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Global and local knowledge linkages: the case of MNE subsidiaries in Argentina

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Abstract

This paper is about the role of MNE subsidiaries in the generation of knowledge and linkages in industrialising countries. It develops an original typology of MNE subsidiaries based on the nature of their global linkages. Then, it explores how this typology is connected with different mental models of MNE's and discusses the impact of these two aspects on intra-subsidiary innovative activity and the formation of knowledge linkages at the local level – two important dimensions affecting subsidiaries' capacity to generate knowledge spillovers in host countries. Based on Argentinean data, the empirical analysis suggests that MNE subsidiaries engage in very diverse types of global networking. More specifically, the paper finds that the nature of such diverse global networks affects the local capabilities and the formation of knowledge linkages at the domestic level. In the light of this finding, we discuss the role of different types of subsidiaries on the generation of technological spillovers in host industrialising countries.

Key words: MNEs, global linkages, local linkages, mental models, Argentina.

JEL Codes: F32, O1, O32

[&] The order of the authors is interchangeable. They have both contributed equally to this paper.

1 INTRODUCTION

This paper is about the role of MNE subsidiaries in the generation of knowledge and linkages in industrialising countries. It contributes to the understanding of the process of knowledge creation and diffusion in association with MNE operations in these types of country. The literature has recently suggested that subsidiaries are not 'leaky containers' of knowledge, but that they may play a more active role in the process of generating externalities. This is related with the fact that subsidiaries are heterogeneous in their internal capabilities and in the extent to which they use resources from global and local sources (Marin and Bell, 2005). In previous contributions the authors have shown the importance of intra-firm/subsidiary capabilities for the generation of relevant knowledge flows to other firms, both at the horizontal and vertical levels (Giuliani and Bell, 2005; Marin and Bell, 2006). This paper instead discusses and explores empirically how linkages at the global level – with both corporate and non-corporate sources – relate to the subsidiary capabilities and the generation of knowledge interactions in the host country.

We use both secondary data from the Argentinean National Innovation Survey (1998-2001), and primary data from an original survey to MNE subsidiaries, carried out in Argentina during the period August-October 2005. The data are analysed using a combination of multivariate statistics and network visualisation techniques.

The empirical analysis suggests that MNE subsidiaries engage in very diverse types of global networking. This is especially relevant in the context of industrialising countries, since 'conventional theories' presume that subsidiaries are passive recipients of knowledge generated at the 'headquarter' location. More specifically, we find that the nature of such diverse global networks affects the accumulation of intra-subsidiary capabilities and their formation of knowledge linkages at the domestic level.

The chapter is organised as follows. Section 2 deals with the conceptual framework of this study. First, it sets out the background by examining the growing body of research focusing on the role of active and heterogeneous subsidiaries for knowledge creation and diffusion within and outside MNEs (Section 2.1). Second, it develops an original typology of MNE subsidiaries based on the different nature of their global knowledge linkages (Section 2.2) and, third, it discusses a set of propositions relating the typology with local learning and diffusion (Section 2.3). Section 3 describes the methodology. Section 4 analyses the empirical evidence, and finally, Section 5 concludes.

2 CONCEPTUAL DISCUSSION

2.1 Background: The Importance of Heterogeneous Subsidiaries for Knowledge Diffusion

There is a relatively widespread view about the way and the reasons why MNEs can contribute to technological development in industrialising countries, a contribution that is supposed to occur mainly via spillover effects. This view rests on three main assumptions about how MNEs operate: first, that MNEs possess and exploit technological assets – an ownership advantage seen as the main reason for the MNE's existence; second, that knowledge is a kind of 'public good' within MNEs, i.e. mobile, and with a joint character within firms[1]; and, third, that the MNE is a tightly integrated organisation, with the behaviour of subsidiaries closely shaped by central strategies and decisions. The combination of centrally accumulated technological assets, knowledge that is easily transferable between units of the MNE, and tightly integrated organisational behaviour provides the basis for a 'pipeline' that delivers spillovers of superior technology from the MNE parents to domestic firms, without the active intervention of local MNE subsidiaries (Caves, 1974; Blomstrom and Kokko,

[1] It means that can be supplied to additional production facilities at very low cost (Markusen, 1995, p174).

2003; Gorg and Greenaway, 2004; Haskel *et al*, 2002). Such effects are presumed to follow on almost inevitably from the centrally driven technological advantage of the MNE.

One important limitation of the research based on this view is that the empirical evidence has not demonstrated the widespread and significant technological effects one might expect from the underlying model (Lipsey, 2002; Gorg and Greenaway, 2004). As pointed out by Rodrik (1999): although "today's policy literature is filled with extravagant claims about positive spillovers from FDI …. the evidence is sobering" (p.605). In our view, this reflects two important shortcomings characterising this type of research. The first is methodological and the second conceptual. The first one is that, by and large, technological effects are never directly measured, but they are implicitly assumed as a result of domestic firms' increased productivity. The second refers to the fact that it is often the case that subsidiaries are conceived as 'leaky containers' of international knowledge, acquired from headquarters via the international pipeline (for a discussion, see Marin and Bell, 2006). As such, they are seen as local passive branches, involved in dyadic links with the headquarters (HQs).

Nowadays, however, this view seems inappropriate. Several studies, mostly referring to advanced countries' contexts, have in fact shown that global MNEs are no longer following an ethnocentric organisational model (Perlmutter, 1969; Barlett and Ghoshal, 1989). Instead they are following more flexible organisational models. In the words of Hedlund (1986) international business is now about *"actively seeking advantages originating in the global spread of the firm"* (rather than just exploiting centrally created technological assets). The early models of the MNE, as a centrally directed and closely integrated organisation, therefore, have lost relevance. Instead, much more flexible approaches have gained importance. These recognise wide-ranging heterogeneity between MNEs, along with varying forms of organisational flexibility and internal heterogeneity in the roles of subsidiaries and their relationships with parents and other subsidiaries.

Alongside these changes a number of studies within the business literature started to focus on subsidiaries as a separate unit of analysis, and emphasised several types of heterogeneities in their capacities and roles. Thus, they developed several typologies emphasising different aspects related with this heterogeneity. The most well known of these typologies is that developed by White and Poynter (1984) who identified five types of subsidiaries according to the scope that subsidiaries have to manage products, markets and value-added: a) The *marketing satellite* is a subsidiary that merely markets locally products manufactured elsewhere, b) The *miniature replica* is a subsidiary that produces and markets locally some of the parent's product lines for the local country, c) The *rationalised manufacturer* is a subsidiary that produces a designated set of component parts or products (inputs) for a multi-country or global strategy, d) The *product specialist* is a subsidiary responsible for developing, producing and marketing a limited range of products for the global market, and e) The *strategic independent* is a subsidiary free to develop lines of business for either local, or global markets.

More recently, Papanastassiou and Pearce (1998) have argued that, due to the substantial changes in trade regulations (globalisation), the *miniature replica* (Type ii above) has tended to disappear. According to the authors, this has been transformed into two different types of subsidiary: i) an *efficiency seeking subsidiary* (or 'rationalised product subsidiary'), which applies existing technologies to supply, at low cost, a small line of the MNEs line of products internationally, or ii) a *knowledge seeking affiliate*, which taps into domestic sources of knowledge to develop products (or contributes to developing them) when the domestic environment provides the conditions (Papanastassiou and Pearce, 1999).

Although Papanastassiou and Pearce (1999) elaborated on one of White and Poynter (1984) type of subsidaries they are actually shifting focus to the nature of the subsidiary operations, as opposed to the strategic motive for establishing the subsidiary (as in White and Poynter classification). A further

classification, again focused on the operational aspects of subsidiaries is that of Gupta and Govindarajan (1994) who emphasised the importance of intra-group flows of knowledge. Those authors classify subsidiaries in four ways, along intra-group flows of knowledge: a) global innovators, when they are responsible for high outflows of knowledge but receive low inflows from the group, b) integrated players, when they both send and receive high flows of knowledge, c) implementers when they have low outflows of knowledge but receive high inflows, and finally, and d) local innovators, when they both receive and send low flows of knowledge.

There are many additional typologies (e.g. Barlett and Ghoshal, 1989, Roth and Morrison, 1992, Birkinshaw and Morrison, 1995) but regardless of whether these focus more on the strategic motives for establishing the MNE subsidiaries (cf White and Poynter, 1984) or on the operational aspects, most tend to confine their attention to the implications of subsidiaries differences for the MNE as a whole, rather than on the host economy. Furthermore, the few that have explored the implications of subsidiaries heterogeneity on the host economy have focused almost exclusively on how the behaviour of subsidiaries themselves were affected, rather than on other aspects of the domestic economy. For example, Taggart (1996), using information from Scotland, empirically evaluated the association between different types of subsidiaries – distinguished according to Porter (1986) and White and Poynter (1984) – and two variables which, in the view of the author, would be important in terms of host country impact: the intensity and nature of R&D carried out within the subsidiary and the autonomy in their decision making with respect to products and markets. Subsequently, the author discussed the reasons why the presence of these two conditions should have a positive impact on the host economy.

Along the same lines, Jarillo and Martinez (1990) examined aspects of MNE subsidiary behaviour in Spain in the 1980s and early 1990s, including their R&D. Based on a typology of subsidiaries developed on the basis of Barlett's (1986) distinction between Global, Multinational and

Transnational organisations, they distinguished three type of subsidiaries: 1) the *autonomous subsidiary* which carries out most of the functions of the value chain in the host country relatively independent from the group, 2) the *receptive subsidiary,* which performs a few of these activities in the country and is highly integrated with the group, and 3) the *active subsidiary*, which carries out most of the activities in the country and these activities are carried out in close co-ordination with the rest of the firm. In their empirical study in Spain then, they noted a distinct trade-off between two types of structural position occupied by subsidiaries. They found that many of them moved towards greater corporate integration at the expense of localised integration. They concluded that many Spanish subsidiaries following higher levels of corporative integration at the beginning of the 90s lost "...'Spanish content'" – apparently including some of the Spanish content of their R&D (p.501).

