

Provided for non-commercial research and education use.
Not for reproduction, distribution or commercial use.



This article appeared in a journal published by Elsevier. The attached copy is furnished to the author for internal non-commercial research and education use, including for instruction at the authors institution and sharing with colleagues.

Other uses, including reproduction and distribution, or selling or licensing copies, or posting to personal, institutional or third party websites are prohibited.

In most cases authors are permitted to post their version of the article (e.g. in Word or Tex form) to their personal website or institutional repository. Authors requiring further information regarding Elsevier's archiving and manuscript policies are encouraged to visit:

<http://www.elsevier.com/copyright>



Contents lists available at ScienceDirect

Research Policy

journal homepage: www.elsevier.com/locate/respol

The local/global integration of MNC subsidiaries and their technological behaviour: Argentina in the late 1990s

Anabel Marin*, Martin Bell

SPRU – Science and Technology Policy Research, University of Sussex, UK

ARTICLE INFO

Article history:

Received 12 October 2007

Received in revised form

30 November 2009

Accepted 7 April 2010

Available online 15 May 2010

Keywords:

MNC subsidiaries

Functional integration

Global innovation

Industrialising countries

ABSTRACT

A growing number of studies suggest that only innovative subsidiaries generate positive technological effects in host countries. In this context, this paper explores the variability in the intensity of innovative activity across MNC subsidiaries within a late-industrialising host economy in connection with two factors: the subsidiaries' functional integration within (a) their global corporations and (b) their host economy. We found that the more innovative subsidiaries were those that enjoy integration to both the local economy and their global corporation. However, they represented a small proportion of all subsidiaries, most of which were disconnected from both their global corporation and the local economy. We also found that, in common with some findings in advanced country contexts, but in contrast to common expectations in industrialising economies, subsidiaries that were strongly integrated into their parent corporations undertook more, not less, intensive innovative activity than those that were well integrated into the host economy.

© 2010 Elsevier B.V. All rights reserved.

1. Introduction

The spillovers literature assumes that most MNCs have by definition the potential to generate positive technological effects in host economies. This potential is supposed to arise in association with the superior technological assets created by MNCs in central locations and delivered to subsidiaries via technology transfer—a long-standing perspective (Caves, 1974; Markusen, 1995; Haskel et al., 2002; Blomström and Kokko, 2003; Javorick, 2004; Driffield and Love, 2007). However, we have learnt from recent evidence in the spillovers literature that this is not the case. Only certain types of MNC subsidiary generate positive spillover effects (Todo and Miyamoto, 2002; Castellani and Zanfei, 2005; Marin and Bell, 2006; Marin and Sasidharan, 2008).

Studies conducted in Argentina, India, Indonesia and Italy, have all found the same pattern: only highly innovative subsidiaries generate positive spillover effects in association with MNC operations in the host economy. Todo and Miyamoto (2002), for instance, found that in Indonesia only subsidiaries engaged in R&D and training activities in the host economy had a positive impact on the productivity of domestic firms. Castellani and Zanfei (2005), 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 invest heavily in disembodied knowledge and human capital. Conversely, technology passive subsidiaries did not generate any significant effect. Finally, Marin and Sasidharan (2008), in India, found that positive spillover effects arose only in association with the activity of 'competence-creating' subsidiaries (i.e. those engaged in the creation of new knowledge assets for the MNC); on the contrary 'competence-exploiting' subsidiaries (i.e. those engaged in the exploitation of existing MNC technological assets in host country contexts) generated negative effects.

This evidence points to the importance of understanding possible reasons for variability in the localised technological activity of subsidiaries in host economies.¹ This paper explores that issue in the context of Argentina, a relatively knowledge-poor industrialising economy where it is important to encompass an array of different kinds of technological activity, not just R&D, that have been shown to underpin spillover effects (Marin and Bell, 2006).

¹ A well-established strand of research about FDI spillovers has emphasised the importance of absorptive capacities in host economies as an influence on the extent to which knowledge delivered by transfer from parent companies to subsidiaries is actually exploited in achieving performance improvements by other firms. However, the studies reviewed above suggest that it is locally created and acquired, not internationally transferred, knowledge that matters and, among these studies, those by Marin et al., explicitly examined the role of absorptive capacity and found it unimportant.

* Corresponding author at: SPRU – Science and Technology Policy Research, Freeman Centre, University of Sussex, Brighton, East Sussex BN1 9QE, UK. Tel.: +44 0 1273 686758; fax: +44 0 1273 685865.

E-mail address: a.i.marin@sussex.ac.uk (A. Marin).

The paper focuses on how the intensity of this range of innovative activity by MNC subsidiaries is associated with two important features of their strategic positioning: (i) their degree of integration within the host economy and (ii) their degree of integration within parent corporations.

We describe these two kinds of integration as two kinds of 'structural position' that subsidiaries may hold. We identify these as mediating variables lying between the innovative activity of subsidiaries and a large number of variables relating to the organisational, strategic and contextual characteristics of MNCs that have been shown to influence the innovative (and other) behaviour of subsidiaries—mainly in advanced country contexts (e.g. Ghoshal and Bartlett, 1988; Nobel and Birkinshaw, 1998; Pearce, 1999; Kuemmerle, 1999; Papanastassiou and Pearce, 1999; Zander, 1999; Granstrand, 1999; Kumar, 2001; von Zedwitz and Gassmann, 2002; Cantwell and Iammarino, 2003; Cantwell and Mudambi, 2005).

Our distinction between these two kinds of structural position is very similar to a distinction that has been prominent in research on the strategy and structure of MNCs since at least the mid-1980s (e.g. Doz and Prahalad, 1984; Porter, 1986; Barlett, 1986; Prahalad and Doz, 1987). In slightly differing ways, this earlier literature has identified two dimensions along which the positions of subsidiaries may vary: (i) the degree to which the functions and roles of subsidiaries are closely integrated into the overall global activities and strategies of the corporation as a whole, and (ii) the degree to which subsidiaries, being more 'responsive' to the specificities of national/local situations, have responsibility for a wide range of functions and are more integrated into the local economy. Jarrillo and Martinez (1990) used a distinction along these lines as the basis for a taxonomic study of the characteristics of subsidiaries in Spain. However, we go beyond that to explore much more explicitly the *relationship between subsidiaries' structural positions and their innovative activity*.

This is a novel analytical step and we reach striking empirical results from its application, several of which run counter to conventional perspectives. In general, we found that the more innovative subsidiaries were those that enjoy integration to both the local economy and their global corporation. However, this particular group of subsidiaries represented only a small proportion of all subsidiaries. Most subsidiaries were disconnected from both their global corporation and the local economy. We also found that subsidiaries' positions that involved greater integration into their global corporations were associated with their innovative activity in the host economy being more, not less, intensive. Conversely, subsidiaries with positions that were more functionally integrated into the host economy were less, not more, actively innovative.

The empirical analysis uses information provided by the National Innovation Survey of Argentine manufacturing industry: 1998–2001, a novel source of data for this type of study of MNC subsidiaries. We use the Survey data for 1998, so reflecting the behaviour of MNC subsidiaries around the mid-to-late 1990s, a period of rapid transition in the Argentine economy. Two aspects of this context are particularly important.

First, this was a period of major transformation between two fundamentally different phases of economic development in Argentina. During the 1930s to the mid-1970s, within the framework of a pervasive import substituting policy regime, the country built up a substantial manufacturing base as part of a large industrial economy with considerable public ownership. Initial changes to this regime in the mid-1970s were followed by a 15-year period of economic crisis and declining industrial production, especially in manufacturing. Further policy change involving greater liberalisation, deregulation and privatisation at the start of the 1990s was followed by a decade of relatively rapid growth, within which output and productivity in manufacturing grew much faster than for several decades, albeit punctuated by reverses in 1995 and 1999.

Second, broad features of inward FDI were changing fundamentally through the 1990s. Inward FDI had been a major contributor to the growth of manufacturing during the import-substitution era, largely on the basis of 'greenfield' investment and its expansion. In particular, MNC subsidiaries underpinned the growth in technologically dynamic sectors such as vehicles, petrochemicals and machinery. Then, during the 'de-industrialisation' phase in the mid-1970s, new FDI in manufacturing was virtually absent and many long-established MNC subsidiaries withdrew from Argentina. This changed dramatically after the reforms of the early 1990s. Inward FDI surged to new levels: as a proportion of GDP, the accumulated stock of FDI increased from 6% in 1990 to 35% in 2004. A substantial proportion of these inflows was once again in manufacturing, where MNC subsidiaries came to account for 69% of total sales of the 200 largest firms by 1998. However, a large proportion of FDI was directed to the acquisition of existing assets via privatisation and mergers and acquisitions—overall between 1992 and 2000, 56% of FDI involved the acquisition of existing companies.

