Do Multinationals Feed Local Development and Growth?

Lucia Piscitello and
Grazia D. Santangelo

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DO MULTINATIONALS FEED LOCAL DEVELOPMENT AND GROWTH?

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Chapter 1

Introduction

Lucia Piscitello and Grazia D. Santangelo

1. The Topic and the Aim of the Volume

Scholars debating on the effects of multinational enterprises (MNEs) have recently reached consensus on the latter's beneficial role, although with the due qualifications in terms of sectors involved, corporate competencies and absorptive capacity of the local economy. Conversely, the debate among policy-makers is still open. This further volume on the topic intends to make the point about the current academic position, providing fresh empirical evidence and conceptual schemes in order to offer additional insights to policy makers.

Traditionally, the impact of MNEs' activity was theorised to depend on the extent of the technological gap between foreign investors and local economies (Findlay, 1978). More specifically, it was suggested that the larger the technological gap between host country firms and foreign-owned firms, the larger the potential for technology transfer and for productivity spillovers to the former. Such a position was challenged by the "technological accumulation hypothesis" (Cantwell, 1989), which was consistent with several pieces of evidences (Kokko, 1994). According to this hypothesis, lower technological gap between domestic and foreign firms implies higher absorptive capacity (Cohen & Levinthal, 1990) of the former, and thus higher expected benefits in terms of technology transfer to domestic firms. Moving from this, a large stream of studies has taken off, focusing on the linkages that MNEs develop with local actors (Rodriguez-Claire, 1996; UNCTAD, 2001; Alfaro & Rodriguez-Claire, 2004; Smarzynska, 2004). Spillovers to the local firms may assume several forms and occur through different (both direct and indirect) channels (see the recent surveys by Lipsey, 2002; Barba Navaretti & Venables,

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2004; Castellani & Zanfei, 2006). MNEs may indeed improve innovative capabilities and competitiveness of local firms by: (1) fostering spin-off process and providing local firms with opportunities to access highly qualified workforce (Fosfuri, Motta, & Ronde, 2001); (2) stimulating imitation, reverse engineering and involuntary diffusion of information on advanced technologies and managerial techniques (Mansfield & Romeo, 1980; Dunning, 1993); (3) causing competitive pressures that stimulate local productivity (Caves, 1974, 1996; Cantwell, 1989); (4) creating backward and forward linkages that increase the demand for local input, make advanced intermediate goods available to users, favour specialisation economies and foster interaction processes with local institutions and universities (Hirschman, 1958; Rodriguez-Clare, 1996; Markusen & Venables, 1999; Santangelo, 2002; Alfaro & Rodriguez-Clare, 2004). Negative effects are instead related to the fact that MNEs might monopolise local markets, thus leading local companies to reduce their production levels and their technical efficiency (Aitken & Harrison, 1999). MNEs might also displace domestic production of input, as they facilitate the entry of foreign suppliers thus destroying pre-existing linkages (Lall, 1978). The net impact on innovation and efficiency of the local host economy does actually depend on which force will prevail (Blomström, 1989, 1991; Haddad & Harrison, 1993; Rodriguez-Clare, 1996). Additionally, potential benefits from Foreign Direct Investment (FDI) might not take place, as a crucial condition to benefit from spillovers is related to the local firms' technological capabilities and absorptive capacity (Cantwell, 1989; Blomström & Kokko, 1998; Aghion, Blundell, Griffith, Howitt, & Prantl, 2006).

Although acknowledged that MNEs' activities have also an impact on their home countries, this side of the story has received less attention so far (Brainard & Riker, 1997; Blomström & Kokko, 1998; Lipsey, 2002; Hansson, 2005). However, due to the emergence of new economic actors in the global scene and to the related challenges for the developed countries from which FDI traditionally departs, this aspect has gained more and more relevance. Within this context, the main concerns refer to the relocation of labour-intensive and innovation-intensive activities in particular to low wage and fast-growing countries, respectively (UNCTAD, 2005). Researchers are increasingly investigating the soundness of this fear. Nonetheless, it should be also recognised that FDI may be a source of opportunities for enhancing competitiveness by allowing multinationals to overcome the weaknesses of their home innovation system as well as to search and pick up unexpected chances for new knowledge exploration. The literature has in fact documented that MNEs go abroad not just for mere market and efficiency factors, but increasingly for accessing sources of knowledge that are localised in several countries in order to strengthen the whole company's technological base (Cantwell, 1995; Dunning & Narula, 1995; Almeida, 1996; Cantwell & Piscitello, 1999; Zanfei, 2000; Frost, 2001). The different motivations for FDI are mirrored in foreign subsidiaries' heterogeneity. In particular, MNEs may undertake competence-creating and/or competence-exploiting

activities (Pearce, 1999; Cantwell & Mudambi, 2005), also named in Kuemmerle's (1997, 1999) words Home Based Augmenting and Home Based Exploiting, respectively. Both activities concern technological competencies and tacit know-how (see Kogut & Zander, 1992; Iwasa & Odagiri, 2004), as well as managerial competencies and skills in marketing, production and organisation (Goshal, Korine, & Szulanski, 1994; Björkman, Barner-Rasmussen, & Li, 2004). Nonetheless, the former aims to the development of new knowledge, while the latter to the adaptation of the existing one to the local environment. Parent company's absorptive capacity as well as the technological gap between MNEs and the host economy play a major role (Gupta & Govindarajan, 2000; Ambos, Ambos, & Schlegelmilch, 2006).

In this context, the present volume has the following aims:

1. Contributing to the analysis of the impact of MNEs' activities on host countries development and growth (Chapters 2 and 3).
2. Analysing and testing the creation of linkages and knowledge flows in local contexts (Chapters 4–6).
3. Investigating the relationships between foreign activities and home countries competitiveness (Chapters 7 and 8).
4. Shedding light on the role of industrial and economic policy (Chapter 9).

More specifically, the impact on host country development is tackled in Chapter 2, which provides a review of the empirical studies on FDI-led growth. Rajneesh Narula and Brian Portelli argue that this is not a process that occurs automatically in the host country, thus reflecting the complex nature of the interrelationships between MNEs and host country economic agents. Host countries cannot capture the full benefits associated with FDI until a threshold level of capabilities is reached. The importance of this threshold absorptive-capacity level highlights the non-automatic interactions between FDI and development in the host country. Not Surprisingly, countries at early stages of economic development do not have fully developed assets and hence their location advantages are presumed to be insufficient to attract inward direct investment, with the exception of FDI arising from the possession of natural resources. Chapter 3 contributes to the literature on the impact of the FDI on growth by focusing on the role of their sectoral composition. The evidence currently available is mixed. With reference to 33 OECD countries, Aykut Dilek and Selin Sayek investigate whether the sectoral composition of FDI matters while contributing to the economic growth of the recipient country by drawing on a data set from various international institutions and country sources. The analysis is based on the premise that the growth effects of FDI may be elusive not only due to the characteristics of the recipient economy but also due to the sectoral characteristics of the flows themselves.

The volume, then, turns to the issue of knowledge flows and linkages creation stemming from MNEs' activities. In Chapter 4, Philip McCann and Ram Mudambi

emphasise the significance of the spatial aspect of MNEs' behaviour, which is influenced by the nature of the MNE's inter-firm relations and by the trade-off concerning information spillovers to and from other local firms. Depending on the result of such a cost-benefit analysis, MNEs make location decisions affecting regional clustering processes and, therefore, local development. Knowledge flows are also the focus of the next chapter where John Cantwell and Camilla Noonan, carry out a patent citation analysis in the German context. Specifically, Chapter 5 examines knowledge localisation by presenting a descriptive analysis of the technology sourcing activities of foreign firms located in Germany between 1975 and 1995. In Chapter 6, Elisa Giluliani and Anabel Marin focus on linkages creation by foreign subsidiaries in a developing economy, such as Argentina by drawing on secondary data from the Argentinean National Innovation Survey (1998–2001), and primary data from an original survey administred to MNEs' subsidiaries. The chapter classifies different types of foreign subsidiaries in terms of global linkages and investigates the local linkages they are able to establish.

The last section of the volume is dedicated to the relationships between foreign activities and home competitiveness. Relying on an original database on Italian multinationals, in Chapter 7 Lucia Piscitello and Larissa Rabbiosi assess whether MNEs succeed in transferring back knowledge and competencies from foreign subsidiaries and whether these are successfully incorporated in the parent's knowledge base. Complementary evidence on the positive impact of foreign investment on the parent's performance in terms of labour productivity and employment is provided by Mara Grasseni and Anna Falzoni in Chapter 8. Their analysis aims to test whether the extent of foreign activities helps to explain parents' performance at home and whether the different characteristics of the parents, in terms of number of employees and labour productivity, matter. Using a panel of Italian firms investing abroad, the authors allow for different effects of outward FDI on firms located at different quantiles of the performance distribution as well as for the geographical area where affiliates are located.

Policy implications are then drawn by Pervez Ghauri in Chapter 9.

2. Empirical Evidence from the Chapters

The empirical evidence and the conceptual discussion carried out in the volume allow shedding light on specific questions that raise within each of the aims put forward above. In particular, as far as the host country perspective is concerned:

(i) *To what extent foreign MNEs represent a crucial source of spillovers for domestic companies? And which are the "working mechanisms" of these knowledge transfers?* The conceptual discussion developed in Chapter 4 points out that the role

played by MNEs greatly depends on the trade-off between knowledge inflows and knowledge outflows in the local context. Specifically, the opportunities for MNEs to benefit from inter-firm local information spillovers are rather more limited than many other authors (e.g. Saxenian, 1994) assume. The reason is that the ability to benefit from such spillovers crucially depends on organisational issues. Unless MNEs are willing and able to decentralise their organisational structures almost to the point of complete hierarchy fragmentation, they will neither benefit from, nor contribute to such local externalities. Focusing on the role of foreign subsidiaries in Argentina, Chapter 6 highlights that "globally diversified" and "globally independent" subsidiaries are likelier to diffuse technological knowledge locally. Conversely, subsidiaries more dependent on the MNE group are less likely to develop dense networks at the local level. Likewise, "globally isolated" subsidiaries tend to behave in isolation also at the local level, not representing a valuable source of knowledge for other firms in the host country.

(ii) *How can development and growth processes take off? And are there privileged locations and sectors?* Chapter 2 argues that the developmental impact of FDI rests on the dynamics of the transfer of technology, but more importantly on the extent of integration of MNE affiliates in the host country systems and of upgrading of local capabilities over time. Indeed it is vital that foreign agents of dynamic comparative advantage complement rather than substitute local agents. That developing countries can benefit from spillovers accruing from MNE activity is a not disputed fact. However, it remains an assumption that MNE activity is a *sine qua non* for economic development, and that greater FDI flows will automatically result in the dissemination of these technologies and organisational practices from developed to developing countries. The sub-national regional aspects is tackled in Chapter 5, where a descriptive evidence on the German case suggests that technological activities undertaken in Germany may be categorised as *home base augmenting* pursuing new lines of technological search at this location — rather than building upon prior research of the parent. This underscores the importance of physical presence at locations that host cutting edge research as firms must locate within the appropriate international centre of excellence to *breathe in the air of innovation*. The sectoral issue is instead addressed in Chapter 3, where the cross-sectional empirical evidence suggests that, as the sectoral composition of FDI gets skewed towards the manufacturing sector, there is a significant and positive effect on economic growth. On the contrary, whenever the sectoral composition of FDI gets skewed towards the services or the primary sector, there is a negative and mostly significant effect on economic growth.

Moving to the home country side, the questions raising are the following:

(iii) *Do MNEs benefit from significant knowledge transfer from their foreign activities? And what modalities and mechanisms do MNEs adopt to value knowledge*

transfers? Which are the main advantages stemming from them? Chapter 7 shows, empirically, that foreign activities improve the parent company's innovativeness and this mainly occurs through reserve knowledge transfer. However, the efficacy of the transfer is greater when person-based mechanisms (in particular teams, visits and meetings) are employed, while the parent company's innovativeness is only partially influenced by the use of ICT and codified mechanisms.

(iv) *Do MNEs' performances also benefit in terms of labour productivity and employment?* The econometric results obtained in Chapter 8 indicate that the impact of the multinational activity varies across firms in different quantiles of the performance distribution and across foreign affiliates' geographical locations. In particular, firms throughout the productivity distribution do not benefit from FDI in less developed countries. Differently, parent firms in the upper quantiles of productivity seem to be positively affected by foreign expansion in developed countries. As for employment, only small firms seem to be negatively influenced by outward FDI. Finally, multinational experience influences positively and significantly parent firms across quantiles of productivity and employment.

Overall, these answers may be useful to orient policymakers to address the following question:

(v) *Which is the role of policy in order to trigger virtuous circles involving multinationals, local development and growth?* Chapter 9 concludes that the interaction between MNEs and governments can be characterised as a sequential process heading from the policies of (developing) countries and regions to the impact on MNEs and through their strategies to an impact on (developing) markets. However, recursive elements and interactions between international institutions, government policies and strategies of MNEs are main mechanisms that influence development. The analysis conducted throughout the volume also suggests that the state's responsibility has to be based on its capabilities and the relative strength of the market and society. In particular, countries with low state capability need to focus on minimal basic functions, while states with strong capabilities should play a more active role in dealing with problems related to market imperfections. In both cases, as far as the management of environment, regulation of monopolies and provision of social benefits are concerned, governments can work together with market and society. Rethinking the role of state also means that it has to explore alternative instruments and ways to enhance the effectiveness of its policies.

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Chapter 2

Foreign Direct Investment and Economic Development: Opportunities and Limitations from a Developing Country Perspective

Rajneesh Narula and Brian Portelli

Abstract

Foreign Direct Investment has attracted increasing interest from developing countries because of the perceived benefits in terms of the injection of capital, technology and knowledge. This article analyses the main analytical underpinnings concerning the inter-relationships between the FDI and host-country economic development. We undertake a brief review of empirical studies on the issue of FDI-led growth process. We highlight a very basic point emerging from the literature, that FDI is not a sine qua non for development. FDI-led growth is not a process that occurs automatically in the host country, and this reflects the complex nature of the interrelationships between multinational enterprises (MNEs) and host-country economic agents. A vast majority of the existing empirical studies indicate that the FDI does not always make a positive contribution to either economic growth or factor productivity. This is often because host countries are not able to capture the bulk of benefits associated with the FDI without a certain threshold level of absorptive capabilities.

1. Introduction

Over the past two decades, the growth of multinational enterprise (MNE) activity has increasingly been regarded as one of the defining characteristics of the world

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economy and an engine of economic growth. MNE-related externalities have been attracting increased interest from developing countries because of the perceived benefits in terms of the injection of capital, technology and knowledge, as well as the potential generation of economic growth in host countries. Key MNE externalities include the knowledge spillovers and linkages from MNEs to domestic firms in host countries. The nature of these MNE externalities may either arise from pure market transactions (e.g., through MNE vertical linkages) or else through knowledge spillovers, which take non-market or non-monetary form.

This general warming of attitudes towards the FDI has taken place in the context of the promotion of outward-looking economic strategies as envisaged by the 'Washington Consensus' institutions, namely, the International Monetary Fund and the World Bank. Hence, developing countries have been undertaking policy shifts from inward-looking, import substitution industrialisation models towards more outward-looking, export-oriented economic policies (Lall & Narula, 2006). The increased role of MNEs in certain sectors is in part a result of aggressive liberalisation of the FDI regimes and privatisation programmes. Indeed, the greatest change has been the reduction in state ownership and the subsequent privatisation of assets.

The less developed a country is, the greater the need for such MNE externalities, as a means to alleviate resource and skill constraints normally associated with underdevelopment. Developing countries actively seek the FDI to strengthen industrial competitiveness and enhance their growth prospects.[1] As a result, developing countries' attitudes towards the FDI have changed, with dramatic improvements in the FDI policy regimes.[2] Governments in developing countries have not only reduced barriers to the FDI, but have also been offering special incentives to attract foreign firms and foster relationships between MNEs and local firms.[3]

The debate on the merits and de-merits of the FDI started in the 1960s (Reuber et al., 1973; Lall & Streeten, 1977) and is still far from over. This topic has assumed greater importance in the context of the anti-globalization movement, which opposes further liberalisation of international trade and investment.

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[1]The relevance of the FDI vis-à-vis economic development, stems from a number of potential benefits to be realised in the host economy. For example, the FDI is less volatile than other private capital flows and provides a stable source of finance to meet capital requirements in developing contexts (Reisen & Soto, 2001).

[2]This is particularly so in the case of those developing countries which until some time ago practised the outright barring of the FDI activity (Caves, 1982).

[3]In 1998, 103 countries offered tax concessions to foreign companies that set up production or administrative facilities within their border (Hanson, 2001).

The FDI and its developmental effects is therefore a topic that attracts considerable attention and interest from academia and policy makers.

The objective of this article is therefore to look at the key analytical issues related to the topic of the FDI and economic development from the point of view of host developing countries, specifically focusing on the impact of the FDI on economic growth and the mechanisms through which this is achieved. After this introduction, Section 2 provides a brief overview of the background of the topic, in terms of the trends in the FDI flows and stocks in developing countries and main regional trends and performances. Section 3 presents an overview of the empirical evidence on FDI-led growth, principally the mechanisms towards this end. We finish this article with some concluding remarks.

2. Background and Trends of the FDI in Developing Countries

The growing importance of the FDI represents one of the defining features of globalisation and the reshaping of the international business environment and there are a number of studies that have examined the changing structure of international production and documented the meteoric growth in FDI activities (Dunning & Narula, 2004). This section highlights some of the salient trends and country/ regional characteristics in terms of inward FDI.