In our study here we are interested in this last kind of relationship. That is, we are interested in the impact on host economies of diverse types of subsidiaries. However, our work is different from previous works in two respects. First, we go one step further in the analysis in that we do not only analyse the effect of the different types/roles of subsidiaries on their own technological activities, i.e. the activities within subsidiaries. We also analyse the association between different types/roles of subsidiaries and the extent to which they establish knowledge linkages with domestic agents – one of the main channels for knowledge diffusion in the host economy. Second, we base our typology of subsidiaries on one particular aspect characterising the local activity of subsidiaries: the extent and nature of their global linkages. In this respect, our typology can be related to the one developed by Gupta and Govindarajan (1994) discussed above. However, there are two important differences between ours and Gupta and Govindarajan's typology. First, we distinguish between intra-corporative and extra-corporative linkages, a distinction that, as it will be seen later, is very meaningful in our analysis. Second we use the extent and nature of global linkages as a proxy, not only of flows of knowledge but also to reflect different types of MNEs' mental models or

subsidiaries' entrepreneurial attitude. In other words we interpret the development of global linkages as a behavioural model in which specific behaviours can be identified.

Next two sections discuss the rationale followed in our analysis. Section 2.2 discusses our original classification of MNE subsidiaries based on global linkages, which lead us to the definition of four types of subsidiaries. Section 2.3 derives a group of propositions about the relationship between types of subsidiaries and their innovativeness and the extent of their local linkages.

2.2 An Original Classification of MNE Subsidiaries for Developing Countries

The different types of linkages (networks) in which subsidiaries are embedded can be considered a very important resource for the subsidiary. This is in line with institutional theories (e.g. White, 1970; Granovetter, 1985, 1992), which have argued that firms' performance is tied to the positioning of firms in the networks in which they are embedded. This is due to the fact that the structural position of a subsidiary in a network may affect the way knowledge is accessed and therefore potentially exploited. For example, a position that is considered to significantly influence the internal capabilities and the success of a firm is centrality (Freeman, 1979), which depends on the number of direct linkages formed by a firm with the rest of the firms in its network. Ahuja's (2000) study on the innovativeness of firms in the chemical industry found that the number of direct collaboration linkages a firm maintains affects its innovative output positively. The positive effect of direct linkages is related to the fact that, first, they enable the sharing of knowledge among firms, without the risk that knowledge is downgraded by a third firm. Second, a high number of direct ties enable a firm to have access to a vast array of differentiated and complementary skills from different firms. In this way, a central firm is able to compare knowledge coming from these different sources and this may enhance its innovation potential and performance (Bell, 2005). This can be applied to MNE subsidiaries: the extent to which they are centrally positioned in a global

knowledge network, which may or may not include the MNE headquarters and the other subsidiaries, is likely to be positively related with the subsidiary's process of accumulation of knowledge and technology, and therefore with its internal capabilities.

As mentioned above, the global knowledge network need not be restricted to the MNE. In fact, on one hand, the 'network based view' of the MNE (Hedlundd, 1986; Prahalad and Doz 1987; Barlett and Ghoshal 1990) emphasises the importance of knowledge interactions and knowledge flows between the different units within the MNE for the processes of knowledge development (on this see also Kogut and Zander, 1993); on the other hand, subsidiaries can also use linkages with other international firms as a way of accessing externally-developed technological knowledge. Moreover, these two types of linkages can be used as alternative ways of knowledge "sourcing" or they can be used in a complementary way.

In principle therefore four types of subsidiaries can be identified:

1. **Globally Diversified (GDiv)** are the subsidiaries that use both linkages with the MNE headquarters and other subsidiaries, and linkages with other international firms or institutions.
2. **Globally Dependent (GDep)** are the subsidiaries engaged in linkages only with the MNE headquarters or other subsidiaries of the corporation.
3. **Globally Independent (GInd)** are the subsidiaries that have developed linkages with other agents in international markets independent of the MNE group.
4. **Globally Isolated (GIso)** are the subsidiaries that do not use global linkages either with the MNE or with other agents.

We interpret subsidiaries' development of global linkages as an important means by which those subsidiaries can acquire externally developed technological knowledge and resources. Furthermore, when these linkages are strong within the MNE (i.e. with HQs or other affiliates) they can be interpreted as reflecting good channels for accessing the common technological resources from the MNE, or as reflecting the operation of a 'common resource model' within the MNE. This, however, is not the only interpretation possible. We also interpret subsidiaries' development of global linkages in general - i.e. with the MNE network and also with other firms - as a reflection of MNE managers' mental models or, more specifically, the entrepreneurial attitudes of the subsidiaries. In the first case, global linkages represent a channel for technology acquisition; in the second case, they represent a behavioural pattern that goes beyond the mere acquisition of technology.

Managers' mental models can be considered "deeply ingrained assumptions, generalizations, or even pictures or images that influence how we understand the world and how we take action" (Senge, 1990:8). They are considered to influence the strategic choices of managers and to even drive MNE international success (Kedia and Mukherji, 1999; Kedia and Perez, 2002). Mental models reflect the way MNEs are organised internally, that is, the organisational context in terms of culture, corporate policies and motivation (Kedia and Mukherji, 1999). In this paper, we do not analyse MNE subsidiaries' mental models directly, but we endeavour to observe them through the nature of the subsidiaries' global linkages, and we build a conceptual link between these two aspects. In other words, we claim that the MNE managers' mental models in their subsidiaries may be connected with their propensity to establish knowledge networks and with their innovative activity. Hence, underlying each of the four types of subsidiaries presented at the beginning of this section (i.e. Globally Diversified, Globally Dependent, Globally Independent and Globally Isolated), there is a specific MNE mental model, which we argue is likely to be associated with both, i) the innovative activity of subsidiaries and ii) their likelihood of generating knowledge linkages in the host economy. We explore these relations more in detail in the following section.

2.3 Global Networks, Innovative Activities and Local Knowledge Linkages: Some Exploratory

Propositions

2.3.1 Globally Isolated Subsidiaries

Globally Isolated (GIso) are the subsidiaries that do not use global linkages with either the MNE or with other agents. As such they represent the laggard benchmark of our MNE typology and for this reason we discuss them first. Since these subsidiaries occupy a position of low integration into the global MNE, their technological behaviour is unlikely to be affected by the MNE: neither constrained by a tight control of the headquarters nor supported by corporate resources. At the same time the low level use of interaction with other international firms reflects that they are not entrepreneurial enough to compensate this isolation from the MNE by using other sources of "support".

Consequently, it seems reasonable to expect that: *Globally Isolated Subsidiaries are likely to demonstrate low levels of local innovative activity.*

This type of subsidiary (totally isolated from the MNE and showing no particular interest in networking with other sources of knowledge – both domestic and foreign), is likely to behave in isolation from the local context. The managers' mental model may be predominantly internally-focused, probably informed about other corporations' activities and practices but mainly uninterested in their experiences.

Hence, we expect that: *Globally Isolated Subsidiaries are highly unlikely to develop knowledge linkages at the local level.*

It is therefore plausible that the GIso subsidiaries have hardly any potential for generating knowledge spillovers in the host country.

2.3.2 Globally Diversified Subsidiaries

Globally Diversified (GDiv) are at the opposite end of our MNE typology. These are subsidiaries that use both linkages with the MNE headquarters and other subsidiaries, and linkages with other international firms or institutions. Our exploratory idea is that Globally Diversified subsidiaries may have established a more horizontal relationship with the MNE, which means that the MNE has moved from an ethnocentric to a polycentric organisational model (Perlmutter, 1969). They source knowledge from a vast array of external actors (suppliers, clients, etc.), and when they acquire knowledge resources from the MNE, they tend to establish horizontal and cooperative linkages with both headquarters and the rest of the subsidiaries. It is conceivable that the managers' mental models in this case are similar to those of the *integrator*, described by Keria and Mukherji (1999) as one who is "more interested in leveraging rather than restraining" (pp.245-46). This means that managers hold a very open-minded and dynamic culture, oriented at the creation of "a worldwide web of relationships with suppliers, developers, designers, distributors, competitors and customers" (p.244).

We argue that this combination of knowledge sources should be associated with an active innovative behaviour on the side of subsidiaries for two reasons. First, because the high intensity of interactions with the MNE reflects a situation where subsidiaries have privileged access to the resources and support from the MNE. Moreover, the fact that this type of subsidiary is also looking for other external sources of knowledge reflects a high intra-subsidiary absorptive capacity (Cohen and Levinthal, 1990). Second, in the presence of a very entrepreneurial mental model it is plausible that the subsidiary will actively engage in processes of knowledge acquisition and generation, oriented at the enhancement of its technological base and absorptive capacity.

This leads us to advance the following proposition: *GDiv subsidiaries can be associated with strong innovative activity.*

Given their entrepreneurial mental model, it is also conceivable that GDiv subsidiaries would seek to exploit any knowledge resource available at closer geographical proximity, and thus we argue that this type of subsidiary is more likely to develop dense knowledge networks with local actors.[2]

This leads us to advance the following proposition: *GDiv subsidiaries are highly likely to develop knowledge linkages at the local level.*

The propositions advanced in this section suggest that the GDiv subsidiary has a high potential for generating local knowledge spillovers. This is connected to the fact that this subsidiary has strong innovative capabilities and access to diversified sources of external knowledge. Therefore knowledge which is potentially transferred through local linkages is likely to be of valuable content.

