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MNC subsidiaries' position in global knowledge networks and local spillovers: evidence from Argentina

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The importance of MNCs in emerging economies has increased substantially in recent times. This paper develops a 'subsidiary-centred' model for the estimation of spillovers from Foreign Direct Investments in Argentina. It conceives MNC subsidiaries as nodes of an inter-organisational network, and it analyses the degree to which different 'positions' in the global knowledge network influence the generation of local spillover effects. It finds that only subsidiaries that are open to extra-corporate knowledge sources (vis-à-vis intra-corporate sources) generate positive local spillovers, and shows that these subsidiaries have entrepreneurial features. The paper opens up new promising research directions.

Keywords: MNC subsidiary; global networks; local spillovers; Argentina

Introduction

The importance of MNCs investing in emerging economies has increased substantially in recent times, and with it the number of studies exploring their impact on the host economy. The studies tend to start out with very optimistic claims about the potential effects of MNCs on the productivity and technological capabilities of host country firms. This is because MNCs are assumed to own superior technological assets, which give them their *raison d'être*, and it is therefore presumed that some of these superior assets could diffuse to domestic firms, generating positive spillover effects. However, the empirical evidence to support these positive effects expected by theorists and policy makers has been rather contradictory and inconclusive (see Jarovick 2004 for a discussion of the empirical literature, and Smeets 2008 for a recent survey). Furthermore, the response to such inconclusive evidence has been limited insofar as researchers have not tended to question the main assumptions underlying the 'pipeline' model (Marin and Bell, 2006) most commonly used to explore FDI-related spillovers in host economies. This model presumes that spillovers arise mostly as a result of technological assets created centrally in MNCs' headquarters, and are then incorporated passively by their subsidiaries. Instead, studies have turned their attention to two other types of explanation for the absence of spillovers: the weak absorptive capacity of domestic firms and host countries (Chudnovsky et al., 2008; Kokko, 1994; Konings, 2001) and the different MNCs' central strategies (or their industry) (Alvarez and Molero, 2005; Chung, 2001; Driffield and Love, 2007; Narula and Dunning, 2000). The former is expected to constrain the ability of domestic firms to fully realise the potential productivity gains from implementing the new technologies introduced by MNCs. The latter is expected to influence the types of

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technology that MNCs transfer to subsidiaries, and hence the scale and significance of the knowledge resources that may subsequently leak to domestic firms.

Unfortunately, these alternative explanations have not always solved the empirical problem (see Alvarez and Moleró, 2005; Damijan et al., 2003; Haskel et al., 2002; Sjöholm, 1999). What is most striking, however, is that, even in the absence of significant effects, spillover studies have not generally put the ‘knowledge pipeline’ model into doubt. In other words, they have not fully taken into account the fact that subsidiaries are heterogeneous – e.g., in terms of their internal capabilities and activities or in terms of the role played within the MNC – and that this heterogeneity may be a possible factor underlying the inconclusive evidence about FDI-related spillover effects. This aspect is neglected even when a wealth of empirical research on the behaviour of MNCs has documented different dimensions of subsidiaries’ heterogeneity in both advanced (see Birkinshaw, 1997; Birkinshaw et al., 1998; Cantwell and Iammarino, 2003; Cantwell and Mudambi, 2005; Granstrand, 1999; Kumar, 2001; Kuemmerle, 1999; Nobel and Birkinshaw, 1998; Pearce, 1999; Papanastassiou and Pearce, 1999; von Zedwitz and Gassman, 2002; Zander, 1999); and industrialising countries (Ariffin and Bell, 1999; Boehe, 2007; Ferigotti and Figueiredo, 2005; Giuliani and Marin, 2007; Marin and Bell, 2010).

In this article, we move beyond the ‘knowledge pipeline’ model by incorporating heterogeneous subsidiaries in the model of spillover generation (thus contributing to further develop a ‘subsidiary-centred’ model). This is in line with recent studies that have found that only innovative subsidiaries generate positive technological externalities in the host economies (Castellani and Zanfei, 2007; Marin, 2006; Marin and Bell, 2006; Marin and Sasidharan, 2010; Todo and Miyamoto, 2006). This paper contributes a further step in that general direction by incorporating into the analysis a novel dimension of subsidiaries’ heterogeneity: their ‘position’ in global knowledge networks. More specifically, we consider a subsidiary as a node of an inter-organisational network, rather than as a unit hierarchically connected to the headquarters – in line with the seminal work of Ghoshal and Bartlett (1990). Hence, we envisage that subsidiaries differ in the degree to which they use their global networks (both intra- and extra-corporate) to acquire and access knowledge and technologies needed to feed their innovative process.¹ We then explore, both conceptually and empirically, the localised spillover effects of different types of subsidiary, distinguished according to their ‘position’ in global knowledge networks and hence to the type of actors that form part of such networks. Based on a previous descriptive study by the authors (Giuliani and Marin, 2007), we distinguish between four types of subsidiary: (1) Globally Diversified (GDiv) subsidiaries, defined as those that establish knowledge linkages with both the MNC headquarters and the other subsidiaries, *as well as* linkages with other international firms or institutions; (2) Globally Dependent (GDep) subsidiaries, which establish knowledge linkages *only* with the MNC headquarters or with other subsidiaries of the corporation; (3) Globally Independent (GInd) subsidiaries, which establish knowledge linkages with other agents in international markets, but *not* with the MNC headquarters or the other subsidiaries; and finally, (4) Globally Isolated (GIso) subsidiaries, defined as those that do not use global linkages with either the MNC or with other international agents.

We estimate FDI spillovers using the familiar production function framework based on data from two National Innovation Surveys from Argentina covering the period from 1992 to 2001, and we achieve interesting and novel empirical results. In particular, we show that *only one* particular type of subsidiary – the Globally Independent subsidiary – displays the positive spillovers expected by theorists and policy-makers, measured by increasing the FDI participation in both sales and skilled workers. The results are robust even when controlling for the absorptive capacity of domestic firms. As for the other types of subsidiary, we find either negative or insignificant spillover effects for Globally Dependent and Globally Isolated subsidiaries, and partially positive effects for Globally Diversified subsidiaries. Given this striking result, we explore further the

characteristics of Globally Independent subsidiaries, and we find that these have distinctive features when compared to the other types of subsidiary. They are more innovative, with regard to a number of indicators; they are more proactive than other subsidiaries as reflected by their embeddedness with both local value chain and non-value chain actors. These features could reflect or be associated with a more pronounced ‘entrepreneurial attitude’ within these subsidiaries vis-à-vis other types of subsidiary (Birkinshaw, 1997; Dimitratos et al., 2009; Liouka, 2007; Zhara et al., 2000). This result is interesting and it is in line with very recent work by Dimitratos et al. (2009), who find that entrepreneurial subsidiaries in the UK are more likely to have a positive impact on the economic development of the host region. But, more importantly, it opens up a new line of research into the existence and role of entrepreneurial subsidiaries in industrialising host countries.

While contributing to the FDI-spillover literature, this paper also sheds light on issues of global–local interactions that are relevant to other academic communities. On the one hand, the ‘subsidiary-centred’ model we adopt here draws extensively on the recent advancements made by international business (IB) and innovation scholars around the conceptualisation and functioning of MNC subsidiaries, which are typically poorly understood in the FDI-spillover community. On the other hand, while most IB and innovation studies are mainly centred on the activities of subsidiaries and their corporations, we look here at the impact that these actors have on the local context – an issue that is of utmost importance also for economic geographers as well as development scholars in general (see, e.g., the November 2008 *Entrepreneurship and Regional Development’s* special issue and Yeung, 2009).

The paper is organised as follows. The second section reviews the literature about the conventional ‘pipeline model’ for estimating FDI-related spillovers and discusses the advancements of recent works into estimations based on ‘subsidiary-centred’ models. The third section presents our original conceptual framework. The fourth section presents the data and the methodology used to estimate FDI-related spillovers. The fifth section presents the empirical results and the sixth section concludes.

Review of the literature: foreign direct investment and technological spillovers

Problems with the conventional ‘knowledge pipeline’ model

The conventional ‘knowledge pipeline’ model, used to explore the existence of technological spillovers associated with FDI in the local economy, is based on a combination of the internalisation/transaction costs theory of the MNC (see Alvarez and Molero, 2005; Blomström and Person, 1983; Blomström, 1986; Blomström and Sjöholm, 1999; Chang and Xu, 2008; Girma, 2005; Haddad and Harrison, 1993; Haskel et al., 2002; Javorcik, 2004; Javorcik and Spatareanu, 2008; Kathuria, 2001; Liu and Wang, 2003). This is essentially based on three main assumptions about how MNCs operate: first, that MNCs possess and exploit technological assets – an ownership advantage seen as the main reason for the MNC’s existence (Caves, 1974; Hymer, 1976); second, that knowledge is a kind of ‘public good’ within MNCs, i.e. it is mobile, and has a joint character within firms (Markusen and Maskus, 1999); third, and more implicitly, that the MNC is a tightly integrated organisation, with the behaviour of subsidiaries being closely shaped by central strategies and decisions. The combination of centrally accumulated technological assets (knowledge that is easily transferable between units of the MNC) and tightly integrated organisational behaviour provides the basis for what we call a ‘knowledge pipeline’ model that delivers spillovers of superior technology from the MNC parents to domestic firms, without the active intervention of local MNC subsidiaries. In fact, in this model, subsidiaries are often presumed to be entirely passive in the process of spillover generation, acting merely as a knowledge conduit at the end of the ‘pipeline’ running from the parent to domestic firms in the host economy (for an in-depth discussion of this, see also Marin and Bell, 2006).