The results presented later in the paper reflect the technological behaviour of MNC subsidiaries at around 'the middle' of these transformations in the 1990s, and interpretation must be located in this context.

The structure of the rest of the paper is as follows. In the next section we locate the study in the context of previous research: outlining the overall theoretical framework in Section 2.1, focusing in Section 2.2 on the specific part that is concerned with subsidiaries structural positions, and developing our core propositions in Section 2.3. In Section 3 we explain the methods used in the empirical analysis. We report the results in Section 4, and the findings are discussed in Section 5.

2. Analytical framework and propositions

2.1. The broad analytical framework

The broad framework for our study is summarised in Fig. 1. The dependent variables relate to aspects of the innovative behaviour of subsidiaries (Block C). We are centrally concerned with Block (B), the structural positioning of subsidiaries, and in particular with two dimensions of this: (i) their degree of integration into the global corporate structure and (ii) the degree of localisation of functions and integration into the host economy. Our empirical analysis examines the association between these dimensions of subsidiaries' structural positioning and their innovative activity in Argentina.

Block A includes the literature concerned with the influences that may shape the structural positions of subsidiaries. One set of literature (Box A2) has analysed how aspects of corporate structure, strategy and organisation have influenced the positioning and behaviour of subsidiaries, including their technological behaviour. These all explore various aspects of what Cantwell (2001) has described as the transformation of multinationals from "technology creators" to "technology organizers" within their networked corporate structures. Such work includes, for instance, Kuemmerle's (1999) study that distinguished between strategies to augment and to exploit the knowledge base of the corporation, the studies by Ghoshal and Bartlett (1988) and Bartlett and Ghoshal (1989) covering transitions from local-to-local to local-for-global, and Granstrand's (1999) study concerned with the transition from demand to supply forces inducing technological activity in foreign subsidiaries.

Another strand of literature has focused more on the localised autonomy of subsidiaries and the development of subsidiary-driven strategies (Box A4), and these have led to syntheses about the interaction between central and local factors shaping the behaviour of subsidiaries—such as the three sets of drivers that

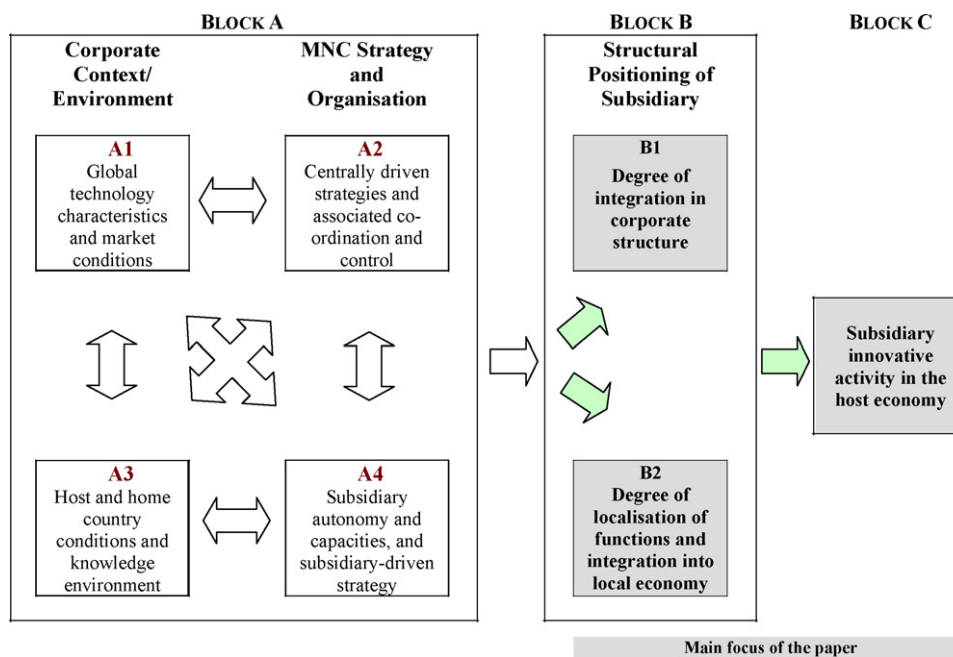


Fig. 1. The analytical framework.

Birkinshaw and Hood (1998) identified: (i) the characteristics of MNCs, (ii) the decisions and strategies of subsidiaries, and (iii) aspects of the local environment that create constraints and opportunities for subsidiaries.

The complexity of relationship examined in this broad body of literature is increased if one moves 'back' in the analytical structure in Fig. 1 to take account of two other sets of studies. The first (Box A1) identifies global factors that shape MNC corporate strategy and structure. These encompass a wide range of technological, market, historical and political factors. For example, *Kogut (2002)* has argued that the diffusion of IT technologies encourages dispersed R&D and other technological activities in subsidiaries; and *Dunning and Cantwell (1986)* have highlighted the important role played by market structure, arguing that in highly concentrated global markets the decentralisation of MNC investment in R&D and other knowledge-intensive activities is likely to be more limited than in oligopolistic markets. The second (Box A3) includes research about how MNCs' host and home contexts shape subsidiaries' technological and other behaviour. For instance, with respect to host country influences, emphasis has been placed on the extent to which subsidiaries are embedded in 'leading-edge industry clusters' (*Birkinshaw and Hood, 2000*) or in knowledge-rich regional environments (e.g. *Cantwell and Iammarino, 2003*); and, reflecting home-country circumstances, others have highlighted the role of different national modes of R&D internationalisation (*Granstrand, 1999*).

The relationships among the variables in Block (A) are complex. However, although these are important in shaping the structural positions of subsidiaries, we do not reach back that far in the analytical framework to identify reasons for the heterogeneity of subsidiaries' innovative activity. This is partly because of two limitations to the contribution we can draw from this body of previous research. First, almost all this work has focused on the experience of subsidiaries in host countries among the knowledge-rich, advanced economies, and evidence from emerging, middle-income economies has either been absent altogether, or limited to very small fractions of survey and case-study samples. Second, to the extent that heterogeneity has been explicitly examined, almost all attention has focused on differences between countries—both

host and home. Limited light has been thrown on our question about intra-host country, including intra-industry, heterogeneity. We therefore take only an intermediate step here by exploring the relationship between the structural positions of subsidiaries (Block B) and their innovative activity (Block C)—recognising that a wealth of further explanatory analysis could be explored 'behind' those structural positions.

2.2. Subsidiaries' structural positioning

As summarised earlier, we build on a well-established conceptual framework in this area that has distinguished between two dimensions: (i) differing degrees of integration within the global corporation and (ii) differing degrees of functional localisation and integration within the host economy. Within this framework, *Porter (1986, p. 7)*, for instance, defined a set of strategies for MNCs based on a combination of (a) geographically dispersed/concentrated configurations and (b) high/low co-ordination of activities. Similarly, *Barlett (1986)* distinguished between MNC strategic responses to forces driving towards (a) greater global integration and (b) greater national differentiation. Subsequently, in seeking to characterise different strategies of subsidiaries in Spain, *Jarrillo and Martinez (1990)* drew on this conceptual framework and distinguished between the subsidiaries' degree of (corporate) integration and its degree of localisation. In a similar vein, but with a more specific focus on the technological activities of subsidiaries, *Papanastassiou and Pearce (1999)* have noted a similar type of distinction between a subsidiary's "position in two knowledge communities, that of the MNE group and that of the host country research institutions and science base." (pp. 90–91).

Our own framework is rooted in this stream of work. It is shown in Fig. 2, together with the terminology we use to describe four different structural positions of subsidiaries.