2.3.3 Globally Dependent Subsidiaries

Globally Dependent (GDep) subsidiaries are engaged in linkages only with the MNE headquarters or other subsidiaries of the enterprise, whereas they show strikingly low levels of interactions with other international agents. While the first aspect can be expected to have a positive effect on the innovative activity of the subsidiary, the second one can be interpreted as a reflection of poor absorptive capacity and low innovative activity. In consequence, with respect to innovativeness, this

[2] It is interesting to note that this type of mental model could be reinforced endogenously, since the structural properties of the MNE knowledge network allow knowledge resources to be generated and shared by the different subsidiaries of the MNE around the world. In such a decentralised and highly connected network, the knowledge acquired by each subsidiary will easily reach all the others, positively contributing to the generation of an intra-MNE innovative environment. Given this, it is plausible that the subsidiary's international and domestic networking is encouraged by the rest of the subsidiaries in the group and that this type of organisational model may produce a positive multiplier effect on the success of the MNE.

type of subsidiary can be expected to be somewhere in-between the other two types (GIso and GDiv). This is explained more in detail below.

On the one hand, by using strong linkages with the MNE headquarters and other affiliates, the GDep subsidiaries can draw on the common technological resources of the MNC and therefore they can benefit from the privileged access to frontier/international knowledge typically owned by the MNE. In other words, they can utilise the global resources of the MNE to access various forms of support for innovation, such as the access of frontier technologies and methods of production. This is particularly important for subsidiaries in developing/industrialising countries, which operate in environments that provide limited technological resources for subsidiaries. Moreover, as suggested by Kogut and Zander (1993), it is especially knowledge that is difficult to codify and understand the one that is transferred within the MNE, which indicates that the transfer of knowledge within the MNE in this way has merits in terms of quality as well.

On the other hand, however, the strong links with the MNE in the context of a lack of links with other firms outside the corporation can be interpreted as reflecting a situation of tight integration within the MNE, which in turn can be seen as reflecting a mental model characterised by high levels of control by the MNE headquarters. According to Keria and Mukherji (1999), the *controller* mindset of an MNE implies that its subsidiaries are subject to the imposition of the headquarters' culture and practices. This means that the local managers will "use a home-country standard as a reference point in managing international activities" (p.241). In fact, the predominant mental model of this type of subsidiary would consider the headquarters' capabilities and resources to be the only one relevant to shape those of the subsidiary. It is very likely therefore that the managers of this type of subsidiaries have a poor entrepreneurial attitude. Furthermore, in practice, they tend not to have access to other external sources, so, it is probable that they have both low absorptive capacity and

less opportunity for learning, and will therefore have a more limited innovative activity than it is observed in the GDiv subsidiary.

This leads us to advance the following proposition: *GDep subsidiaries can be associated with relatively strong innovative activities, which are nevertheless more limited than those observed for the Globally Diversified subsidiaries but certainly higher than those of the Globally Isolated subsidiaries.*

Furthermore, because of the existence of privileged access to the MNE's knowledge, and of a *controller*-like mindset, this type of subsidiary is unlikely to establish knowledge linkages with third parties in the host economy. This is particularly so in developing countries, where the local actors are often believed to suffer from a certain technological backwardness from the MNEs. This means that the subsidiary's behaviour will be shaped by the headquarters' home culture and practices, minimising knowledge interactions with 'dissimilar' or 'cognitively distant' agents, such as other host country enterprises.

This leads us to advance the following proposition: *GDep subsidiaries are unlikely to develop knowledge linkages at the local level, very similarly to the Globally Isolated subsidiaries.*

What follows from these propositions is that this type of subsidiary could potentially generate knowledge spillovers in the host country – because of their privileged access to MNE technological resources – but fail to do so due to their *controller*-like mental model, which inhibits the formation of local knowledge linkages.

2.3.4 Globally Independent Subsidiaries

Globally Independent (GInd) are the subsidiaries that have developed linkages with other agents in the international markets, but not with the MNE group.[3] This reflects a situation of strong independence from the headquarters. We argue that MNE subsidiaries interacting with international partners, quite autonomously from the headquarters, need to have a significant degree of initiative and dynamism in looking for external sources of knowledge – e.g. rather than passively acquiring knowledge from the headquarters. This may be connected with a rather autonomous and more entrepreneurial mental model, especially if compared with the centralised organisational model of the GDep subsidiary (Marin and Bell, 2005).

For two reasons, therefore, it is conceivable that GInd subsidiaries are characterised also by a rather active innovative behaviour at the local level. The first is connected to their mental model, which suggests that the GInd subsidiary will purposefully invest to accumulate the internal technological capabilities to compete at the international level. The second reason is that, as suggested by Cohen and Levinthal (1990), the activity of looking for external sources of knowledge requires that the subsidiary has accumulated a certain degree of knowledge (i.e. absorptive capacity) in order to be able to search and exploit commercially the absorbed knowledge. However, unlike the GDep subsidiary, the GInd subsidiary lacks the access to the MNE's tacit and complex knowledge, which means that its innovative activity will be based solely on the access of codified knowledge available in the market (Kogut and Zander, 1993). For this reason, we can plausibly argue that the GInd subsidiary has weaker innovative capabilities than the GDiv subsidiary, although we cannot predict a difference with the GDep subsidiary. The latter certainly has access to a more tacit and complex form of knowledge coming from the MNE, but the GInd subsidiary has access to a more varied array of knowledge sources, which is also important for the innovative activity of the subsidiary.

[3] The existence of this type of subsidiary can be associated with the case in which the MNE is a financial holding and its subsidiaries operate in very diversified industries, as diverse as metalworking and food production. In this case in fact, the headquarters may not possess any technological capabilities in the specific sector of operation of its subsidiaries.

Therefore, in principle, it is conceivable that: *GInd subsidiaries can be associated with relatively strong internal innovative activities, which are more limited than those observed for the Globally Diversified subsidiary but higher than those of the Globally Isolated subsidiary.*

The key difference with the GDep subsidiary becomes visible when we look at the formation of local linkages. As mentioned, in GInd subsidiaries, managers operate under a rather free and autonomous mental model, and it is plausible that they would pursue the right combination between domestic and international knowledge resources to develop their internal innovative activities. Thus, we argue that GInd subsidiaries are more keen on establishing knowledge linkages in the host country, especially with domestic firms, which are geographically and/or cognitively proximate to the subsidiary.[4]

This leads us to advance the following proposition: *GInd subsidiaries are likely to develop knowledge linkages at the local level, similarly to Globally Diversified subsidiaries.*

The propositions advanced in this section therefore suggest that the GInd subsidiaries have some potential in generating local knowledge spillovers. More specifically, they might not reach the level of Globally Diversified subsidiaries, due to their more limited innovative activities, but they certainly offer a much higher potential than Globally Dependent subsidiaries, which are unlikely to establish local linkages at the domestic level.

3 METHODOLOGY

The empirical analysis is based on two different types of data and methodology. First, we use secondary data from the Argentinean National Innovation Survey (1998-2001) and apply standard

[4] The proximity of firms permits frequent face-to-face interactions and tacit knowledge exchange.

statistical inference. Second, we use primary data from an original survey to MNE subsidiaries, carried out in Argentina during the period August-October 2005, and this allows us to run a qualitative analysis and apply network visualisation techniques. In line with this, this section is organised as follows: Section 3. 1 presents the methodology referring to the Innovation Survey data and Section 3.2 describes the analysis of the case studies.

3.1 Analysis Based on Innovation Survey Data

This section first describes general features of the data used in this analysis. It then goes on to discuss the indicators developed to measure the different nature of global and local linkages, and the innovative activity of subsidiaries. Finally, it describes the tests used to explore the association between our typology and the different intensities of innovative activity and local linkages of subsidiaries.

3.1.1 The Innovation Survey Data

The Innovation Survey is a novel source of information for this type of study of spillovers and MNE subsidiaries, providing both detailed information about subsidiary and domestic firm behaviour, and a large number of observations (around 1600 industrial firms – 20% of which are subsidiaries).

The Survey was carried out by the National Statistical Office and is representative of the population of manufacturing firms in the country. It interviewed 333 subsidiaries. The representative manufacturing subsidiary has been established in Argentina for 35 years. However, 25% of the subsidiaries have been in the country less than seven years whilst a substantial 10% were established more than 100 years ago. These subsidiaries employed, on average, 400 personnel (range, 16-6000 personnel); average annual sales amounted to approximately 125 million Argentinean Pesos (in 1998 when 1 Argentinean Peso was equivalent to US $1) (range, 694 thousand to 4400 million), of which

9% was exported (range, 0-99%). Europe is the home country of 46% of subsidiaries, 25% were owned in USA, and 25% in other Latin American countries. The remaining 3% have home countries spread around other parts of the world. Two industries account for 39% of subsidiaries: chemicals and allied products (21%) and food kindred products (17.5%). Motor vehicles and equipment have 9% of the subsidiaries and the rest distribute fairly evenly across the remaining industries.

The survey, following the broad framework of the Oslo Manual, provides information about a wide range of technological activities at the firm level. We use this data to construct a range of indicators of knowledge linkages and innovative activity of MNE subsidiaries and domestic firms. These two types of indicators are discussed below.

3.1.2 Indicators

(i) Indicator of Global linkages

An indicator capturing differences in the structure of global linkages of the subsidiaries was calculated by combining two types of information about the subsidiaries' behaviour: (a) their use of knowledge interactions with international agents and, (b) the importance attributed by the subsidiaries to these agents as possible sources of information for innovation activities[5]. A more detailed explanation of how this indicator was constructed is reported in the Appendix.