This model has two associated problems. The first is conceptual and concerns the mismatch between the assumptions underlying the model and more recent theorising and evidence from the IB literature about how MNCs actually operate. As is rightly pointed out by Tallman (2003), within the IB literature a:

... transition is happening of the dominant model of the MNC from the market failure approach of internalization theory and transaction costs economic theory to the market imperfections approach of capabilities or knowledge-based theory of the firm. (Tallman, 2003, p. 495)

The former tends to see the MNC as a centrally directed unit, emphasising its capacity to organise activities internally, including the transfer of knowledge. The latter, in contrast, conceives the MNC as a knowledge-sharing network, emphasising the importance of geographically dispersed innovative activities carried out by different subsidiaries within MNCs. During this transition, many scholars have started to reject the idea that subsidiaries are ‘merely distant tools of corporate management, reacting as ganglia to impulses sent downward through the bureaucratic nervous system’ (Taggart, 1998, p. 663), and have forcefully put forward the idea that subsidiaries are more autonomous from the headquarters and more entrepreneurial than was conventionally thought (Bartlett, 1986; Birkinshaw, 1997). Although becoming widely accepted in the 1990s, the seeds of this new conception of the MNC go back at least to the works of Perlmutter (1969) and Ronstadt (1977), who identified different ways in which MNC could organize their internal resources and decentralize their R&D activities. At the end of the 1990s several empirical works showed how pervasive the internationalization of MNCs industrial R&D was (Niosi, 1999; Pearce, 1999; Gassman and Zedtwitz, 1999; Patel and Vega, 1999), also pointing at the differences existing across subsidiaries in terms of their levels of entrepreneurship and innovative activity – with some merely carrying out processes of local product adaptation and others maintaining laboratories conducting blue-sky research (Nobel and Birkinshaw, 1998). What is most interesting, however, is that a wealth empirical studies showed that innovative and autonomous subsidiaries were not just a prerogative of advanced countries, but could be found also in developing and emerging economies (Ariffin and Bell, 1999; Niosi and Godin, 1999; Hobday and Rush, 2002; Marin and Bell, 2010; Ferigotti and Figueiredo, 2005; Giuliani and Marin, 2007; Boehe, 2007). These arguments raise important questions about the ‘pipeline’ models of spillover generation, which, as already mentioned, ignore the potential role of heterogeneous subsidiaries and tend to assume that subsidiaries in developing countries to be passive branches of the MNC headquarter.

The second problem with the spillovers literature is empirical and concerns the inconclusive evidence of spillovers’ effects (Crespo and Fontouro, 2006; Smeets, 2008). Early studies using cross section and industry data provided generally positive effects (see Blomstrom and Wolf, 1994; Caves, 1974; Globerman, 1979; Kokko, 1994). More recent studies, however, using firm-level data and panel data analysis, have failed to provide convincing evidence of positive effects, particularly for spillovers occurring in developing or emerging economies. This is the case both when the estimations are (a) restricted to horizontal spillovers (see for instance Kathuria, 2000; Kinoshita, 2001; Konnings, 2001; Marin and Bell, 2006); and (b) when they are inter-industry or vertical (see for instance Merlevede and Schoors, 2006; Yudeba et al., 2003). These inconclusive results are found in many cases even after controlling for the absorptive capacity of domestic firms or for different MNCs’ central strategies (or those of their particular industry) (see Alvarez and Molero, 2005; Blomstrom and Sjöholm, 1999; Castellani and Zanfei, 2003; Javorcik and Spatareanu, 2008; Peri and Urban, 2006.) (For a recent review of the empirical literature see Crespo and Fontouro, 2006, and Smeets, 2008.)

Beyond the 'pipeline' model: 'subsidiary-centred' models

Dissatisfied by the conventional 'pipeline' model, in recent years a new wave of studies has started to explore how subsidiaries' heterogeneity affects the generation of spillover effects in host countries – developing 'subsidiary-centred' models of spillover estimations (Castellani and Zanfei, 2007; Marin and Bell, 2010; Marin and Sasidharan, 2010; Todo and Miyamoto, 2006). These studies all converge in indicating the same pattern: only highly innovative subsidiaries generate positive spillover effects in association with MNC operations in the host economy. Castellani and Zanfei (2007), for instance, in Italy, found that positive spillovers arose only when foreign affiliates were R&D intensive, co-operated with local counterparts, and had long been established in Italy. Marin and Bell (2006), in Argentina, found positive effects only when subsidiaries invested heavily in disembodied knowledge and human capital. Conversely, technology-passive subsidiaries, i.e. those that do not invest in knowledge activities in the host economy, did not generate any significant effect. Todo and Miyamoto (2006), in Indonesia, found that only those subsidiaries engaged in R&D and training activities in the host economy had a positive impact on the productivity of domestic firms. Marin and Sasidharan (2010), in India, based on Cantwell and Mudambi's (2005) distinction between 'competence-creating' and 'competence-exploiting' subsidiaries, found that positive spillover effects arose only in association with the former (i.e., those engaged in the creation of new knowledge assets for the MNC); while 'competence-exploiting' subsidiaries (i.e., those engaged in the exploitation of existing MNC technological assets in host country contexts) generated negative effects.

These models represent a pioneering attempt to incorporate, within models of localised spillover generation, the rich and mostly qualitative empirical evidence about subsidiaries' differentiated behaviours and characteristics discussed earlier (Birkinshaw et al., 2005; Ariffin and Bell, 1999; Niosi, 1999; Boehe, 2007; Cantwell and Mudambi, 2005; Frost, 2001; Ferigotti and Figueiredo, 2005; Giuliani and Marin, 2007; Hobday and Rush, 2007; Marin and Bell, 2010). However, up until now studies have incorporated only one possible dimension of subsidiaries' heterogeneity into the analysis of spillover effects: their innovative intensity in the host country. In this paper we move beyond this existing research by incorporating a new dimension of subsidiary heterogeneity: its position in global knowledge networks. This new perspective is relevant because subsidiaries' position in their global networks is indicative of the openness of the subsidiary to a wealth of global resources – an aspect that we argue could potentially influence the generation of spillovers, as elaborated in the section that follows.

Conceptual framework: a subsidiary-centred model based on subsidiaries' 'position' in global knowledge networks

A key dimension of subsidiaries' heterogeneity is their 'position' in global knowledge networks. This dimension was firstly emphasised by Ghoshal and Bartlett (1990) in their article 'The multinational corporation as an inter-organizational network', which depicts the MNC as a loosely coupled organisation composed of actors or units with heterogeneous resources and even conflicting interests.² This article made a landmark contribution to the literature, as it offered an entirely new perspective in the analysis of the MNC, shifting the focus from *within* the corporation to its connections with *external* organisations. In other words, it suggested that MNC subsidiaries obtain resources and technological assets not only from their corporation (headquarters or other affiliates), but also from a web of relations with actors external to the corporation (clients, suppliers, universities, etc), which may be critical for its success. According to Ghoshal and Bartlett (1990, p. 604), the MNC is:

... a network of exchange relationships among different organizational units, including the headquarters and the different national subsidiaries that are collectively embedded in... an external network consisting of all the organizations such as customers, suppliers, regulators and competitors with which the different units of the MNC must interact.

This perspective, which is becoming increasingly central in contemporary accounts of MNCs' behaviour (Andersson et al., 2002, 2005), opens up a completely new line of investigation regarding the implications of different subsidiaries' positions in global networks for the local context. In this paper, we concentrate on the implications of different subsidiaries' positions in global networks on localised spillover effects. We focus on global linkages because MNC subsidiaries are often seen as the key nodes of global–local connections (Cantwell and Iammarino, 2001). Scholars often call for an understanding of the way in which local economies manage to tap into global knowledge and consider subsidiaries to be critical actors in this process (Zhou and Xin, 2003; Thompson, 2002; Yeung et al., 2006; Giuliani, 2008). However, we claim that MNC subsidiaries are not all *equally* connected to global sources of knowledge, and in fact, as we have shown in an earlier work (Giuliani and Marin, 2007), they differ widely in the nature and intensity of their global connections. Hence, our research question is: *does the way in which MNC subsidiaries' position into global networks of knowledge influence the way in which local knowledge spillovers are generated?*

Drawing on an earlier qualitative research (Giuliani and Marin, 2007), we identify four types of subsidiary, according to how they are positioned within their inter-organisational knowledge network, namely (Figure 1):

- *Globally Diversified (GDiv)* are those subsidiaries that have established knowledge linkages with both the MNC headquarters and other subsidiaries, *as well as* with other international firms or institutions.
- *Globally Dependent (GDep)* are those subsidiaries that have established knowledge linkages *only* with the MNC headquarters or the other subsidiaries of the corporation.
- *Globally Independent (GInd)* are those subsidiaries that have established knowledge linkages at the extra-corporate level with other agents in international markets, *but not* with the MNC headquarters or the other subsidiaries.
- *Globally Isolated (GIso)* are those subsidiaries that have neither established knowledge linkages within the MNC nor with extra-corporate international actors. This type of subsidiary is very often ignored in the literature, which assumes that subsidiaries, because they are part of a MNC, have automatic access to corporate knowledge and technologies. However, we expect this group to be important, particularly in the context of emerging/developing economies where both the levels of competition and the technological complexity of demand are typically relatively low. Consequently there may well be a considerable number of subsidiaries that, focusing on the relatively 'easy' local market, can exist whilst having neither a significant level of integration into their MNC nor a significant integration into other global knowledge networks.

