statistical analysis of a sample of 49 companies	Considerable similarity in networking behaviour between FDI plants and domestic plants
Rama and Ferguson (2007)	The electronics industries of Madrid	Study case	FDI plants are able to create local networks and develop social capital

Table 2. Characteristics of the sample, by type of ownership				
	A		B	
	Domestic plants	FDI plants (aff.+J.-V)	Domestic plants +<50%	Affiliates
% of total no. of establishments	84.7	15.3	88.5	11.5
% in total sales	24.0	76.0	29.6	70.4
R&D				
% in total R&D expenditure	24.7	75.3	32.4	67.6
Mean R&D per employee (in euros)	5977.3	9830.7	6712.2	5951.0
R&D as % of establishment sales	3.3	2.0	3.2	1.6
R&D as % of establishment costs	4.3	2.1	4.3	1.0
Mean number of engineers	**7.5**	**64.9*** **	**8.5**	**77.6*** **
% of firms that launched new products	77.9	88.5	78.2	89.5
Mean number of new products	8.4	5.3	8.3	5.2
Mean share of new products in total sales	29.1	27.9	29.0	28.2
% of firms that launched new processes	46.5	45.8	46.4	47.1
Mean number of new processes	1.7	1.1	1.7	1.1
Age: % of establishments				
Before 1980	37.7	51.9	37.9	55.0
1980-1989	41.6	33.3	41.6	30.0
After 1990	20.8	14.8	20.5	15.0
Sector: all	84.7	15.3	88.5	11.5
Sector:importance =>3 (1)				
Electronic components	82.0	18.0	84.0	16.0
Telecomunication equipment	82.9	17.1	90.2	9.8
Informatics and office equipment	80.8	19.2	80.8	19.2
Consumer electronics	83.3	16.7	83.3	16.7
Other electronic products	85.4	14.6	89.6	10.4
Non-electronic products	82.6	17.4	84.8	15.2
Services	90.5	9.5	93.6	6.4
Firms engaged in 3 and more sectors (=>3)	24.5	17.9	24.1	19.1
Firms engaged in 4 and more sectors (=>3)	8.4	10.7	8.0	14.3

Note: Columns A include joint-ventures among FDI plants; columns B do not include joint ventures among FDI plants

(1) Plants were asked to rate the importance of their sales for various products from 0 to 5 in a Likert scale

(2) Statistics are based on the mean comparison Ttest for continuous data and on crosstabulations using Pearson's chi-square test for categorical data.

Table 3. Networking in domestic versus FDI plants

	Domestic plants	FDI plants
% of firms with cooperation: B (A not sig.)	**47.5**	**76.2 ***
Type of cooperation: A		
Joint production – subcontracting	93.2	88.9
Joint purchases of inputs and equipment	19.7	33.3
Joint marketing	21.9	23.5
Joint commercialization in Spain	36.5	44.4
Joint exporting	16.9	16.7
Joint after-sales services	23.6	35.3
Joint R&D	41.1	56.3
% of firms that subcontract: B	**44.1**	**68.4 ****
% of firms that work as subcontractors: B	31.5	33.3
Perception of importance of within-group subcontracting:	**16.2**	**42.9 *****
Importance of subcontracting: A (same for B)		
Importance < 25% of production	66.2	53.3
Importance 25-50% of production	20.6	33.3
Importance > 50% of production	13.2	13.3
Motive for subcontracting: A (same for B)		
Peak load	33.8	13.3
Lack of specialised machinery	16.2	13.3
Lack of specialised employees	4.4	0.0
Cost reduction	35.3	46.7
Other motives	10.3	26.7

Notes: A: Includes joint ventures among FDI plants B: Does not include joint ventures among FDI plants.
* Significant at 1%, ** significant at 5%, *** significant at 10%.

Table 4. Spatial extent of linkages: domestic versus FDI plants

	Same region	National	International
Domestic plants			
Inputs	**54.5**	25.4	**20.1**
Outputs	**49.5**	35.7	**14.7**
Cooperation	**63.3**	22.6	**14.1**
Subcontracting (location of supplier)	**82.4**	**14.7**	**2.9**
Subcontracting (location of client)	**56.5**	**37.0**	**6.5**
FDI plants			
Inputs	**29.7 ***	21.0	**48.9 ***
Outputs	**28.3 ***	38.9	**32.9 ***
Cooperation	**40.6 ****	23.4	**36.1 ****
Subcontracting (location of supplier)	**85.7*****	**0.0*****	**14.3*****
Subcontracting (location of client)	**50.0*****	**16.7*****	**33.3*****

Note: * Significant at 1%, ** significant at 5%, *** significant at 10%

Table 5. Characteristics of networks and plants: domestic versus FDI plants

Plant characteristics	Cooperation networks		Subcontracting networks: Clients		Subcontracting networks: Subcontractors	
	Domestic plants	FDI plants	Domestic plants	FDI plants	Domestic plants	FDI plants
General characteristics						
Size: average number of employees	**79.0**	**1258.7 ***	**81.5**	**1498.7 ***	**61.6**	**2354.3 ***
Size: average sales (in thousands of euros)	**8159.5**	**164612.2***	**8796.3**	**185919.2***	**6644.6**	**37124.5 ***
Costs per employee (in euros)	**83744.8**	**346757.5***	**89191.9**	**375291.9***	**81730.4**	**580124.9***
R&D						
R&D per employee (in euros)	8228.2	13563.9	8854.9	16321.2	**6703.2**	**19549.7*****
Average number of engineers	**10.7**	**93.9***	**10.9**	**112.5 ***	**9.5**	**21.8 *****
Firms that launched new products	90.3	93.8	92.4	92.3	89.5	100.0
Average number of new products	12.8	6.4	13.3	6.5	13.2	6.3
Average share of new products in total sales	36.2	28.0	35.9	22.2	37.3	18.0
Firms that launched new processes	50.7	50.0	50.8	45.5	61.4	50.0
Average number of new processes	2.5	1.3	2.5	1.4	3.1	1.0

Note: * Significant at 1%, ** significant at 5%, *** significant at 10%.

[1] The notion of “networks” in IB studies is obviously different from that proposed by Bianchi and Bellini (1991), who refer to inter-firm linkages of *independent* companies.

[2] In the context of international outsourcing, Bardhan and Jaffe (2005), for example, find that the more innovative firms did not offshore their R&D activities.

[3] Catalonia accounted for 41.8% of the industrial plants and 33.8% of employment in this Spanish industry, Madrid, 29.4% and 41.7% respectively, and the Basque Country for 7.3% and 4.3% Rama, R., and A. Calatrava. (2002). 'The advantages of clustering: The case of Spanish electronics subcontractors'. *Int.J.Technology Management* (24),764-791.

[4] We study establishments with over 20 employees because only firms of this size are included in Spanish statistics, thereby enabling us to compare our sample to the population.

[5] Clients are establishments that subcontract out part of their production, whereas subcontractors are establishments that perform some manufacturing work on behalf of other companies.

[6] Available upon request.

[7] Comparing the two groups of companies within each RC(results not given) empirically supports, in general, the argument that MNEs tend to adopt networking practices similar to domestic clustered firms.

[8] We use a non-parametric test because of the small absolute number of firms, although the sample is representative of electronics affiliates in Spanish RAs.

[9] Statistics are based on the mean comparison Ttest for continuous data and on crosstabulations using Pearson's chi-square test for categorical data.

[10] Exact tests and Monte Carlo tests are used for the reasons explained in note 8.