Over the past two decades, world FDI inflows have more than tripled, increasing from around US$ 55 billion in the late 1980s and reaching US$ 651 billion in 2002. As Table 2.1 illustrates, in 2002 more than 70 per cent of total world FDI inflows have been directed to developed countries, with the remainder being shared by developing regions. It is noteworthy that an increasingly large proportion of aggregate FDI flows takes the form of cross-border mergers and acquisitions (M&As) which includes the acquisitions of public enterprises through various national privatisation programmes. In 1999, M&As accounted for around 80 per cent of total FDI inflows, corresponding to substantial high shares across developing regions (UNCTAD, 2000). The take-over of former parastatal companies represented an increasingly important FDI driver in developing economies as these countries continue to liberalise their economies (Liberatori & Pigato, 2000).

Inward FDI stock in developing countries has increased from US$ 307.5 billion in 1980, and has reached US$ 2,340 billion in 2002. This corresponds to around 33 per cent of total world inward FDI stock. The magnitude of inward FDI stock going to developed economies, accounting to 65 per cent of world total in 2000, compared to 56 per cent in 1980. For the developing economies, the same share decreased from 44 per cent in 1980 to around 35 per cent in 2002. Table 2.1 illustrates

Table 2.1: Basic world FDI indicators.

Type of economy	In US$ (millions)		As a % of GFCF		In US$ (millions)		Per cent share in worldtotal		Average % growth	As a % of GDP	
	1980	2002	1980	2002	1980	2002	1980	2002	1980–2002	1980	2002
World	54,957	651,188	2.3	12.2	699,415	7,122,506			39.9	6.7	22.3
Developed economies	46,530	460,334	2.7	12.3	391,946	4,594,850	56.0	64.5	46.6	4.9	18.7
Developing economies	8392	162,145	1.2	10.5	307,469	2,339,788	44.0	32.9	28.7	12.6	36.0
Developing countries excluding China	8335	109,445	1.3		301,219	1,891,896	43.1	26.6	23.0	13.5	35.8

Source: UNCTAD and FDI database.

these trends. It is noteworthy that within the developing country groupings, there are marked differences among the developing regions. It is noteworthy to highlight the relative 'weight' of China in terms of inward FDI attraction in recent years. For example, in 2002, China's share in total inward FDI stock stood at 6 per cent, compared to 0.1 per cent in 1980.

The important role of FDI in host economies is highlighted in specific indicators, such as the share of inward FDI flows as a percentage of gross fixed capital formation (GFCF), as well as the share of inward FDI stock as a percentage of gross domestic product (GDP). The share of inward FDI inflows as a percentage of GFCF measures the relative weight of the FDI in total aggregate investment taking place in the host economy. Total investment includes both public and private sector investment in the host country. On the other hand, the share of inward FDI stock as a percentage of GDP provides a tentative measure of the importance of inward FDI stock in relation to total economic activity taking place in the host country (as measured by the GDP). Table 2.1 illustrates the increased importance of the FDI flows and stock as evidenced from increasing shares in both indicators between 1980 and 2002.

Within the various regional groupings, it is equally evident that not all developing regions have been equally successful in attracting the FDI to their economies. For example, whereas in 1980, Sub-Saharan Africa and South America had almost the same level of inward FDI stock, with a share of world total at 4.0 and 4.2 per cent respectively, their respective shares in 2002 were very different. Sub Saharan Africa's share stood at 1.7 per cent of total inward FDI stock compared to 6.2 per cent for South American region. Although decreasing its shares over the 1980–2002 period, Southeast Asia maintained the highest share for developing countries. Alternatively, looking at the average growth rates over the period 1980–2002, it is more evident that inward FDI stock towards developed economies has grown at an average rate of 48 per cent. The highest growth rate is that for South America with 61 per cent and the lowest growth rate is that for Sub-Saharan Africa at 14.8 per cent. Table 2.2 illustrates these trends.

A reason behind cross-regional disparities of the FDI in developing countries may be due to the concentration of the FDI in few selected countries. Indeed, it is estimated that the five largest host countries in developing world received 62 per cent of total FDI inflows (UNCTAD, 2002a). These handful of countries primarily include the newly industrialised Asian countries, particularly China. As illustrated in Table 2.2, in each of the developing regions, just five countries accounted for over 70 per cent of all inward FDI flows.

It is also evident that the onset of globalisation has transformed the modes of MNE production and trade in both developed and developing countries. This is reflected in changes in the extent of information and technology in economic

Table 2.2: Basic FDI indicators for developing regional groups.

Host region	FDI Inflows						FDI inward stock				
	In US$ millions		As a % of GFCF		In US$ millions		% share in world total		Average % growth	As a % of GDP	
	1980	2002	1980	2002	1980	2002	1980	2002	1980–2002	1980	2002
Developing economies	8392	162,145	1.2	10.5	307,469	2,339,788	44.0	32.9	28.7	12.6	36.0
Sub-Saharan Africa	239	7452	0.3	10.7	27,840	122,723	4.0	1.7	14.8	10.9	37.5
South America	3631	25,836	3.2	14.6	29,345	441,110	4.2	6.2	61.0	5.9	48.8
Southeast Asia	3558	88,613	0.1	7.2	216,139	1,304,973	30.9	18.3	21.9	27.9	38.0
Least developed countries	537	5232	3.6	6.6	3,419	46,099	0.5	0.6	54.3	3.1	23.5

Source: UNCTAD and FDI database.

Table 2.3: FDI to developing regions in relation to total inward FDI stock.

	1980	**2002**
Africa	10.5	7.3
North Africa	1.4	2.1
Other Africa	9.1	5.2
South Africa	5.4	2.2
Concentration ratio in 2002 (5 largest recipients: South Africa, Nigeria, Egypt, Tunisia, Angola)	70.1	
Latin America and the Caribbean	16.4	32.6
South America	9.5	18.9
Other Latin America and the Caribbean	6.8	13.7
Brazil	5.7	10.1
Concentration ratio in 2002 (5 largest recipients: Brazil, Bermuda, Argentina, Mexico, Chile)	77.6	
Asia and Pacific	73.1	60.1
South East Asia	70.3	55.8
China	2.0	19.1
Concentration ratio in 2002 (5 largest recipients: China, Hong Kong, Singapore, Malaysia, Indonesia)	79.4	

Source: UNCTAD and World Investment Report (various).

activities, trade intensity and FDI liberalisation policies and the new rules of international trade and investment (Narula, 2003a). In the context of these developments, over the past two decades the sectoral trends (primary, manufacturing and services) in the FDI have also registered substantial changes. An important development has been the sharp decline in FDI stock going into primary sector economic activities, the share of which has registered a decrease by more than half between 1988 and 1997 (Table 2.3). On the other hand, the services sector has registered a growing share over the same period. It is also noteworthy that the greater importance of the services sector has been underpinned by the M&As boom between 1987 and 2000. It is estimated that the share of the services sector M&As, in 1999 was more than twice the sum of the primary and manufacturing sector (UNCTAD, 2000). In terms of the level of FDI stock, the manufacturing sector remains the most important economic sector in the developing country group. It is also important to highlight the extensive regional disparities in sectoral composition. The African region appears to go against the overall developing country trends with the share of primary goods remaining

Table 2.4: Share of inward FDI stock by sector in developing countries.

Sectors	Asia (%)		LAC (%)		Africa (%)		Total (%)	
	1988	**1997**	**1988**	**1997**	**1988**	**1997**	**1988**	**1997**
Primary	8.4	3.5	8.8	5.7	51.8	53.4	10.3	3.9
Manufacturing	62.1	62.9	67.4	28.8	20.8	26.6	62.3	60.7
Services	29.4	33.6	23.8	55.5	27.4	19.8	27.4	35.4
Total	100	100	100	100	100	100	100	100

Source: UNCTAD and World Investment Report (1999).

substantially high and constant and the share of services sector diminishing. This outcome partly reflects the fact that a large number of MNEs operating in Africa are still attracted by the abundance of natural resources rather than the market or other host-country location–specific advantages (Narula, 1996). This form of FDI has different implications for growth and development in host economies than FDI in manufacturing and services. Hiemenz et al. (1991) found that natural resource oriented FDI in contrast to manufacturing FDI tends to be undertaken independently of macro-economic conditions and other host-country factors. The Latin American and the Caribbean regions have registered a large drop in the share of the manufacturing sector with a corresponding increase in the share of the services sector (Dunning & Narula, 2004). The Asian region has exhibited a large and relatively stable share of manufacturing sector activities (see Table 2.4).

These data provide an indication of the trends and importance of FDI in the developing country context, especially with regards to shares in global FDI stocks and flows and the relative 'weight' of the FDI with respect to investment and economic activity in the host country. In addition to highlighting the trends in inward FDI flows and stocks, it is important to examine actual studies and empirical evidence on the potential for leveraging the role of the FDI for economic growth. It is also relevant to examine and highlight the mechanisms through which FDI-led growth is achieved. Are there any determinant factors that facilitate this process? These questions and corresponding caveats are tackled in the next section.

3. FDI, Economic Growth and MNE Externalities

From the point of view of host developing countries, the central question concerning the role of the FDI in development is to what extent do the FDI and MNE

activities contribute to the generation of host-country economic growth through the realisation of MNE externalities (Portelli, 2006). This question is linked to the realisation of the necessary preconditions for MNE externalities and FDI-led growth to emerge. In this section, we stress the point that the impact of the FDI on host-country economic growth revolves around the nature and extent of these externalities, whether occurring in the same industry of the MNE or else in upstream industries (i.e. supplier firms).[4] Irrespective of their nature and form, these externalities have an impact on FDI-led host-country economic growth prospects. Externalities are the mechanism through which productivity gains by locally-based firms occur, leading to the generation of economic growth in the host economy. Through these externalities, FDI inflows can potentially break the vicious circle of underdevelopment (as evident in low savings, low investment and low growth poverty traps) by easing capital, technology and knowledge constraints in the host economy. For example, MNEs are likely to bring in the host-country capital, technology and knowledge and potentially lead to increased exports boosting international competitiveness (Blomstrom, 1990). MNE externalities, technology spillovers and vertical linkages are tackled first as the mechanisms through which the generation of economic growth in the host country occurs. In passing, certain determinant factors for technology spillovers and growth are highlighted.

3.1. MNE Externalities

MNEs are among the most important actors in the generation and control of new technology and they utilise the tangible and intangible resources in different host countries to the most productive use.[5] The fact that technologies used by foreign affiliates are not always available at arm's length for host economies, adds to the importance attached to the FDI as the most tenable form of technology acquisition for industrial upgradation. FDI activity may involve the explicit transfer of technology and in addition, the transfer of complementary resources such as management expertise and processes to best utilise this technology. For example, Djankov and Hoekman (1999) show that firms receiving the FDI or involved in joint ventures tend to acquire new technologies more frequently than those without the FDI

[4]In the case of vertical externalities, i.e. those externalities emerging from the links between an MNE in one sector with upstream sectors, can take monetary form (as emerging from pure market transactions) as well as non-monetary, in the form of knowledge and technology spillovers.

[5]New technology generation is highly concentrated in a number of advanced industrial countries, taking place in large MNEs. For a discussion on the role of MNEs in the globalisation of innovation, see for example, Narula (2003a).

and provide training programmes. The rest of this section evaluates the extant empirical evidence.

3.1.1. Technology spillovers It is important to highlight that technology spillovers are hard to quantify. This is firstly because the various learning and transfer processes that underlay spillovers are hard to measure. Secondly, in the case of FDI spillovers, it is difficult to determine the means by which technology transfer through FDI affects the productivity growth of host-country based firms. Most empirical studies have dealt with these problems by taking the view that the technology gap which may exist between local firms and MNE affiliates is reflected in the observed differences in the level of total factor productivity (TFP), i.e., how labour and capital are utilised in host-country firms. The effect of MNE technology spillovers can then be captured by changes in the level of TFP observed at the firm level, after controlling the impact of other variables that may influence the firm's productivity performance. A considerable number of studies have focused on the MNE impact on intra-industry TFP, stressing the possibility that MNEs exert a positive impact on the productivity levels of local firms. However, these studies examine the productivity externalities without trying to understand the mechanism through which these are realised. Such studies have therefore focused on the indirect evidence of externalities by exploring whether increases in the presence of MNEs in a country or sector are associated with increases in local firms' productivity in that country or sector or in upstream sectors. One robust finding in this regard is that MNEs tend to have higher productivity than domestic firms in the same sector (for example, Haddad & Harrison, 1993; Kokko et al., 2001).[6] Utilising this methodology, a number of studies indicate efficiency gains as a result of technological spillovers from MNE affiliates to local firms in the same industry, as for example, Blomstrom and Persson (1983) for Mexico, and Blomstrom and Sjoholm (1999) for Indonesia. Using the same methodology, other studies indicate negative effects of the FDI on local firms as Haddad and Harrison (1993) in the case of Morocco. This methodology has its pitfalls, since MNEs might be attracted by sectors that are more productive in the first place and thus the validity of TFP growth as a measure of MNE spillover effects stands for some reassessment (Aitken & Harrison, 1999).[7] As Aitken and Harrison note, cross-sectional studies are subject to a critical identification problem. At the micro level, foreign firms may be located in high productivity industries as opposed to causing productivity externalities. At the macro level, high growth countries may attract more FDI as opposed to the FDI causing this high growth. If

[6]When they adjust for firm size, Haddad and Harrison do not find differences in productivity between foreign and local firms.

[7]This point is stressed by Hanson (2001) in his critique of the method.

this is the case, the coefficients on cross-section estimates are likely to overstate the positive impact of foreign investment. As a result, one might find evidence of positive externalities from foreign investment where no externalities do occur.[8]

Given this issue, empirical studies of FDI spillovers through panel data are used to deal with this endogeneity problem. For developing countries, these studies find no indication of the existence of positive horizontal externalities. In fact, many studies find evidence of negative horizontal externalities. In a recent review of the micro evidence on externalities from foreign owned to domestically owned firms which pay particular attention to panel studies, Gorg and Greenaway (2002) conclude that the effects are mostly negative. An explanation for this result might be that MNEs minimise technology leakages to competitors, while simultaneously tend to improve the productivity of suppliers by transferring knowledge to them (see for example, Portelli & Narula, 2006, Scott-Kennel, 2006). More recent studies have examined the notion of positive externalities from the FDI towards local firms in upstream industries; Blalock and Gertler (2003) find evidence of positive vertical externalities.[9] This argument points to the notion that if the FDI were to generate spillovers, they are more likely to be vertical rather than horizontal in nature. However, most empirical studies of FDI spillovers have regressed local firm productivity on FDI activity within the same sector. Although such studies find no horizontal spillovers, the empirical work at the intra-industry level might therefore not be suitable to capture wider spillover effects on the host economy, such as those created between MNEs and their suppliers. It is evident from the empirical literature that it is difficult to find robust evidence of positive externalities from multinationals to local firms in the same sector (horizontal externalities). Indeed, many studies for developing countries have paid particular attention to causality problems and have actually found evidence of negative horizontal externalities arising from multinational activity while confirming the existence of positive externalities from multinationals to local firms in upstream industries (vertical externalities).

3.1.2. MNE vertical backward linkages and labour mobility Two ways in which the FDI transfers technology to the host-country based firms is via MNE backward linkages and labour mobility.[10] MNEs can benefit the host economy

[8]For a more detailed analysis of this method, see for example, Alfaro and Rodriguez Clare (2003).

[9]This new evidence, however, needs to be taken with caution. Methodological issues remain regarding estimation techniques and measurement of variables, in particular productivity measures.

[10]In addition to these two mechanisms, the literature identifies horizontal linkages and international technology spillovers as other potential forms of technology transfer modes. However, in the case of countries in early stages of development and with weak industrial bases, the importance of these may not be so pronounced. However, intra-firm transfer technology may occur from the parent firm to the foreign affiliate.

through the backward linkages they generate; i.e. relations with local suppliers of intermedi-ate inputs in their production process. As a result, MNE affiliates may transfer technologies to local firms in their value chain; i.e., either to those firms who supply them with intermediate goods or to local buyers in the host country. Notwithstanding the extensive empirical literature on the FDI and spillovers, there are hardly any empirical studies that analyse the explicit link between linkages and spillovers (Blomstrom et al., 2000). Whereas the formation of inter-firm linkages does not necessarily mean that technology spillovers to local firms occur, vertical backward linkages may represent an important medium for technology spillovers (Lim, 2000). It is unlikely that MNEs are able to contain the full value of this explicit and implicit transfer of technology to vertically linked firms in the host economy. Therefore, it can be hypothesised that inter-firm linkages represent a good basis for knowledge spillovers and introduction of new technologies to host-based firms (Blomstrom & Kokko, 1998). This is also a point highlighted in the seminal literature on vertical backward linkages (Lall, 1980; Watanabe, 1983; UNCTC, 1981) which has shown that through these inter-industry relations MNEs may assist local suppliers in the development and upgrading of their technological capabilities.[11]

Certain determinant factors for MNE backward linkages have been identified in the literature. For example, the larger the host market and the more sophisti-cated the technological capabilities of local suppliers, the more pronounced the MNE linkages are expected to be. Local procurement by foreign affiliates tends to increase over time as a result of the experience from investment, upgrading in the host-country receptor conditions and possibly lower costs of local sourcing (Driffield & Mohd. Noor, 1999; McAleese & McDonald, 1978; Gorg & Ruane, 1998; Scott-Kennel, 2006). Rodriguez Clare (1996) shows that more linkages are created when the production process of MNEs involves the intensive utilisation of intermediate goods, when the costs of communication between parent and affiliate are high, and when the home and host country are not too different in terms of variety of intermediate goods produced. McAleese and McDonald (1978) argue that backward linkages tend to increase primarily with the addition of production processing stages over time and in relation to the growth of the industrial base in the host country. This point is reiterated in various studies such as in Aitken and Harrison (1991). Blomstrom and Kokko (1997) suggest that some host-country characteristics that may influence the extent of linkages are

[11]MNE assistance to suppliers may involve the training in management and organization, assistance in the adoption of superior technology and extending markets and is tantamount to technology spillovers through vertical linkages.

market size, local content regulations and the size and technological capability of local firms. Government policies can play an important role in the creation of MNE vertical linkages.[12] The extent of MNE vertical linkages depends extensively on the procurement strategies of foreign affiliates (Chen, 1996) as well as the manner with which local sourcing increases in intensity over time (Rasiah, 1994).[13] Given the absorptive capacity structures in developing countries, some authors find it unrealistic for developing countries to attract the FDI with high linkage potential (Stewart, 1976; Rodriguez-Clare, 1996). Absorptive capacities are dealt with in greater depth in Section 3.3.