To explain why different subsidiaries' positions in global networks influence local spillovers we contend that different network positions may reflect different internal characteristics of subsidiaries and that this, in turn, may influence their potential to generate spillovers in the host economy. More specifically, we propose that different positions are associated with different levels of subsidiaries' entrepreneurship, and that this is what underpins the differing propensity of subsidiaries to generate localised spillover effects. This is elaborated in the remaining of this section and summarized in Figure 2.

Intra-Corporate Knowledge Linkages	High	Globally Dependent	Globally Diversified
	Low	Globally Isolated	Globally Independent
		Low	High

Extra-corporate knowledge linkages at the global level

Figure 1. Typologies of subsidiaries according to the ‘position’ in their global inter-organisational knowledge network

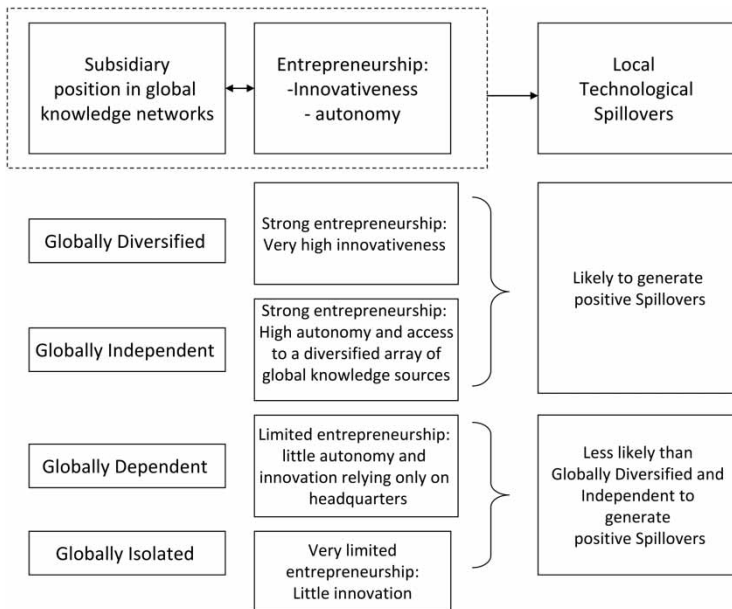


Figure 2. The conceptual framework

(a) Linking subsidiaries’ positions in global knowledge networks with entrepreneurship

A central tenet of this paper is that a high degree of openness to extra-corporative sources of knowledge is associable with different dimensions of subsidiaries’ entrepreneurship such as innovativeness, proactivity and risk-taking (Bartlett and Ghoshal, 1989; Birkinshaw, 1997; Dimitratos et al., 2009; Jack and Anderson, 2002; Liouka, 2007; Zhara et al., 2000).³ Although entrepreneurship can be observed through other factors, we maintain here that the subsidiary’s openness to extra-corporative sources fosters diversity in the type of knowledge assets accessed, an aspect that is bound to increase the subsidiary’s innovation and value-adding potential (Laursen and Salter, 2006; Yamin and Otto, 2004). Also, the search for and access to extra-corporate knowledge requires taking the risk of using alternative sources of knowledge to that relatively ‘safe’ knowledge coming from within the corporation. Thus, subsidiaries that privilege access to extra-corporate knowledge are more likely to be risk-taking and proactive than those that rely mainly on intra-corporate knowledge sources (Boojihawon et al., 2007). In fact, subsidiaries whose position in the global inter-organisational networks is such that it relies mainly on intra-corporate knowledge may reflect non-entrepreneurial behaviour. On this basis, we consider that Globally Independent

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and Diversified subsidiaries, the two types of subsidiaries that are in externally oriented positions, to be more entrepreneurial than GDep and GIsO subsidiaries.

(b) Linking subsidiaries' global network positions, entrepreneurship and localised spillovers

All these considerations lead to our key hypothesis in this paper, which is that Globally Independent and Globally Diversified subsidiaries are more likely to generate spillovers than Globally Dependent and Isolated subsidiaries. This is because, as explained above, their positions may reflect different degrees of entrepreneurship – and this is a dimension that carries important implications at the local level (Dimitratos et al., 2009). Through their diversified external linkages these subsidiaries will be in the position to enrich their internal skills and capabilities, which means that valuable knowledge is likely to spill over from those organizations, as opposed to subsidiaries displaying much more limited opportunities for global learning (i.e., GDep and GIsO subsidiaries). Also, if we consider that the degree of external openness reflects the risk-taking and proactive behaviours of the entrepreneurial subsidiary, we can add that GDiv and GInd subsidiaries may be eager to develop added value for the corporation, and may thus behave at the local level in ways that impact positively on host countries' firms. For instance, they may choose to develop linkages to exploit valuable local resources, initiating or nurturing innovative projects with local actors (firms, public organisations, universities). In this way, they may also become embedded into multiple innovation networks and act as *boundary spanners* for different previously unconnected local actors, such as a technology centre and a local firm, boosting the beneficial effects that domestic firms can obtain by the presence of MNCs in their territory. Another way in which entrepreneurial subsidiaries may generate localised positive spillovers is through their search for value-adding results, which may stimulate local managers to undertake creative and innovative initiatives that are very valuable for firms in emerging economies, where these are generally lacking.⁴ Domestic firms have the opportunity to imitate or learn from such valuable initiatives, and increase their productivity accordingly.

In contrast, we argue that Globally Dependent subsidiaries, which identify the MNC as the unique or predominant source of technological knowledge, may reflect a high degree of technological dependence on the MNC. It is plausible that such dependency reflects a lack of entrepreneurship (Boojihawon et al., 2007), as well as local managers' pronounced and narrow-minded approach to business, operating exclusively on the basis of their headquarters' hierarchical mandates (Keria and Mukherji, 1999). We expect local managers of GDep subsidiaries to have less creative potential than those of GInd or GDiv subsidiaries. This is because they may simply react as passive 'ganglia' (Taggart, 1998, p. 663) to the impulses sent downward by the headquarters, and because they fail to access a wealth of diverse knowledge through extra-corporate linkages that, as already mentioned, are a fundamental component of innovation (Laursen and Salter, 2006). For this reason, we argue that GDep subsidiaries are less likely than GInd and GDiv subsidiaries to generate spillovers in the host economy.

Finally, Globally Isolated subsidiaries are probably the least likely to generate spillovers because their 'position' in the global knowledge network is that of an isolated node. Although these subsidiaries may certainly maintain enriching local linkages,⁵ we notice in this paper that their isolation from any global source of knowledge may limit their ability to act as global–local nodes, especially if compared to the other types of subsidiaries discussed above. Hence, although these subsidiaries may not be totally isolated at the local level, it is plausible that their global isolation conveys at the subsidiary level little technological novelty, which in turns limits the quality of knowledge that may leak out of the subsidiary. Furthermore, the limited number of linkages established with extra-corporate actors at the global level suggests that they may not be entrepreneurial enough to compensate for this isolation from the MNC by

using other sources of knowledge locally. On these grounds, we believe that this type of subsidiary is less likely to generate spillovers than other types of subsidiaries, particularly GInd and GDiv subsidiaries.

Data and methodology

The data source: The Argentine Innovation Survey 1992/96–1998/01

The empirical analysis reported here uses a novel source of information for this type of study – i.e., the information provided by two Innovation Surveys in Argentina, collected by the National Statistical Council (INDEC) in 1996 (1992–1996 survey) and 2001 (1998–2001 survey). In the first Innovation Survey 1639 firms were interviewed, and in the second 1688.⁶ In both cases around 20 per cent of the firms were MNC affiliates; 316 firms in the first survey and 333 in the second. The sample of firms changed from one survey to the other; nevertheless a group of 869 firms were interviewed in both periods, and 171 from this group were foreign affiliates.⁷ Table 1 reports descriptive statistics about the sample. The first four columns show absolute levels, the last four show ratios between the values for foreign and domestic firms.

Table 2 shows the distribution of domestic and subsidiaries across different sectors in the Survey 1992–1996. Columns (1) and (2) show the distribution of firms across industries for the whole manufacturing sector, according to the National Census in 1993 (Column 1) and within the sample used in the Innovation Survey (Column 2), respectively. A comparison of Columns 1 and 2 shows that the distribution of firms across sectors is similar in the Census and in the sample, which a good indication of the representativeness of our sample. Columns (3) and (4) show the sectoral distribution of firms according to the origin of capital (domestic vs. foreign) within the sample. Column (5) shows an indicator of foreign penetration per industry, measured by the ratio between subsidiaries' sales and the total sales per industry.

The distribution of subsidiaries across the four groups in the typology (Globally Diversified, Globally Dependent, Globally Independent and Globally Isolated – see Annex 1 for the methodology used to classify subsidiaries) is shown in Table 3, along with a number of economic characteristics for each group. Not surprisingly most subsidiaries are Globally Diversified. Surprisingly, however, the second largest group is that of Globally Isolated subsidiaries. It is striking that, although this group is often an empty cell in this kind of typological framework applied to advanced economy contexts,⁸ it accounts for 30 per cent of all the subsidiaries in Argentina. Furthermore, more than half of all subsidiaries (GInd and GIsso subsidiaries) demonstrate a network position of low reliance on their global corporation. This seems a high proportion, given the extent to which close integration of subsidiaries is commonly seen as one of the main characteristics of MNC structures.