On these bases, four types of subsidiaries were identified:

- Globally Isolated: when the subsidiary does **not** use and does not value any linkage at the international level;

[5] The possible agents for which we have information about their importance as external sources of knowledge are seven: (a) Public institutions such as: universities, research centres, and laboratories, (b) Suppliers, (c) Clients, (d) Headquarters, (e) Other subsidiaries, (f) Other companies, (g) Consultants, and (k) Public Agencies.

- Globally Diversified: when the subsidiary uses and highly values linkages with HQ, other subsidiaries **and all the other** sources;
- Globally Dependent: when the subsidiary uses and highly values linkages **only** with the headquarters (HQ) and other subsidiaries (Subs) of the MNE;
- Globally Independent: when the subsidiary uses and values linkages only with other sources but **not with** the HQ and Subs.

(ii) Indicator of Local linkages

In order to capture the general intensity with which subsidiaries establish linkages with domestic agents – firms and institutions – an indicator was calculated simply as the sum of all knowledge interactions of the subsidiary at the local, regional and national level. Accordingly, this indicator ranges from a minimum of 0, when the subsidiary has no knowledge interactions in the host country, to a maximum of 33. A more detailed explanation of how this indicator was constructed is reported in the Appendix.

(iii) Indicators of technological activity

In line with most studies of firm-level innovation in industrialising economies, we take a broad view of innovation. This encompasses both the activities performed (not merely R&D but also a wide array of design and engineering activities), and the outputs they generate (not just innovations that are globally novel and reflected in patents but, much more common, a wide range of major and incremental changes that are novel with respect to the local industry or firm itself). Moreover, such locally innovative activities and outputs may encompass much more than new kinds of product and process hardware, but also new forms of organisation and procedure.

We use fifteen indicators to evaluate different intensities of technological activity of subsidiaries. These can be grouped in four categories: (a) Investments in disembodied knowledge, (b)

Investments in embodied technology, (c) Human capital, and (d) Outputs. These are explained below.

(a) Investments in disembodied knowledge

These measures indicate different efforts carried out by firms in order to acquire and/or develop (new) technological knowledge, which is not embodied in any kind of equipment, instruments, manual, patent, etc. In principle, these could be potentially the most important sources of locally-driven knowledge spillovers from subsidiaries to domestic firms since they cover the kinds of knowledge that are potentially most mobile and most likely to 'leak' from subsidiaries. Five measures are used:

I Intensity of expenditures on R&D

II Intensity of expenditures on innovation-related industrial design

III Intensity of expenditures on innovation-related management

IV Intensity of expenditures on innovation-related consultancy

V Intensity of payments for technology transfer contracts and licence.

(b) Investment in capital-embodied technology

These measures indicate the efforts carried out by firms to introduce new technological knowledge embodied in equipment, machinery or licences. Although this kind of investment is likely to be a very important source of productivity growth in the investing firms, it does not seem likely to be a significant driver of 'genuine' spillovers to other firms. Although information about the introduction of capital embodied assets in one firm may leak to another, the knowledge actually embodied in those assets is probably much more 'sticky'. Three measures are included:

VI Intensity of expenditures on capital goods for innovations,

VII Intensity of expenditures on IT hardware and software for innovation tasks,

VIII Intensity of imports of capital goods.

(c) Human capital

These indicators measure the intensity of human resources employed by firms, which, in principle, are capable of being oriented to monitor, incorporate and develop new technological knowledge. The measures are complementary to R&D expenditures, because they capture resources potentially capable of being destined to innovative activities, in the same way as the expenditures on R&D activities. Nevertheless, they may be more useful for evaluating firms in industrialising countries, since, as stated before, firms in these types of country carry out much of their technological efforts outside formalised R&D units.

IX *Skill intensity, measured as the number of engineers, other professionals and technicians employed in production as a proportion of total employment.*

X *'Specialised' Innovative Labour, measured as the proportion of employees exclusively dedicated to innovation tasks: R&D, design tasks, etc.*

XI *Intensity of expenditures on innovation-related training.*

(d) Results of innovative efforts

All the indicators discussed before have one common problem: they reflect the efforts made by the firm to create knowledge, but they are not showing effectiveness in the creation, the knowledge effectively created and the use of the knowledge created externally. R&D expenditures, as well as the expenditures on licenses or technology transfer or machinery, probably underestimate technological activities related to production, and technology related to information processing (Patel, 2000). Technical employees, and the educational background of employees, to some extent solve these problems, but again, it reflects resources *capable* of being oriented to exploration activities or activities of knowledge creation, but they may be oriented to other activities, and even when they are doing these kind of activities, it is not possible to know their effectiveness.

It is interesting therefore to use some indicators of results of technological efforts in a complementary way. The indicators used here are imperfect since, with the exception of patents, all of them are either subjective or lack of qualification in relation to the degree of novelty involved. Nevertheless, they still provide additional elements to distinguish firms according to their technological activity, so they will be used in some of the applications. Four indicators are calculated:

XII Number of patents: number of patents granted by each firm

XIII Product innovations accomplished during the period[6]

XIV Process innovations accomplished during the period[7]

XV Percentage of total sales – to local and/or external markets – explained by innovative products.[8]

3.1.3 Testing the relevance of the typology

In order to test the significance of our typology in explaining different innovative behaviours and local linkages, two types of test were carried out. First, the significance of differences in behaviour across the whole range of subsidiary types was assessed either by ANOVA or Chi^2. ANOVA was used to test the association with types of behaviour measured in continuous variables (e.g. R&D expenditure or training intensity); Chi^2 when the variable to be explained is categorical or non-continuous (e.g. the age of the products, or the indicators of interaction with other organisations). Second, a *post hoc* test (a Bonferroni test) was carried out to detect the significance of differences in behaviour of particular pairs of subsidiary types.

3.2 Analysis Based on the Original Survey to MNE Subsidiaries in Argentina

[6] The Innovation Survey asked the firms about the type of product innovations achieved during the period, giving the firms five different options. To calculate an indicator of intensity of product innovation we simply added the yes answers to each option.

[7] The Innovation Survey asked the firms about the type of process innovations introduced during the period, giving the firms different four different options. To calculate an indicator of intensity of process innovation we simply added the yes answers to each option.

[8] This indicator only used data of the second Innovation Survey (1998-2001).

The original survey was carried out during the period August-October 2005 and it was directed to a number of MNE subsidiaries operating in Argentina. The totality of MNE subsidiaries operating in Gran Buenos Aires were contacted by phone to appoint an interview and the response rate was of about 20 per cent. Accordingly, a total of 38 subsidiaries were involved in the study, representing all industrial sectors (from High Tech to Low Tech). The survey was carried out through in-depth, face-to-face interviews and they were based on a semi-structured questionnaire. The interviewees were the chief production managers of the subsidiary plants. The interviews were designed to obtain information in four key areas: (1) the subsidiary knowledge linkages with international actors, including the headquarters and the MNE as a whole; (2) the formation of knowledge linkages with domestic or foreign firms located in Argentina; (3) the type of relationship/organisation structure existing between the subsidiary and the MNE (i.e. headquarters and other subsidiaries) and (4) the internal knowledge generation effort.

Since our research question was aimed at exploring the relationship between global and local linkages, the information referring to Points (1) and (2) above has been used to map the subsidiaries' ego-networks (Wasserman and Faust, 1994). A social network is defined as a set of nodes linked by a type of social relationship. In this paper the nodes are represented by firms, and the relationship by the transfer of knowledge among firms. The collection of data on each subsidiary's linkages was based on a free-recall method (Wasserman and Faust, 1994); the respondents were asked to *name* the firms, operating in Argentina, with which a transfer of knowledge existed. This question allowed the collection of relational data for each subsidiary, described in network terminology as 'egos' (Marsden, 2005). Respondents could name firms, which were both domestic and foreign. Network data were analysed by visualisation tools (*Netdraw*) and completed the qualitative information collected through the interviews.

In this paper we analyse only four cases of MNE subsidiaries, selected among the sample of 38 subsidiaries to illustrate each one of the types of subsidiary derived from our framework. Each case falls in one of the four typology of subsidiaries identified. These cases are used here purely for descriptive and exploratory purposes, with no pretence to test causal relationships. Instead, the aim of these case studies is to provide qualitative insights to understand what underpins the relationship between global and local linkages, in a complementary way with respect to the Innovation Survey's data (Section 3.1). The selected subsidiaries operate in mature industries such as: the bakery oven, the tubes and pipes, the food and press industry. According to OECD classification, these industries fall into different categories of technological intensity, being Medium-High tech (oven industry), Medium-Low tech (tubes and pipes) and Low tech (food and press industry). As previously mentioned, these cases are illustrative and do not pretend to have any statistical representativeness of the Argentinean industry.

4 EMPIRICAL RESULTS

4.1 Analysis Based on the Data from the Innovation Survey in Argentina (1998-2001)

This section comments briefly on some general features of the different types of subsidiaries (Section 4.1.1), then reports on the association between them and the subsidiaries' technological behaviour (Section 4.1.2). Section 4.1.3 explores the relationship between global and local linkages, and finally Section 4.1.4 explores the implications of these empirical results for the potential for spillover effects of each type of subsidiary.

4.1.1 The typology: some general features of each type of subsidiary

Table 1 shows the distribution of subsidiaries according to the type of global linkages they maintain. The distribution is not significantly biased. However, the two more important groups are globally diversified (34%) and globally isolated (31%), and a relatively smaller number of subsidiaries engage in international linkages independently from the MNE group (12%). Finally, there are 22% of subsidiaries that rely exclusively on the MNE group for their international interactions.