Another way in which the FDI transfers technology to the host-country based firms is via labour mobility. Workers employed by an MNE affiliate are most likely to receive and acquire knowledge of superior technology and management practices. Through the switching of employers or even the start-up of new business enterprises with the help of MNE trained personnel, the knowledge embodied in human capital can spill over to other host country-based firms. A number of studies have been undertaken to provide insights into the spillovers emerging from labour turnover. For example, Katz (1987) finds that many managers of local firms in Latin America were previously trained in MNE affiliates at the start of their careers. Gershenberg (1987) shows that MNEs provided more management training than local private firms and that a small percentage of job changes involve a movement from multinationals to domestic firms. Spillovers from labour linkages are determined according to the type of training given to the labour force as well as to the labour mobility (Slaughter, 2001; Fosfuri et al., 2001). As we discuss later, absorptive capacity is a determinant factor to the FDI impact at the host country level.

3.2. FDI and Economic Growth

The realisation of MNE externalities potentially leads to the generation of economic growth at the macroeconomic level. At the macroeconomic level, cross-sectional empirical work by Borensztein et al. (1998), Carkovic and Levine (2002), and Alfaro et al. (2003) find little support that the FDI has an exogenous positive effect on economic growth. However, their evidence suggests that local conditions, such as the level of education and the development of local financial markets play an important role in allowing the positive effects of the FDI to

[12]For further discussion, see UNCTAD (2001).

[13]When analysing MNE linkages, it is important to keep in mind that MNEs benefit host economies only if linkages generated are beyond those already generated or displaced.

materialise. In the widely cited paper in the literature, Borensztein et al. (1998), using a dataset of the FDI flows from industrialised countries to 69 developing countries, find that the FDI is an important vehicle for transferring technology and higher growth only when the host country has a minimum threshold of human capital.[14] De Mello (1999) finds a positive and significant impact of the FDI on output growth in OECD and Asian non-OECD countries. However, the FDI tends to increase output growth through higher productivity in technologically leading countries and through capital accumulation in technological laggards. Elsewhere, Reisen and Soto (2001) find a positive correlation between the FDI and portfolio equity flows on the one hand and GDP growth on the other. Other evidence in the literature confirms the positive impact of the FDI on growth, but highlight that developing countries need to have reached a certain threshold level of development in their location factors, *inter alia* in the level of human capital and the physical infrastructure prior to be able to internalise the associated benefits of the FDI (Saggi, 2000). De Mello (1997) points out the differences in the growth impact of the FDI across countries based on such capabilities. Since host-country technological capabilities are likely to determine the scope for spillovers from foreign to domestic firms, the growth impact of the FDI tends to be limited in technologically less advanced countries. The same authors go further to argue that the FDI raises growth only in those countries where the labour force has reached a minimum threshold of educational attainment. Xu (2000) finds strong evidence of the positive effect of the FDI on total factor productivity growth in host countries,[15] but reiterates that the absorption of MNE's technology may require a certain level of human capital accumulation on the recipient side. In the same vein, Zhang (2001) finds that the impact of FDI growth is country specific and tends to be positive where policies favouring free trade and education are adopted to encourage export oriented FDI.

3.3. Determinant Factors — Absorptive Capacity

The empirical evidence seems to suggest that a number of determinant factors need to be in place at the host-country level for MNE externalities to occur and FDI-led growth to be realised. There is consensus in the literature highlighting

[14]Likewise, Xu (2000) using data on U.S. MNEs finds that a country needs to reach a minimum human capital threshold in order to benefit from the technology transfer from MNEs, and that most developing countries do not meet this threshold.

[15]This result pertains to US survey data on manufacturing MNEs and the technology transfer effect is significant only for developed countries.

these determinant factors, grouped under the concept of *absorptive capacity*. The realisation of MNE technology spillovers as well as FDI-led growth are determined by the absorptive capacity of host-country economic agents, be they firms, individuals or institutions. The concept of technological congruence or absorptive capacity[16] is a function of the capability of the country to benefit from technological spillovers from the more industrialised countries and the ability to accumulate and best utilise technology and knowledge. Absorptive capacity includes the ability to search and select the most appropriate technology to be assimilated from existing ones available, as well as the activities associated with creating new knowledge. Absorptive capacity also reflects the ability of economic agents to integrate the existing and exploitable resources — technological opportunities — into the production chain, and the foresight to anticipate potential and relevant technological trajectories (Criscuolo & Narula, 2002). Laggard 'economic units' (countries or firms) must possess *inter alia*, the ability to absorb, internalise and utilise the knowledge potentially made available to them. Absorptive capacity in economic units corresponds to the appropriate supply of human capital and technological capability to be able to generate new technologies and consequently use productive resources efficiently. The development and upgrading of capabilities is expected to translate into productivity growth for firms as well as countries.[17] Absorptive capacity is significant for development because it allows domestic economic actors to internalise knowledge that exists elsewhere (either within the domestic economy or externally) that is made available directly or indirectly to them. There are several ways in which technology flows occur, either through arms-length means (such as, through licensing) or through trade in intermediate goods, plant and equipment or even products or services (Narula, 2003b). As in the focus of this article, technology flows may also be made available through the modality of the FDI. Although not the only means available, spillovers from the FDI are indeed regarded as one of the most practical and efficient means by which industrial development and upgrading can be promoted (Narula & Dunning, 2000). While the *potential* for MNE-related spillovers is clear, as are the opportunities for industrial upgrading therefrom, it is increasingly acknowledged that the nature, level and extent of the benefits vary considerably with the levels of absorptive capacity.

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[16]Abramovitz (1990, 1995) distinguishes between two elements of social capability and technological congruence or absorptive capacity. Dahlman and Nelson (1995) define national absorptive capacity as the 'ability to learn and implement the technologies and associated practices of already developed countries'.

[17]Although one has to highlight that there are other intervening factors in play see e.g., Abramovitz, (1986, 1995; Dahlman & Nelson, 1995).

It should also be stressed that while human capital represents a core aspect of absorptive capacity and that a host country should possess a minimum threshold stock of knowledge that will allow it to absorb MNE externalities, its presence is also not a sufficient condition for knowledge accumulation (Criscuolo & Narula, 2002). Knowledge accumulation requires the simultaneous presence of institutions and economic actors that determine the stock of knowledge in a given location and the efficient use of markets and hierarchies — be they intra-firm, intra-industry or intra-country (Narula, 2003b). This knowledge is not costless and must be accumulated over time. Hence, while physical and human capital are necessary conditions for catching-up, the lack of appropriate incentives for production and investment can compromise the success of the technological upgradation (Lall, 1992; Lall & Narula, 2006).[18]

The contrasting empirical evidence on the impact of the FDI at the host-country level reinforces the claim that MNE externalities and knowledge spillover effects are not automatic as one would tend to believe, but are affected by several host-industry and host-country factors. An important characteristic for the emergence of technology spillovers is the technology gap between MNE affiliates and local firms in the host country. Kokko (1994) and Kokko et al. (1996) provide evidence for the hypothesis that spillovers are easier to identify empirically when the technological attributes of local firms match those of the MNE affiliates. Specifically, Kokko et al. (1996) argue that a high technology gap combined with low competition prevents spillovers to the host economy. The absorptive capability of host-country firms to absorb foreign technology appears to be an important determinant of the size of FDI spillovers. Kokko et al. (2001) highlight the importance of past experience in industrialisation as a precondition for international transfer of technology and the absence of this experience is concomitant to lack of absorptive capacity by the local sector (Radosevic, 1999). For example, in the Sub-Saharan African region, host to the majority of least developed countries (LDCs), the conditions that stimulate technological assimilation (such as developed human capital, adequate physical infrastructure and a dynamic business climate) are absent, leading to constraints in mastering foreign, imported technology as well as to compete in international markets (Mytelka, 1985; Lall & Pietrobelli, 2002). The development of capacities and capabilities is key to both potentially attracting more FDI inflows as well as increasing the potential for MNE technological spillovers tenable to industrial upgradation of the host economy.

[18]For example, the availability of a large stock of suitably qualified workers does not in itself result in efficient absorption of knowledge, although the definition of human capital shares some commonality with the concept of absorptive capacity.

Moreoever, the improvement in location factors is an imperative path for host countries to undertake since the competition for the FDI among developing countries is heavily intensifying (see, for example, Mytelka, 1996; Mudambi, 1998). An increasingly significant factor in influencing MNE location decisions is the presence of sophisticated, created assets (in the form of developed human capital and domestic firms' technological capabilities) in host countries (Narula & Dunning, 2000; Noorbakhsh et al., 2001). It is therefore crucial, especially in the context of intense competition for the FDI that developing countries formulate policies that improve local skills and build human resource capabilities, in order to be able to benefit most from FDI and MNE activity. For instance, Borensztein et al. (1998) show that, at country level, a minimum threshold of absorptive capacity is necessary for the FDI to contribute to higher productivity growth, while Narula and Marin (2003) show that only firms with high absorptive capacity are likely to benefit from FDI spillovers. In other words, possessing educated people is a precondition for a country's increased absorptive capacity, which contributes to enhanced productivity.

4. Conclusions

This article has reviewed and discussed some of the main empirical issues concerning the FDI and development, focusing on the emergence of MNE externalities and the potential of FDI-led growth. The last two decades have witnessed a surge in global FDI flows and developing countries are more eager than ever to attract such investment flows to their ailing economies. The surge in flows and policy fervour to the FDI in general has led to a reinforcement of the role of MNEs in host countries, as well as a renewed interest of policymakers in host developing countries to maximise the benefits from the FDI towards long-term economic development. The contribution of the FDI to development is less controversial in theory than in practice, since it is theoretically plausible that the FDI provides a channel for capital injection, technology and knowledge transfer. This belief has been reinforced by the successful industrial upgradation experience of newly industrialised countries, and has as a result fuelled the belief that the FDI is a *sine qua non* for development (Lall & Narula, 2006). However, notwithstanding the evidence that the FDI can have a potential contribution to both income growth and factor productivity in host countries, it is increasingly evident that it complements rather than substitute local factors tenable to economic development. It has been argued that absorptive capabilities *inter alia* the level of human capital, matter for a positive impact of the FDI on host-country economic growth and MNE spillovers. Host countries cannot capture the full benefits associated with the FDI

until a threshold level of capabilities is reached. The importance of this threshold absorptive capacity level highlights the non-automatic interactions between the FDI and development in the host country. Realistically, countries at early stages of economic development do not have fully developed created assets and hence their location advantages are presumed to be insufficient to attract inward direct investment, with the exception of the FDI arising from the possession of natural assets. Hence, whereas some 'resource gaps' in the host economy can be filled immediately by the attracting of FDI flows (investment, production, employment, tax revenue), other benefits inextricably linked to development such as knowledge and technology upgrading take time to emerge or possibly never take place.[19] The developmental impact of the FDI rests on the dynamics of the transfer of technology, but more importantly on the extent of integration of MNE affiliates in the host-country systems and how much upgrading of local capabilities takes place over time, since it is vital that foreign agents of dynamic comparative advantage must complement rather than substitute local agents. The growth of MNEs and their dominance of certain sectors are often associated with their pre-eminent position in the creation and ownership of technological assets. That developing countries can benefit from spillovers accruing from MNE activity is not a disputed fact. However, it remains an assumption that MNE activity is a *sine qua non* for economic development, and that greater FDI flows will automatically result in the dissemination of these technologies and organisational practices from developed to developing countries.

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[19]See, for example, the discussion of static versus dynamic benefits from the FDI in Lall (2000).

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Chapter 3

The Role of the Sectoral Composition of Foreign Direct Investment on Growth

Dilek Aykut and Selin Sayek

1. Introduction

Following the rapid increase in the 1990s, foreign direct investment (FDI) has become the most stable and largest component of capital flows into developing countries (World Bank, 2005). The second half of the 1990s also marked significant changes in the sectoral distribution of FDI flows in many countries. In particular, FDI flows in services rose to overtake FDI in manufacturing in several developed and developing countries (Figure 3.1). Such countries have made considerable progress in their investment and trade policies, opening up the services sector to foreign participation and provoking a significant shift in the composition of FDI towards services. Most of FDI in services has been directed to infrastructure and financial sectors, in response to developing country efforts to privatize and liberalize these sectors. In fact, the share of these two sectors in FDI stock has reached to one-third in developed and almost 20 percent in developing countries.

Although there is a significant increase in FDI in services sector globally, the sectoral compositions of FDI still vary significantly among countries depending on the characteristics of the country and the policies related with the sector. For example, in East Asia and the Pacific — mostly led by China — and Canada, manufacturing sector is still the main sector, whereas in many African countries the primary sector continues to be the leading sector in the composition of FDI. In other countries, services sector has become the dominant sector.

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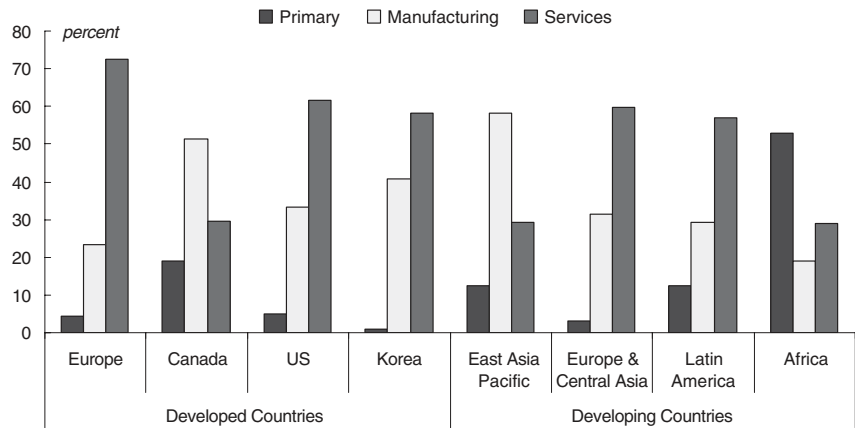

Figure 3.1: FDI inflow stock by sector, 2004.
Source: Global Development Finance, World Bank.
Note: For Africa, total FDI stock data is for 2002.

In light of this evident shift and differences among countries, more analysis is needed to understand the implications of the sectoral composition of FDI in terms of its impact in the recipient economy since it may partly explain differential experience among countries. As discussed in detail in the next section, FDI in each sector has different characteristics in terms of motivation, financing and more importantly linkages to the rest of the economy. In terms of linkages, for example, primary sector is mostly capital intensive and the scope for linkages between foreign companies and the rest of the economy is often limited. On the other hand, FDI flows in manufacturing sector may have a larger impact in the economy through a broad range of potential linkage-intensive activities. Conventionally defined, services sector includes a wide range of different activities such as finance, infrastructure (such as electricity, water, and telecommunications), wholesale and retail, real estate as well as tourism. FDI in the sector is mostly to serve the domestic market hence potential forward linkages for the sector are quite strong, while backward linkages may vary by industry. Hence, the composition of FDI may influence the impact of FDI inflows in an economy.

This chapter tries to understand whether or not the sectoral composition of FDI matters while contributing to the economic growth of the recipient country using a data set from various international institutions and country sources. It starts by looking into the correlation among the sectoral pattern of FDI and economic growth for a sample of 33 countries. The analysis is based on the premise that the growth effects of FDI may be elusive not only due to the characteristics of the recipient

economy, i.e. the absorptive capacity, but also due to the characteristics of the flows themselves. The appropriate measure of the sectoral composition of FDI is an open field, and the chapter also tries to shed light by discussing alternative measurements regarding the composition, its evolution, and also the absolute trends in the sectoral FDI flows.

The rudimentary correlation analysis we complete suggests that the sectoral composition of the FDI flows may play a significant role in influencing economic growth. Our empirical evidence also shows that both the level of FDI and the sectoral composition of these flows are important contributors to economic growth. The results suggest that as the sectoral composition of FDI gets skewed towards the manufacturing sector, there is a significant and positive effect on economic growth. On the contrary, the results indicate that as the sectoral composition of FDI gets skewed towards the services or the primary sector, there is a negative and mostly insignificant effect on economic growth.

The rest of the chapter is organized as follows: the literature survey is provided in Section 2; details about the data and empirical results are presented in Section 3 and Section 4 concludes the chapter.