Table 1. Some features of the firms included in the pooled Innovation Survey

Concept	All firms				Ratio foreign to domestic firms*			
	1992	1996	1998	2001	1992	1996	1998	2001
Average								
Number of Employees	229	214	210	200	2.9	3	2.5	2.5
Exports intensity	12.7	18	21.5	26.6	1.9	1.6	1.6	1.7
Imports intensity	13.2	15.1	16.9	13.2	2.6	2.7	2.5	2.7
Investment intensity	6.4	7.9	12.5	7	0.6	0.4	1.6	0.8

Source. Argentinean Innovation Surveys 1992–1996 and 1998–2001.

Note. *The values are calculated as ratios between the values of foreign and domestic firms. So for instance the value 2.9 in 1992 for Number of employees indicates that in this year the number of employees was 2.9 higher in subsidiaries than in domestic firms.

Table 2. Distribution of firms across sectors and origin of capital (1992–1996)

Industries	Distribution of firms across industries		Distribution of firms per origin of capital		Foreign penetration
	Total manufacturing sector 1993 (1)	Innovation Survey (1992–96) (2)	Sample Innovation Survey (1992–1996)		Subsidiaries' sales/total sales (5)
			Domestic firms (number) (3)	Foreign firms (number) (4)	
Food and kindred products	24%	23%	300	45	42%
Tobacco industries	0%	0%	0	2	100%
Textile mill products	3%	9%	119	11	28%
Apparel and other finished products	6%	3%	47	0	0%
Leather and leather products	2%	2%	23	3	26%
Lumber and wood products except furniture	6%	3%	42	3	29%
Paper and allied products	1%	2%	27	7	55%
Printing publishing and allied products	7%	5%	60	9	14%
Petroleum refining and related industries	0%	1%	7	6	89%
Chemicals and allied products	3%	9%	81	64	66%
Rubber and miscellaneous plastic products	4%	5%	64	18	66%
Stone clay glass and concrete products	5%	5%	52	19	68%
Primary metal industries	1%	4%	43	12	62%
Fabricated metal products	15%	5%	67	12	20%
Machinery and equipment	8%	9%	118	21	49%
Computer and office equipment	0%	0%	2	0	0%
Electronic	3%	4%	50	12	78%
Communication	1%	1%	15	6	49%
Precision, photographic medical optical	1%	2%	18	5	38%
Motor vehicles and equipment	3%	5%	47	24	54%
Transportation equipment	1%	1%	18	1	1%
Miscellaneous manufacturing industries	7%	3%	45	3	25%
Total	100%	100%	1245	283	

Source. Industrial Census 1994 and Innovation Survey 1992–1996.

The distribution of the types of subsidiary in terms of firm size (number of employees) indicates that Globally Dependent and Globally Diversified subsidiaries are the largest firms. With regard to the other indicators (sales/employees; export and import intensity; market share) we find that Globally Independent and Diversified subsidiaries seem to be the most efficient categories in terms of sales per employee. They also have, on average, the highest export–intensity within the sample. However, there are no differences in the domestic market share held by each type of subsidiary. It is also interesting to note that Globally Dependent and Diversified subsidiaries have higher levels of FDI participation in ownership than the other types, particularly when

Table 3. General features for each type of subsidiary

Indicators	Globally isolated	Globally dependent	Globally diversified	Globally independent
Number of subsidiaries (%)	103 (31)	74 (22)	115 (34)	41 (12)
Number of employees (Mean)	389	634	562	427
Sales/employee ('000 \$) (Mean)	271	383	506	425
Export intensity (%) (Mean)	7	8.04	10	11
Import intensity (%) (Mean)	7	12	11	7
Market share ^(*) (%) (Mean)	3.03	3.07	3.04	3.03
Age (Mean)	32	41	32	35
FDI (%)	83	92	67	83

compared with Globally Independent subsidiaries. Finally, the age of the subsidiaries is in general quite high (minimum 32 years), reflecting the long-established importance of FDI in Argentina. Globally Dependent subsidiaries have been established in Argentina for longer (41 years), but the subsidiaries' age does not differ significantly across the other three types of subsidiary, suggesting that none of these categories was peculiarly dominated by the recent phase of rapidly growing FDI during the 1990s and hence differentially influenced by its characteristics – e.g., its M&A intensity.

Estimating the spillover effects of subsidiary types

As is common practice, we model FDI spillovers within the familiar production function framework. Variations of the following basic equation were used to investigate spillover effects:

$$\frac{Y_{ijT}^d}{L_{ijT}^d} = \lambda \frac{I_{ijT}^d}{L_{ijT}^d} + \beta FDI_{jT-1} + \eta Z_{ijT}^d + T^d + S^d + \alpha_i + \varepsilon_{ijT}$$

The dependent variable is value added per employee. Data on capital stocks are unfortunately not available. *I/L* is total investment per employee and is constructed to control per capital intensities. The subindex *d* refers to domestic firm, *i* is the firm, *j* denotes five-digit sub-industry and *T* time. *T* can adopt four values in our data set: 1992, 1996, 1998, 2001. *FDI* measures the scale of the MNC's presence in each sub-industry *j* in the period *T-1* and it is introduced to capture the spillover effects. We calculate three measures of MNCs' presence: FDI share of sales, employment and skilled workers.⁹ These are calculated as the share of total sales/employment/skilled workers in the five-digit sub-industry *j* that is accounted by the sales/employment/skilled workers of foreign-owned firms in that sub-industry. Very often studies on spillover effects are aggregated at two digits (divisions). We work with FDI participation at five digits (subclasses). This provides greater variability and increases the possibility of identifying the desired effects.

Since we are interested in exploring the spillover effects of different types of subsidiary in addition to the standard measure of FDI participation, which includes measures of sales/employment/skilled workers per industry for all subsidiaries, we calculated a measure of FDI participation for each type of subsidiary. Hence, we calculated a measure of FDI participation (in sales, employment and skilled workers) per five-digit industry for Diversified, Independent, Dependent and Isolated subsidiaries.

S and *T* are industry and time dummies, and *Z* includes a set of control variables:

- Two measures of competition: (1) the Herfindahl index (calculated as the sum of squared establishments' shares of the industry's total gross output) to measure the degree of concentration in different industries; and (2) import penetration to measure potential competition from the external sector. These variables are included to capture differences in competition across sectors which might have promoted greater efficiency in the domestic industry.¹⁰
- A measure of domestic firms' level of internal capabilities: skills, calculated as the ratio between skilled/non-skilled workers, and size, proxied by the number of employees. We use skills instead of R&D because of the number of missing values of the R&D variable, and also because skills is a better proxy for the level of internal capabilities of firms in emerging economies, where firms rarely have formal labs of R&D.

Several aspects of the estimation methods merit further comment:

- First, we use fixed effects to control for unobserved heterogeneity. This controls, for instance, for differences in productivity levels across firms and industries, which might affect the level of foreign direct investment.
- Second, to address the identification problem highlighted by Aitken and Harrison (1999) (i.e., endogeneity between FDI and productivity growth), we introduce the variable measuring FDI participation lagged one period, which in our database means lagged between two and four years.
- Third, to take into account the potential correlation between the error terms for firms in the same industry, we cluster standard errors in industry–year combinations.

This estimation method and the inclusion of group and industry dummies (G and S) should reduce the potential problems arising from the omission of unobservable variables that might undermine the relationship between FDI and productivity growth of domestic firms. In particular, by using fixed effects, we remove plant-specific, industry and regional fixed effects such as heterogeneous long-term strategies of the firms, and differences in the regional infrastructure and/or technological opportunity of the industries;¹¹ the use of dummy variables removes fixed characteristics of domestic firms that belong to particular sectors.

However, there could still be a bias in the estimators if there are important unobserved variables excluded from the model that change across firms and over time (such as the managerial abilities of domestic firms). By introducing among the control variables under Z a variable that changes across firms and over time we expect to minimise this possibility.¹²

Also, in principle, there could be a problem about representativeness, because the participation of FDI is calculated from the sample data. In practice, however, the survey sample includes all the 500 largest industrial firms in Argentina. It is very likely, therefore, that almost all the subsidiaries in manufacturing industries in Argentina are included in the sample of 283 subsidiaries in the survey, since they are typically large.

Finally, a need for caution arises from an element of selection bias, as our data do not represent the full population of plants, only the surviving plants present in all periods. Our estimators of the impact of FDI should therefore be interpreted only with respect to surviving firms.¹³

Empirical results

Subsidiary's position in global knowledge networks and FDI spillovers

In this section we report the empirical results of our estimations of spillovers. We proceeded in two steps. First, we ran estimations using the conventional 'knowledge pipeline' model, also

controlling for the absorptive capacity of domestic firms (Table 4). Second, we estimated spillovers using our ‘subsidiary-centred’ model, which distinguishes subsidiaries according to their position in the global knowledge network. Also, in the latter case, we also controlled for the absorptive capacity of domestic firms (Table 5). Our results in Table 4 show that, in the case of the simple ‘pipeline’ model, results are not significant, showing that MNC subsidiaries in general do not generate spillovers in the host economy – a result which is consistent with previous estimations in Argentina by Marin and Bell (2006). These results hold if we control for domestic firms’ absorptive capacity, for which we also obtain insignificant coefficients. It is nevertheless interesting to note that, among the control variables, the variables controlling for capital intensity, size and skills are positive and significant in all cases. On the contrary, concentration is negative and significant.