Table 1: Distribution of subsidiaries according to the type of global linkages

Types of subsidiary	Number of subsidiaries	Percentage
1) Globally Diversified	115	34
2) Globally Dependent	74	22
3) Globally Independent	41	12
4) Globally Isolated	103	31

Source: Own elaboration based on data from the Second Innovation Survey in Argentina

Table 2 shows some general features of the different types of subsidiaries.

Table 2: General Features of each type of subsidiary

	GDiv (I)	GDep (II)	GInd (III)	GIsol (IV)
Sales/employee – '000 pesos (Mean)	506	383	425	271
Export Intensity – (%) (Mean)	10	8.4	11	7
Import Intensity – (%) (Mean	11	12	7	7
Market Share[1]– (%) (Mean)	3.3	3.7	3.4	3.3
Age	32	41	32	35
FDI %	92	92	67	83

1 Calculated as the ratio between a firm's total sales and the aggregate sales of all firms in its 5-digit industry

The distribution of the types of subsidiary in terms of firm size (number of employees) is roughly what one might expect. GDiv and GInd subsidiaries, the two more entrepreneurial groups, are, not surprisingly, the largest firms. They also have, on average, the highest export-intensity within the sample. Conversely, the GDep and the GIsol are the smallest. GDep subsidiaries have on average the highest domestic market share, import intensity, age and FDI participation. However, with

respect to the last indicator they do not differ from GDiv. It is not surprising either that GInd subsidiaries have the smallest FDI participation.

Finally, Table 3 shows the distribution of the different types of subsidiaries across categories of industries with different technological intensity – grouped according to the OECD classification of industries.

Table 3: Distribution of types of subsidiaries across industry OECD

	Globally Diversified	**Globally Dependent**	**Globally Independent**	**Globally Isolated**	**Total**
	I	**II**	**III**	**IV**	
Low Tech	32 (28%)	17 (23%)	**22 (54%)**	**42 (41%)**	113 (34%)
Medium- Low Tech	**27 (23%)**	16 (22%)	8 (20%)	14 (14%)	65 (20%)
Medium – High Tech	46 (40%)	**35 (47%)**	8 (20%)	37 (36%)	126 (38%)
High-Tech	10 (9%)	6 (11%)	3 (7%)	10 (10%)	29 (9%)

In the table we have highlighted the cells where the percentage of a particular type of subsidiary in a determined OECD type of industry is higher than for the average – i.e. when the type is over represented in the industry. So for instance, we have highlighted the cell combining GIsol and Low Tech, because there are 41% of *Isolated* subsidiaries operating in Low tech industries while for the whole sample it is 34%. The same happens with the GInd, but in this case the over-representation is even larger. In fact, more than half of the GInd subsidiaries are in Low Tech sectors. GDep subsidiaries are over-represented in Medium-High tech industries, and GDiv in Medium-Low. Nevertheless, the last group does not have a distribution across type of industry that differs substantially from the one of the whole sample.

4.1.2 Global linkages and innovative activities of subsidiaries

In this section we explore the relevance of these different types of MNE subsidiaries for the patterns of innovative activity of the subsidiaries in the host economy. We are interested in how the diverse

structure of the subsidiaries' global linkages relates to their effective technological activities in the host countries. Table 4 shows the results of the analysis obtained when indicators of inputs of the innovative activity are analysed, Table 5 shows the results of the analysis of differences in innovative outputs.

The differences across the four groups are mostly significant, and it strikes that GIso subsidiaries have by far the lowest scores in all the indicators. Consistent with our discussion in Section 2.1, this latter type of subsidiary has significantly weaker internal resources than those observed for the other types of subsidiary. In contrast, GDiv subsidiaries have significantly higher internal resources than the other subsidiaries in three indicators (*Investment in disembodied technologies*, *Labour in innovation activities* and *Skills intensity*), while GDep subsidiaries are higher in two. In particular, they have invested quite intensively in the acquisition of machine-embodied technologies, scoring quite high in two indicators (*Investment in Embodied technologies* and in *Capital Goods*). Finally, GInd subsidiaries perform well with respect to investment in capital goods, and show a quite high investment in R&D intensity, though not significantly different from other types of subsidiaries.

Table 4: Type Global linkage and innovative behaviour: Inputs[1]

	Type of Subsidiary					
	GDiv (I)	**GDep (II)**	**GInd (III)**	**GIsol (IV)**	**ANOVA Test**	**Post Hoc test[5]**
Indicators	(Mean Value per Type)					
Aggregated indicators						
Investments in Embodied Technologies[2]	**2.7**	**3.5**	2.6	0.9	Significant***	II>IV***
Investments in Disembodied Technologies[3]	**0.9**	**0.8**	0.8	0.4	Significant***	I>IV***
Selected Individual indicators[4]						
Investments in capital goods	0.06	**0.09**	**0.09**	0.01	Significant***	II, III >IV ***
R&D expenditures	0.26	**0.31**	**0.35**	0.18	Not significant	
Labour in innovation activity	**18**	11	12	7	Significant***	I>IV, II ***
Skills Intensity	**0.39**	0.34	0.13	0.24	Significant***	I>IV, III***

[1] All the measures are intensities, so the tests of differences are controlled by size.
[2] Calculated as the sum of the items under category (b) in section 4.1.2 above.
[3] Calculated as the sum of the items under category (a) in section 4.1.2 above
[4] The test identifies the pairs that differ significantly. In this table we only include the comparisons that differ significantly relative to the type with the highest values.
[5] For simplicity only some of the indicators discussed in section 4.1.2 – the more conventional – are included separately here. However, all of them show a similar pattern.

Table 5 shows a similar pattern, but with a more clear superiority of GDiv subsidiaries. In effect they are by far the most innovative ones, having granted more patents by firm, and launched more innovative products to domestic and foreign markets (16% and 11% respectively). They have also introduced more significant product and process innovations, i.e. of the type that are novel for the world economy or the country. GInd subsidiaries and GDep subsidiaries also perform well in some particular indicators. The former, especially with respect to patents and the introduction of significant product and process innovations – novel for the world economy – and the latter, with respect to the percentage of truly innovative products sold in internal and external markets. Finally, GIso subsidiaries have very poor innovative outputs: the average number of patents granted by each firm is strikingly low (0.06), especially if compared with GDiv subsidiaries (0.54). Similarly, the percentage of truly innovative products sold by GIsol subsidiaries is quite low, even when one considers only the products sold in the internal market (6%).

Table 5 Types of subsidiary and innovative activity: outputs

	GDiv (I)	GDep (II)	GInd (III)	GIsol (IV)	ANOVA Test/Chi2	Post Hoc test[3]
Indicators						
Patents	**0.54**	0.18	**0.21**	0.06	Significant ***	I>IV, III***
Product Innovation[1]						
Category IV[2]	**27**	22	**27**	12	Significant ****	
Category III	**33**	**24**	22	17		
Category II	31	41	34	47		
Category I	9	13	17	24		
Process Innovation[1]						
Category IV[2]	**14**	12	**15**	3	Significant***	
Category III	**24**	15	15	13		
Category II	51	61	59	60		
Category I	10	12	12	24		
Percentage of truly innovative products sold by the company						
To internal market	**16%**	**15%**	7%	6%	Significant	(I, II> IV, III)***
To external markets	**11%**	**10%**	6%	2%	Significant	(I, II>IV)*** (I>III)***

1 Four categories of product and process innovation were defined: the value IV corresponds to product and process innovators that introduced innovations new for the world economy, the value III to product and process innovators that introduced innovations new only for the country, the value II to product and process innovators whose innovations were new only for the company, and the value I to companies declaring that they did not introduce product and process innovations.

[2] The cells show the percentage of firms that introduced product (or process) innovations new for the world economy within each type of subsidiaries. So, for instance cell

[3] The test identifies the pairs that differ significantly. In this table we only include the comparisons that differ significantly relative to the type with the highest values.

In sum, two common observations cut across the results in Tables 4 and 5.

First, the analysis of the data clearly supports the exploratory propositions discussed in Sections 2.3.1 and 2.3.2. On the one hand, it seems clear that Globally Isolated subsidiaries perform significantly more poorly than the other three groups with respect to all indicators of innovative behaviour. On the other hand, Globally Diversified subsidiaries perform better with respect to almost all indicators.

Second, however, the analysis does not allow us to draw clear conclusions about the relative innovative activity of the other two types of subsidiary: namely the GDep and GInd groups. In other words, the analysis done here does not allow us to disentangle the contradictory effects of dependence on the innovative activity of the subsidiaries. In effect, on the one hand GDep subsidiaries ranked second (a better position than GInd subsidiaries), in several indicators of innovative activity – e.g. total investments in embodied and disembodied technologies and the percentage of truly innovative product. This result could be interpreted as reflecting the advantages associated with better access to the technological resources of the MNE. On the other hand, with respect to some indicators such as patents, introduction of significant innovations or R&D, the group of GInd subsidiaries is the one that performed better, immediately following the GDiv group. In some cases therefore, it seems to be more important for the innovative activity of a subsidiary to be independent from headquarters and to have an active entrepreneurial attitude, rather than to be fully supported by the MNE. Therefore the question about the circumstances in which dependency provokes a positive effect on the innovative activity of the subsidiaries, or alternatively, the circumstances in which the independence or an entrepreneurial attitude in subsidiaries can compensate for the lack of access to the technological resources of the MNE, remains open.

4.1.3 Global and local linkages

In this section we explore the relationship existing between our typology and the intensity of local knowledge linkages. We analyse two types of local linkages: Linkages with Local Agents in general, and Linkages with Local Suppliers and Clients. The results suggest that an important association may exist between the organisational model of MNE subsidiaries and their likelihood to generate local linkages, as predicted in Section 3.2.