Among previous studies, it is probably the work of *Jarrillo and Martinez (1990)* that comes closest to the way we use this framework. In the context of Spanish manufacturing in the 1980s and 1990s, they found that differences in subsidiaries positions on these two dimensions were associated with intra-country heterogeneity in the nature and scale of a wide range subsidiaries'

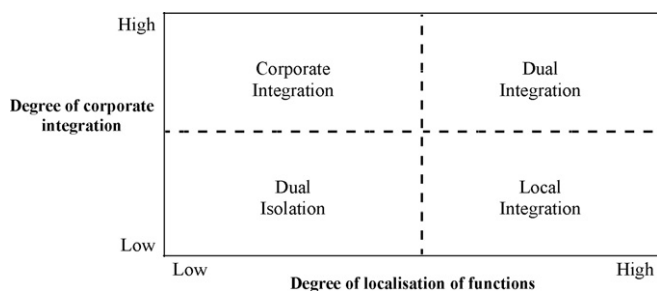


Fig. 2. The structural positioning of MNC subsidiaries.

activities, including their R&D. They noted in particular a distinct trade-off between two types of structural position occupied by subsidiaries. Between the early 1980s and the early 1990s, many of them moved towards greater corporate integration *at the expense of* localised integration. As a result, the authors noted that many Spanish subsidiaries “...are losing some ‘Spanish content’” – apparently including some of the Spanish content of their R&D (p. 501). However, we take a different approach to operationalising the dimensions of corporate integration and functional localisation. In their work, the subsidiaries’ innovative activity was identified only in terms of R&D-related variables, and these were included in the array of 11 variables used to characterise the positions of subsidiaries on the two dimensions. We take two different steps. First, in order to explore more clearly the association between structural positions and innovative activity, we disentangle variables relating to the definition of subsidiaries’ structural positions from those concerned with their innovative activity. Second, as explained later in Section 3, we identify innovation much more broadly than simply consisting of R&D, an issue that is particularly important in industrialising country contexts. We include design and engineering activities, organizational changes, process innovations and the outputs of these activities reflecting innovations that are novel both globally and to the firm.

2.3. Exploratory propositions

We outline here a number of propositions about the association between each of the four structural positions in Fig. 2 and the innovative activity of subsidiaries.

2.3.1. Locally integrated subsidiaries

The literature indicates that locally integrated structural positions may be occupied by subsidiaries for a host of differing and interacting reasons, as sketched earlier in Section 2.1. For example, high localisation might arise from locally ‘autonomous’ subsidiaries pursuing aggressive ‘subsidiary development’ strategies that are rich in ‘subsidiary initiatives’ (Birkinshaw, 1997). Alternatively it might also arise as a result of centrally directed corporate strategies, perhaps involving the corporate allocation of broad functional mandates to particular subsidiaries in the context of global network structures (Cantwell and Mudambi, 2005). However, for the purposes of this work, this category simply defines a structural position without any presumption about why it may have arisen. A key feature of this position is the breadth and depth of functional localisation, encompassing a relatively wide array of roles along a firm’s value chain—a structure that is likely to be relatively intensive in its demands for supporting innovative activities. This kind of structure is also likely to be associated with some maturity of the subsidiary in the host economy and also with relatively high firm size, both likely to reinforce the development of innovative activities. Consequently:

Proposition 1. *Subsidiaries with Locally Integrated structural positions are likely to demonstrate relatively high levels of local innovative activity.*

2.3.2. Corporately integrated subsidiaries

The literature offers two lines of argument about subsidiaries’ corporate integration and their innovative activity. Correspondingly we develop two alternative propositions about the effects of relatively high corporate integration—defined and operationalised here (see Section 3) as involving low localisation of subsidiary functions.

First, in some perspectives, high corporate integration is seen as reflecting high levels of control, linked to corporate interests in minimising duplication and aligning dispersed innovative activities with overall corporate interests (Andersson et al., 2005; Jarrillo and Martinez, 1990). From this type of analysis one would expect high levels of corporate integration to be associated with relatively low levels of local innovative activity, especially when (as in this segment of the quadrant) corporate integration is associated with a limited range of functions being undertaken locally. Hence:

Proposition 2.1. *Subsidiaries with Corporately Integrated structural positions are likely to demonstrate low levels of local innovative activity.*

However, the perspectives underlying that proposition may be unduly focused on more advanced forms of R&D and globally novel forms of innovation, giving inadequate attention to D, D & E functions involved in a wider range of innovative activities—for example, those associated with incremental product and process upgrading to sustain a subsidiary’s competitiveness in domestic or export markets. There is a growing body of evidence to suggest that MNC subsidiaries pursue such wider forms of innovation relatively intensively. Moreover, parent companies can draw on the global resources of the corporation to provide various forms of support for such innovation, without establishing formal structures for the localisation of R or D or design functions in the subsidiary. In these cases, high levels of corporate integration would favour high levels of local innovative activity in subsidiaries, particularly in the case of subsidiaries in less advanced contexts which will need to compensate for the lack of resources in the local environment accessing resources from the global environment.

Proposition 2.2. *Subsidiaries with Corporately Integrated structural positions are likely to demonstrate high levels of local innovative activity.*

2.3.3. Dually integrated subsidiaries

Global and local integration are seen sometimes as alternatives rather than complementary positions, particularly in studies that see local embeddedness as potentially reducing the possibility of influence and involvement of MNC headquarters in subsidiaries activities (Forsgren and Phallberg, 1992; Andersson and Forsgren, 1996; Andersson et al., 2005). We see them as potentially complementary positions, following for instance Håkanson and Nobel (2001) and Almeida and Phene (2004). We also expect subsidiaries enjoying these two types of integration to be highly innovative because they are likely to exploit two kinds of mechanism for acquiring knowledge and related capabilities for innovation—both: (a) support from their corporate group which might be crucial in the case of subsidiaries in less advanced contexts and (b) local technology accumulation associated with the extensive functional localisation and integration into the local economy. Consequently:

Proposition 3. *Dually Integrated subsidiaries, combining locally integrated with corporately integrated structural positions, are likely to demonstrate relatively high levels of local innovative activity.*

2.3.4. Dually isolated subsidiaries

Since these subsidiaries occupy a position of low integration into the technology-related functions of the global corporation, their technological behaviour is unlikely to be affected much by the parent: neither constrained by control nor supported by corporate resources. At the same time with only a limited range of functions undertaken locally, they are unlikely to engage intensively in innovative activities. Consequently, it seems reasonable to expect that:

Proposition 4. *Subsidiaries with Dually Isolated structural positions are likely to demonstrate low levels of innovative activity.*

An important feature of these propositions is that, as well as reflecting academic understanding reported in the literature, they engage directly with, and in the case of Propositions 1 and 2.2, run counter to, widespread perceptions that still have significance influence in policy discourse in large parts of the industrialising world. This is particularly so in Latin America and South Asia where it is commonly argued that locally integrated structural positions are associated with, indeed are a necessary condition for, significant levels of local innovative activity, and that relatively high degrees of corporate integration are associated with low levels of local innovative activity—as in Proposition 2.1.

3. Data and methods

The empirical analysis reported here uses information provided by the National Innovation Survey in Argentina (1998–2001), though we use only the data for 1998 to exclude the effects of the financial crisis in 2000. This survey was carried out by the National Council of Statistics (INDEC). The sample used in the Innovation Survey (1688 firms, 333 of which are subsidiaries) is representative of the total population of industrial firms in the country.² Following the broad framework of the Oslo Manual, it provides information about a wide range of technological activities at the firm level.³ We draw on this information to develop indicators of the innovative behaviour of subsidiaries and their structural positioning—as explained in Section 3.2.

To explore the association between the structural position of subsidiaries and their innovative behaviour we use two types of tests: ANOVA when the variable measuring innovative behaviour is continuous, and Chi² when the variable is discrete.⁴ When ANOVA is significant, we use *post hoc* tests to detect which specific pairs of structural positions show significantly different innovative behaviour.

3.1. The indicators

3.1.1. The innovative activity of MNC subsidiaries

In common with most studies of firm-level innovation in industrialising economies, our view of innovation encompasses not merely R&D but also a wide array of design and engineering activities. The outputs from those activities include not just innovations that are globally novel and reflected in patents but, much more common, a wide range of minor and incremental changes that are novel with respect to the local industry or the firm itself. Moreover, the outputs of such locally innovative activities may encompass

much more than new kinds of product and process hardware. They also include new forms of organisation and procedure. Also, in examining the *process* of innovation, it is interesting and useful to encompass not just its inputs and outputs, but also aspects of the activity itself, such as the kinds of interaction with other organisations.

Reflecting this broad conception of innovation, we compute 16 indicators reflecting three different aspects of innovative activity: (i) *Innovation inputs*: 8 indicators in three groups covering investment in disembodied and capital-embodied technology and also expenditure on professional and technical human capital; (ii) *'Outputs' from innovative activity*: 5 indicators covering product, process and organisational innovations as well as patented invention; and (iii) *Innovation-related interactions*: 3 indicators reflecting overall national and international interactions as well as more specific links with host country firms and other organisations. (The computation of these indicators is explained more fully in Annex 1.)