The results in Table 5 arising from the ‘subsidiary-centred’ model are far more revealing than those of the ‘pipeline’ model. First, they support our view that Globally Diversified and Globally Independent subsidiaries are more likely to generate spillovers than the other types of subsidiary. We find positive and significant results for Globally Diversified subsidiaries, although only when spillovers are measured on employment data (*Labour*), a result that persists as significant when we control for domestic firms’ absorptive capacity. What is most striking, however, is the result obtained for Globally Independent subsidiaries, which have a positive and significant coefficient both when spillovers are based on *Sales* and when they are calculated on *Skilled workers*. These results remain unchanged if we control for the absorptive capacity of domestic firms. The coefficient for Globally Dependent subsidiaries is negative and significant when we estimate spillovers using *Skills* and control for domestic firms’ absorptive capacity. This indicates that this type of subsidiary is having a negative effect on the more advanced domestic firms, which can be explained by competition or market-stealing effects (Aitken and Harrison, 1999). Finally, Globally Isolated subsidiaries do not generate any spillover effects.

In sum, our results suggest that Globally Independent subsidiaries are those with the higher potential for generating spillovers in the host country. Given this important result, in the next section we explore the nature and characteristics of this type of subsidiary.

Globally Independent subsidiaries: are they more entrepreneurial than the rest? An exploration

Globally Independent subsidiaries are seldom discussed in the literature, which is essentially anchored to the idea that subsidiaries have important connections with the headquarters – especially on the technological side. In contrast, we have found that this group of subsidiaries, which sources knowledge only through extra-corporate connections, is quite important in Argentina. In the third section we have argued that this behaviour might reflect a significant degree of entrepreneurship, as the managers cannot rely on what is internally available, but have to engage in a purposeful search for technologies and knowledge by establishing partnerships with actors outside the corporation. In this section, we explore this dimension further and look at whether some of the characteristics of this type of subsidiary – vis-à-vis the other types – are consistent with entrepreneurial behaviour. As suggested in the third section, a feature of entrepreneurial subsidiaries is that their managers pursue new business opportunities and aim at expanding the scope of their responsibilities within the MNC. To do so, they typically undertake risky and uncertain initiatives, and are also very proactive and innovative.

In order to explore the degree of entrepreneurship of GInd subsidiaries, we consider two sets of indicators available in our dataset, namely: (a) indicators aimed at capturing the proactiveness of the subsidiary (Table 6(a); explained in Appendix 2), and (b) indicators about their innovative activities within the local economy (Table 6(b)).¹⁴ As concerns (a), we report indicators about the

Table 4. Spillovers in the 'pipeline' model*

Independent variables	'Pipeline' model			'Pipeline' model controlling for the absorptive capacity of domestic firms		
	Labour	Sales	Skilled workers	Labour	Sales	Skilled workers
	FDI participation in ²					
Spillover effects						
FDI All types of subsidiary (FDI All types of subsidiary* Skills DFs)	0.025 (0.16)	-0.069 (-0.52)	0.092 (0.96)	0.18 (0.94)	-0.038 (-0.25)	0.14 (1.27)
				-0.09 (1.17)	0.029 (0.03)	-0.22 (-0.24)
Other variables						
Investments/Labour	0.033 (3.66)***	0.033 (3.64)***	0.032 (3.64)***	0.031 (3.48)***	0.031 (3.52)***	0.030 (3.46)***
Size	0.4 (8.48)***	0.4 (8.32)***	0.4 (8.47)***	0.42 (8.24)***	0.41 (8.17)***	0.41 (8.34)***
Skills	1.32 (3.18)***	1.33 (3.2)***	1.33 (3.2)***	1.10 (2.34)**	1.07 (2.12)**	1.07 (2.17)**
Competition	0.035 (1.10)	0.38 (1.2)	0.037 (1.2)	0.034 (1.08)	0.039 (1.24)	0.04 (1.29)
Concentration	-0.54 (-1.72)*	-0.54 (-1.74)*	-0.55 (-1.76)***	-0.55 (-1.74)*	-0.55 (-1.77)*	-0.58 (-1.84)*
No. of observations	1349	1349	1348	1344	1344	1343
R-squared	16%	16%	16%	15%	16%	15%

Notes. *All the estimations are robust and we cluster standard errors, so we are controlling for the potential presence of heteroskedasticity.

Table 5. Spillovers in the 'subsidiary-centred' model

Independent variables	'Subsidiary-centred' model		'Subsidiary-centred' model controlling for the absorptive capacity of domestic firms			
			FDI participation in ²			
	Labour	Sales	Skilled workers	Labour	Sales	Skilled workers
Spillover effects ³						
FDI Isolated Subsidiaries (FDI Isolated Subsidiaries*Skills DFs)	0.59 (1.4)	-1.41 (-1.81)*	0.11 (0.77)	0.6 (1.32) -0.64 (-0.20)	-0.95 (-1.19) -3.34 (-0.93)	0.16 (1.1) 2.5 (1.5)
FDI Dependent Subsidiaries (FDI Dependent Subsidiaries*Skills DFs)	0.59 (0.85)	-0.12 (-0.33)	-0.04 (-0.18)	0.72 (1.08) -2.11 (-0.85)	0.0056 (0.02) -0.18 (-0.12)	0.19 (0.86) -2.6 (-1.82)*
FDI Diversified Subsidiaries (FDI Diversified Subsidiaries*Skills DFs)	1.10 (2.71)***	0.059 (0.33)	-0.22 (-1.61)	1.17 (2.77)* ** 1.29 (1.22)	0.18 (0.95) 1.89 (0.94)	-0.077 (-1.09) -0.48 (-0.36)
FDI Independent Subsidiaries (FDI Independent Subsidiaries*Skills DFs)	0.54 (0.67)	1.24 (2.74)***	0.72 (3.72)***	0.98 (1.05) 2.52 (1.26)	1.29 (2.85)*** 0.074 (0.05)	0.54 (5.13)*** 1.32 (1.02)
Other variables						
Investments/Labour	0.033 (3.83)***	0.054 (5.82)***	0.051 (5.74)***	0.051 (6.09)***	0.051 (5.74)***	0.05 (5.92)***
Size	0.41 (9.38)***	0.44 (7.55)***	0.45 (7.91)***	0.42 (9.34)***	0.45 (7.74)***	0.44 (7.56)***
Skills	1.37 (3.35)***	0.52 (2.27)**	0.51 (2.19)**	1.01 (1.8)*	0.99 (1.74)*	0.93 (1.7)*
Competition	0.024 (0.79)	0.034 (0.95)	0.078 (2.37)**	0.046 (1.47)	0.036 (1.02)	0.077 (2.28)**
Concentration	-0.65 (-2.03)**	-1.1 (-2.67)***	-0.955 (-2.66)***	-0.91 (-2.92)***	-0.98 (-3.56)***	-0.82 (-2.75)***
No. of observations	1349	1349	1348	1344	1344	1342
R-squared	16%	15%	16%	15%	15%	15%

Notes. *All the estimations are robust and we cluster standard errors, so we are controlling for the potential presence of heteroskedasticity.

Table 6. Indicators of subsidiaries' entrepreneurship

		Globally Isolated (I)	Globally Dependent (II)	Globally Diversified (III)	Globally Independent (IV)	Anova/ Chi2	Post hoc test
(a) Proactiveness							
(1) Using local sources of funding	Frequency	74%	65%	76%	86%	Significant	(IV > II, III)***
(2) Linkages with local universities	Average	0.02	0.2	0.1	0.3	Significant	(IV > I, II)*** (III > I)***
(3) Linkages with local labs	Average	0.0	0.03	0.1	0.4	Significant	(IV > I, II, III)*** (III > I, II)*
(4) Local embeddedness	Average	1.5	1.4	2.8	4.5	Significant	(IV > I, II, III)*** (III > I, II)***
(b) Innovation							
(1) Intensity of R&D expenditures	Average	0.23	0.17	0.22	0.24		
(2) Intensity of expenditures on design	Average	0.06	0.16	0.15	0.41	Significant	(IV > I)***
(3) Intensity of expenditures on innovation-related management	Average	0.04	0.07	0.02	0.2	Significant	(IV > III)***
(4) Intensity of expenditures on capital goods for innovations	Average	1.7	2.1	2.1	2.6		
(5) R&D employees	Average	1.1	1.4	1.3	1.7		
(6) Patent intensity	Average	0.02	0.01	0.001	0.13	Significant	(IV > I, II, III)***

Source. Own elaboration based on Innovation Survey data.

proactiveness of subsidiaries in the formation of *local* linkages with partners that do not form part of the subsidiary's value-chain – such as funding agencies, universities and research labs – as this has been found in the literature to reflect subsidiaries' entrepreneurship (Liouka, 2007). We find that, in all cases, Globally Independent subsidiaries have more intense local networking activities than the other subsidiaries. We also developed an indicator of 'local embeddedness,' which includes linkages with all possible local actors (universities, research labs, business associations as well as suppliers and clients) and we find significant and higher values for Globally Independent subsidiaries. Table 6(b) reports average indicators for a set of input and output dimensions of the subsidiary innovative process. With regard to the input dimensions, we used only objective indicators such as the expenses involved in R&D or in other activities (design, innovation in management, new capital goods) as well as the number of R&D employees. We find that Globally Independent subsidiaries have higher values than the other typologies, though differences are not always significant. Significant differences are found for the intensity of R&D in design activities as well as for innovation-related management. As concerns output indicators, we look for patent intensity, measured as the number of patents per employee, and we also find a significantly higher value for GInd subsidiaries when compared with the other typologies.