2. The Literature Survey

The vast amount of literature on the impact of FDI on economic growth lacks robust results, and the shift of the sectoral composition of FDI as well as its variation among countries may partially explain that. The literature shows that the positive impact of FDI is not immediate but FDI has generated positive spillovers and economic growth in some countries, some industries, and during some periods.[1] Although most macroeconomic studies support the positive growth impact of FDI, they only identify the linkage in combination with other factors. Some of these factors are related to the 'absorption' capacity of the country that receives the foreign investment, such as level of development (Blomstrom, Lipsey, & Zejan, 1994), or endowment of human capital (Borensztein, de Gregorio, & Lee, 1998). Other studies highlight the importance of supportive business environment in the country in order to convert the technology and knowledge spillovers from FDI into economic growth. For example, factors such as trade openness (Balasubramanyam, Salisu, & Sapsford, 1996) or domestic financial market development (Alfaro, Chanda, Kalemli-Ozcan, & Sayek, 2004) are shown to be

[1]See Caves (1996) for an extended discussion on multinational enterprises (1996), their evolution and effects. Furthermore, see Lipsey (2002) and Lim (2001) for an extended literature survey on the relationship between the FDI and economic growth.

crucial. Although these and many other studies indicate that FDI can generate overall economic growth when certain conditions are in put, there is also a strand of studies arguing that the effect of FDI on economic growth tends to be weak and most of these studies suffer from reverse causality (Rodrik, 1999; Carkovic & Levine, 2003). Firm-level studies add more doubt to the dispute since some studies fail to find significant positive effect of foreign presence in the industry (Aitken & Harrison, 1999; Djankov & Hoekman, 2000; Konings, 2001), whereas some others provide convincing evidence of positive spillovers (Keller & Yeaple, 2003; Javorcik, 2004).[2]

Theoretically, FDI is expected to contribute to economic growth by providing much-needed capital in productive areas of the economy. In addition, FDI is believed to generate additional impact through externalities in the form of technology transfers and spillovers. The externalities may lead to improvements in productivity and efficiency in many ways. When the foreign firm is more efficient than the domestic firms, domestic firms can improve their productivity by copying the technology and management skills of the foreign firm as it penetrates the market. Even if the foreign firm is not more efficient, domestic firms might be forced to improve their efficiency because of the increased competition from foreign firms — through so-called horizontal spillovers. This said, the increased market share of the foreign company might also crowd out the domestic firms and push them to less efficient production levels. However, the potential positive impact is not limited to the industry that receives the FDI; it may be diffused to the rest of the economy through the interactions with local suppliers and consumers — backward and forward linkages, respectively. When the necessary conditions are in put, the aggregate positive spillovers may further accelerate the economic growth of the country. The impact of FDI may obviously vary greatly depending on characteristics of the sector and its linkages to the rest of the economy. As discussed earlier, the linkage potential differs across the primary, manufacturing and services sectors. There are various other sector specific factors that may influence the impact of foreign investment, ranging from motivation to financing of the investment. In addition, different sectors may require different conditions to cause positive impact in the economy.

The impact of FDI in primary sector, for example, is not always expected to be positive. Major part of FDI in primary sector comes as mega-projects with huge amounts of capital flowing into a country. These projects have limited linkages to

[2]Each study uses data for different countries. See Görg and Strobl (2001) for an extended literature survey on firm level studies. Furthermore, while earlier studies concentrated on identifying horizontal spillovers, the more recent studies have focused on identifying the vertical spillovers. The difference as such could explain the differential results obtained in the literature.

domestic economy as they usually use few local intermediate goods and are mostly export-oriented. In addition, FDI flows to the sector tend to be more volatile (World Bank, 2005). Most investments are large and sensitive to world commodity prices. Also, in general the financing composition is highly skewed towards intercompany loans. Domestic ownership requirement (or restriction on foreign ownership) encourages intercompany loans while limiting the equity component of FDI and intercompany loans tend to be as volatile as private debt flows (World Bank, 2004c). In addition, high resource flows to the sector tend to reduce the competitiveness of the country in other sectors (Dutch disease), increase rent-seeking behavior, and could cause deterioration of institutions (Sachs & Warner, 2001; Sala-i-Martin & Subramanian, 2003). This might be particularly problematic for countries with high reliance on the sector. On the other hand, investment in the sector might be particularly important for many countries with insufficient capital and technology. Furthermore, the sector usually brings large foreign currency earnings, contributing to balance of payments financing. The overall effect depends on whether the positive or negative effects outweigh. In fact, a negative economic impact is not the inevitable outcome. In the presence of solid institutions, there is anecdotal evidence that FDI in primary sector may generate positive impact in a country.[3]

Contrary to primary sector, FDI in manufacturing sector has much larger potential to affect the recipient economy as the linkages to the recipient economy are better defined. Foreign firms in manufacturing sector invest rather than export to a country for either efficiency-seeking or market-seeking purposes, or a combination of both. When it is purely efficiency seeking, FDI is more likely to bring in the technology and know-how that is compatible with the country. It usually generates significant employment and provides training. Foreign firm usually use some level of local intermediate products. Hence, FDI has significant horizontal and backward linkages. In addition, foreign company exports increase the total exports, and in turn the foreign currency receipts of the country. This said, these linkages are less significant when FDI comes through enclave type of arrangements, such as export-processing zones, and the possibility of the crowding out effect increases as foreign firms also serve the domestic market. In summary, FDI in manufacturing is expected to have significant impact in the recipient economy, where the direction of effect depends on the conditions enlisted above.

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[3]With strong policy and right institutional framework, Botswana has become a middle-income country within one generation by the help of large FDI flows into its diamond and other mining industries. Export receipts and government revenues boosted by the FDI were invested wisely to create initial momentum in economic growth (UNCTAD, 2003; Coolidge & Rose-Ackerman, 1997).

Unlike the primary and manufacturing sectors, where output is tradable, services are mostly nontradable and require close proximity between producers and consumers.[4] Therefore, much of the FDI in the sector is market-seeking, where forward linkages of FDI are well defined and potential impact of FDI in the sector is immense. For example, in the highly capital-intensive infrastructure sector, FDI can provide the necessary funding and technology to improve capacity to meet increasing demand, as well as improve the quality and lower the cost of the services. In the same vein, FDI in the banking sector can have an important impact on both the efficiency and stability of the banking system through increased competition and increased access to global financial markets.[5] If FDI in the sector improves these services in a country, almost all other sectors will be positively affected. However, FDI in the sector may also have notable negative effects. It has significant crowding-out potential. Due to less than competitive market structure and capital intensity of the main industries in the sector, foreign investors command superior market power. Hence, the impact of FDI is highly dependent on the existence of an appropriate and stable regulatory system that maintains appropriate incentives for foreign investors to improve the supply capacity and ensure the provision of services in infrastructure and banking sectors. In addition, most of the FDI in the sector come through mergers and acquisitions in developed countries and privatization deals in developing countries both of which are not necessarily associated with new investments (Klein, 2000). Moreover, with the exception of business services and tourism, FDI in services do not generate foreign currency; instead, companies repatriate their earnings periodically.

The number of empirical studies that cast the relationship of FDI in different sectors and its impact on growth is slim due to data limitations. Almost all firm-level studies mentioned above use manufacturing-sector data without conclusive results. Existing literature on the impact of services sector FDI usually looks at the impact of liberalization in the services sector. For instance, privatization and increased competition in the telecommunications sector has increased the capacity and reliability of services in developing countries depending on their sequence of occurrence (Carsten, Mattoo, & Rathindran, 2002). Country case studies highlight the importance of an appropriate regulatory system for positive

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[4]Not all services are nontradable or require physical proximity. For example, some information-technology services (software programming, database, and customer support) and business process services (call centers) are not location-bound and can be provided without proximity to customers. However, with exceptions in mind, services are conventionally portrayed as intangible, invisible, and perishable, requiring simultaneous production and consumption.

[5]See Goldberg (2004) for a discussion on the FDI in the financial sector.

impact of liberalizations in infrastructure sector.[6] Similarly in banking sector, foreign-owned banks are typically found to have better-quality loan portfolios, higher net worth, and a higher ratio of income to costs than domestic banks (Clarke, Cull, D'Amato, & Molinari, 2000) and the efficiency of the sector increases by penetration of the foreign companies (Claessens, Demirgüç-Kunt, & Huizinga, 2001). The findings suggest that effective supervision and regulation of domestic financial markets are important to ensure the benefits of foreign entry in financial markets (World Bank, 2001; International Monetary Fund, 2000). The analysis closest to ours in spirit is where Alfaro (2003) studies the differential growth effects of FDI to these broad categories of sectors by analyzing the contribution of increased FDI to each sector on economic growth. Along these lines Chakraborty and Nunnenkamp (2006) study the role of FDI in generating increased economic activity in the sector in which it occurs, as well as the overall economy using sectoral FDI data for India. As will be discussed below, the approach followed in this chapter differs from the one explored in both papers, where rather than testing for the role of the level of FDI to each sector we hypothesize that it is the composition of FDI flows alongside aggregate FDI inflows that influence the growth prospects of the host country.

3. Data and Empirical Investigation

In this section, we describe the data that will be used in the analysis, specifically the measures of the sectoral composition of FDI, the levels of FDI, economic growth, and a number of control variables commonly used in the growth regressions. In Section 3.1, alternative ways of measuring the sectoral composition and pattern of FDI are discussed, whereas in Section 3.2 the variables used in the econometric growth analysis are introduced.

3.1. Sectoral Pattern of FDI

Sectoral FDI data is collected from the U.N. Economic Commission for Latin America and the Caribbean, based on country sources for Latin American

[6]In Peru, lack of such a framework led to increased prices of telecom services as well as uneven provision of services to poorer parts of the country. In Argentina, Mexico, and Venezuela, despite the sharp increase in investments in the telecom sector immediately after privatization, the capacity of the sector subsequently fell below the regional average (UNCTAD, 2004). In the electricity sector, Chile suffered an energy crisis in 1998 due to weaknesses in their regulatory and institutional frameworks (Gabriele, 2004). In 2004, Argentina also experienced electricity shortages following the problems that arose after the government imposed the price freeze in 2002.

countries; National Bureau of Statistics of China; ASEAN for other Asian countries; and OECD, UNCTAD, and country sources for other countries. The official institutions (International Monetary Fund and OECD) recommend United Nations International Standard Industrial Classifications (ISIC) to be used (see the appendix) but in each country classification may vary to some extend. Though the international classification standards are implemented in the data collection by national authorities, the fact that the analysis given below uses data collected from various sources requires that one keeps this drawback in mind when interpreting the results.

Two alternative routes can be taken in depicting the sectoral pattern of FDI flows; one focuses on the magnitude of the *absolute* level of FDI flows in each sector, while the alternative focuses on the *relative* level of FDI flows in each sector. In more detail, the former measures depict the extent of FDI flows in a certain sector, scaled by an alternative size measure. For example, one could look at the FDI flows to a sector as a share of the GDP or alternatively as a share of the economic activities in that specific sector. Given the objective of correlating these alternative measures of sectoral FDI patterns with economic growth we start by discussing simple correlations among these alternative measures.

Studying the relationship between economic growth and these absolute patterns of sectoral FDI flows provides insight into the differential contribution of each sector's investment to economic growth.[7] Figures 3.2a–3.2c show the simple correlation between the FDI in each sector as a share of that sector's GDP and the overall economic growth rate. The figures are suggestive of a positive relationship between economic growth and all types of FDI, regardless of the sector of investment. However, the correlation coefficients are statistically insignificant, suggesting that in fact, statistically, there is no correlation between FDI and economic growth, regardless of the sector in which FDI occurs. With no implication of statistical significance though, one observes a slightly stronger relationship between services sector FDI and economic growth, with the simple correlations being 8%, 10%, and 18% between economic growth and the primary sector FDI, manufacturing sector FDI, and services sector FDI, respectively.[8] In an effort to identify possible directions of relationship, the figures are based on the imputation of the average of FDI flows in each sector between 1996 and 1999 and the

[7]Alfaro (2003) undertakes such an analysis, and finds that manufacturing FDI contributes positively and significantly to economic growth, whereas FDI in the primary sector contributes negatively to economic growth and the FDI in the services sector does not contribute significantly to economic growth.

[8]No weight is attached to these magnitudes, given the simple nature of the correlations, where no other controlling factor is taken into account.

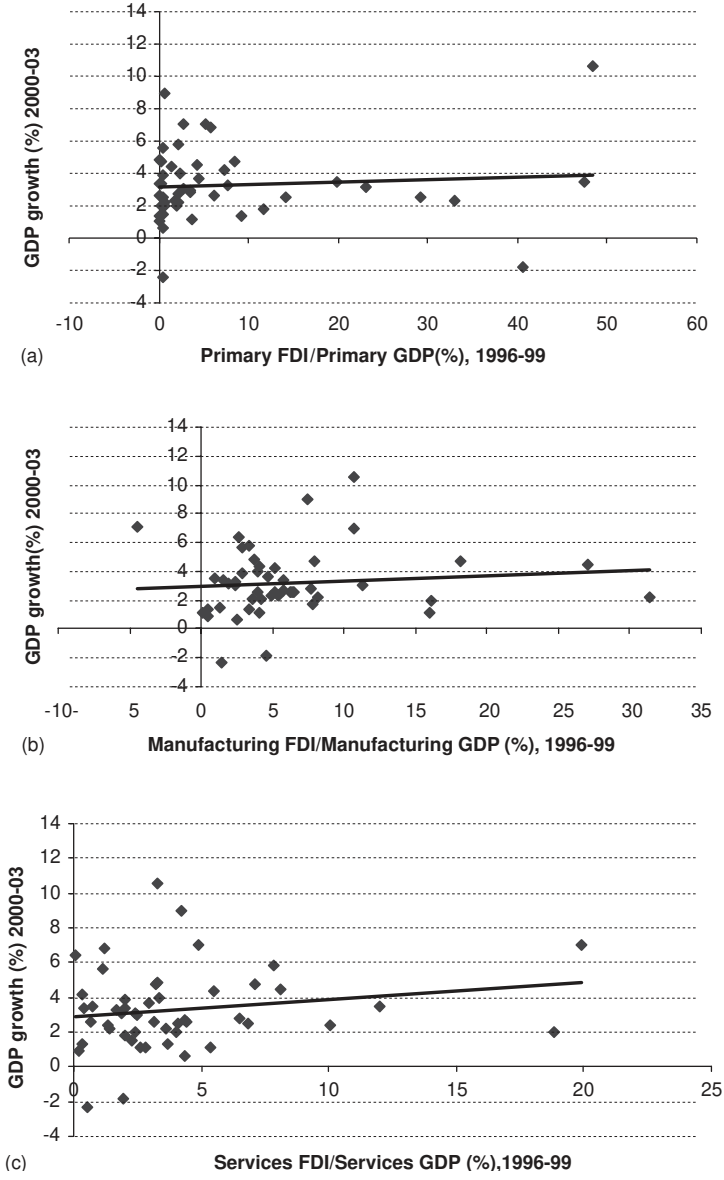

Figure 3.2: (a) Economic Growth and Primary FDI. (b) Economic Growth and Manufacturing FDI. (c) Economic Growth and Services FDI.

Note: Primary sector is approximated by agriculture sector GDP; Authors' calculations.

averages of economic growth between 2000 and 2003. This allows us to rule out the possibility of economic growth in a country attracting more FDI in each sector, and is suggestive of a possible causal relationship from the FDI flows to economic growth.

The correlation between overall economic growth and the FDI flows to each sector does not differentiate between the possibilities of horizontal or vertical spillovers. Depending on the relative magnitude as well as the sign of these linkages, FDI can have different impact in the sector that receives the investment and the overall economy. As discussed earlier, the immediate effect of FDI is expected to be in the recipient sector through effects such as increased investment and higher competition for the domestic firms among others. Moreover, through the interactions with the suppliers and consumers — which vary among sectors, FDI can affect the rest of the economy. To gauge such differential effects, we complement the above discussion by looking into the correlation between the same measures of FDI flows in each sector with the growth of economic activity in the relevant sector.

The simple correlations in Table 3.1 are suggestive that the positive correlation between the sectoral FDI flows and the sectoral economic growth prevails, the comparative magnitudes of the simple correlations seem to be different from those with the overall economic growth. However, similar to the above-reported correlation coefficients, none of those in Table 3.1 are statistically significant, which suggests a lack of any correlation of either within sector growth and FDI specific to that sector or FDI in any sector and economic growth. As above, though with no statistical significance discussion, the simple correlation between primary sector FDI and growth in the primary sector GDP is 10%, while simple correlation between manufacturing sector FDI and growth in the manufacturing sector GDP is 12% and the simple correlation between services sector FDI and growth in the services sector GDP is the lowest at 7%. Interestingly, however, these correlations

Table 3.1: Simple correlations between the sectoral FDI inflows and economic growth.

	Sectoral GDP growth (2000–2003)	**Overall GDP growth (2000–2003)**
Primary FDI/primary sector GDP (1996–99)	0.104	0.084
Manufacturing FDI/manufacturing sector GDP (1996–99)	0.120	0.097
Services FDI/services sector GDP (1996–99)	0.068	0.175

in comparison with those with overall economic growth suggest that the horizontal effects, i.e. the intra-industry effects, might be different from the vertical, i.e. inter-industry effects. As in primary and manufacturing sectors, the intra-industry effect of FDI can be greater than its effects on the overall economy; or as in services sector, FDI may have a greater impact in overall economy compared. However, one should exert caution, as stating such effects robustly requires an in-depth econometric analysis.

To the extent that the impact of FDI flows on economic growth varies depending on the sector that receives it, one can also envisage that the sectoral composition of FDI flows will have an impact on the economic growth. In other words, while the magnitude of FDI flows might be important in generating economic activity, the sectoral composition of these flows might also exert additional and independent growth effects. We start by calculating the FDI sectoral shares, as the share of net FDI inflows into a specific sector in the aggregate net FDI inflows to that country.

As a way to create a measure for the composition of FDI and its impact on economic growth, we calculated the correlation between the sectoral compositions, i.e. share measures of FDI, and economic growth. Formulating the composition of FDI is not an easy task, however. As several countries experienced significant repatriation over the years, the share measures calculated as the share of FDI in the sector in total FDI, can have extremely high negative percentage values. Table 3.2 provides the simple relationship between the average share FDI measures and growth both for the recipient sector and overall economy, suggestive of a change in the direction of relationship when one considers share measures rather than the magnitude of FDI activities, as was depicted earlier. Furthermore, not only do the signs of correlation change, but the significance also alters. The results suggest that even if the absolute level of FDI in each sector does not seem to have a

Table 3.2: Simple correlations between measures of the composition of FDI and economic growth.

	Sectoral GDP growth (2000–2003)	**Overall GDP growth (2000–2003)**
Primary FDI/total FDI (1996–99)	0.47*	0.38*
Manufacturing FDI/total FDI (1996–99)	−0.10	0.05
Services FDI/total FDI (1996–99)	−0.45*	−0.38*

Note: The significance level of the correlation coefficient is denoted by *. * denotes significance at 1% level.

statistically significant correlation with the economic growth performance of the sector or the overall economy, the sectoral composition of FDI flows might have a statistically significant, and possibly different sign and size of correlation with economic performance. These preliminary results are indicative of a positive, zero, and negative correlation between a sectoral composition of FDI skewed towards more primary, manufacturing, and services sectors, respectively, and both sectoral and overall economic growth performance.