The 16 indicators are combined in four composite indexes of innovative activity. Three of these correspond to the groups summarised above: an *index of innovative output*, an *index of innovative inputs*, and an *index of networking intensity*. The fourth is an *overall index of innovation* based on all 16 indicators. These indexes were calculated using factor analysis, with the weights of the different variables therefore endogenously determined rather than imposed exogenously by ourselves (Annex 1 explains the methodology and shows the factor loadings.)

3.1.2. The structural positions of MNC subsidiaries

The analysis rests on a typology of four categories of firm based on their 'High' and 'Low' positions on each of the two dimensions summarised in Fig. 2. The method used to develop these categories is summarised below and explained more fully in Annex 2.

- (i) The degree of integration into the global corporation. This dimension is identified in terms of two kinds of interaction—one concerned with the scope and intensity of innovation-related interactions with the subsidiaries' parents or affiliates, the other with trade-related interactions.⁵ Subsidiaries were classified as demonstrating *High Integration* into the global corporation when they were classified as having high levels of interaction in both these domains (accounting for 39% of the total number of 331). All other subsidiaries were classified as showing *Low Integration* into the global corporation (61% of the total).
- (ii) The degree of localisation of functions. This dimension takes into account the local embeddedness of the subsidiary with respect to both production-related and technology-related functions. Localisation of the latter refers exclusively to the *existence* of activities concerned with technology-related functions (R&D and design), independently of their *scale or effectiveness*. As explained above, the scale and effectiveness of technological activities are aspects of the innovative intensity of subsidiaries and, as shown later, the scale/effectiveness of these functions may diverge widely from their mere existence.

² Since this is a survey conducted by the National Statistical Council, the response rate was very high (76%).

³ More detailed information about the Innovation Survey, the data provided and the characteristics of the sampled firms, including a comparison of MNC subsidiaries and local firms, can be found in Marin and Bell (2006).

⁴ ANOVA is preferable in this case relative to regression because the variable measuring the structural position is categorical, not ordinal.

⁵ Two issues should be noted about the way this indicator was calculated. First, since we intend to assess the relationship between levels of integration within corporate structures and the intensity of subsidiaries' innovative behaviour, there could be a selection bias against firms that declared they had not used headquarters or other affiliates as the main source of information for innovation activities simply because they were not innovators. We have therefore eliminated from the analysis the two subsidiaries that declared all sources as not significant. Second, the proxy for intra-corporate trade will probably underestimate intra-corporate flows of goods and services since it considers only the country of the headquarters, not the country of other affiliates with which the subsidiary could be trading.

Subsidiaries were classified as demonstrating a *High Localisation* of functions when a relatively high proportion of their total sales consisted of their own products, and a relatively low proportion of their imports consisted of final products, and they had a formal R&D laboratory or Design department (38% of the total). All other subsidiaries were classified as demonstrating a *Low Localisation* of functions (62% of the total).

3.2. Subsidiary structural positions: descriptive data

The distribution of the 331 subsidiaries across the four groups in the typology is shown in Table 1, along with a number of economic characteristics for each group. It is striking that, although the first group, the *Dually Isolated* category, is often an empty cell in this kind of typological framework in studies in advanced economy contexts,⁶ it accounts for almost 40% of all the subsidiaries in Argentina. Furthermore, more than a half of all subsidiaries (Categories I and III combined) demonstrate a low degree of integration into global corporate structures. This seems a surprisingly high proportion, given the extent to which close integration of subsidiaries is commonly seen as one of the main characteristics of MNC structures.

The distribution of the types of subsidiary in terms of firm size (number of employees) is roughly what one might expect. The *Locally and Dually Integrated* subsidiaries (Types III and IV), which perform the widest array of functional tasks within the host economy, are the largest firms. Conversely, the low locally integrated subsidiaries (Types I and II) are the smallest. With respect to economic performance, both the *Corporately Integrated and Dually Integrated* subsidiaries seem to be the most efficient categories in terms of sales per employee. They also have, on average, the highest export and import intensity within the sample. However, not surprisingly, the highest domestic market share is held by the *Locally Integrated* subsidiaries. It is interesting that the two types of subsidiary that are more integrated into their corporate structures (*Corporately and Dually Integrated*) have only slightly higher levels of FDI participation in ownership than the other types. Finally, the age of the subsidiaries is in general quite high (around 35 years), reflecting the long-established importance of FDI in Argentina. But the subsidiaries' age does not differ significantly across the types, suggesting that none of the 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.

4. Results

This section reports on the association between the subsidiaries' structural positions and their technological behaviour (Section 4.1) and then discusses these associations and their interpretation (Section 4.2).

4.1. Types of subsidiary and local technological behaviour

We show the relationships between the types of subsidiary and their innovative behaviour in two ways: first with respect to the four composite indicators of innovative intensity (Table 2), and second with respect to selected elements of those composites (Table 3). The latter include more commonly used partial indica-

⁶ In the work of Barlett (1986) and then Jarrillo 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.

tors of the intensity of technological activity: R&D expenditure, employment of professional and technical skills, imports of capital goods for innovation, patenting and innovation-related links in the host economy.⁷ Four clear patterns are evident from these results.

First, high levels of *local integration* (Group III) do not seem, on their own, to be associated with high levels of local innovative activity in subsidiaries. With a few exceptions, the indicator values for the technological behaviour of this group of subsidiaries are among the lowest in the whole sample—being significantly higher than only those for the dually isolated subsidiaries (Group I), and then only with respect to two of the indexes in Table 2. This broad picture also applies for the selected partial indicators in Table 3. Thus, although these firms (being classified as locally integrated) typically have some of the functional bases for innovative activity (e.g. they may have R&D laboratories or design departments), they do not do a great deal with them—not allocating particularly high levels of inputs to innovation, not generating particularly high levels of innovative output, and not engaging in strong innovative-related interactions with local firms and other organisations. Similarly, despite their high level of local integration, the subsidiaries in this group have relatively a low intensity of innovation-related interactions within the host economy—being surpassed in this respect by both Groups II and IV (Table 2, Row 3.1). So, contrary to the expectation in Proposition 1, and also in contrast to widely held views in the policy discourse about FDI in Latin America, high levels of local integration appear to generate relatively low, not high, levels of innovative activity.

Second, in contrast to what one might expect from studies like Taggart (1996) or Jarrillo and Martinez (1990) – as reflected in Proposition 2.1 – high levels of *corporate integration* (Type II subsidiaries) do not seem to be associated with limited local innovative activity. Instead, consistent with Proposition 2.2, they are associated with relatively high levels. In particular this group demonstrates more intensive activity than *Locally Integrated* subsidiaries across all the indicators in Table 2. The difference is significant in the case of the overall index of innovative performance and also the index of innovation-related networking intensity. The latter is not simply a reflection of international links in the composite index, but is strongly reflected also in the partial indicators for innovation-centred links (a) with all host country organisations and (b) via vertical linkages with host economy customers and suppliers (Table 3, Rows 3.1 and 3.2). The difference between this group and the *Locally Integrated* subsidiaries is also significant with respect to the intensity of employment of professional and technical skills—a partial indicator within the index of innovation inputs (Table 3, Row 1.2).

Third, the most striking result is the demonstration that Type IV subsidiaries (*Dually Integrated*) are more clearly committed to local innovation activities than all the other groups—consistent with Proposition 3. This applies across all the composite indicators in Table 2, with significant differences in all cases. The same pattern is also evident across most of the partial indicators in Table 3, the exceptions being that *Corporately Integrated* subsidiaries show higher values for patenting and skill intensity. It is important to stress that these *Dually Integrated* subsidiaries combine both high degrees of corporate integration and high localisation of functions. Consequently, when it occurs in this combination, high localisation of functions does not show the low levels of innovative activity associated with high localisation on its own (as above). In particu-

⁷ In the case of skills and patents, separate analysis is justified also because they are not well represented in the indexes (see Annex 1).

Table 1
A typology of subsidiaries: some general economic features.

Indicator	Types of subsidiary ^a				Average of all firms
	I dually isolated	II corporately integrated	III locally integrated	IV dually integrated	
Number of firms %	131 (39%)	74 (22%)	72 (22%)	54 (16%)	
Size–employees (mean)	214	429	535	683	409
Sales/employee–'000 pesos (median)	128	197	112	188	152
Export intensity–(%) (mean)	14	17	15	17	15
Import intensity–(%) (mean)	18	25	13	19	19
Market share ^b –(%) (mean)	3.9	3.3	4	3.8	3.8
FDI participation (%) (mean)	84	92	79	91	86
Age of subsidiaries–years (mean)	36	37	36	32	36

^a The bold/underlined figures in the table simply highlight the larger values in each row without implying any statistically significant difference.