With respect to the patterns discussed, Table 6 shows that, not surprisingly, the Globally Isolated Subsidiaries are also locally isolated. They have developed linkages with local agents much less intensively than the other types (Linkages with Local Agents is 1.2, while Linkages with Local Suppliers and Clients is 1.13). At the same time, in line with the results from the previous section, and also with the discussion of Section 2.3, Globally Diversified Subsidiaries are again the group that use local linkages more intensively (6 and 1.64). In principle, these results are consistent with the exploratory propositions discussed in Section 2.3.

Table 6: Global and local linkages

	GDiv (I)	**GDep (II)**	**GInd (III)**	**GIsol (IV)**	**ANOVA Test**	**Post Hoc test[3]**
Indicators:						
Linkages with local agents	**6**	2.4	**4**	1.2	Significant***	I, III, II>IV I, III>II I>IV
Linkages with local suppliers and clients	**1.64**	1.28	**1.46**	1.13	Significant***	I, III, II>IV I, III>II I>III

It is interesting to note as well that, in contrast to the analysis in the previous sections, here, the relationship between types of subsidiary and types of local linkages seems clearer. In effect, in line with our arguments in Section 2.3, GInd subsidiaries tend to establish local linkages quite intensively – i.e. they are second only to the GDiv subsidiaries. This also means that GInd subsidiaries are significantly more capable of generating linkages than GDep Subsidiaries (2.4 and 1.28), consistent with our expectations in Section 3.2.3.

4.1.4 Implications for spillover effects

As predicted, **Globally Isolated Subsidiaries** are in a condition in which they (i) do not establish significant international linkages, (ii) have weak internal knowledge resources and innovative capabilities, and (iii) have formed poor domestic knowledge linkages. This case, quite consistent with our conceptual discussion in Section 2.3.1, highlights the fact that subsidiaries with poor internal resources are less likely to establish knowledge linkages (Giuliani and Bell, 2005). This is because they are either unable to generate valuable knowledge to transfer or because they have poor absorptive capacities (Cohen and Levinthal, 1990).

A particularly interesting result regards **Globally Diversified Subsidiaries,** which (i) rely on a highly differentiated set of international knowledge sources, (ii) have strong internal knowledge resources and innovative capabilities and (iii) have developed substantial knowledge linkages at the domestic level. This may be due to two concurrent factors. First, as shown in Section 4.1.1, this type of subsidiary has strong internal resources and high innovative capabilities, an aspect that also suggests that the knowledge that they are likely to transfer is of valuable content. Second, as explained in Section 2.3.2 and corroborated in Sections 4.1.2 and 4.1.3, Globally Diversified Subsidiaries may be characterised by a prominent entrepreneurial attitude that leads its managers to be willing to construct knowledge networks not only internationally, as demonstrated by their diversified global sourcing, but also with firms – both foreign and domestic – operating in Argentina. According to our data, GDiv subsidiaries are valuable channels of international knowledge into the host economy and possibly have high potential for generating positive spillover effects.

Globally Dependent Subsidiaries are characterised by (i) strong linkages with the headquarters or the MNE group more generally, (ii) moderate (to high) internal knowledge resources and innovative

capabilities (iii) but limited local linkages. GDep subsidiaries have established comparatively less domestic knowledge linkages than GDiv and GInd subsidiaries (see below). This may be due to the fact that the strong dependence on the MNE knowledge resources may generate little incentive to establish dense networks at the domestic level. Hence, in spite of the fact that this subsidiary has internal resources and innovative capabilities, its organisation model may inhibit the significant creation of domestic knowledge linkages and spillovers.

Finally, **Globally Independent Subsidiaries** are characterised by (i) the development of linkages with other agents in international markets, which are independent from the MNE group, (ii) moderate (to high) internal resources and innovative capabilities (iii) quite intensive local knowledge linkages. The formation of linkages may be due to the entrepreneurial and dynamic behaviour of this type of subsidiary, which may actively seek collaborations both at the international and domestic level. However, because it does not benefit from technology transfer by the MNE headquarters, GInd subsidiaries' internal capabilities are slightly less advanced than in the cases of Globally Diversified, as indicated in Section 4.1.2. In consequence, although the formation of linkages is high, the value of the knowledge transferred may not be as high as in the previous case.

The Innovation Survey data, however, do not allow us to throw more light on the reasons underpinning these different behaviours. These are therefore explored in-depth using four illustrative cases in the section that follows.

4.2 Linking Global to Local: Four Illustrative Cases of MNE Subsidiaries

This section presents four cases of MNE subsidiaries, which were each selected to illustrate each one of the types of subsidiaries derived from our framework. The first case is that of a subsidiary operating in the tubes and pipes' industry that is connected to a highly diversified array of

international sources of knowledge, including the subsidiary's headquarters and the MNE's other subsidiaries, as well as a number of foreign suppliers and/or clients (**Globally Diversified).** The second case is about a subsidiary specialising in the production of bakery ovens, whose only source of knowledge is represented by the headquarters (**Globally Dependent**). The third case is about a firm operating in the food industry, which acquires knowledge from several international sources but not from the headquarters or the MNE's subsidiaries (**Globally Independent**). Finally, we leave the **Globally Isolated** subsidiary as the last case, which is about a subsidiary operating in the press industry, which has not established any relevant linkages with external sources of knowledge at the international level. We give here a detailed account of each of these cases and address the issue of the formation of linkages at the domestic level.

4.2.1 The case of a Globally Diversified Subsidiary in the tubes and pipes' industry ('A')

This is an informing case about a MNE characterised by horizontal and collaborative relationships between subsidiaries and the headquarters. The group operates in the production of tubes and pipes for agriculture and civil infrastructures and, since 2003, the property has become fully Latin American with subsidiaries in several Latin American countries, including Brazil, Chile, Mexico, Costa Rica, Venezuela, Colombia and most of the Central American countries.[9] The salient characteristics of this MNE is that it has adopted an organisation model such that the headquarters is 'shared', that is, it is rotating over time across the different countries (and subsidiaries) according to the specific requirements of the MNE. For example, our respondent in the Argentinean subsidiary 'A' declared that "at the beginning the headquarters was in Costa Rica because it had a more 'foreign style' in doing business, now it is moving downwards (i.e. to the Southern Cone), closer to where most of the production is done." Very interestingly, the respondent describes this process in the following way: "it is like a father who has sons living in different countries and moves to live with each of them, changing over time." And then he adds, "what we want to achieve is the

[9] The group has 24 plants in 13 Latin American and Central American countries.

elimination of a legal boundary, where what matters is the Latin American region as a whole, not a particular country." Each subsidiary is thus highly participative in the strategic decision making of the whole MNE.

The Argentinean subsidiary 'A' carries out both design and manufacturing processes. The design is aimed at the development of specific types of tubes and the improvement of watering methods. The process and product development, however, is aimed at the development of products that are suitable for the Argentinean and the broader Latin American markets. The interesting aspect here is that other subsidiaries carry out intense design and product development activities – such as, for example, in Ecuador and Mexico – and that these activities are shared across the whole MNE. As noted above, the subsidiaries actively cooperate among each other and executives travel intensively across all subsidiaries – keeping them all always in contact. They get feedback, observe, learn and transfer this information to the other subsidiaries. As the respondent put it "there is an atomisation of the information". In order to achieve higher integration and to facilitate cross-subsidiary interactions, the MNE is currently making an attempt to codify the knowledge, in order to improve their coordination. For example, "each country specialises in something and the others know the codes, so if they need that something they can apply it. Anyway, this is in process and still there is a great bulk of production which will persist being produced in all countries since they provide the domestic market mainly." 'A' claims to interact particularly strongly with the subsidiaries in Ecuador and Mexico, but the respondents highlights "this is for technical reasons but, broadly speaking, this is a very horizontal group and no dominant position is purposefully searched by any of the subsidiary."

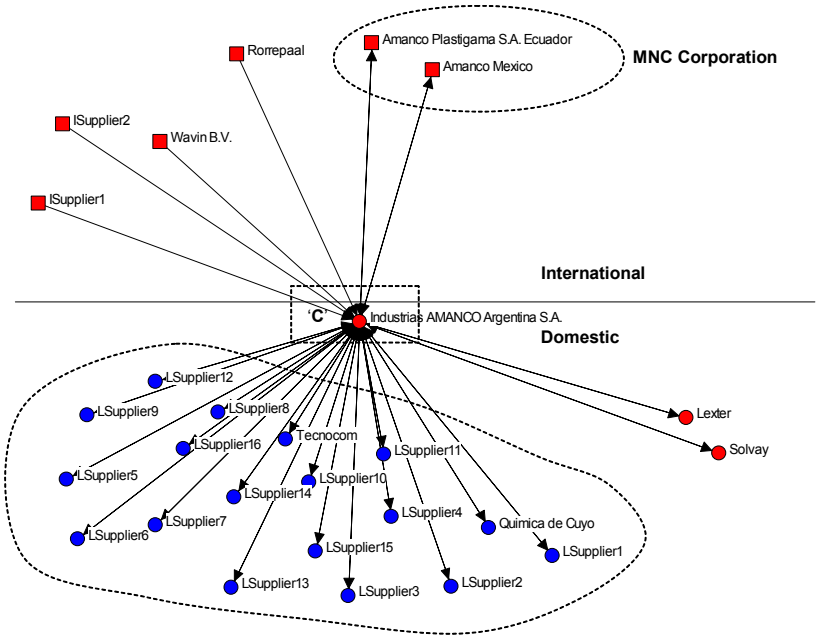
In addition to the MNE's knowledge resources, 'A' searches for a wider array of international sources of knowledge. A critical source in this case is represented by a North American leading company in the production of tubes and pipes. They basically adapt and imitate this company's product because, during the convertibility period, they had a licensing agreement with this company

to sell its products in Argentina. Although this type of activity is no longer sustainable (this product in Argentinean Pesos are unaffordable for the local market), they still have a strong relationship with the US company and they are allowed to visit their plants.