This evidence provides support for the idea that Globally Independent subsidiaries may display certain features of internal entrepreneurship. Not only are they more proactive than other subsidiaries in developing global linkages, they are also more proactive than other subsidiaries in developing local linkages. At the same time they seem to be more innovative than the other subsidiaries with respect to a number of indicators, which means that, in principle, they have more valuable resources to diffuse to local firms in emerging economies. All of this helps to explain why GInd subsidiaries are more likely than other types of subsidiaries to generate spillovers in the host country. These results are promising; however, they are only exploratory. Much more careful and detailed research needs to be conducted in order to explore the nature and impact of entrepreneurial subsidiaries in emerging host economies.

Conclusion

This article contributes to the literature on FDI spillovers by developing a 'subsidiary-centred' model, which takes into account a new dimension of subsidiaries' heterogeneity – their position in global knowledge networks – and explores the impact of this heterogeneity on the generation of localised spillovers. To be more precise, the paper analyses the potential of four different types of subsidiary for generating localised spillover effects: *Globally Diversified* (those that establish knowledge linkages with both the MNC and other international firms or institutions); *Globally Dependent* (those that establish knowledge linkages *only* with the MNC), *Globally Independent* (those that establish knowledge linkages with other agents in international markets, but *not* with the MNC), and *Globally Isolated* (those that do not use global linkages with either the MNC or with other international agents). We have argued that only *Globally Diversified* and *Globally Independent* subsidiaries were likely to generate spillovers. Our argument was based on the fact that these types of subsidiary are likely to be more entrepreneurial than the other two types (GDep and GIso) because their active search for knowledge linkages that are also, or even exclusively, outside corporate boundaries could reflect a certain degree of entrepreneurship and risk-taking attitude. Because we know that entrepreneurial subsidiaries are by definition more proactive and more likely to generate value added and innovation for the corporation (Birkinshaw, 1997; Dimitratos et al., 2009; Liouka, 2007; Zhara et al., 2000), we hypothesise that they will have more opportunities to generate positive spillover effects in the local economy. This is in part because they would have more valuable resources to diffuse to local firms and also because, in their eagerness to develop added value for the corporation, they may choose to

develop local linkages in order to tap into local resources. Tapping into local knowledge may in turn be a way through which innovative new projects with local actors (firms, public organisations, universities) would be initiated or nurtured, allowing positive spillovers to emerge.

Using data from two National Innovation Surveys of manufacturing industry (1992–1996 and 1998–2001) in Argentina, we carry out an econometric estimation to test which of the four types of subsidiary generate spillovers in the host economy. As we expected, GDep and GIso subsidiaries do not generate positive spillover effects in the host economy. More importantly, we find positive and significant effects for the Globally Independent subsidiary, both using share of sales and skilled workers, and after controlling for the absorptive capacity of domestic firms. We also find positive and significant results for Globally Diversified subsidiaries, but only when spillovers are measured with respect to share of employment, and the effect is weakened when controlling by the absorptive capacity of domestic firms.

The results obtained here for the Globally Independent subsidiary are striking, especially if one takes into account the fact that these are seldom discussed in the literature, which is essentially anchored to the idea that subsidiaries have important connections with the headquarters. Given this important result, we explored the validity of our underlying argument about the relationships between different types of subsidiary in terms of network positions and their degree of entrepreneurship. We explored two dimensions of entrepreneurship – i.e., proactivity and innovativeness – and compared Globally Independent subsidiaries with the other types. We found support for our initial argument that Globally Independent subsidiaries are more entrepreneurial than the rest – at least on the basis of the indicators that were available in the survey. This could explain why these subsidiaries generate positive spillover effects.

These results are novel and promising. However, they are only exploratory and they carry important limitations. First, we only estimate horizontal spillovers at the five-digit level while vertical spillovers are not analysed; second, we do not have access to data on capital and materials so we have only imperfect proxies for constructing the production function of domestic firms, and we are not able to control by endogeneity using the now popular semi-parametric methodology proposed by Levinsohn and Petrin (2003). Third, our data only allowed a first approximation of the analysis of entrepreneurship, which we know to be a multi-faceted and complex subsidiaries' characteristics and one which deserves more fine-grained measures.

For these reasons, we believe that a lot more careful and detailed research needs to be conducted in order to analyse the nature and impact of subsidiaries in emerging host economies. In spite of the limitations, we believe that these results are very important as they contribute to open up a promising new research agenda regarding how the heterogeneity of subsidiaries (in terms of their entrepreneurship or other characteristics which have been emphasised by the growing IB literature) influences the local context. By 'local', in this paper, we mean the 'national' level as our data did not allow a different scope of geographical analysis, which is a limitation of this work. However, we strongly believe that future research should go from the national to the sub-national levels, and should investigate how different types of subsidiary contribute to the generation of knowledge flows at the regional or cluster levels.

Notes

1. We focus specifically on knowledge networks, which involve the transfer or exchange of technological knowledge (e.g., machine-embodied technologies, technical advice, training and the like). Thus we do not observe other types of network – i.e., financial networks, production networks, ownership networks – as we are interested in aspects of the subsidiary that influence its generation of knowledge spillovers more directly.
2. Although developed in the late 1980s–1990s, this perspective is in line with and elaborates upon the pioneering idea of the geocentric firm put forward by Perlmutter (1969).

3. Entrepreneurial subsidiaries (ESs) are defined as those that advance new ways to use or expand their resources, with the objective of increasing the scope of their responsibilities within the MNC (Bartlett and Ghoshal, 1986; Birkinshaw, 1997). In seeking new opportunities, ESs innovate, take risks, use resources beyond the control of the headquarters and (radically) depart from existing practices (Birkinshaw, 1997; Zhara et al., 2000; Liouka, 2007; Dimitratos et al., 2009).
4. The literature on innovation in firms in industrialising countries has clearly documented how difficult it is for firms in emerging economies, which often enter new industries by using existing technologies, to move from imitation to innovation (the creation of new technologies) (Bell and Pavitt, 1993). An indication of this fact is provided by the following figures: in 2002 only 12 per cent of world patents were issued to developing country firms and developing countries accounted for less than 10 per cent of total world R&D expenditure, while these countries account for 89 per cent of the total world population.
5. We would like to thank an anonymous referee for pointing this out.
6. The difference is due to the rate of response, which changed from one survey to the other.
7. The estimation of spillover effects also requires information about added value at the firm level. Since this is a question not included in the Innovation Surveys, added value was obtained from the Industrial Survey 1992, which uses the same representative sample of manufacturing firms as the Innovation Surveys.
8. In the work of Bartlett (1986) and then Jarillo and Martinez (1990), this is identified in principle as a 'habitable' position, but in practice it is left un-named and unoccupied. Taggart (1998) is an exception to this pattern and identified a position similar to this – the 'quiescent' subsidiary that has limited localised activities and fewer linkages within the global corporation.
9. Skilled workers is measured here as number of employees with a university degree.
10. This is important because during the period analysed important pro-market reforms were introduced and developed in Argentina.
11. This also removes other factors that, even when they are not fixed over time, might be roughly constant over a four-year period, such as the level of education, or regional policies.
12. We will not, therefore, introduce other methods to address this issue (such as those proposed by Olley and Pakes, 1996) because they usually require very restrictive assumptions about, for example, markets and, therefore, as indicated by Griliches and Mairesse (1998), they may introduce additional bias into the estimation.
13. In principle a correction should be introduced using information about those domestic firms that exited the industry. However, we do not have information about these firms. Furthermore, because of unpredictable competition effects, it is difficult to anticipate the direction of the possible bias arising from the absence of data about these non-surviving firms.
14. In the Innovation Survey there is no variable or question that helps to illuminate the risk-taking behaviour of subsidiaries, so we could not therefore include this in our analysis.
15. For each measure we have carried out sensitivity analysis, by changing the threshold of the value (i.e., from higher or equal to three, to equal to four), as well as the number of extra-corporate sources (from at least two to at least three). We did not observe significant changes in our classification of subsidiaries, so we do not expect any bias to have affected our estimations. Sensitivity analysis is available upon request by the authors.

References

- Aitken, B., and Harrison, A. (1999) Do domestic firms benefit from direct foreign investment? Evidence from Venezuela. *American Economic Review*, 89, pp. 605–618.
- Alvarez, I., and Moleró, J. (2005) Technology and the generation of international knowledge spillovers: An application to Spanish manufacturing firms. *Research Policy*, 34, pp. 1440–1452.
- Andersson, U., Bjorkman, I., and Forsgren, M. (2005) Managing subsidiary knowledge creation: The effect of control mechanisms on subsidiary local embeddedness. *International Business Review*, 14(5), pp. 521–538.
- Andersson, U., Forsgren, M., and Holm, U. (2002) The strategic impact of external networks: Subsidiary performance and competence development in the multinational corporation. *Strategic Management Journal*, 23, pp. 979–996.
- Ariffin, N., and Bell, M. (1999) Firms, politics and political economy: Patterns of subsidiary-parent linkages and technological capability-building in electronics TNC subsidiaries in Malaysia, in: K. S. Jomo, G. Felker and R. Rasiah (eds) *Industrial Technology Development in Malaysia*.