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

Table 2
Types of subsidiary and innovative behaviour: inputs and human capital.

Indexes ^a	Types of subsidiary (mean value per type)				ANOVA test	Post hoc test ^b
	I dually isolated	II corporately integrated	III locally integrated	IV dually integrated		
1. Overall Index of Innovation	–0.52	0.39	–0.12	0.66	Significant ^{***}	(IV, II > I, III) ^{***} (III > I) ^{***} (IV > II) [*]
2. Index of innovative output	–0.26	0.24	0.16	0.38	Significant ^{***}	(IV > I, III) ^{***} (II > I) ^{***}
3. Index of innovative inputs	–0.14	0.09	0.031	0.11	Significant ^{***}	(IV, II > I) ^{***} (III > I) [*]
4. Index of networking intensity	–0.36	0.50	–0.23	0.63	Significant ^{***}	(IV, II > I, III) ^{***}

^a Annex 1 explains how the composite indexes were calculated.

^b The post hoc test identifies the pairs that differ significantly. We explore Bonferroni, Scheffe and Sidak and they all provide the same results.

^{*} Significance at 10% level.

^{**} Significance at the 5% level.

^{***} Significance at the 1% level.

lar, although locally integrated subsidiaries demonstrate low levels of innovation–relation links with organisations and other firms in the host economy, when local integration is combined with corporate integration subsidiaries show high levels of innovation linkage in the host economy (Table 3, Rows 3.1 and 3.2).

Finally, Type I subsidiaries (*Dually Isolated*) perform as expected in Proposition 4: they demonstrate low commitment to local innovative activities compared to all the other groups with respect to all indicators.

4.2. Discussion and interpretation of the findings

4.2.1. Methodological issues

Three aspects of the underlying methodology seem important in interpreting the results of this analysis.

First, as far as we know, this study is the first that has examined issues about the structural positions of MNC subsidiaries and their technological behaviour on the basis of data derived from a large-scale national innovation survey. The consequent ability to work

Table 3
Types of subsidiary and innovative behaviour: selected indicators.

Indicators ^a	Types of subsidiary (mean value per type)				ANOVA test	Post hoc test ^b
	I dually isolated	II corporately integrated	III locally integrated	IV dually integrated		
1. Innovative inputs						
1.1 Intensity of R&D expenditures	0.18	0.35	0.28	0.4	Significant ^{***}	IV, II > I, III ^{***}
1.2 Skills Intensity	0.16	0.25	0.17	0.20	Significant ^{***}	(II > I, III) ^{***}
1.3 Intensity of expenditures on capital goods for innovations	0.04	0.05	0.05	0.1	Significant ^{***}	(IV > I, II, III) ^{***}
2. Innovative output (patents)						
2.1 Number of Patents/Number of firms per group	0.11	0.72	0.16	0.14	Significant ^{***}	II > I ^{***}
2.2 Percentage of firms with at least one patent (%)	4	14	7	10	Significant ^{***}	
3. Networking intensity						
3.1 Linkages specifically in the host country	2.16	4.6	2.3	5.3	Significant ^{***}	(IV, II > I, III) ^{***}
3.2 Vertical linkages to other firms in the host country	1.3	1.5	1.3	1.6	Significant ^{***}	(IV > I, II, III) ^{***} (II > I, III) ^{***}

^a In order to control by size all the indicators are calculated as intensities with respect to total sales or total employment.

^b The post hoc test identifies the pairs that differ significantly. We explore Bonferroni, Scheffe and Sidak and they all provide the same results.

^{*} Significance at 10% level.

^{**} Significance at the 5% level.

^{***} Significance at the 1% level.

with a large sample of more than 300 observations must give the reported findings a degree of generalisability that contrast with much of the previous work in this area that has tended to be based on small numbers of company case studies or on surveys with very small and selective samples—especially when their typically low response rates are taken into account.

Second, the main results about the association between structural positions and innovative activity are broadly similar across a range of different indicators. This is particularly clear in the case of both the four composite indexes (Table 2) and the selected partial indicators shown in Table 3. This is important with respect to the aims of this particular paper—to examine factors associated with the heterogeneity of a wide range of subsidiaries' innovative behaviour and not merely narrow aspects of it such as R&D expenditure, and here we stress again that we have identified only strong associations without clear causality effects. But it is also important with respect to the questions about FDI spillover effects that lie behind this paper. Particularly in the studies by Marin and colleagues (see Section 1), positive spillover effects are shown to be associated with several different indicators covering a range of knowledge-creation and knowledge-acquisition activities in subsidiaries, and our results here therefore connect the immediate findings about the structural positions of subsidiaries in this paper to the wider debate about FDI spillovers.

Third, our novel typology of the structural positioning of subsidiaries appears to be an effective and useful tool. It has generated descriptive characterisations of the types of subsidiary (Table 1) that seem broadly consistent with expectations. More important, while it is rooted in long-standing theoretical and conceptual foundations (e.g. Barlett, 1986; Prahalad and Doz, 1987), it has been designed and operationalised in ways that permit considerable precision in interpretation. For example, the approach disconnects (a) the mere existence in subsidiaries of some form of functional activity concerned with technology and innovation (R&D and design) from (b) the intensity with which such activities are actually pursued. In contrast to other studies in this area (e.g. Jarrillo and Martinez, 1990), this permits a more convincing analysis of the relationship between structural integration and the intensity of innovative behaviour. In a similar way, the extent of production and market links between subsidiaries and other firms in the host economy (a component of the structural positioning of subsidiaries) is distinguished from the extent to which such links may serve as channels for innovation-related information flows (a component of the innovation-related indicators). This contrasts with the approach in many other studies that *presume* the existence of innovation-related knowledge flows running through production/market linkages, sometimes using the former as proxies for the latter. As shown here, though, more precise and separate identification of the two kinds of linkage enables us to show that the two may not coincide—as in the case of subsidiaries with high levels of local integration (and hence, among other things, with strong production/market links with local firms) that have a relatively a low intensity of innovation-related interactions with other firms in the host economy.⁸ Finally, the operational design also identifies structural positions independently of the important management and organisational concepts that may contribute to explaining the positions—as in Block A in Fig. 1. In principle this permits in subsequent work the analysis of *relationships between* subsidiaries' structural positioning and variables that have not been

⁸ This is consistent with the work of Giuliani (2007) in the context of Chilean wine production showing that the networks of knowledge-centred links between firms did not closely map to the network of business-related links. Instead, as suggested here in the case of MNC subsidiaries, links were associated primarily with the strength of the knowledge bases of the firms.

considered here, such as 'subsidiary autonomy' and 'subsidiary power', or characteristics of MNCs with different home-country origins.⁹ This highlights the point that more than just structural positioning needs to be woven into the picture to understand the heterogeneity of subsidiaries' technological behaviour, and hence its possible importance in understanding the uneven occurrence of FDI spillovers.

4.2.2. Other factors and mediating variables

4.2.2.1. *Industry characteristics.* Several studies have indicated that the technological characteristics of industries influence patterns of FDI and the characteristics of subsidiaries. It is plausible therefore that these influenced the patterns identified above because the technological characteristics of industries and the type of structural position were connected. For example, studies have shown that MNCs in 'high-tech' industries use more decentralised approaches to innovation, as well as providing relatively intensive support to innovation in subsidiaries (e.g. Reddy, 2005; Niosi, 1999); and these may therefore be more likely to fall into the *Dually Integrated* category. In such cases the technological behaviour of subsidiaries might be better seen as being shaped partly by their type of industry and not simply by their structural positioning.

However, Table 4 suggests that this was not important in this study. It indicates the association between the four types of subsidiary and the types of industry in which the subsidiary is engaged—in terms of industry categories that are similar to the commonly used OECD distinctions between differences in 'technology-intensity'. Although there were differences between the types of industry that were most important in each category of subsidiary (Row 1), it is difficult to discern any signs of a positive relationship between the technological intensity of industries and the different types of subsidiary and hence with their differences in innovative activity. For instance, firms operating in Agro-Food Commodities industry (usually assigned to the category of low technology-intensive industries) are over-represented within the group of *Dually Integrated* subsidiaries, the group that is the most technologically active. Also, subsidiaries in the automotive industry – commonly considered to be relatively technology-intensive, at least in OECD economies – are over-represented in two types of subsidiary: both the *Corporately integrated* and *Locally integrated* categories—types of subsidiary with widely differing degrees of technologically active performance. Thus, there does not appear to be (at least not at this level of aggregation) an industry-effect by which the technology-intensity of industries shapes the structural positioning of subsidiaries and/or their innovative behaviour.