Another way to eliminate these outliers that are mostly due to high levels of repatriation of earnings, is to impute the share of each sector's net FDI inflows as a share of the *absolute* value of net FDI flows. This imputation is based on the premise that the share of the net inflows in the total value of FDI-related transactions, not whether the flows are net positive or negative inflows, is important. For example, assume there is a 100 unit net FDI inflows in the manufacturing sector, no FDI inflows in the primary sector, and −200 units of net FDI inflows (on account of repatriations) in the services sector. The total absolute value of net FDI transactions are taken as 300 units, where the share of manufacturing sector is 33% and the share of services sector is imputed as −66%. Higher absolute values of this sectoral share measure should be interpreted as suggesting increased extent of foreign firm activity, whether it is an inflow in the current period or a repatriation of previous inflow-related economic returns. The same observations discussed for Table 3.2 are evident in the analysis using these alternative sectoral composition measures, as can be seen from Table 3.3, which report the correlations among this alternative sectoral composition measure and economic growth.

Table 3.3: Simple correlations between alternative measures of the composition of FDI and economic growth.

	Sectoral GDP growth (2000–2003)	**Overall GDP growth (2000–2003)**
Primary FDI/absolute value of the total FDI (1996–99)	0.48*	0.39*
Manufacturing FDI/absolute value of the total FDI (1996–99)	−0.10	0.08
Services FDI/absolute value of the total FDI (1996–99)	−0.48*	−0.42*

Note: The significance level of the correlation coefficient is denoted by *. * denotes significance at 1% level.

The above exercise highlights the importance of the composition of FDI in order to understand its impact on growth, but also the importance of the choice of the measure of this pattern. Both the interpretation and the implications of the analysis may differ depending on the measure used in the analysis. In Section 4, we limit the econometric analysis to one of these above-discussed measures, and warn the reader against generalizing these results as they are limited by the choice of the measure capturing the pattern of the sectoral FDI flows.

3.2. Econometric Specification and Control Variables

The purpose of our empirical analysis is to examine the differential growth effects of FDI in the three main sectors of investment, namely, primary, manufacturing, and services sector. In other words, we are investigating the effects of not only the level of FDI inflows on the economic growth of the host economy, but also the possible effects of the sectoral composition of these FDI flows. In doing so, the exercise below is based on a growth regression analysis, where alongside the extent of FDI and its sectoral composition several control variables are included.

The empirical growth analysis literature is abundant. However, in an influential paper, Mankiw, Romer, and Weil (1992) (MRW) derive an empirical specification based on the assumption that countries are unlikely to be at their steady states, and therefore transitional dynamics should be more important. In this vein we follow the same specification. We study the direct effect of the level of FDI flows, as well as the direct effects of the sectoral composition of these FDI flows on economic growth. Therefore, based on MRW, we estimate the following equation:

$$\text{Growth}_i = \beta_0 + \beta_1 \text{InitialGDP}_i + \beta_3 \text{FDI}_i + \beta_4 \text{FDI\_comp}_i + \beta_5 \text{Control}_i + \varepsilon_i \quad (1)$$

The choice of the control variables is based on previous economic growth studies.[9] The growth rate of output is measured as the growth of real per capita GDP in constant dollars; data are obtained from the World Bank (2004b). FDI is also taken from the World Bank, World Development Indicators database, measured as the net FDI inflows. The net FDI inflows measure the net inflows of investment to acquire a lasting management interest (10% or more of voting stock) in an enterprise operating in an economy other than that of the investor. It is the sum of equity capital, reinvestment of earnings, other long-term capital, and short-term capital as shown in the balance of payments.

[9]For a detailed overview of the theory and the evidence regarding economic growth, see Barro and Sala-i-Martin (1995).

The control variables for the econometric analysis are complied from various sources. Gross domestic investment measure consists of the outlays on additions to the fixed assets of the economy plus net changes in the level of inventories. Macroeconomic stability is proxied by inflation, measured as the percentage change in the GDP deflator. The financial market depth is measured by either the share of money and quasi-money in GDP (M2 as a share of GDP), as the share of private sector credit of the whole financial sector in GDP, or as a share of private sector credit extended by only deposit banks as a share of GDP. Openness to international trade is measured as the ratio of the sum of exports plus imports to total output. Government consumption is captured by the ratio of central government expenditure as a share of GDP. All of these data are obtained from World Bank's (2004) World Development Indicators.

The institutional stability and quality in the economies are proxied by using data from the International Country Risk Guide (ICRG). The ICRG reports data on the risk of expropriation, level of corruption, the rule of law, and the bureaucratic quality in an economy, and is a monthly publication of Political Risk Services.

Finally, human capital is measured as the 'average years of secondary schooling', obtained from Barro and Lee (1996). Table 3.4 provides a list of the variables included in the analysis, for which a detailed description and sources are provided in the appendix.

Table 3.4: List of variables.

Dependent variable:
• Real GDP per capita growth rate
Independent variables:
• FDI sectoral composition indicators
• Net FDI inflows (as a share of GDP)
Control variables:
• Initial real GDP per capita
• Government consumption (as a share of GDP)
• Domestic investment (as a share of GDP)
• Liquid liabilities (as a share of GDP)
• Inflation rate
• Human capital
• Openness
• Corruption
• Regional dummy variables

3.3. Empirical Findings: Cross-Sectional Analysis

As discussed above, based on MRW, we estimate equation (1) as stated above:

$$\text{Growth}_i = \beta_0 + \beta_1 \text{InitialGDP}_i + \beta_3 \text{FDI}_i + \beta_4 \text{FDI\_comp}_i + \beta_5 \text{Control}_i + \varepsilon_i \quad (1)$$

Initially a cross-sectional analysis is undertaken, where the analysis is carried out for the period 1990–2003. As discussed in the previous sections, a priori we expect the manufacturing sector to play a positive role in generating growth, the primary sector to play a negative role in generating growth, and are ambiguous about the effect of the services sector on growth. Since the sum of the three sectoral share measures constructed adds up to one, only two are included in each regression. The pair combination choice is driven by the correlation among the three sectoral shares; given the very high negative correlation among the services and manufacturing share measures, we include one or the other in the analysis. Table 3.5a reports the findings when we include manufacturing and primary sector shares, while Table 3.5b reports the findings when we include services and primary sector shares.

Table 3.5a shows results for a selection of control variables that are widely used in the empirical growth literature. These controls include, but are not limited to, initial income, financial market depth, level of openness, inflation rate, quality of institutions, and government spending. In column I, we control for the initial level of economic activity and expect to find a negative effect on account of conditional convergence. The result is as expected, suggesting the validity of a conditional convergence, where the poorer countries grow faster. We also control for the depth of local financial markets and, as discussed in King and Levine (1993) and many others, we expect to find a positive effect on growth. As expected we find that deeper the local financial markets are, higher the growth rate is across countries. Furthermore, in column I we find that FDI level itself does not have a significant effect on economic growth, whereas the composition of these FDI flows are found to be significant. We find a positive effect of increased shares of manufacturing FDI in total FDI on economic growth and a negative effect of increased shares of the primary sector in FDI on growth.

The negative effect of a change in the composition of FDI flows in favor of the primary sector suggests that the above-discussed negative effects outweigh the possible positive effects of increased capital stock in capital-deficient economies. This result can be interpreted as the negative effect of extractive industries on economic growth. Three possible factors that could be driving this

Table 3.5a: Growth effects of the sectoral composition of FDI inflows Dependent variable: Growth of Real GDP per capita (1990–2002).

Independent variable	I	II	III	IV	V	VI	VII
Initial income	−0.95	−1.03	−1.13	−1.53	−1.03	−1.36	−0.20
	−2.21**	−2.42**	−2.68**	−2.64**	−2.21**	−2.37**	−0.48
Share of manufacturing	0.001	0.002	0.002	0.001	0.002	0.001	0.001
FDI in total FDI	2.07**	2.03**	2.07**	1.60*	1.68*	1.78*	1.72*
Share of primary sector	−0.01	−0.02	−0.02	−0.02	−0.03	−0.02	−0.01
FDI in total FDI	−1.77*	−1.89*	−2.27**	−2.01**	−2.61**	−2.05**	−0.60
FDI as a share of GDP	0.15	0.27	0.39	0.31	0.42	0.34	0.38
	1.17	1.41	1.82*	1.49	2.01**	1.67*	2.47**
Financial Markets	1.62	0.83	1.33	1.70	1.07	1.91	0.34
	2.01**	2.17**	1.74*	2.56**	1.20	3.13***	0.57
Openness	—	−0.84	−1.35	−1.51	−1.02	−1.48	−2.05
	—	−1.23	−1.84*	−2.16**	−1.18	−2.14**	−4.27***
Inflation	—	—	−0.004	−0.004	−0.004	—	−0.005
	—	—	−3.35***	−2.67**	−3.27***	—	−4.70***
Institutions	—	—	—	0.47	—	0.72	—
	—	—	—	1.53	—	2.28**	—
Transition	—	—	—	—	−1.18	—	—
	—	—	—	—	−1.91*	—	—
Government	—	—	—	—	—	−0.11	0.00
	—	—	—	—	—	−1.78*	0.01
Investment	—	—	—	—	—	—	0.28
	—	—	—	—	—	—	3.26***
R^2	0.34	0.38	0.49	0.56	0.51	0.60	0.68
Number of observation	39	39	39	38	39	38	39

Note: This table excludes the services share in the total FDI. We included initial human capital in the regressions and the results remained qualitatively unchanged. Institutions are measured using the corruption index from the ICRG FDI as a share of GDP and the financial markets indicators are logged. Liquid liabilities are used as the financial market indicators. The significance level of the correlation coefficients are denoted by *,**, and ***. * denotes significance at 10% level, ** denotes significance at 5% level, and *** denotes significance at 1% level.

negative effect can be discussed. First of all, foreign investment in such industries could create a crowding out effect for the domestic firms. Such crowding out could change the market structure of the industry, increasing inefficiencies due to high concentration rates of ownership. Furthermore, such market structure alterations could increase rent-seeking activity and could cause significant deterioration in the institutions of the local economy. This crowding out effect can also be interpreted as a Dutch Disease problem, where significant inflows in such natural resource-related industries could alter the real exchange rate and create negative incentives for production in the tradable goods sectors (Sachs & Warner, 2001; Sala-i-Martin & Subramanian, 2003). In addition, the investment usually comes in the form of intercompany loans, rather than long-term investment equity component. This adds to the volatility of the investments, and given the large share of such investments in gross capital formation and their influence on exchange rates, volatility may cause further economic difficulties in some countries.

The positive effect of a change in the composition of FDI flows in favor of the manufacturing sector is as expected. The manufacturing sector investments are expected to create more backward and forward linkages in the local economy by nature. Production of final goods in the manufacturing industry could create backward linkages with the local producers via demand for locally supplied intermediary inputs, through the turnover in the local labor market, and connections built through possible outsourcing activities. Such positive spillover effects are found in some micro-based analysis of the effect of FDI on the local economy, where most of these studies are limited to the manufacturing sector itself.

In columns II through VII, additional control variables are included in the analysis. The findings regarding the composition of FDI are robust to the inclusion of additional control variables, except for the change in the significance level of the share of primary sector variable in column VII. The impact of the level of FDI, parallel to the findings of the literature, although always positive has a significance level that is not robust across specifications. However, generally speaking, the results reported in Table 3.5a suggest a positive and significant effect of FDI levels on growth, regardless of the composition of the foreign investment flows. They also suggest that the composition plays a significant role in influencing economic growth, with a positive effect of a compositional change favoring manufacturing and negative effects of a compositional change favoring the primary sector.

In column II, we add the level of openness of the economy, measured as the ratio of the sum of export and imports to GDP. Although insignificant, we find that the effect of increased openness on growth is negative. In column III, we include the inflation rate, as a proxy for macroeconomic instability. As expected,

we find a negative and significant effect of inflation on economic growth. This finding is robust across regressions. In column IV, we include a measure of institutional quality, measured as corruption. We expect a positive relationship on account of the measurement of the index. As expected, there is a positive effect of less corruption on economic growth, however the significance level is not found to be robust. In column V, we test for regional differences in the growth patterns of economies in our sample. Given the increased role of FDI in the transition economies over the past decade we include a dummy to capture these economies. We find that there is a significant regional effect. In column VI, we include the government-spending variable, expecting a negative effect. Finally in column VII, we control for domestic investment to ensure that the finding of a positive effect of FDI on growth is not driven by the omission of domestic investment from the analysis. We find that the effect of FDI on growth is in fact strengthened, as well as a positive impact of domestic investment on growth. The only result that changes is the significance of the primary sector share in total FDI, which becomes insignificant but continues to play a negative role. This finding requires further analysis.

Table 3.5b runs the same regressions with the services and the primary sector shares variables, replacing the manufacturing sector share with services sector share. The finding of the negative effect of primary sector FDI is robust to the inclusion of the manufacturing or services sector in the analysis, as is evident in the negatively significant coefficient on the primary sector share measure in both Tables 3.5a and 3.5b. As expected from the highly negative correlation between the share of manufacturing and services sectors in FDI, we find that a change in the composition of FDI flows in favor of the services sector creates a detrimental effect on economic growth. This finding is robust across regressions with different sets of control variables, as is evident from Table 3.5b.

The negative effect of the services sector FDI on economic growth can be explained by the nature of such investments. Although, investment in the services sector are dominantly in non-traded goods which seem to have very strong forward linkages to the local economy, different sub-sectors within the services industry could play different roles in influencing domestic growth. The FDI activity in infrastructures was mostly driven by privatization-led mergers and acquisitions (M&As), which do not necessarily increase the total investment in the local economy. Similarly, as discussed above, pricing behavior of multinational enterprises (MNEs), and the status of the institutional and regulatory environment in the local economy could generate a dominating negative effect of the services sector FDI on economic growth. Foreign investments in the banking sector are usually found to exert a positive effect on the efficiency of the financial system but with no link to the local economic growth.

Table 3.5b: Growth effects of the sectoral composition of FDI inflows Dependent variable: Growth of Reel GDP per capita (1990–2002)

Independent variable	**I**	**II**	**III**	**IV**	**V**
Initial income	−0.94	−1.02	−1.12	−1.02	−1.37
	−2.21**	−2.42**	−2.69**	−2.21**	−2.37**
Share of services sector FDI in total FDI	−0.001	−0.002	−0.002	−0.001	−0.001
	−2.41**	−2.16**	−2.20**	−1.68*	−1.85*
Share of primary sector FDI in total FDI	−0.01	−0.02	−0.02	−0.03	−0.02
	−1.83*	−1.96**	−2.32**	−2.64**	−2.09**
FDI as a share of GDP	0.15	0.26	0.39	0.41	0.33
	1.14	1.41	1.83*	2.00*	1.67*
Financial Markets	1.60	1.81	1.32	1.06	0.88
	1.99**	2.16**	1.73*	1.19	3.06***
Openness	—	−0.86	−1.37	−1.05	−1.50
	—	−1.25	−1.85*	−1.18	−2.14**
Inflation	—	—	−0.004	−0.004	−0.003
	—	—	−3.36***	−3.29***	−2.33**
Institutions	—	—	—	—	0.73
	—	—	—	—	2.30**
Transition	—	—	—	−1.14	—
	—	—	—	−1.78*	—
Government	—	—	—	—	−0.11
	—	—	—	—	−1.74*
R^2	0.34	0.38	0.49	0.51	0.59
Number of Observations	39	39	39	39	38

Note: This table excludes the manufacturing share in the total FDI. (See notes for table 5a). The significance level of the correlation coefficients are denoted by *,**, and ***. * denotes significance at 10% level, ** denotes significance at 5% level, and *** denotes significance at 1% level.

4. Conclusions

FDI flows have increased significantly over the past decade, especially the inflows to developing countries. This phenomenon is the result of the joint influences of both demand and supply side factors. On the supply side the improved business cycle conditions among many of the industrialized countries during the early 1990s have contributed to the increasing FDI inflows worldwide. On the demand side, local authorities have significantly improved their efforts to attract

more FDI; these efforts are evident in the many investment promotion agencies established and the number of FDI-favoring laws and regulations introduced each year in several economies. These efforts by the local authorities are mostly due to the positive effects of FDI that are envisaged. Despite this belief of positive spillover effects from foreign to local firms, the empirical evidence is not yet conclusive, other than stating that there are necessary conditions that allow countries to benefit from the FDI they attract. Our belief is that the lack of a robust finding regarding the positive relationship between FDI and economic growth is mostly on account of the aggregation of FDI data, that the results will be much stronger if one considers not only the effect of increased quantities of FDI but also the sectoral composition of these FDI flows.

We believe that the sectoral composition of the FDI flows play a significant role in influencing economic growth. FDI in the primary sector is expected to generate mostly negative effects on the local economy through the following factors which are expected to dominate: effect on the market structure, possible Dutch disease effects through influence on the real exchange rate, and low linkages of the industry with the local economy by nature. Accordingly, it is expected that as the share of the primary sector FDI in total FDI flows increases, it will be detrimental to the local economy's growth rate. Contrary to the primary sector FDI, due to its deeper backward and forward linkages, it is expected that FDI in the manufacturing sector will generate positive growth effects in the local economy. Forming a priori expectation regarding the influence of FDI in the services sector on economic growth is much less straightforward, given the different impacts of sub-sectors such as infrastructure, financial sector, tourism, and real-estate investments.