Three other international suppliers are particularly important for the transfer of knowledge and technology in 'A'. All of them are producers of machinery from Italy, the Netherlands and China. As we can see, this is a very dynamic subsidiary, very actively sharing knowledge with the rest of the MNE and also very entrepreneurial in establishing other international linkages – which eventually benefit the whole MNE. This profile is in line with the idea that the managers' mental models of this subsidiary are similar to that of the *integrator,* described by Keria and Mukherji (1999) since they are "more interested in leveraging rather than restraining" (pp.245-46).

At the domestic level, 'A' collaborates intensively with several local suppliers (raw materials, metalworking) (see Figure 1). More interestingly, 'A' has established numerous linkages with domestic firms aimed also at the development of new materials for tubes and pipes (e.g. materials that comply with environmental standards and mechanic standards for the final product to be resistant). This behaviour is in line with the subsidiary's dynamic and entrepreneurial mental model, and it is likely to have a much higher developmental impact than the other subsidiaries presented in the rest of this section ('B', 'C' and 'D'). Domestic linkages formed by 'A' are much higher and also of a higher quality (interactive, oriented to develop new products, so highly innovative), than in the other cases.

Figure 1 The case of a Globally Diversified subsidiary



Source: Own data. Graph based on Netdraw

4.2.2 The case of a Globally Dependent subsidiary in the bakery oven industry ('B')

The Argentinean subsidiary 'B' has a long history in the production of industrial ovens. It was set up through a licensing agreement with an Italian company in the 1950s. In 1990, after circumstances led the original Italian licensor to exit the market, subsidiary 'B' was taken over by another European company that is among the leaders in the production of bakery ovens worldwide. The two established an agreement by which 'B' sold a considerable part of its property to the European counterpart, in exchange obtaining unlimited access to frontier technologies. This is achieved through the transfer of updated designs of new machines and plants as well as through the visits of engineers to assist the changes in the production processes.

Our respondent in 'B' quite frankly admitted that the subsidiary's technological inputs came almost entirely from the headquarters and he described 'B' as a purely 'technology taker' subsidiary, with very limited R&D being carried out within the subsidiary. As the respondent put it "in this field the

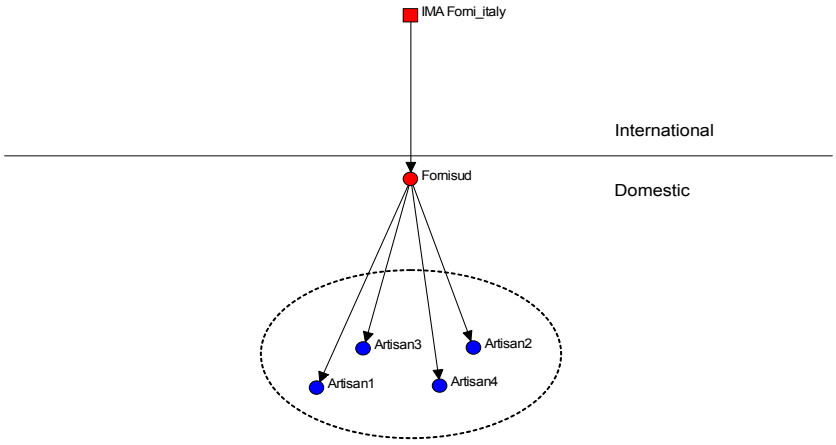
best technologies are produced by industrialized countries and Argentina is isolated from the rest of the world." More specifically, the respondent claimed that the headquarters operates on the technological frontier and therefore 'B' "is not able to invent anything" because the technological gap is considered to be too wide. 'B' does indeed have a technical laboratory but it is used just to adapt the imported designs to the Argentinean market and the respondent claims that adaptations are very minor. In the case of 'B', the dependence on the headquarters is very high and the relationship is strongly hierarchical and unidirectional.

At the intra-subsidiary level, therefore, 'B' accesses frontier technologies and operates with a high technological sophistication, but this is entirely due to the high dependence from the headquarters rather than to its internal effort. In fact, 'B' follows a quite passive learning behaviour with no initiative to undertake an innovative path different from what as been transferred by the headquarters. It is plausible to consider this behaviour as being associated with a mental model of the subsidiary's managers, who are quite resilient to undertaking independent and risky paths of innovation and networking (i.e. very resilient to explore).

In line with our argument in Section 3.2.2 and with the results of the Argentinean Innovation Survey (Section 4.1), we find that this subsidiary develops very limited linkages at the domestic level (see Figure 2). The only linkages that are formed are with a few, very small artisan firms, which do some metalworking for 'B'. 'B' transfers some technical knowledge through the interaction, but the impact of this type of linkage in terms of generation of technological externalities in the host economy is likely to be limited because: (i) the relationship between 'B' and the artisans is unidirectional, and no process of interacting learning is promoted through these types of linkage; and (ii) the artisans have themselves very limited potential to amplify the knowledge that they have received from 'B' and diffuse it to other firms in the country. In contrast, the incoming knowledge is

much more likely to run into the 'dead-end' of firms that diffuse little to other firms in their economic context (Giuliani and Bell, 2005).

Figure 2 The case of a Globally Dependent subsidiary



Source: Own data. Graph based on Netdraw.

4.2.3 The case of a Globally Independent Subsidiary in the food industry ('C')

Thirty-five years ago 'C' started as a national firm for the production of bakery products and grew in a market where the only competitor offered products for the lower-end of the bread market. It entered the market by targeting a very specific market-niche oriented at production of high quality and fresh products. Today, the firm is the leader in the domestic market, retaining more than 50% of the market share. It became part of a multinational group in 1997, when it was acquired by a foreign investor. However, the foreign property has only a financial interest in the firm and no specific expertise or tradition in the production of bakery products.

Innovation is central to this firm. Its challenge is to differentiate a product that is normally considered as a commodity, such as bread. Accordingly, it has made a huge effort to diversify and

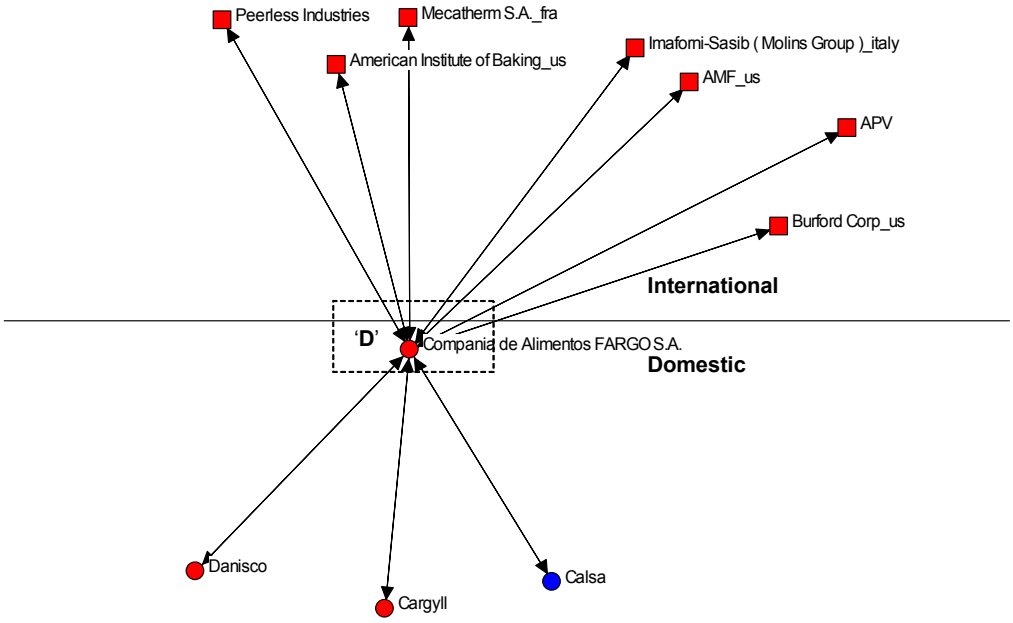
customise the product, very similar to other industries (e.g. the diary industry). In order to customise its products, 'C' has differentiated the offer into several product lines, an activity that has required substantial product development at the local level. Besides product development, manufacturing and marketing are carried out entirely at the domestic level. In effect, 'C' is completely autonomous from the headquarters. In this respect, the respondent mentions that "the property does not know whether we are developing a new product or not, we have total freedom in our choices, all they are interested in is our balance-sheet at the end of the financial year." Interestingly, as the respondent put it "to be independent from the headquarters is more difficult but much more challenging and interesting (nicer)" (*mas lindo* in original).

Because of this, they have a number of international sources of knowledge that feed the active process of innovation, but none of them comes from the MNE. The fundamental source is represented by the American Institute of Baking, which is a private institute in the US, supported by the four or five largest baking companies in the US, and they are those that generate knowledge worldwide in this industry. This institution organises Master courses and carries out substantial R&D, both of which are important sources of knowledge for 'C' – e.g. many of the employees have gone to go to attend Master courses there. Other sources of international knowledge come from literature and from fairs and congresses. Moreover, interactive and mutual learning is considered to occur with some of their international suppliers.

In Argentina, 'C' has formed relationships with a number of domestic suppliers (wheat, yeast, sunflower juice, etc) and these relationships are also based on joint product development (Figure 3). It is interesting to note that 'C' has established particularly strong linkages with three large suppliers, one of which is Argentinean. Being connected to large suppliers is important as it may generate a multiplying effect in the generation of externalities, and the impact of these linkages on other firms in the economy may be more important than that of linkages with other smaller domestic firms (i.e.

the dead-ends observed in the case of subsidiary 'B'). This is because large suppliers may amplify the knowledge received from 'C' and transfer it to a wider array of other domestic firms.