4.2.2.2. *Historical process.* It is also important to consider the historical processes by which the subsidiaries arrived at the structural positions in which we happened to capture them in our snap-shot cross-section in 1998. This may be particularly important in the light of the radical changes in the economic context of subsidiaries in Argentina that had arisen in the 1980s and especially the early 1990s. At least two aspects of this should be borne in mind.

First, our findings may well be influenced by the legacy effects of former domestic companies that became subsidiaries of MNCs via the very large share of mergers and acquisitions (M&As) within the exceptionally rapid growth of FDI in the 1990s. For example,

⁹ However, we recognise that, because the concept of structural positioning has been operationalised in this way, it may seem to obscure the importance of *direct* influences of other factors in Block A on the innovative behaviour of subsidiaries independently of structural positions. For example, it is well recognised in the literature (e.g. Granstrand, 1999) that there are important differences between the strategies of MNCs from different home countries with respect to the degree of decentralisation of innovative activity to subsidiaries outside the parents' home economy.

Table 4
Types of subsidiary and types of industry.

	Type of subsidiary				Chi ²
	I Isolated	II Corporately integrated	III Locally integrated	IV Dually integrated	
	Type of industry (Reflecting differences in 'technological intensity' ^b)				
Over-represented types of industry in each group of subsidiaries	Durable goods	Automotive, 'High-Tech' diffusers of technical progress ^c	Automotive	Agro-food commodities	Significant***
Under-represented types of industry in each group of subsidiaries	Automotive Agro-food commodities	Durable goods Traditional sectors	Durable goods	Durable goods	

^aThe industries shown are only those that are over- or under-represented in each type of subsidiary.

^b The six industry categories consist of aggregations of all three-digit industries in terms of broad distinctions that are similar to those in the commonly used OECD categories of differing 'technology-intensity', but modified by Ferraz et al. (1997) to be more appropriate in the context of Latin America.

^c This category consists of electronics-related and other 'High-technology' industries.

does this help to explain the observed behaviour of the *Locally Integrated* subsidiaries that demonstrated the presence of formal bases of localised technological functions (the existence of R&D laboratories, design departments, etc.), but also low levels of technological activity and limited innovation-related interaction with local firms or other organisations? One might speculate that a significant proportion of the subsidiaries demonstrating this peculiar combination were the technological 'shells' of former locally owned firms which had undertaken significant technological activities in the past that where subsequently run down following FDI via M&A. Alternatively, the characteristics of the *Dually Integrated* group might lead to a more positive view about the role of mergers and acquisitions. The strong technological activities of subsidiaries in this group might reflect MNC strategies of acquiring locally owned firms with strong technological activities and then reinforcing their further technological development. Perhaps both those interpretations are valid. This would be consistent with the observations of the R&D-intensity of subsidiaries in the UK by Cantwell and Mudambi (2005) who showed that FDI via M&A might lead to destructive or positive effects, depending on whether the subsidiaries had 'competence-creating' or 'competence-exploiting' mandates within their corporate structures (p. 1123).

Second, our results may also have been influenced by a context-driven evolution away from subsidiary structures and behaviours that had been prevalent during the earlier import substituting policy regime. It is well recognised that such policy regimes encouraged the emergence of multi-domestic subsidiaries with low degrees of corporate integration and highly extended arrays of localised functions (Kosacoff, 2000)—the characteristics of the *Locally Integrated* subsidiaries here. In that context, does the large number of subsidiaries in the *Dually Isolated* category reflect the transitional erosion of their former positions as *Locally Integrated* multi-domestic subsidiaries that have subsequently 'withered' in a more open economy—moving towards a narrower range of localised functions?

Clearly these and other aspects of history probably matter a lot.¹⁰ But, as with most other studies in this area, we have examined only a cross-section of subsidiary behaviour—in the same way as Cantwell and Mudambi (2005) who focused on the distinction (as of the early-1990s) between the 'competence-creating' and 'competence-exploiting' mandates of MNC subsidiaries in the UK

as an influence on their R&D-intensity. Those authors also emphasised that the observed cross-section reflected historical moments on long-term trajectories of subsidiary development but, like us, they were unable to throw light on those trajectories. Overcoming such limitations will require the design of research about subsidiary behaviour that explicitly addresses question about how it changes over time—in particular (i) how do their structural positions change in particular kinds of context and (ii) how does the innovation activity associated with particular positions also change?

5. Conclusions

Two aspects of the paper merit further summarising comment: (i) the distribution of subsidiaries across types of structural position, and (ii) the associations between those positions and the intensity of subsidiaries' local innovative activity. In the absence of similar studies in other contexts, associated comment about details of policy would be premature. However, even within the limitations of this study, it may be useful to note implications for common aspects of broader policy discourse, especially in Latin America, about the technological role of FDI.

5.1. The distribution of subsidiaries across structural positions

Two features of the distribution seem surprising. First, more than half of the subsidiaries in Argentina in the late 1990s did not demonstrate a commonly discussed feature of corporate globalisation over the recent decades: the close integration of subsidiaries' activities within the global corporate networks of their parent companies. About 60% of them occupied structural positions with limited corporate integration: the *Dually Isolated* and *Locally Integrated* groups; and within that nearly 40% occupied the, *Dually Isolated* position that has often been identified empirically as an empty cell in similar studies. These observations may reflect the relatively comprehensive scope of our sample of 331 subsidiaries compared to previous studies of MNC subsidiaries that have frequently relied on much smaller surveys and selective samples.

Second, about 16% of the subsidiaries, occupied the *Dually Integrated* position, involving both high corporate integration and high localisation of functions. In the absence of comparable observations it is not clear whether this should be seen as a 'large' or 'small' proportion. But it is a highly significant group because it demonstrates that, contrary to some studies and common perceptions, high levels of corporate and local integration are not necessarily alternatives, but may be complementary—as identified for example by Håkanson and Nobel (2001) in their study of Swedish subsidiaries. The significance of that group of subsidiaries, as well as the *Corporately*

¹⁰ Apart from the context-driven changes discussed here, there are inherent time-related processes in reaching the structural positions with more substantial innovative activities – as emphasised, for example, by Håkanson and Nobel (2001) in discussing their equivalent of the *Dually Integrated* structural position: "...reaching this position is not easy and requires concerted management effort" (p. 415).

Integrated group, is all the greater because the associated intensity of their local technological activity has implications for the wider issue of FDI-related spillovers in host economies.

5.2. Associations between subsidiaries' structural positions and their local innovative activity

Three aspects of this association are particularly interesting relative to previous research.

First, our findings suggest that, on its own, greater localisation of functions (as in the *Locally Integrated* group) is *not* associated with high levels of local technological activity in subsidiaries. This runs counter to a common expectation that has contributed to widespread policy debate in Latin America and to policy implementation in at least Argentina—i.e. the expectation that measures to increase the localisation of subsidiaries' functions will have positive effects on their local innovative activity. Our findings suggest that such measures are unlikely on their own to have much effect on subsidiaries' technological behaviour. Perhaps more important, such approaches may militate against the long-term development of specialisation in particularly competitive functions—and hence, among other things, perhaps constrain the emergence of more globally integrated positions.

Second, our demonstration of a positive association between local innovative activity and the degree of corporate integration—either in combination with low levels of localisation of functions (the *Corporately Integrated* position) or especially as a complement to high levels of local integration (the *Dually Integrated* position)—contrasts with other views. In particular, it is sharply different from the findings of Jarrillo and Martinez (1990) which suggest there is a trade-off between high corporate integration and high levels of local innovative activity in host economies. It also runs counter to widely held views among policy communities in Latin America that see FDI in general, and close corporate integration of technological activities in particular, as having *negative* effects on local innovative activity.

Third, at a more general level, our findings about the positive association between local innovative activity and *particular types* of subsidiary have wider significance because of connection to questions about FDI spillovers and associated approaches to policy. As discussed in the introduction to the paper, earlier studies, especially Marin and Bell (2006) and Marin and Sasidharan (2008) have shown that the spillovers from FDI depended heavily on the intensity of subsidiaries' technologically activity. In other words, it is not merely the *existence* of FDI that yields spillover benefits for the economy, but what subsidiaries *actually do* once they have been established or acquired. Consequently, those studies have argued that policy measures that focus simply on attracting FDI may be wasting scarce resources. Instead, they should be directed towards stimulating innovative activities in subsidiaries after they have been established. Now, however, our findings in this paper indicate that intensive innovative activities are associated only with certain types of structural position—those involving relatively high levels of integration with their global corporations. This suggests that policy initiatives that seek to stimulate the innovative activity of subsidiaries occupying other structural positions may also be a waste of resources. But focusing only on the *current* positions of subsidiaries may miss the key point about the historical processes that shape those positions over time—hence, we would argue, also shaping the intensity of innovative activity they undertake.