- Bartlett, C. A. (1986) Building and managing the transnational: The new organizational challenge, in: M. E. Porter (ed) *Competition in Global Industries* (Cambridge: Harvard Business School Press).
- Bartlett, C., and Ghoshal, S. (1989) *Managing Across Borders: The transnational solution* (Boston: Harvard Business School).
- Bell, M., and K. Pavitt (1993) Technological accumulation and industrial growth: contrasts between developed and developing countries, *Industrial and Corporate Change*, 2(2), pp. 157–211.
- Birkinshaw, J. (1997) Entrepreneurship in multinational corporations: The characteristics of subsidiary initiative. *Strategic Management Journal*, 18(3), pp. 207–229.
- Birkinshaw, J., Hood, N., and Jonsson, S. (1998) Building firm-specific advantages in multinational corporations: The role of subsidiary initiative. *Strategic Management Journal*, 19, pp. 221–241.
- Birkinshaw, J., Hood, N., and Young, S. (2005) Subsidiary entrepreneurship, internal and external competitive forces, and subsidiary performance. *International Business Review*, 14, pp. 227–248.
- Blomström, M. (1986) Foreign investment and productive efficiency: The case of Mexico. *Journal of Industrial Economics*, 35, pp. 97–112.
- Blomström, M., and Person, H. (1983) Foreign investments and spillover efficiency in an underdeveloped economy: Evidence from the Mexican manufacturing industry. *World Development*, 11, pp. 493–501.
- Blomström, M., and Sjöholm, F. (1999) Technology transfer and spillovers: Does local participation with multinationals matter? *European Economic Review*, 43, pp. 915–923.
- Boehe, D. M. (2007) Product development in MNC subsidiaries: Local linkages and global interdependencies. *Journal of International Management*, 13, pp. 488–512.
- Boojihawon, D. K., Dimitratos, P., and Young, S. (2007) Characteristics and influences of multinational subsidiary entrepreneurial culture: The case of advertising paper. *International Business Review*, 16, pp. 549–572.
- Cantwell, J., and Iammarino, S. (2001) EU regions and multinational corporations: Change, stability and strengthening of technological comparative advantages. *Industrial and Corporate Change*, 10(4), pp. 1007–1037.
- Cantwell, J., and Iammarino, S. (2003) *Multinational Corporations and European Regional Systems of Innovation* (London: Routledge).
- Cantwell, J., and Mudambi, R. (2005) MNE competence-creating subsidiary mandates. *Strategic Management Journal*, 26, pp. 1109–1128.
- Castellani, D., and Zanfei, A. (2003) Technology gaps, absorptive capabilities and the impact of inward investment on productivity of European firms. *Economics of Innovation and New Technology*, 12(6), pp. 555–576.
- Castellani, D., and Zanfei, A. (2007) Multinational firms and productivity spillovers: The role of firms heterogeneity, in: G. Benito and H. Greve (eds) *Progress in International Business Research* (Amsterdam: Elsevier), p. 1.
- Caves, R. (1974) Multinational firms, competition and productivity in host-country markets. *Economica*, 41, pp. 176–193.
- Chang, S., and Xu, D. (2008) Spillovers and competition among foreign and local firms in China. *Strategic Management Journal*, 29, pp. 495–518.
- Chudnovsky, D., Lopez, A., and Rossi, G. (2008) Foreign direct investment spillovers and the absorptive capabilities of domestic firms in the Argentinean manufacturing sector (1992–2001). *Journal of Development Studies*, 44(5), pp. 645–677.
- Chung, W. (2001) Identifying technology transfer in foreign direct investment: Influence of industry conditions and investing motives. *Journal of International Business Studies*, 32, pp. 211–229.
- Crespo, N., and Fontoura, M. (2007) Determinant factors of FDI spillovers – What do we really know? *World Development*, 35(3), pp. 410–425.
- Damijan, P. J., Knell, M., Majcen, B., and Rojec, M. (2003) The role of FDI, R&D accumulation and trade in transferring technology to transition countries: Evidence from firm panel data for eight transition countries. *Economic Systems*, 27, pp. 189–204.
- Dimitratos, P., Liouka, I., and Young, S. (2009) Regional location of multinational corporation subsidiaries and economic development contribution: Evidence from the UK. *Journal of World Business*, 44, pp. 180–191.
- Driffield, N., and Love, J. (2007) Linking FDI motivation and host economy productivity effects: Conceptual and empirical analysis. *Journal of International Business Studies*, 38, pp. 463–473.
- Ferigotti, C., and Figueiredo, P. N. (2005) Managing learning in the refrigerator industry: Evidence from a firm-level study in Brazil. *Innovation: Management, Policy and Practice*, 7, pp. 222–239.

- Frost, T. (2001) The geographic sources of foreign subsidiaries' innovations. *Strategic Management Journal*, 22, pp. 101–124.
- Gassmann, O., and von Zedtwitz, M. (1999) New concepts and trends in international R&D organization. *Research Policy*, 28, pp. 231–250.
- Ghoshal, S., and Bartlett, C. (1990) The multinational corporation as an interorganizational network. *Academy of Management Review*, 15(4), pp. 603–625.
- Girma, S. (2005) Absorptive capacity and productivity spillovers from FDI: A threshold regression analysis. *Oxford Bulletin of Economics and Statistics*, 67(3), pp. 281–305.
- Giuliani, E. (2008) When MNC subsidiaries 'like it foreign': Patterns of local knowledge transfer in Costa Rican high tech industries. *Development and Change*, 39(3), pp. 385–407.
- Giuliani, E. and Marin, A. (2007) Relating global and local knowledge linkages: The case of MNC subsidiaries in Argentina, in: L. Piscitello and G. Sarcangelo (eds) *Do Multinationals Feed Local Development and Growth?* (Amsterdam: Elsevier).
- Globerman, S. (1979) Foreign direct investment and spillover efficiency benefits in Canadian manufacturing industries. *Canadian Journal of Economics*, 12(1), pp. 42–56.
- Granstrand, O. (1999) Internationalization of Corporate R&D: a study of Japanese and Swedish corporation. *Research Policy*, 28(2–3), pp. 275–302.
- Griliches, Z. and Mairesse, J. (1998) Production functions: the search for identification, in: S. Strom (ed) *Econometrics and Economic Theory in the Twentieth Century* (Cambridge: Cambridge University Press).
- Haddad, M., and Harrison, A. (1993) Are there positive spillovers from direct foreign investment? Evidence from panel data for Morocco. *Journal of Development Economics*, 42, pp. 51–74.
- Haskel, J., Pereira, S. and Slaughter, M. (2002) Does inward foreign direct investment boost the productivity of domestic firms? *Working Paper Series, No. 8724*, National Bureau of Economic Research, Cambridge.
- Hobday, M., and Rush, H. (2007) Upgrading the technological capabilities of foreign transnational subsidiaries in developing countries: The case of electronics in Thailand. *Research Policy*, 36, pp. 1335–1356.
- Hymer, S. (1976) *The International Operations of National Firms: A study of foreign direct investment* (Cambridge, MA: MIT Press).
- Jack, S. L., and Anderson, A. R. (2002) The effects of embeddedness on the entrepreneurial process. *Journal of Business Venturing*, 17, pp. 467–487.
- Jarrillo, J., and Martinez, J. (1990) Different roles for subsidiaries: The case of multinational corporations in Spain. *Strategic Management Journal*, 11(7), pp. 501–512.
- Javorick, B. (2004) Does foreign direct investment increase the productivity of domestic firms? *American Economic Review*, 94(3), pp. 605–627.
- Javorcik, B., and Spatareanu, M. (2008) To share or not to share: Does local participation matter for spillovers from foreign direct investment? *Journal of development Economics*, 85, pp. 194–217.
- Kathuria, V. (2000) Productivity spillovers from technology transfer to Indian manufacturing firms. *Journal of International Development*, 12, pp. 343–369.
- Kathuria, V. (2001) Foreign firms, technology transfer and knowledge spillovers to Indian manufacturing firms: a stochastic frontier analysis. *Applied Economics*, 33, pp. 625–642.
- Keria, B., and Mukherji, A. (1999) Global managers: developing a market for global competitiveness. *Journal of World Business*, 34(3), pp. 230–250.
- Kinoshita, Y. (2001) R&D and technology spillovers via FDI: Innovation and absorptive capacity. *CEPR Discussion Paper No. 2775*.
- Kokko, A. (1994) Technology, market characteristics, and spillovers. *Journal of Development Economics*, 43, pp. 279–293.
- Konings, J. (2001) The effects of foreign direct investment on domestic firms: Evidence from firm level panel data in emerging economies. *Economics of Transition*, 9, pp. 619–633.
- Kuemmerle, W. (1999) Foreign direct investment in industrial research in the pharmaceutical and electronics industries – results from a survey of multinational firms. *Research Policy*, 28, pp. 179–193.
- Kumar, N. (2001) Determinants of location of overseas R&D activity of multinational enterprises: The case of US and Japanese corporations. *Research Policy*, 30, pp. 159–174.
- Laursen, K., and Salter, A. (2006) Open for innovation: The role of openness in explaining innovation performance among U.K. manufacturing firms. *Strategic Management Journal*, 27, pp. 131–150.
- Levinsohn, J., and Petrin, A. (2003) Estimating production functions using inputs to control for unobservables. *Review of Economic Studies*, 70(2), pp. 317–342.