Figure 3 The case of a Globally Independent subsidiary



Source: Own data. Graph based on Netdraw.

4.2.4 The case of a Globally Isolated Subsidiary in the press industry ('D')

Finally, the example of an isolated subsidiary proposed here is that of a company working in the press industry ('D'). This choice may seem quite bizarre, as firms operating in the press industry need necessarily to be connected to international press agencies (e.g. Reuters). However, our focus here was not directed to this type of codified knowledge (i.e. news) but to the acquisition of knowledge in the way business is run and the journal is managed and produced. For example, knowledge about how to develop a new format, how to change the newspaper's marketing strategies, how to target new market niches, etc. In this respect, this company is determined as Globally Isolated because it is totally independent from international sources of knowledge. It was set up some 130 years ago and more recently has been acquired by a North American press agency.

Also the newspaper is managed and the decision-making process is carried out exclusively in Argentina and, as said, the subsidiary is completely independent from the headquarters. It is only during severe financial crises that the headquarters intervenes in supporting the journal but only from a financial side, never from a knowledge-centred one. The mental models of the company managers seemed to be quite independent and to operate in isolation from the domestic and international context. For this reason, we considered this subsidiary to have barely no impact on the generation of knowledge spillovers in the host country.

5. CONCLUSIONS

This study has to be considered a highly speculative attempt to open up the black box of FDI and knowledge spillovers. It was about the role of MNE subsidiaries in the generation of knowledge linkages in industrialising countries. It departs from the widely acknowledged view that subsidiaries are 'leaky containers' of knowledge and it stresses that it might be important to consider a different model, one in which subsidiaries may play a more active role in the process of generating externalities. This is related with the fact that subsidiaries are heterogeneous in their internal capabilities and in the extent to which they use resources from global sources and local sources (Marin and Bell, 2005).

The paper has discussed and empirically explored the relationship between three important dimensions characterising the MNE subsidiaries' potential for spillover effects in host countries: a) the nature of subsidiaries' global linkages, b) their local innovative activities and c) their knowledge linkages with local firms. In order to explore these relationships, we have considered subsidiaries' development of global linkages as a reflection of MNE managers' mental models (Kehria and Mukherji, 1999) and then we have discussed how subsidiaries, which differ in terms of their global

linkages and of their mental models, do also differ in terms of their innovative activities and of their propensity to establish local knowledge linkages.

In order to explore this issue, we used both secondary data from the Argentinean National Innovation Survey (1998-2001), and primary data from an original survey to MNE subsidiaries. The empirical analysis has suggested that MNE subsidiaries engage in very diverse types of global networking, and that, in connection with these networking activities, they develop different internal capabilities and have different potential for spillover effects. This is especially relevant in the context of industrialising countries, since, as said, 'conventional theories' presume that subsidiaries are passive recipients of headquarters' generated knowledge. More specifically, we have identified four different types of subsidiary, characterised by distinct behaviours in terms of their innovative activity and of formation of knowledge linkages in the host economy.

In this sense these findings have contributed to identify significant dimensions in the explanation of situations with different potential for spillover effects in association with FDI. We have advanced the idea that only under certain organisational and managers' mental models, can subsidiaries be in a condition to diffuse technological knowledge locally. In our analysis, this occurs in the case of Globally Diversified and Independent subsidiaries. In contrast, when subsidiaries are dependent on the MNE group, they seem less likely to develop dense networks at the local level, leading these types of subsidiary to be considered as dead-ends in the global knowledge pipeline. Finally, Globally Isolated subsidiaries tend to behave in isolation also at the local level, not representing a valuable source of knowledge for other firms in the host country.

The findings of this work also have several interesting implications more in general on the issue of innovation in MNEs subsidiaries. More specifically, we have provided arguments and empirical evidence that contribute to understanding reasons that could explain the underlying heterogeneity of

innovative activity by the MNE subsidiaries in host industrialising countries. First, we have shown that the intensity and nature of global linkages is associated with the intensity of innovative activity of subsidiaries. This is a very well known fact in the industrialised world (e.g. Ahuja, 2000). However, it has been less studied in the case of firms operating in industrialising countries and even less in the case of subsidiaries of MNEs in these types of country. Second, we have started to explore conceptually the influence of different 'mental models' and/or entrepreneurial attitudes of subsidiaries on their innovative activity, a novel issue within the international business literature in relation to subsidiaries operating in advanced contexts, but that has not been explored at all in the industrialising world. Third, in relation with this issue the results of our research have raised a set of new interesting questions about the influence of different MNEs' mental models on the innovative activity of subsidiaries in host industrialising countries, and therefore on the potential for spillover effects of different types of MNE subsidiaries. For instance, in which circumstances dependency has a positive effect on the innovative activity of subsidiaries, and in which circumstances it becomes more relevant for these activities to have an independent or autonomous behaviour attitude.

Finally, this analysis was set within specific empirical and methodological limits. The first is that this study has not directly tested the relationship between the four different types of subsidiaries and the generation of spillovers. Instead, it has looked at the factors that are associated with the presence of knowledge spillovers: the innovative activities of the subsidiaries and their knowledge linkages in the host country. This is an issue that we are going to explore in future research. The second limitation is related with the qualitative analysis, and refers to the fact that the four case studies used in this analysis were selected among a number of MNE subsidiaries on the basis of the quality of the information collected, which allowed the behaviour of each type of subsidiary to be illustrated in detail and in a complementary way to the statistical analysis of Section 4.1. For this reason, the selection was done *ad hoc* and has no pretension of statistical representativeness of the Argentinean MNE subsidiaries. Finally, in relation with the quantitative part, it should be borne in

mind that our analysis has not explored in detail the influence of industry effects on the behaviour of MNE subsidiaries. This relationship, as shown in Table 2 of this chapter, is not so strong as to affect our results. Nevertheless there is some kind of weak association between our typology of subsidiaries and the type of industry is present in the data. In consequence, this is an aspect that could be analysed in more detail in future research.

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Appendix: Indicators of Global and Local Linkages

Global and Local linkages are indicators of the extent to which subsidiaries utilize and value interactions with others international and/or local agents. The Innovation Survey asked subsidiaries a number of linked questions about their interactions with other organisations in connection with innovation and problem solving. We used the responses from two of these questions to develop indicators measuring different intensities of ***innovative-related linkages*** with international and local agents.

- **Question (1): Main sources of information for innovation activities**

  The survey asked firms about the importance of alternative sources of information for innovation activities. They had to rank each source according to its importance for the firms. The possible importance varies from 1 (no importance) to 4 (very important source). Headquarters and other subsidiaries were two options among eleven possible sources offered by the survey. Others included: internal sources, public institutions, competitors, suppliers, consultants, journals, conferences, etc.

- **Question (2): Knowledge Interactions with other agents**

  Firms were asked: first whether they used knowledge interactions with any of eleven types of organisation for their current activities: (a) Universities, (b) Technology Research Centres, (c) Laboratories, (d) Institutions of Technological Co-operation, (e) Suppliers, (f) Clients, (g) Headquarters, (h) Other subsidiaries, (i) Competitors, (j) Consultants, and (k) Public Agencies. Second, they were asked to indicate the geographic area where the identified organisations were located. They were given the following

options: 1) Local, 2) Regional, 3) National, 4) Latin-America, 5) European Union, 6) USA or Canada, 7) Asia, 8) Others.

On the basis of these two questions, two indicators of innovation-related interaction were constructed. The first intends to capture different intensity and types of global linkages and the second the same but focusing on local linkages. These are explained below.

(iii) Indicator of Global linkages

The indicator of global linkages was calculated by combining the information from Questions (1) and (2) in the following way.

First, to be able to combine the information contained in Question (1) about the importance of the source/linkage, and the information contained in Question (2), about the localisation of linkage/interaction we select the sources/agents from Questions (1) and (2) that coincide. So we end up working only with seven possible agents/sources: (1) Headquarters, (2) Other subsidiaries, (3) Clients, (4) Competitors, (5) Suppliers, (6) Consultants, (7) Public Agencies.

Second, we eliminated those sources that did not come from foreign countries in Question (2) (i.e. the ones that have not indicated this specific source to come from either the Region, Latin America, European Union, USA & Canada, Asia, Others)

Third, by subsidiary we added up the number of international linkages/sources mentioned in Questions (1) and (2) **(var A)**.

Finally, the indicator of 'Global Linkages' was calculated as the product of the number of international linkages/sources (**var A**) and the importance of each possible source/linkage, which according to Question (1) could vary from 1 to 4**.**. Accordingly, the value of 'Global Linkages' of firm *x* ranges from 0 to (7*4) = 28 (seven, is the maximum number of global linkages that the subsidiaries might have

Then we classified the firms into four groups.

- Globally Isolated: when the subsidiary **does not** use and **does not** value any linkage at the international level;
- Globally Dependent: when the subsidiary uses and highly values linkages **only** with the headquarters (HQ) and other subsidiaries (Subs) of the MNE;
- Globally Diversified: when the subsidiary uses and highly values linkages with HQ, other subsidiaries **and all the other** sources;
- Globally Independent: when the subsidiary uses and values linkages **only** with other sources but **not with** the HQ and Subs.

(ii) Indicator of Local Linkages

In order to capture the general intensity with which subsidiaries establish linkages with domestic agents – firms and institutions – an indicator was calculated simply as the sum of all the 'Yes' answers to the Question (2) above, but only when the interactions of Question (2) are at Local, Regional and National Level.