Annex A. Measuring the innovative activity of subsidiaries

The analysis reported in this paper uses four composite indexes of the innovative behaviour of MNC subsidiaries. Three of these

Table A.1

Factor loadings: index of innovative inputs.

Indicators	Factor loadings
R&D	0.47
Industrial design	0.21
Innovation-related management and consultancy	0.09
Capital goods for innovation	0.20
Payments for technology transfer	0.39
Imports of capital goods	0.18
IT	0.23
Skills intensity	0.00

reflect different aspects or dimensions of innovative activity: innovation inputs, outputs and inter-organisational linkages. Each is based on a number of underlying indicators. The fourth is a meta index that combines all 16 of the indicators used in computing the three separate indexes.

The underlying indicators are based on information derived from the National Innovation Survey in Argentina (1998–2001), using the data for 1998. All four indexes are calculated by factor analysis, using the Principal Factor Method (PF) rather than Maximum Likelihood (which is more sensitive to departure from normality). These indicators, along with the results of the factor analysis, are explained below.

A.1. Index of innovation inputs

The eight underlying indicators for this index were designed to reflect three different kinds of input to innovation.

- (i) Investment in disembodied knowledge:
 - I Intensity of expenditures on R&D.
 - II Intensity of expenditures on innovation-related industrial design.
 - III Intensity of expenditures on innovation-related management and consultancy.
- (ii) Investment in capital-embodied technology:
 - IV Intensity of expenditures on capital goods for innovations.
 - V Intensity of payments for technology transfer contracts and licences.
 - VI Intensity of imports of capital goods.
 - VII Intensity of expenditures on IT.
- (iii) Employment of human capital:
 - VIII Skill intensity, measured as the number of engineers, other professionals and technicians employed in production as a proportion of total employment.

Table A.1 shows the factor loadings (or correlation between each variable and the index) which reflect the contribution of each variable to the index. The proportion of total variance explained by the variation in the index is 90%.

A.2. Index of innovative output

Five underlying indicators were used.

- IX Number of patents granted to each firm.
- X Product innovation accomplished during the period.
- XI Process innovation accomplished during the period.
- XII Organisational innovations accomplished during the period.
- XIII Percentage of total sales – to local and/or external markets – explained by innovative products.

The number of patents includes only patents granted in USA and Europe, and we have excluded patents granted only in Argentina. Consequently it is very likely that they reflect new to the world

Table A.2

Factor loadings: index of innovative output.

Indicators	Factor loadings
Patents granted	0.04
Product innovation accomplished during the period	0.7
Process innovation accomplished during the period	0.6
Organisational innovations accomplished during the period	0.43
Percentage of innovative sales	0.5

innovations. However, the overall significance of such patenting by subsidiaries located in Argentina is very small. There were only 18 patents between 1998 and 2001, taken out by 15 subsidiaries. The remaining 318 subsidiaries did not patent during the period analysed.

With respect to product, process and organisational innovations (X and XI and XII), the Innovation Survey asked the firms about the type of innovation accomplished during the period, giving four different options: (a) innovations new for the world economy, (b) innovations new only for the country, (c) innovations new only for the company, and (d) no innovations. We draw on responses to these questions to define four corresponding categories of innovation: innovation new to the world was given the highest value (4) and no innovations the lowest (1).

Table A.2 shows the factor loadings indicating the contribution of each variable to the index. The proportion of the total variance explained by variations in the index is 81%.

A.3. Index of innovation-related interactions

This index is based on three underlying indicators.

XIV Networking intensity in general.

XV Linkages with other organisations specifically in the host country.

XVI 'Vertical' linkages with other firms in the host economy.

Indicator XIV was calculated simply as the sum of all the 'Yes' answers to a survey question about the subsidiaries' interactions with any other national and international organisations in their innovation-related activities. The 12 response options included parent companies and other affiliates as well as universities, technology centres, suppliers, consultants and so forth. Indicator XV was calculated more specifically as the sum of interactions with all organisations in Argentina, and Indicator XVI was calculated as the sum of interactions specifically with suppliers or customers in Argentina. Table A.3 shows the factor loadings for each variable. The proportion of total variance explained by variation in the index is 100%.

A.4. Overall index of innovative intensity

This index is based on all of the 16 indicators of innovative activity used to compute the three indexes described above. Table A.4 shows the factor loadings for each variable. The proportion of the total variance explained by variations in the index is 45%.

Table A.3

Factor loadings: index of network intensity.

Indicators	Factor loadings
Networking intensity	0.88
Linkages with other organisations in the host country	0.91
Vertical linkages with other firms in the host economy	0.70

Table A.4

Factor loadings: overall index of innovative intensity.

Indicators	Factor loadings
R&D	0.10
Industrial design	0.04
Innovation-related management and consultancy	0.26
Capital goods for innovation	0.21
Payments for technology transfer	0.15
Imports of capital goods	0.08
IT	0.12
Skills intensity	0.13
Patents granted	0.13
Importance given to product innovation	0.39
Importance given to process innovation	0.39
Importance given to organisational innovation	0.36
Percentage of innovative sales	0.31
Networking intensity	0.82
Linkages in the country	0.82
Vertical linkages	0.60

Annex B. Measuring the structural positions of MNC subsidiaries

Firms are first classified into structural position categories on the basis of their 'High' and 'Low' positions on each of two dimensions: (i) their degree of integration into the global corporation and (ii) their degree of localisation of functions. The two dichotomies are then combined to create four categories of structural position. The bases for the two underlying classifications are explained below.

B.1. 1 The degree of integration into the global corporation

The degree of subsidiaries' corporate integration has been assessed in several ways in the literature. We focus here on two aspects that have been frequently highlighted as significant in the literature about the technological role of MNCs in late-industrialising economies: the subsidiary's position in the corporate structure with respect to (a) innovation and (b) trade.

B.1.1. Innovation-related positions in the corporate structure

Data from two questions from the survey were used:

- (i) *Interactions with other local and international agents*—in which firms were asked about their innovation-related interactions with other organisations (as noted in Annex 1). Information about two of the response options is used here: (i) parents and (ii) other affiliates.
- (ii) *The main sources of information for innovation activities*—in which firms were asked about the importance of alternative sources of information for innovation activities. Information about 2 of the 11 possible response options is used here: (i) parent company headquarters and (ii) other affiliates.

An indicator of subsidiaries' innovation-related positions in the corporate structure was calculated in the following way. First we ranked the information from Question (ii) on a scale from 1 (irrelevant) to 4 (highly important) in order to create *varA* (an indication of importance). Second, we summed the number of times that each company declared it had interacted with the headquarters and with other affiliates from different regions to create: *varB* (an indication of quantity). Then third, we calculated the variable 'innovation-related position in the MNC' as the product of *var A* and *var B*. This varies between 0 and 24. Then, using the median value of this indi-

cator we classified subsidiaries into two groups¹¹—those with a *High* and a *Low* level of innovation-related integration in the MNC.

B.1.2. Trade-related positions in the corporate structure

Data from three questions in the survey were used—about: (i) the country of origin of the MNC parent, (ii) the main country of origin of the subsidiaries' technology imports and (iii) the main country to which the subsidiary exports. An indicator was calculated in the following way. Any match between the country of origin of the MNC and either the subsidiaries' main country of exports or its main country of technology imports were used as proxies of trade *with the MNC*. So, subsidiaries were classified in two types—those with (1) *High* trade with the MNC when the countries match in one or both cases, or (2) *Low* trade with the MNC when the countries did not match in either of the two cases.

Finally, the innovation-related and trade-related structural positions of the subsidiaries were combined to generate the overall indicator of their degree of integration into the global corporation. Subsidiaries were classified as demonstrating *High Integration* when they were classified as having: both (a) a high level of innovation-related integration and (b) high trade-related integration with the MNC. All other subsidiaries were classified as showing *Low Integration* into the global corporation.¹²

B.2. The degree of localisation of functions

The array of functions taken into account includes both production and technological functions. Four questions from the survey were used:

B.2.1. Production functions

(i) The origin of the products sold by the company

The proportion of sales arising from (a) goods produced by the company (own products) or (b) other firms' products. (The higher the proportion of own products, the greater the intensity of local production activities.)

(ii) The importance of imports of final goods

The proportion of firms' total imports falling into four categories: inputs, parts, final products and capital goods. (The lower the proportion of final products, the greater the intensity of local production activities.)