- Liouka, I. (2007) Opportunity identification in MNC subsidiaries: Context and performance implications (Unpublished doctoral dissertation). University of Glasgow, Department of Management, Glasgow.
- Liu, X., and Wang, Ch. (2003) Does foreign direct investment facilitate technology progress? Evidence from Chinese industries. *Research Policy*, 32, pp. 945–953.
- Marin, A. (2006) Technologically active subsidiaries and FDI related spillovers in industrialising countries: Evidence from Argentina (Unpublished doctoral dissertation). University of Sussex, SPRU, Brighton.
- Marin, A., and Bell, M. (2006) Technology spillovers from foreign direct investment (FDI): An exploration of the active role of MNC subsidiaries in the case of Argentina in the 1990s. *Journal of Development Studies*, 42(4), pp. 678–697.
- Marin, A., and Bell, M. (2010) The local/global integration of MNC subsidiaries, and their Technological behaviour: Argentina in the Late 1990s. *Research Policy*, 39(7), pp. 919–931.
- Marin, A., and Sasidharan, S. (2010) Heterogeneous MNC subsidiaries and technological spillovers: Explaining positive and negative effects in India. *Research Policy*, 39(9), pp. 1227–1241.
- Markusen, J. and Maskus, K. (1999) Multinational firms: Reconciling theory and evidence. *NBER Working Paper No. 7163*, National Bureau of Economic Research, Cambridge, MA.
- Merlevede, B. and Schoors, K. (2006) FDI and the consequences towards more complete capture of spillover effects. *Working paper of Faculty of Economics and Business Administration, Ghent University, Belgium* 06/372.
- Narula, R., and Dunning, J. (2000) Industrial development, globalisation and multinational enterprises: new realities for developing countries. *Oxford Development Studies*, 28, pp. 141–167.
- Niosi, J. (1999) The internationalization of industrial R&D. From technology transfer to the learning organization. *Research Policy*, 28, pp. 107–117.
- Niosi, J., and Godin, B. (1999) Canadian R&D abroad management practices. *Research Policy*, 28, pp. 215–230.
- Nobel, R., and Birkinshaw, J. (1998) Innovation in multinational corporations: Control and communication patterns in international R&D operations. *Strategic Management Journal*, 19, pp. 479–496.
- Olley, S., and Pakes, A. (1996) The dynamics of productivity in the telecommunications equipment industry. *Econometrica*, 64, pp. 1263–1297.
- Papanastassiou, M., and Pearce, R. (1999) *Multinationals, Technology and National Competitiveness* (Elgar: Cheltenham).
- Patell, P., and Vega, M. (1999) Patterns of internationalisation of corporate technology: Location vs. home country advantages. *Research Policy*, 28, pp. 145–155.
- Pearce, R. D. (1999) Decentralized R&D and strategic competitiveness: Globalised approaches to generation and use of technology in multinational enterprises (MNEs). *Research Policy*, 28, pp. 157–178.
- Peri, G., and Urban, D. (2006) Catching up to foreign technology? Evidence on the ‘Veblen-Gerschenkran’ effect of foreign investments. *Journal of Development Economics*, 65(2), pp. 389–415.
- Perlmutter, H. V. (1969) The tortuous evolution of the multinational corporation. *Columbia Journal of World Business*, 4, pp. 9–18.
- Ronstadt, R. C. (1977) *R&D abroad by US multinationals* (New York: Praeger).
- Sjoholm, F. (1999) Technology gap, competition and spillovers from direct foreign investment: Evidence from establishment data. *Journal of Development Studies*, 36, pp. 53–73.
- Smeets, R. (2008) Collecting the pieces of the FDI knowledge spillovers puzzle. *The World Bank Research Observer*, 23(2), pp. 107–138.
- Taggart, J. H. (1998) Strategy shifts in MNC subsidiaries. *Strategic Management Journal*, 19, pp. 663–681.
- Tallman, S. (2003) The significance of Brice Kogut’s and Udo Zander’s article, ‘Knowledge of the firm and the evolutionary theory of the multinational corporation’. *Journal of International Business Studies*, 34(6), pp. 495–497.
- Thompson, E. R. (2002) Clustering of Foreign direct investment and enhanced technology transfer: Evidence from Hong Kong garment firms in China. *World Development*, 30(5), pp. 873–889.
- Todo, J., and Miyamoto, K. (2006) Knowledge spillovers from foreign direct investment and the role of local R&D activities: Evidence from Indonesia. *Economic Development and Cultural Change*, 55, pp. 173–200.
- von Zedwitz, M., and Gassmann, O. (2002) Market versus technology drive in R&D internationalization: four different patterns of managing research and development. *Research Policy*, 31, 569–588.
- Yamin, M., and Otto, J. (2004) Patterns of knowledge flows in MNE innovation performance. *Journal of International Management*, 10, pp. 239–258.

- Yeung, H. W., Liu, W., and Dicken, P. (2006) Transnational corporations and network effects of a local manufacturing cluster in mobile telecommunications equipment in China. *World Development*, 34(3), pp. 520–540.
- Yudeba, K., Kozlov, K., Melentjeva, N., and Ponomareva, N. (2003) Does foreign ownership matter? Russian experience. *Economics of Transition*, 11(3), pp. 383–410.
- Zander, I. (1999) What do you mean 'global'? An empirical investigations of innovation networks in the multinational corporation. *Research Policy*, 28, pp. 195–213.
- Zahra, S. A., Dharwadkar, R., and Gerard, G. (2000) *Entrepreneurship in Multinational Subsidiaries: The effects of corporate and local environmental contexts*, working paper series 99/00-027, Georgia Institute of Technology's Center for International Business Education and Research.
- Zhou, Y., and Xin, T. (2003) An innovative region in china: Interaction between multinational corporations and local firms in a High Tech cluster in Beijing. *Economic Geography*, 79(2), pp. 129–152.

Appendix

(1) MNC subsidiary typology

The classification of subsidiaries across different types was based on two questions from the Innovation Survey:

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

The survey asked firms about the importance of alternative sources of information for innovation. Headquarters and other subsidiaries were two options among eleven other possible sources. The others included: internal sources, public institutions, competitors, suppliers, consultants, journals, conferences, etc. They had to rank each source according to its importance for the firm. The possible importance varies from 1 (not important) to 4 (very important).

Question (2): Knowledge interactions with other agents

Firms were asked: first, whether they have used knowledge interactions with any of the following eleven types of actor 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, where these actors were located geographically. 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.

We combined the answers to these two questions to develop indicators that permitted the identification of subsidiary types. To do so we have proceeded in the following way:

- We have eliminated the sources of information in Question (1) that were not actors (e.g., journals, conferences, etc), and the actors from Question (2) that were not included in Question (1). We were left therefore with the following seven possible actors: (1) headquarters, (2) other subsidiaries, (3) clients, (4) competitors, (5) suppliers, (6) consultants, (7) public agencies.
- We have only considered international linkages – i.e., data about information sources from foreign countries.
- We have created two variables, by adding up, by subsidiary, the number of international linkages maintained by a subsidiary, according to the type of actors (corporative vs. extra-corporative), distinguishing between: (i) *CLINKS*, which ranges from 0 to 2 reflecting the two corporative sources (i.e., the headquarters and the subsidiaries), and (ii) *NCLINKS*, which ranges from 0 to 5 reflecting the five extra-corporative sources (clients, competitors, suppliers, consultants, public agencies). These variables reflects the type of corporative and non-corporative global linkages *used* by each subsidiary.
- We have calculated an indicator of the importance of global linkages for both *CLINKS* and *NCLINKS*, based on the values (ranging from 1 to 4) given by the respondents in Question (1). Accordingly, the importance of *CLINKS* ranges from 0 to 8 (because the corporative sources of information are two), and the importance of *NCLINKS* ranges from 0 to 20 (because the non-corporative sources of information are five). We consider that a subsidiary *highly values corporate linkages* when it gives a score equal or higher than 3 to either one or both of the corporate sources. Similarly, we consider that a

subsidiary *highly values extra-corporate linkages* when it gives a score equal or higher than 3 to at least two of the five international sources.¹⁵

Then we classified subsidiaries into four groups in the following way:

- Globally Dependent: those subsidiaries that *use* and *highly value* global linkages *only* with the headquarters (HQ) and other sister subsidiaries (in this case).
- Globally Independent: those subsidiaries that *use* and *highly value* linkages *only* with other global actors but *not with* the HQ and subsidiaries;
- Globally Diversified: those subsidiaries that *use* and *highly value* global linkages with the HQ, other subsidiaries *and also with other* actors;
- Globally Isolated: those subsidiaries that *do not use* and *do not highly value* linkages with global actors.

(2) Indicators of subsidiary proactiveness

In order to capture subsidiaries' local proactiveness we consider a set of indicators of local linkages and embeddedness. Among them, the indicator of 'Local embeddedness' was calculated simply as the sum of all the 'Yes' answers to Question (2) above, but only when the interactions of Question (2) are at local, regional and national level.