The cross-sectional empirical evidence discussed in this chapter suggests that both the level of FDI and the sectoral composition of these flows are important contributors to economic growth. The results suggest that as the sectoral composition of FDI gets skewed towards the manufacturing sector, there is a significant and positive effect on economic growth. On the contrary, the results suggest that as the sectoral composition of FDI gets skewed towards the services or the primary sector, there is a negative and mostly significant effect on economic growth. These results should be taken as strong motivation for further studies of the issue, where the time-series feature of the data is also accounted for using panel analysis.[10] Future studies should furthermore test for the possible

[10]Using the current dataset, we undertook some preliminary panel analysis, where the Hausman test suggested the use of fixed effects. Due to data limitations, we were forced to take 3-year averages of the series, which allowed for at most four data points. Preliminary results suggested supporting evidence to the cross-sectional results presented above. However, a more in-depth analysis is necessary.

endogeneity of the composition of FDI, which could differ along the growth path of economies. Due to lack of appropriate instruments the robustness of the above results to the possible endogeneity bias is not reported.[11] Regardless, the motivational cross-sectional evidence on these differential effects of the sectoral composition of capital flows provided in the chapter, to the best of our knowledge, have not been shown before in such a framework. The result of this chapter suggests that countries should not only focus on attracting more FDI, but should look into policies that will allow maximization of benefits through appropriate composition of the flows.

Much more extensive analysis of the issue is necessary before concluding this discussion. As shown in the chapter, the pattern of the sectoral FDI flows can either be captured through the magnitude of FDI inflow activities or as the sectoral composition of these flows. While the above analysis is based on one such measure of the sectoral composition of the flows, robustness checks of these results using the alternative share measures as well as flows measures remain to be done in future work. In addition, industrial structure plays an important role in the impact of FDI in an economy, and greater disaggregation in sub-sectors may yield different results.

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[11]In preliminary testings, following the agregate FDI literature, we use the lagged FDI as a share of GDP and the level of the real exchange rate as instruments (see Wheeler & Mody, 1992; Markusen & Maskus, 2002, regarding evidence that FDI shows very persistent behavior; and Blonigen, 1997, for evidence regarding the relationship between the real exchange rate and the FDI). However, overidentification tests suggest that these instruments are not appropriate instruments for the sectoral composition of the FDI. These preliminary results suggest the necessity of future work to further understand the factors that govern the sectoral composition of the FDI, which will also assist in determination of appropriate instruments for the composition itself.

Appendix

A1. Countries in the Samples

Argentina, Australia, Austria, Belgium, Bolivia, Brazil, Bulgaria, Canada, Chile, China, Colombia, Costa Rica, Czech Republic, Denmark, Ecuador, Estonia, Finland, France, Germany, Greece, Honduras, Hungary, Iceland, Indonesia, Ireland, Italy, Japan, Kazakhstan, Korea, Lao PDR, Malaysia, Mexico, Morocco, Netherlands, New Zealand, Nicaragua, Norway, Paraguay, Peru, Philippines, Poland, Portugal, Russia, Slovak Republic, Spain, Sweden, Switzerland, Thailand, Trinidad Tobago, Tunisia, Turkey, United Kingdom, United States, Venezuela, and Vietnam.

A2. Data Sources and Descriptions

Foreign direct investment, sectoral level: The International Monetary Fund Balance of Payments Manual (1993) and the OECD's Benchmark Definition of FDI recommend countries to identify the sector classification of FDI according to United Nations International Standard Industrial Classification (ISIC) of all economic activity. ISIC (Rev. 3.1) identifies three main sectors: primary sector including agriculture and mining and quarrying (coal, petroleum and other metals and minerals); manufacturing sector; and services sector including infrastructure (electricity, gas and water as well as transport and telecommunication), construction, wholesale and retail, financing and insurance, real estate and business services, education and health.

The FDI data in this study is collected from the U.N. Economic Commission for Latin America and the Caribbean, based on country sources for Latin American countries; National Bureau of Statistics of China; ASEAN for other Asian countries; and OECD, UNCTAD, and country sources for other countries. This classification may vary to some extent in each country.

Foreign Direct Investment: The net FDI inflows measure the net inflows of investment to acquire a lasting management interest (10% or more of voting stock) in an enterprise operating in an economy other than that of the investor. It is the sum of equity capital, reinvestment of earnings, other long-term capital, and short-term capital, as shown in the balance of payments. *Source*: World Development Indicators (WDI), World Bank (2004).

Growth and output levels: Both are imputed from the real GDP per capita, constant dollars. *Source*: WDI, World Bank (2004).

Liquidity (M2/GDP): Money plus quasi-money as a share of GDP. Liquid liabilities of the financial system (currency plus demand and interest bearing liabilities of the financial intermediaries and non-blank financial intermediaries)

divided by GDP. *Source*: World Bank Financial Structure Database. (http://www.worldbank.org/research/projects/finstructure/database.htm).

Private sector credit of financial system: The value of credits by financial intermediaries to the private sector divided by GDP. It excludes credits issued by central and development banks. Furthermore, it excludes credit to the public sector and cross claims of one group of intermediaries on another. *Source*: World Bank Financial Structure Database.

Private sector credit extended by banks: Credit by deposit money banks to the private sector as a share of GDP. *Source*: World Bank Financial Structure Database.

Domestic investment: 'Gross fixed domestic investment' measuring the outlays on additions to the fixed assets of the economy plus net changes in the level of inventories. *Source*: World Bank (2004).

Inflation: Annual percentage changes in the GDP deflator. *Source*: World Bank (2004).

Government consumption: Total expenditure of the central government, including both current and capital (development expenditures and excluding lending minus repayments, as a share of GDP. *Source*: World Bank (2004).

Openness: Measured as the trade volume, exports plus imports as a share of GDP. *Source*: World Bank (2004).

Human capital: Human capital measured as the average years of secondary schooling in total population. *Source*: Barro and Lee (1996). Updated version downloadable from: http://www.cid.harvard.edu/ciddata/ciddata.html.

Bureaucratic quality: The institutional strength of the economy. High levels of quality imply that the bureaucracy has the strength and expertize to govern without drastic changes in policy, or interruption in public services. *Source*: ICRG.

Risk of expropriation: The probability that the government may expropriate private property. *Source*: ICRG.

Corruption: This index captures the likelihood that government officials will demand special payments, and the extent to which illegal payments are expected throughout government tiers, and is based on a survey of a panel of international experts. A higher corruption index corresponds to a less corrupt country. *Source*: ICRG.

Real effective exchange rate: Calculated as the ratio of the local price index to the multiplication of the US price index and the official exchange rate. *Source*: International Monetary Fund.

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Knowledge Flows in Local Context

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Chapter 4

MNEs' Location Behaviour and Industrial Clustering*

Philip McCann and Ram Mudambi

1. Introduction

Economic geographers and urban and regional economists often discuss largely the same issues from somewhat different perspectives. The different analytical techniques adopted and empirical tests employed can sometimes lead to rather differing opinions and conclusions, and often these reflect largely methodological differences as to how to parsimoniously capture a particular issue. Where the topics being discussed also overlap with other fields such as international trade or international business, the variety of analytical insights arrived at, often simply reflects the variety of analytical perspectives adopted.

In this paper, we examine one important example of these differences in terms of a topic which is central to the interests of economic geographers and regional economists, namely that of industrial location behaviour. In particular, we examine the case of the location behaviour of the multiplant and multinational firm, specifically because the analysis of this issue is treated differently by economic geographers, regional economists, international trade economists and the international business and management schools. The spatial behaviour of the multinational enterprise (MNE) has significant implications for regional and local development, because of the sheer scale of the foreign direct investment (FDI)

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operations undertaken by the MNEs in all industrial and commercial sectors. Yet, the differences in the treatment of this topic by these different schools leads to major problems of interpretation and comparison, particularly regarding issues of industrial 'clustering'.

One of the most hotly debated aspects of globalization — the global disaggregation of the value chain — provides a critical template against which to view the intertwined issues of geography and the MNE. This disaggregation is the outcome of firms combining the *comparative advantages* of geographic locations with their own resources and competencies to maximize their *competitive advantage*. The interplay of comparative advantage and competitive advantage determines both the boundaries of the firm (outsourcing decisions) as well as the optimal location of value chain components (offshoring decisions). There is considerable evidence that knowledge plays a key role in the relationship between location and value creation (Pyndt & Pedersen, 2006). The '*smile of value creation*' emerges from concentrations of high value activities at the two ends of the value chain and illustrates the crucial role of knowledge (see Figure 4.1). R&D knowledge generates high value added at the upstream end of the value chain (development, design, research, strategic planning, etc.). Similarly, marketing knowledge generates high value added at the downstream end (advertising, after-sales support, market research, etc.). Over time, dynamic competencies are based on linking the two ends of the 'smile' so that marketing knowledge is used to calibrate and focus R&D-based knowledge creation (Leenders & Wierenga, 2002; Winter, 2003).

This paper argues two major points. First, both economic geography and regional economics have much to learn from these other fields concerning the

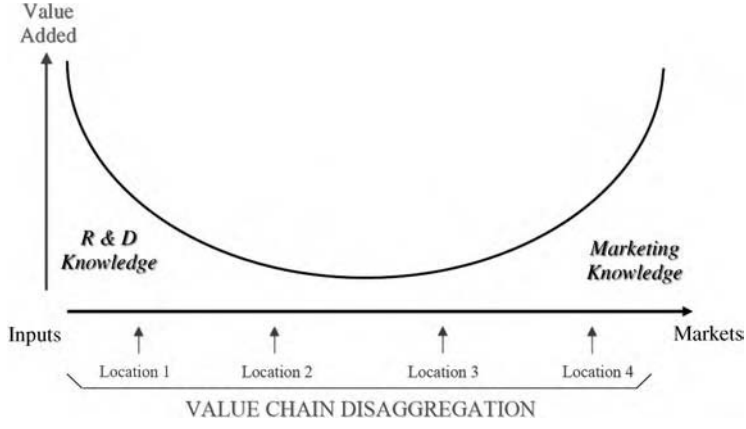

Figure 4.1: MNEs, knowledge and location.

strategic behaviour of the MNE. Economic geographers and regional economists tend to focus on the explicitly spatial aspects of MNE behaviour, and the resulting implications of the MNE location behaviour for regional development and regional policy, but do not treat MNE organizational issues, which are entwined with MNE locational issues, seriously (Phelps, 1997).

Second, we address the contribution that can be made by economic geography and regional economics to both the international business literature and international trade theory.[1] An unfortunate outcome of the tentative treatment of information and organizational issues of the MNEs in economic geography and regional economics, is that most of the seminal work on the explicitly spatial aspects of firms within these fields is largely unknown outside them.[2] Yet the explicitly spatial insights of economic geographers and regional economists have much to contribute to the MNE debates in the other fields of international economics and international business, for two reasons.

(i) Traditional international business and international trade theory approaches include no explicit geography within the schema, and cannot deal with locational issues at sub-national geographical scales.[3] (ii) The ignorance of firm location theory, outside the fields of economic geography and regional economics, has allowed the growing debates within the international business literature concerning the explicitly spatial behaviour of the MNE to be dominated by the banal notions of geographical space contained within the vague (Porter, 1990) notion of 'clusters'. Part of the reason for the popularity of the Porter clusters approach is that it allows commentators to draw selectively on, and to use more or less interchangeably, the nomenclature, terminology and insights of the fields of economic geography and regional economics, without any real consideration of the analytical assumptions embedded in each of these concepts (Gordon & McCann, 2000). Yet, such a selective approach means that many of the Porter-type contentions become almost entirely untestable (McCann & Sheppard, 2003; Martin & Sunley, 2003) and this is unfortunate, because good analysis and policy-making demands that our models are clear and testable. This lack of analytical rigour is particularly

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[1]Our review of the literatures discussed here is not meant to be exhaustive. We have included specific references to indicate the type of analyses employed by these different fields and their underlying assumptions, as they relate to the argument of the paper.

[2]For example, Markusen's (2002) seminal *Multinationals and the Theory of International Trade*, includes multiple references to international economics, international business and management, but no single reference to work by economic geographers or regional economists. This is also the case in best-selling international business textbooks, such as Ball et al. (2004).

[3]While new economic geographers (Fujita et al., 1999) have drawn on new international trade models (Helpman & Krugman, 1985), most trade theory dealing with MNEs remains fundamentally aspatial (Markusen, 2002).

problematic when analysing the regional development impacts of the MNEs. We will argue, adopting a transactions cost perspective, that the Porter notion of an industrial cluster implicitly precludes the inter-firm organizational arrangements characterizing the MNE. As such, the Porter clustering literature provides few, if any, grounds for determining whether an MNE should locate in a cluster.

The time is ripe for a clear and consistent analysis of how industrial location concepts from economic geography and regional economics relate to those in the international business and international economics fields. Such an attempt requires us to adopt a transactions-costs perspective on the organization, boundaries and linkages of the firm, a familiar approach in the international business literature but much less so in the trade literature (Markusen, 2002) and not at all in economic geography. Using this approach we can then consider how the location behaviour of the MNE firm influences, and is influenced by its strategic objectives, depending on the nature of the firm's inter-firm relations, and also depending on how the costs and opportunity costs of any inward or outward information spillovers affect the firm.

At this point we emphasize that the strategic logics underlying different 'modes of entry' used by the MNEs to undertake the FDI are very different. Thus, whether an MNE uses a greenfield or acquisition entry mode is likely to depend upon the entry objective. Greenfield establishments are more likely to be associated with leveraging the MNE's knowledge and other assets (exploiting the firm's existing competencies), while acquisitions are more likely to be associated with creating or upgrading competencies. Over time, subsidiary responsibilities may evolve, so that the MNE hierarchy is re-organized.

The paper is organized as follows. In the next section we discuss the rationale for and the nature of the MNE as perceived by the international business economics and international trade theory literatures. In Section 3, we discuss and compare the various approaches employed to describe and analyse the explicitly geographical location behaviour of the MNE from international business, international trade theory, regional economics and economic geography perspectives. We argue in Section 4 that many of the traditional analytical frameworks for discussing MNE location behaviour have recently given way to the Porter notion of a cluster. This is, however, an oversimplification of the complexities of MNE location behaviour, the analysis of which requires a careful consideration of the interrelationships between location theory and MNE information and organizational issues. In order to understand the conditions under which an MNE will find it advantageous to locate in a particular type of cluster, it is necessary to consider how MNE information and organizational issues are related to different inter-firm typologies of industrial clusters. In Section 5 we therefore present a typology of the clusters evident in regional economics and economic geography. By adopting

a transaction-costs perspective on inter-firm relations, this approach coherently links the economic geography and regional economics literatures to the international business literature. Section 6 then integrates these analytical underpinnings of clusters to the organizational and behavioural logic of the MNE. This allows us to point to various possible avenues of theoretical and empirical research.

2. The Nature of the Multinational Enterprise

The analysis of the nature and strategic competitive behaviour of the MNE has been undertaken in the two related fields of international business and international trade theory.

The mainstream of international business theory emerged from the Reading school and its early development was strongly influenced by its progenitors' roots in neoclassical economics (Dunning, 1977; Buckley & Casson, 1976). It soon found an interested audience of management scholars who applied the theory to a wide variety of issues involving the organization, strategy and impact of the MNE. In the international business and management literature, the explanation for the existence of MNEs is based on the assumed existence of firm-specific intangible assets, which give the MNE firm major cost advantages over foreign producers (Caves, 1982). Within this broad theme, the strategic behaviour of the MNE has traditionally been analysed within the framework of Dunning's (1977) 'eclectic' or 'OLI' paradigm' which posits that multinational activities are driven by three sets of advantages, namely ownership (O), location (L) and internalization (I) advantages. According to this approach, it is the particular configuration of these sets of advantages that either encourage or discourage a firm from undertaking foreign activities and becoming an MNE.

Ownership (O) advantages are perceived to be the firm-specific advantages that emanate directly from resources or assets owned or controlled by a firm, such as economies of scale or product diversification; the management of organizational expertize; the ability to acquire and upgrade resources; marketing economies; and access to domestic markets and to capital. Location-specific (L) advantages are assumed to be based on the resources, networks and institutional structures that are specific to a country. Examples here are low wages and the availability of cheap natural resources; labour productivity; the size and character of markets; transport costs; and the psychic distance from key markets to the home country of the MNE, the tariff and tax structures, attitudes towards the FDI, and the structure of competition. All of these can underpin value chain disaggregation (Figure 4.1).

None of these potential ownership (O) features or advantages are specific to MNE or to international business research, as each of these individual elements

is already contained within the standard industrial economics literature. Nor are any of the potential location (L) features specific to MNE or to international business research, as each of these elements is already contained within the standard urban, regional geographical economics literatures. Rather, what is different in the international business literature from these other fields is the particular way in which these features are combined with a third hypothesized advantageous feature of the MNE, namely the internalization (I) advantages.

For international business analysts, the most crucial perceived advantage of the MNEs is known as internalization (I) advantages. These are the hypothesized advantages that accrue to a firm when it eliminates the transaction costs associated with market interactions, and internalizes these activities by bringing them inside the hierarchy of the firm (Buckley & Casson, 1976). As such, the firm is perceived to gain an advantage from being able to better coordinate a complex set of interrelated activities by moving from a market system, in which the firm would be forced to rely on imperfect or non-existent markets, to a planned and organized system of internal markets. In particular, in the case of the MNE, the key imperfect market which the firm seeks to replace is that of the pricing of crucial proprietary knowledge across geographical boundaries. On one hand, knowledge can be regarded an asset that is generated by a firm, but at the same time knowledge also often has many of the attributes of a public good. Therefore, in order to profit from investment in knowledge development, in some cases it will be more efficient for the firm to use an internal hierarchy to internalize knowledge production and to monitor and control its use in a way that the market is unable to do. In these situations, knowledge is being treated as an intermediate product, and the firm accrues profits from the sale of the resulting final product or service produced on the basis of this knowledge. In cases where there are imperfections across international markets, the international business school argues that a hierarchically organized MNE can often be the most efficient means of production. As such, market failure may therefore often be the primary rationale for the existence of the MNE.

The second field of analysis which discusses the nature of and rationale for the MNE is trade theory. In early neo-classical trade theory there was no MNE as such, because traditional neo-classical trade theory was based on the twin assumptions of constant returns to scale and perfect competition in production. New trade theory (Helpman & Krugman, 1985; Krugman, 1990) extended the analysis of international trade by incorporating both economies of scale and product differentiation into trade models, both of which are features of the MNEs, and new economic geography (Fujita et al., 1999) also included a role for agglomeration and transport costs in determining trade patterns. However, within both of these subsequent approaches, each individual differentiated product is

still identified with a single firm at a single location, such that there was still no multiplant or multinational production (Markusen, 2002). It is therefore only relatively recently that the MNE has begun to be incorporated into trade models.