B.2.2. Technological functions

(iii) The existence of R&D laboratories.

(iv) The existence of Design departments.

We refer exclusively here to the *existence* of activities concerned with R&D and design, independently of their scale or effectiveness.

Subsidiaries were classified as demonstrating a *High Localisation* of functions when: (a) more than 60% of their sales (the median value)¹³ consisted of their own products, and (b) less than one-third

of their imports (the median value) consisted of final products, and (c) they had a formal R&D laboratory or Design department. All other subsidiaries were classified as demonstrating a *Low Localisation* of functions.

References

- Almeida, P., Phene, A., 2004. Subsidiaries and knowledge creation: the influence of the MNC and host country on innovation. *Strategic Management Journal* 25, 847–864.
- Andersson, U., Bjorkman, I., Forsgren, M., 2005. Managing subsidiary knowledge creation: the effect of control mechanisms on subsidiary local embeddedness. *International Business Review* 14, 521–538.
- Andersson, U., Forsgren, M., 1996. Subsidiary embeddedness in the multinational corporation. *International Business Review* 5, 487–508.
- Barlett, C.A., 1986. Building and managing the transnational: the new organizational challenge. In: Porter, M.E. (Ed.), *Competition in Global Industries*. Harvard Business School Press, Cambridge, pp. 367–401.
- Bartlett, C., Ghoshal, S., 1989. *Managing Across Borders: The Transnational Solution*. Harvard Business School, Boston.
- Birkinshaw, J., 1997. Entrepreneurship in multinational corporations: the characteristics of subsidiary initiative. *Strategic Management Journal* 18 (3), 207–229.
- Birkinshaw, J., Hood, N., 1998. Multinational subsidiary evolution: capability and charter change in foreign-owned subsidiary companies. *The Academy of Management Review* 23 (4), 773–795.
- Birkinshaw, J., Hood, N., 2000. Characteristics of foreign subsidiaries in industry clusters. *Journal of International Business Studies* 31 (1), 141–154.
- Blomström, M., Kokko, A., 2003. Human Capital and Inward FDI. EIJ Working Papers Series 167. The European Institute of Japanese Studies, Stockholm.
- Cantwell, J., 2001. Innovation and information technology in MNEs. In: Rugman, A.M., Brewer, T.L. (Eds.), *The Oxford Handbook of International Business*. Oxford University Press, Oxford, UK, pp. 431–456.
- Cantwell, J., Iammarino, S., 2003. *Multinational Corporations and European Regional Systems of Innovation*. Routledge, London and New York.
- Cantwell, J., Mudambi, R., 2005. MNE competence-creating subsidiary mandates. *Strategic Management Journal* 26, 1109–1128.
- Castellani, D., Zanfei, A., 2005. Technology gaps, absorptive capabilities and the impact of inward investment on productivity of European firms. *Economics of Innovation and New Technology* 12 (6), 55–576.
- Caves, R., 1974 May. Multinational firms, competition and productivity in host-country markets. *Economica* 41, 176–193.
- Doz, Y.L., Prahalad, C.K., 1984. Patterns of strategic control within multinational corporations. *Journal of International Business Studies* 15, 55–72.
- Dunning, J., Cantwell, J., 1986. The changing role of multinational enterprise in the international creation, transfer and diffusion of technology. In: *Proceedings of the Conference on Innovation Diffusion*, Venice, March.
- Driffield, N., Love, J., 2007. Linking FDI motivation and host economy productivity effects: conceptual and empirical analysis. *Journal of International Business Studies* 38 (3), 460–473.
- Ferraz, J.C., Kupfer, D., Haguenaer, L., 1997. *Made in Brasil: Desafios Competitivos Para a Industria*. Campus, Rio de Janeiro.
- Forsgren, M., Phallberg, C., 1992. Subsidiary influence and autonomy in international business. *International Business Review* 1, 41–51.
- Ghoshal, S., Bartlett, C.A., 1988. Innovation processes in multinational corporations. In: Tushman, M.L., Moore, W.L. (Eds.), *Readings in the Management of Innovation*. Ballinger, USA, pp. 499–518.
- Giuliani, E., 2007. The selective nature of knowledge networks in clusters: evidence from the wine industry. *Journal of Economic Geography* 7 (2), 139–168.
- Granstrand, O., 1999. Internationalization of corporate R&D: a study of Japanese and Swedish corporations. *Research Policy* 28, 275–302.
- Håkanson, L., Nobel, R., 2001. Organizational characteristics and reverse technology transfer. *Management International Review* 41 (4), 395–419.
- Haskel, J., Pereira, S., Slaughter, M., 2002. Does inward foreign direct investment boost the productivity of domestic firms. NBER Working Paper No. 8724. National Bureau of Economic Research, Cambridge, MA.
- Jarrillo, J., Martinez, J., 1990. Different roles for subsidiaries: the case of multinational corporations in Spain. *Strategic Management Journal* 11 (7), 501–512.
- Javorick, B., 2004. Does foreign direct investment increase the productivity of domestic firms? In search of spillovers through backward linkages. *American Economic Review* 94 (3), 605–627.
- Kogut, B., 2002. International management and strategy. In: Pettigrew, A., Thomas, H., Whittington, R. (Eds.), *Handbook of Strategy and Management*. Sage Publications, London, pp. 261–278.
- Kosacoff, B. (Ed.), 2000. *Corporate strategies under structural adjustments in Argentina: responses by industrial firms to a new set of uncertainties*. MacMillan, Basingstoke.
- 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, 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, 159–174.

¹¹ Top and low quartiles were used alternatively as cutting points in sensitivity tests but the results did not change substantially.

¹² Two issues should be noted about the way this indicator was calculated. First, since we intend to assess the relationship between levels of integration within corporate structures and the intensity of subsidiaries' innovative behaviour, there could be a selection bias against firms that declared they had not used headquarters or other affiliates as the main source of information for innovation activities simply because they were not innovators. We have therefore eliminated from the analysis the two subsidiaries that declared all sources as not significant. Second, the proxy for intra-corporate trade will probably underestimate intra-corporate flows of goods and services since it considers only the country of the headquarters, not the country of other affiliates with which the subsidiary could be trading.

¹³ Top and low quartiles were used alternatively as cutting points in sensitivity tests but the results did not change substantially.

- Marin, A., 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), 678–697.
- Marin, A., Sasidharan, S., 2008. Heterogeneous MNC' subsidiaries and technological spillovers: explaining positive and negative effects in emerging economies. UNU-Merit Working Paper Series, 2008/066.
- Markusen, J., 1995. The boundaries of multinational enterprises and the theory of international trade. *Journal of Economic Perspectives* 9, 169–189.
- Niosi, J., 1999. Introduction—the internationalization of industrial R&D: from technology transfer to the learning organization. *Research Policy* 25, 107–117.
- Nobel, R., Birkinshaw, J., 1998. Innovation in multinational corporations: control and communication patterns in international R&D operations. *Strategic Management Journal* 19, 479–496.
- Papanastassiou, M., Pearce, R., 1999. *Multinationals, Technology and National Competitiveness*. Elgar, Cheltenham.
- Pearce, R.D., 1999. Decentralised R&D and strategic competitiveness: globalised approaches to generation and use of technology in multinational enterprises (MNEs). *Research Policy* 28, 157–178.
- Porter, M.E., 1986. *Competition in Global Industries*. Harvard Business School Press, Cambridge, MA.
- Prahalad, C.K., Doz, Y., 1987. *The Multinational Mission: Balancing Local Demands and Global Vision*. Free Press, New York.
- Reddy, P., 2005. R&D-related FDI in developing countries: implications for host countries. In *Globalisation of R&D in Developing Countries: Proceedings of the Expert Meeting*. United Nations, New York and Geneva.
- Taggart, J.H., 1996. Multinational manufacturing subsidiaries in Scotland: strategic role and economic impact. *International Business Review* 5 (5), 447–468.
- Taggart, J.H., 1998. Strategy shifts in MNC subsidiaries. *Strategic Management Journal* 19, 663–681.
- Todo, Y., Miyamoto, K., 2002. Knowledge diffusion from multinational enterprises: the role of domestic and foreign knowledge-enhancing activities. OECD Technical Paper 196. Organisation for Economic Cooperation and Development, Paris.
- von Zedwitz, M., Gassmann, O., 2002. Market versus technology drive in R&D internationalization: four different patterns of managing research and development. *Research Policy* 31, 569–588.
- Zander, I., 1999. What do you mean 'global'? An empirical investigations of innovation networks in the multinational corporation. *Research Policy* 28, 195–213.