Many of the issues raised by the international business literature are now being incorporated in general equilibrium trade-IO models. These include issues such as the internalization and pricing of knowledge assets (Markusen, 1984, 2002), the advantages of horizontal (Horstmann & Markusen, 1992; Markusen & Venables, 2000) and vertical integration (Grossman & Hart, 1986; Aghion & Tirole, 1997) and the advantages of sub-contracting and licensing versus the FDI (Horstmann & Markusen, 1987; Ethier & Markusen, 1996; Helpman & Grossman, 2002; Markusen, 2002). However, even allowing for these recent developments in trade theory, and also allowing for the focus on multi-product firms in the new industrial economics literature (Tirole, 1988; Laffont & Tirole, 1993), Markusen (2002) contends that most trade-IO models are still generally of a type which assumes a single firm is associated with producing a single good at a single location, thereby excluding a role for the MNEs and multiplant firms.

3. Analysing the Geographical Location Behaviour of the MNE

The work on the MNEs in both international business analysis and trade theory has tended to focus on the relationships between the FDI, information and organization. With the exception of a few studies focused on the US (Shaver & Flyer, 2000) and Italy (Mariotti & Piscitello, 1995; Mudambi & Navarra, 2003), very little work has taken place in these fields concerning the sub-national regional location behaviour of the MNE. Geography is defined simply in terms of home country versus foreign country. Explicitly spatial work on the MNEs has been primarily in the field of economic geography. In this section we contrast these two approaches.

3.1. The International Business Approach

Within both the international business literature and the Markusen trade theory work, the location L decision of the MNE is viewed as being interrelated with both the O, and I characteristics of the firm. Each of these three aspects of Dunning's (1977) eclectic paradigm are perceived to interact to explain the location decision of the MNE. Therefore, while location advantages are only the direct component, the ownership and internalization advantages also influence the actual decision that is taken. As such, the location decision is a complex one, since it subsumes within it decisions regarding the mode of entry and the industry of

entry (Mudambi & Mudambi, 2002) as well as the location of entry into a market. Within both the international business literature and the international trade literature, this level of complexity was handled primarily by adopting several stylized models of the geographical behaviour of the MNEs, the most important of which was the product cycle model of Vernon (1966), and its subsequent developments (Johanson & Vahlne, 1977; Hood & Young, 1979).

In terms of international geographical issues, these theories imply a clear hierarchical ordering to the MNE's spatial allocation of activities. Modern and up-to-date activities of recent vintage would tend to take place in the home country of the MNE while more mature, standardized and relatively outmoded activities would tend to take place in overseas markets. The international geography would thus be divided into core and periphery locations, distinguished primarily in terms of the level and complexity of the information locally generated and handled. Regional or sub-regional locations within individual countries were almost entirely ignored. Yet, the revival of interest in economic geography and the development of free trade areas has forced many observers to consider these issues.

By the 1980s, however, this view of foreign subsidiary management was argued by some to be potentially misleading (Mowery & Rosenberg, 1979). The product cycle had by that time become so highly compressed that many MNEs were engaged in programs of almost contemporaneous research, development and product introduction in many major markets (see Vernon (1979), Cantwell (1995), Dunning (1992), and Howells (1990), with conflicting evidence in Patel and Pavitt (1991)).

The locational analysis of the MNE at the sub-national regional level is now coming to be regarded as ever more important by many analysts and policy-makers from the international business school (Mucchieli & Mayer, 2004) as well as by regional economists and economic geographers (Hill & Munday, 1994; Hill & Morgan, 1998). Within individual countries, identifying the conditions under which MNEs will locate in large or small urban centres, in central or peripheral locations, and in specialized or diversified areas, is now regarded as essential. As such, issues such as agglomeration, clustering or dispersion become crucial in evaluating alternative location choices and possibilities within individual countries or within individual areas of integration. Given that there is currently almost no theoretical analysis of the location behaviour of the MNEs at the sub-national regional level within either the international business or the international trade theory literatures, it would appear that there is currently an ideal opportunity for the explicitly spatial insights of economic geography and regional economics concerning firm location behaviour to be better integrated within the international business and international trade literatures.

3.2. The Regional Economics and Economic Geography Approaches

Yet, in spite of the current limitations of the international business literature and the international trade theory for analysing the location behaviour of the MNE at the sub-national level, it would be wrong to assume that the traditional regional economics and regional science literature has been in any way more advanced in providing an understanding of the regional geographical behaviour of the MNE. Analytical frameworks currently available are too specific for analysing the MNE in traditional regional economics, and too general in the case of economic geography.

The existing microeconomic location theory literature within the traditional regional economics tradition can be argued almost entirely unsuited to dealing with MNE issues on the grounds that the mathematical specifications too narrowly-defined to be meaningful. There are three reasons for this.

Firstly, microeconomic location theory (Eswaran et al., 1981; d'Aspremont et al., 1979) generally analyses the individual firm as a single point in space, and is therefore automatically inappropriate for analyzing many aspects of the MNE. Moreover, where multi-facility location modelling does exist (ReVelle, 1987), it is not constructed in terms that relate to the issues either behind the OLI framework or the product-cycle and stage-theory literatures.

Secondly, applying a microeconomic location-production function methodology to even the most basic notion of the firm in the real world is actually far more complex than it appears at first (McCann, 1999) and extending this thinking to an MNE is currently not possible.

Thirdly, as we have already seen, much of the geographical relocation of activities within the MNEs consists of the reallocation of activities and resources within an existing spatial configuration of establishments, with little or no discernable external changes (Healey & Watts, 1987) of a type which can be modelled by microeconomic location theory.

On the other hand, much of the traditional economic geography literature on MNE firm location behaviour can be argued to be far too general for coherently analysing the MNE. The traditional economic geography approach often adopts stylized geographical versions of the product cycle model which adapt the insights of the orthodox product cycle model to sub-national regional space. In these economic geography versions of the product cycle model (Healey & Watts, 1987; Hayter, 1997; Dicken, 2003) the general stylized argument is that multiplant firms (MPFs) will tend to locate their information-intensive activities and facilities in knowledge centres, such as dominant dynamic cities, while locating more routine and standardized activities in more geographically peripheral regions, in order to take account of lower local factor costs. As such, the inter-regional product cycle

geography of the MPF within an individual country should exhibit a similar pattern to the international geography of the MNE. Similarly, in the case of inward investment by foreign-owned MNEs, the simple logic here also suggests that investment locations will be driven by analogous considerations.

A problem with these stylized geographical versions of the product cycle model, however, is that they are based on a range of assumptions relating to the nature of the MPF and the MNE, many of which may no longer be tenable. In particular, the modern organizational structure, logic and behaviour of the MNE appears to have changed significantly over the last three decades since the product cycle model was first developed. The MNEs are nowadays acknowledged to adopt a much more sophisticated approach to multinational organization and parent-subsidiary relationships than the simple hierarchical model implied by the product cycle theory.

There are several possible reasons for these changes. Firstly, on the demand side, increasing wealth has led to a growth in the demand for more customized products. From the perspective of the MNEs, the outcome of this has been described as a movement from mass production to 'mass customization' (Kotha, 1995), i.e. including a substantial pre-manufacture design function, whereby the MNE firm continues to exploit its home country expertize of exploiting economies of scale and scope, while at the same time incorporating the potential for considerable country-specific differentiation. Secondly, on the supply side, it is argued that many of the newer information and communication (ICT) technologies have greatly reduced the advantages of size, such that many of the previous cross-subsidization based advantages of MNEs are assumed to have been largely dissipated. On the other hand, however, the MNE as a network firm may also be uniquely positioned to coordinate the activities of different subsidiaries in a manner which gives it dynamic advantages.

The desire to produce a greater variety of products or services within a networked system appears to have led to major changes in the role played by subsidiaries (Pine et al., 1993) and an increased role for strategic decision making at the subsidiary level focussed on information-based activities (Cantwell, 1987). Technological advantages created in one location can be used in another, so that there may be a multi-directional flow of information and goods between relatively autonomous subsidiaries. In order to realize these advantages, the MNEs have to adopt more sophisticated means of coordination so as to continually maintain their local and global knowledge advantage, In turn, these changes have generally lead to changes in parent-subsidiary relations and the management of this process of change can lead to tensions and conflicts within the MNE (Asakawa, 2001). These tensions arise because of the conflicts associated with the fact that the parent firm and headquarters operations will often wish to retain

the scale advantages of a hierarchical organization while at the same time also wanting to benefit from the local knowledge gained via the relatively more autonomous subsidiaries. Under such conditions of conflicting goals and organizational stresses (Simon, 1952, 1959) the MNEs may adopt satisficing (Cyert & March, 1963) strategies that may be sub-optimal from the point of view of the MNE as a whole. In other words, subsidiaries embedded in leading technological centres of competence (Cantwell & Janne, 1999) may be sources of potential competitive advantage that actually remain unrealized due to the internal political structure of the MNE (Mudambi & Navarra, 2004). As such, the nature of the location and the nature of the activity located there may not always be optimal.

In addition to this sub-optimal location-matching problem, from the perspective of the economic geography of the MNE and the MPF, these various organizational changes also imply that many of the simple centre-periphery assumptions of the product-cycle model may no longer be tenable. The fact that more subsidiaries may gain a relatively higher level of autonomy does not necessarily imply that all establishments will be progressively located in so-called knowledge centres. The reason for this is that the actual economic geography of these organizations will also depend crucially on the emerging organizational structure of the firm. For example, the geographical reach and responsibility of a subsidiary may change over time (Birkinshaw, 1996). Initially a subsidiary may originally acquire a regional mandate, where it is responsible for the coordination of activities with regard to a particular class of products, overseeing other subsidiaries in the same region. Eventually, it may obtain a global product mandate where its responsibilities become worldwide. Yet, such developments do not necessarily imply observable location changes. Rather, it is often the internal logic and organization of the activities within the network of the MPF or MNE establishments which is adjusted. The locational logic of any subsequent new 'greenfield' investments will also depend on this emerged organizational system (e.g., Anand & Delios, 1995).

In order to counter some of these problems, within traditional economic geography there has been some case-study work describing the various organizational-geographical aspects of the MPF and the MNE (Arita & McCann 2002; Hayter, 1997; Bloomfield, 1981; Sheard, 1983). Yet, very little has been generalized from this case-study type of work, because the examples analysed tend to be very heterogeneous both technologically and geographically. Interestingly, however, these case-studies do tend to indicate that these simple geography-product-cycle stylized models can provide very little indication of the actual sub-national regional geographical behaviour of MPFs or the MNEs, without a detailed analysis of the organizational logic of the firms concerned (Arita & McCann, 2002, 2004).

4. MNEs and Industrial Clustering

Most recent analyses of the location behaviour of the MNEs have moved from one stylized construct to another alternative stylized construct. The new stylized construct of MNE locational behaviour, regularly employed in the international business literature but also in some areas of economic geography (Tallman et al., 2004), is the Porter (1990) concept of a 'cluster'. Not only has this Porter clusters concept been added to the existing toolkit of stylized product-cycle constructs, but also it has come to dominate much of the recent literature on this subject. We would argue that in terms of analysing the spatial behaviour of the MNEs, this Porter concept actually creates more analytical problems than it solves.

Within the management literature, a key aspect of a location's attractiveness for a firm is its potential for enhancing competitive advantage (Porter, 1990, 1998a, 1998b). The Porter literature argues that a central feature of such competitive regions is the presence of an industrial cluster, which provides the individual firm with valuable local resources, inputs, infrastructure and opportunities for learning from other local firms and institutions through intentional and unintentional knowledge inflows. In some situations these potentially favourable aspects of a location can reinforce each other, leading to a virtuous cycle in which there appear to be continuing advantages to investing in particular areas over other alternative locations. The implication of this analysis is that clusters once formed, have a strong element of irreversibility, and firms therefore have much to gain from locating in such clusters. This Porter thinking has recently pervaded all areas of the international business literature, because it appears to provide a way in which the (L) component of the OLI paradigm can be discussed at the sub-national level.

As we have already seen, in most of the international business literature the focus is on the MNE, which is recognized as a complex network spanning national borders, whereas the industrial cluster is treated rather simplistically as a source of knowledge (Kuemmerle, 1999). On the other hand, in most of the literature in economic geography and regional science, the focus is on the location of the MNE subsidiary within the industrial cluster, while the MNE is treated as a unitary entity interacting with a local system of innovation (Pinch et al., 2003).

Thus, as we see in Figure 4.2, in the international business literature the analysis concentrates on the multinational firm (Cantwell & Mudambi, 2004). In the context of knowledge flows, the MNE sees the host location as a source of knowledge. The subsidiary is then the 'pod' through which this knowledge is assessed, filtered and matched to the firm's requirements. This relates to what has been termed the firm's absorptive capacity — the greater this capacity, the wider the range of knowledge that that subsidiary can examine.

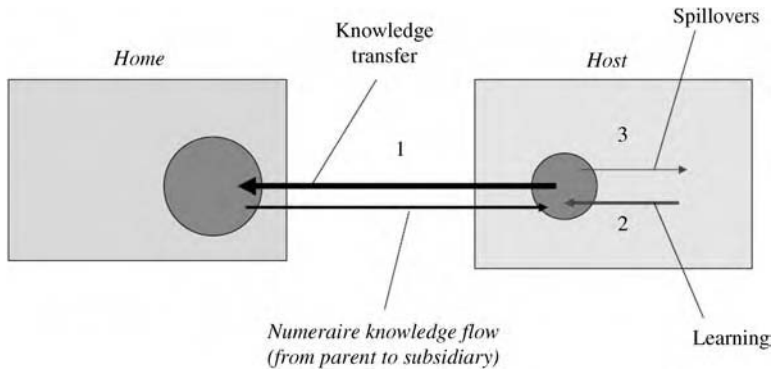

Figure 4.2: MNE competence-creating knowledge flows.
Source: From Cantwell and Mudambi (2004).

Therefore, greater absorptive capacity is generally associated with greater knowledge flow from subsidiary to parent. Of the knowledge flows in Figure 4.2, the MNE is most interested in the inflow of knowledge. Hence, it is interested in the extent to which the location can create such inflows. The subsidiary absorbs and serves as a conduit for some knowledge inflows (so-called spillovers). However, it also recombines these inflows to create new knowledge using its specific resource base in the location. Thus, in Figure 4.2, the flow from subsidiary to parent (1) is not the same as the inflow into the subsidiary from the location (2). The MNE is interested in both the flows (1) and (2), but these have different implications for the role of subsidiary. If flows (1) and (2) are fairly equal, the subsidiary serves mainly as a conduit for the acquisition of cluster knowledge. A large flow (1) and small flow (2) implies that the subsidiary has a substantial local resource base with which it enhances knowledge inflows for use by its parent MNE. A large flow (2) coupled with a small flow (2) can imply either that the knowledge is locally 'sticky' (Szulanski, 1996) or that subsidiary's knowledge strategy is misaligned with that of its MNE parent.

On the other hand, as we see in Figure 4.3, in the economic geography literature, the analysis concentrates on the location (Maskell, 2001). The institutional environment (rule of law, property rights) governs inter-personal relations and encourages the formation of firms. The National System of Innovation (NSI) that encompasses the public, private and non-profit sectors fosters an open and learning environment that encourages the formation of firm networks. Geographic factors generate a munificent location based on the NSI — hi-tech labour and an open and learning business environment. This open and learning environment is embodied in the largest firms in the local cluster. These largest firms serve as 'flagship' firms and

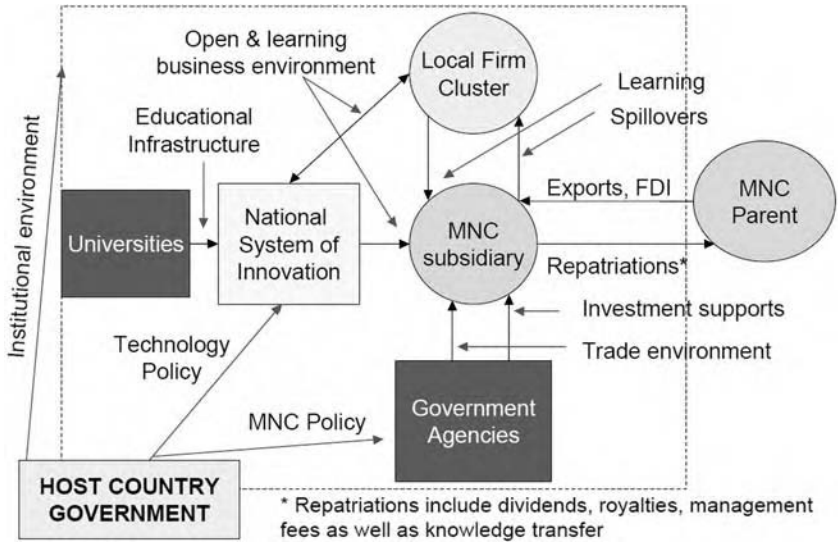

Figure 4.3: The cluster system of innovation.

are the hubs of networks made-up of small and medium-sized enterprises (SMEs). The network linkages enhance the innovativeness of these SMEs.

Within the international business literature, the particular way in which the Porter (1990) argument has generally been interpreted is both positive and normative. The positive conclusion is that the MNEs have much to gain from locating in clusters (Cantwell & Piscitello, 2005). On the basis of this positive conclusion, the additional normative conclusion is that the MNEs should generally locate facilities where other similar establishments are also located. For example, 'knowledge-intensive' MNE activities should simply be located in knowledge-intensive regions populated by other similar knowledge-intensive activities and establishments. On the other hand, rather more routine activities which are not knowledge-intensive should simply locate in lower-wage areas along with other similar activities.

The vast majority of the traditional economic geography work on the MNEs has been largely excluded from these discussions. However, there is one particular school of economic geography research, which has made some limited impact on the international business and management literature, and this is the Uppsala school (Solvell & Malmberg, 2002; Malmberg & Maskell, 2003; Solvell, 2003). The Uppsala school of international business has been unique, in that it has developed by maintaining a continuous dialogue amongst regional scientists, economic geographers and management scholars, and it is in this strand of the literature that

we find a systematic treatment of the linkage between industrial clusters and the MNEs. This is one of the few literatures where both the industrial cluster and the firm are treated as complex evolving entities (Bathelt et al., 2004).

According to the Uppsala school, knowledge flows are the main connections between cluster dynamics and the organizational and strategic decisions within the MNE (Malmberg & Maskell, 2002; Dicken & Malmberg, 2001). This approach recognizes the symbiotic nature of innovation in the cluster and in the MNE. Thus, the internal innovation system of the MNE (Figure 4.2) and the cluster system of innovation (Figure 4.3) each affect the evolution of the other. Following these arguments, it becomes apparent that the MNE knowledge network can therefore be leveraged to generate two unique advantages: (1) *transfer*, i.e. the use of knowledge created anywhere in the network at all other nodes of the network and (2) *integration*, i.e. the synthesis of knowledge flows from the parent, other subsidiaries and from its host location.

There is a difference, however, between the traditional international business approach and the Uppsala school. With its focus on the MNE, the mainstream international business literature places more emphasis on transfer. On the other hand, influenced as it is by the economic geography literature, the Uppsala school places more emphasis on integration. While the Uppsala school recognizes the importance of the parent-subsidiary relationship in the MNE, it primarily analyses the cluster network (Figure 4.3) and the subsidiary's embeddedness in it (Andersson, Forsgren, & Holm, 2002). We would suggest that a complete understanding of the interactions between the MNE and clusters requires an analysis of both knowledge transfer and knowledge integration (Figure 4.4).

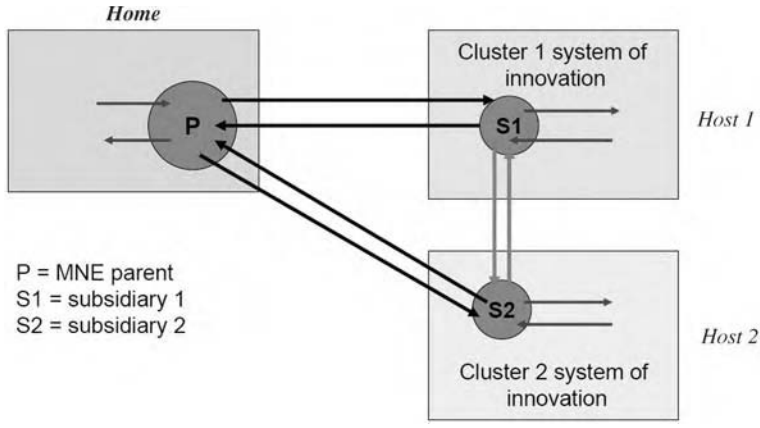

Figure 4.4: The MNE knowledge network.

4.1. Entry Objectives and Location

It has been recognized for some time that the MNEs are differentiated networks wherein subsidiaries differ greatly in terms of their resources, competencies and mandates (Nohria & Ghoshal, 1994). The MNE's network now contains a diversity of subsidiary units undertaking a range of roles. This has been expressed in several different ways, e.g., assembly-type versus research-related production facilities, market-seeking versus asset-seeking FDI, home-based exploiting versus home-base augmenting FDI, national mandates versus centre of excellence mandates and so on. All of these typologies have been integrated under an overarching typology distinguishing between competence creation and competence exploitation (Cantwell & Mudambi, 2005). This substantial literature points to the fact that, over the past two decades or so, subsidiaries have been evolving out of their traditional role of being the subservient executors of headquarters commands. This process has been called 'subsidiary evolution' (Birkinshaw & Hood, 1998).

Competence-exploiting subsidiaries are MNE focussed in terms of creating and maintaining competitive advantage. Hence, they have little to gain and much to lose from locating in clusters. The knowledge-based assets of their MNE network that are the source of their competitive advantage are very valuable and one of their main location objectives is the protection of this knowledge. Hence, such subsidiaries are driven by the private good aspect of knowledge.

Competence-creating subsidiaries, on the other hand, are cluster focussed in terms of creating new sources of competitive advantage for their parent MNEs. In this process, they can take on competence-creating roles with progressively higher levels of responsibility.

- *Receiver competence*: As pods or 'listening posts' they assess, filter and process cluster knowledge, enhancing the MNE's receiver competence (Mudambi & Navarra, 2004).
- *Absorptive capacity*: In turn, receiver competence is the basis for the creation of absorptive capacity (Cohen & Levinthal, 1990), where the subsidiary adapts knowledge inflows to fit firm-specific requirements. This knowledge can then be transmitted to other parts of the MNE network in a usable form.
- *Knowledge integration*: Subsidiaries with high levels of absorptive capacity are able to integrate inflows from diverse sources in the creation of new competencies (Figures 4.1 and 4.3) and may be better able to absorb tacit knowledge (Cantwell & Santangelo, 1999). This role is often accompanied by strategic responsibility in the form of a regional or world product mandate for a particular aspect of the MNE's operations (Birkinshaw, 1996; Mudambi, 1998).

Table 4.1: Entry objectives and entry modes.

Entry objective	**Entry mode**	
	Greenfield	**Acquisition**
Competence-exploiting	• Forward linkage creation • Investment in marketing, logistics, distribution	• Forward linkages leveraged and enhanced • R&D intensity decreases
Competence-creating	• Backward linkage creation • Investment in in-house R&D, alliances, university partnerships	• Backward linkages leveraged and enhanced • R&D intensity increases

It may be readily seen that the notion of receiver competence is primarily related to knowledge transfer, while the notion of absorptive capacity contains elements of both transfer and integration.

Relating this analysis to the spatial domain, it may be seen that the entry objective and entry mode are strongly linked. One would expect the data to be concentrated in the diagonal boxes in Table 4.1. *Ceteris paribus*, competence-exploiting subsidiaries are likely to be set up in a greenfield mode, since the MNE possesses the key competencies in-house and can obtain most complementary competencies through market transactions. Similarly, competence-creating subsidiaries are likely to be acquired, since it is precisely the key competencies that are objective of the entry. Over time, however, subsidiary evolution is likely to occur, so that a cross-sectional view of an MNE will see subsidiaries in all four boxes (Cantwell & Mudambi, 2005).

These cluster-type discussions have led to an additional implicit assumption arising within the international business literature. This implicit assumption is that where we observe several MNE firms of apparently similar characteristics located relatively close to one another, then cluster features must be present and information spillover mechanisms must be operating locally (DTI, 2002). In the fusion between the international business literature and the economic geography literature (Dunning, 2002), these approaches and conclusions are highly pervasive. Yet, from an analytical perspective this line of thinking is extremely problematic, for three reasons.

Firstly, even if the distribution of activities across space is random (Ellison & Glaeser, 1997), some activities will appear clustered even though there are no differences in the interactions between firms. Observations of spatial industrial concentration are thus not necessarily an evidence of Porter-type clusters.

Secondly, in the Porter model, the critical geographical dimension over which any such (information) competitive advantage is assumed to operate is never specified. This is problematic, because there is much empirical evidence to suggest that information spillovers in the dynamic MNE sectors extend well beyond the dimensions of the individual metropolitan areas (Audretsch & Feldman, 1996; Suarez-Villa & Walrod, 1997) and may well extend beyond a state, regional (Arita & McCann, 2000) or even national scale (Cantwell & Iammarino, 2000, 2002).

Thirdly, while certain combinations of resources and features may tend to perpetuate locational advantage, it is not clear which firms this might be relevant for. In particular, it is not clear from the Porter logic, from an MNE viewpoint, what the balance is between the costs of locating in a cluster and the opportunity costs of not doing so.

In order to consider these issues, we must first consider the assumptions implicit in the various notions of industrial clusters that are evident in the regional economics and economic geography literatures. Whereas the central rationale for the MNE is to internalize information transactions costs within the individual firm, a key rationale for industrial clustering is to internalize information transactions costs within the group of clustered firms, rather than within an individual firm. By adopting a transactions-costs approach to understanding the types of inter-firm relations, which exist within a cluster, it becomes clear that there are many conditions under which it is not advantageous for an MNE or an MPF firm to locate facilities within a cluster.

5. Analytical Typologies of Clusters

If we adopt a transactions-costs perspective, we can define three distinct types of industrial clusters, according to the nature of firms in the clusters, and the nature of their relations and transactions within the cluster (McCann & Gordon, 2000; McCann et al., 2002; McCann & Sheppard, 2003; Simmie & Sennet, 1999). These three distinct types of industrial clusters are the *pure agglomeration,* the *industrial complex* and the *social network*. The key feature which distinguishes each of these different ideal types of spatial industrial cluster, is the nature of the relations between the firms within the cluster. The characteristics of each of the cluster types are listed in Table 4.2, and as we see, the three ideal types of clusters are all quite different.

In the model of pure agglomeration, inter-firm relations are inherently transient. Firms are essentially monopolistically atomistic, in the sense of having almost no market power, and they will continuously change their relations with other firms and customers in response to market arbitrage opportunities, thereby leading to intense local competition. As such, there is no loyalty between firms, nor are any

Table 4.2. Industrial clusters: A transactions cost perspective.

Characteristics	Pure agglomeration	Industrial complex	Social network
Firm size	Atomistic	Some firms are large	Variable
Characteristics of relations	Non-identifiable, fragmented, unstable	Identifiable, stable trading	Trust, loyalty, joint lobbying, joint ventures, non-opportunistic
Membership	Open	Closed	Partially open
Access to cluster	Rental payments location necessary	Internal investment location necessary	History experience location necessary, but not sufficient
Space outcomes	Rent appreciation	No effect on rents	Partial rental capitalization
Notion of space	Urban	Local, but not urban	Local, but not urban
Example of cluster	Competitive urban economy	Steel or chemicals production complex	New industrial areas
Analytical approaches	Models of pure agglomeration	Location-production theory, input-output analysis	Social network theory (Granovetter, 1973)
Dynamics	Stochastic	Strategic	Mixed

particular relations long-term. The external benefits of clustering accrue to all local firms simply by reason of their local presence. The cost of membership of this cluster is simply the local real estate market rent. There are no free riders, access to the cluster is open and consequently, it is the growth in the local real estate rents which is the indicator of the cluster's performance. This idealized type is best represented by the notion of clustering underlying models of new economic geography (Krugman 1991; Fujita et al., 1999). The notion of space in these models is essentially urban space, in that this type of clustering only exists within individual cities.

The industrial complex is characterized primarily by long-term stable and predictable relations between the firms in the cluster. This type of cluster is most commonly observed in industries such as steel and chemicals, and is the type of spatial cluster typically discussed by classical (Weber, 1909) and neo-classical (Moses, 1958) location-production models, representing a fusion of locational analysis with input–output analysis (Isard & Kuenne, 1953). Component firms within the spatial grouping, each undertake significant long-term investments, particularly in terms of physical capital and local real estate, in order to become part of the grouping. Access to the group is therefore severely restricted both by high entry and exit costs, and the rationale for spatial clustering in these types of industries is that proximity is required primarily in order to minimize inter-firm transport transactions costs. Rental appreciation is not a feature of the cluster, because the land which has already been purchased by the firms is not for sale. The notion of space in the industrial complex is local, but not necessarily urban, in that these types of complexes can exist either within or outside of an individual city. This complex model is actually the single explicitly spatial element in the transactions costs approach of Williamson (1979), where the focus is on the types of flow-process scale economies which firms can realize by being part of vertically -integrated production complexes.

The third type of spatial industrial cluster is the social network model. This is associated primarily with the work of Granovetter (1973), and is a response to the hierarchies' model of Williamson (1975). The social network model argues that mutual trust relations between key decision-making agents in different organizations may be at least as important as decision-making hierarchies within individual organizations. These trust relations will be manifested by a variety of features, such as joint lobbying, joint ventures, informal alliances and reciprocal arrangements regarding trading relationships. However, the key feature of such trust relations is an absence of opportunism, in that individual firms will not fear reprisals after any reorganization of inter-firm relations. Inter-firm cooperative relations may therefore differ significantly from the organizational boundaries associated with individual firms, and these relations may be continually reconstituted. All of these behavioural features rely on a common culture of mutual trust, the development of which depends largely on a shared history and experience of the decision-making agents and is likely to extend beyond business firms to include employee unions and other stakeholders. Firms emerging from such clusters are likely to attempt to re-create this environment when they set up operations in foreign locations (Tüselmann et al., 2003).

This social network model is essentially aspatial, but from the point of view of geography, it can be argued that spatial proximity will tend to foster such trust relations, thereby leading to a local business environment of confidence, risk-taking

and cooperation. Spatial proximity is necessary but not sufficient to acquire access to the network. As such, membership of the network is only partially open, in that local rental payments will not guarantee access, although they will improve the chances of access.[4] The geographical manifestation of the social network is the so-called 'new industrial areas' model (Scott, 1988), which has been used to describe the characteristics and performance of areas such as Silicon Valley and the Emilia-Romagna region of Italy (Piore & Sabel, 1984; Scott, 1988; Storper, 1997; Castells & Hall, 1995). In this model space is once again local, but not necessarily urban.

In reality, all spatial clusters will contain characteristics of one or more of these ideal types, although one type will tend to be dominant in each cluster. Yet, as we see there are some elements of each of these particular cluster frameworks which are mutually exclusive of the other cluster typologies. Therefore, in order to understand the advantages to the firm of being located in any particular cluster, it is first necessary to determine which of the ideal types of industrial cluster, described in Table 4.2, most accurately reflects the overall characteristics and behaviour of the firms in the cluster. Clearly, the major problem with the simple Porter clusters model is that in addition to the Porter emphasis on the role played by local information in acting as a spur to competitiveness, the various elements of all three of the above cluster typologies are all repeated in the Porter framework without any particular ordering, ranking or discrimination. Unfortunately, this lack of discrimination fundamentally weakens the whole basis of the Porter cluster argument.

A key distinguishing feature of our typology of clusters relates to the underlying inter-temporal dynamics. In pure agglomeration clusters, the dynamics are purely stochastic, driven by the open membership and consequent low entry barriers. Entry is based on the munificence of factor availability (supply side factors) and perceived industry profitability (demand side factors). Intra-cluster competition ensures that this dynamic process aids cluster survival. Failure and exit weed out weaker ideas and firms. This is the Porter argument in favour of encouraging competitive forces to promote competitiveness.

In industrial complex clusters, on the other hand, membership is virtually closed. Entry and exit is closely regulated by the major cluster participants. In many cases (e.g., Toyota City — Aichi Prefecture, BASF-city — Ludwigshafen) the cluster is controlled by a 'flagship firm'. The dynamic evolution of the cluster

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[4]The work of Scott (1988) also draws on the transactions cost institutional economics framework of Williamson. Our inclusion of Scott's work in this third category reflects the fact that the new industrial spaces model generates a semi-fragmented grouping of firms with semi-flexible inter-firm transactions, rather than a system of tightly integrated, hierarchically organized, stable, predictable and identifiable inter-firm transactions, of the sort which exists in the industrial complex model.

is therefore controlled by the strategic goals and objectives of the dominant firm or firms. Cluster survival is closely connected to the survival of the major cluster participants. Thus, intra-cluster competition is virtually absent, while inter-cluster competition provides the dynamic of survival.

Social network clusters contain elements of both stochastic and strategic dynamics. Given the dependence on trust and shared history, entry processes are slower than that in pure agglomeration clusters. However, intra-cluster variation can be quite significant, so that over time such a cluster is likely to evolve more flexibly than an industry complex cluster that must always serve the interests of at the most a few major players.

For our purposes, it is important to understand how transactions cost descriptions of clusters inform our discussion of the attractiveness of clusters for MNEs. As we have already seen, the central rationale for the MNE is as a means of internalizing information transactions costs within the individual firm, whereas the rationale for industrial clustering is to internalize information transactions costs within the group of clustered firms. It is thus necessary to consider how the organizational characteristics and objectives of the MNE and the MPF relate to the costs and benefits of the information spillover characteristics and inter-firm behaviour of the other clustered firms.

6. Information Spillovers and MNE Location Behaviour

There is some evidence to suggest that beneficial information spillovers may operate in certain locations. For example, it is well known that R&D-intensive industries tend to be highly spatially concentrated (Almeida & Kogut, 1997; Castells & Hall, 1994; Saxenian, 1994), and this spatial concentration has tended to persist even in the face of rising local labour, land and other local input costs. However, the involvement of the MNEs in clusters is not ubiquitous. There is evidence that this involvement is very sensitive to the nature of the industry structure in which the firm operates (Cantwell & Kosmopoulou, 2002). This finding can be shown to be consistent with the arguments outlined in the previous section, but in order to see this we must reconsider the firm's perceptions of the benefits of information spillovers. In particular, we must distinguish between information spillovers which result in knowledge inflows from those which result in knowledge outflows, and also we must distinguish between unintentional and intentional knowledge flows.

While we may safely assume that all firms regard knowledge inflows positively, irrespective of whether they are intentional or unintentional, a firm's perceptions of the benefits of knowledge outflows will depend on the structure of the

industry in which the firm competes. This is because unintentional knowledge outflows have both a positive and a negative effect on the individual firm. The private effect of an unintentional knowledge outflow on the owner-originator firm is a leakage of its valuable intellectual capital, which would be viewed negatively by the firm (Grindley & Teece, 1997). The potential positive effect of an unintentional knowledge outflow, however, is the public good aspect of knowledge (d'Aspremont et al., 1998), contributing to a virtuous cycle by strengthening the knowledge base of the region and making it a more attractive location for other knowledge-bearing firms. This, in turn, should generate larger future knowledge inflows to all the firms in the group.

In a competitive market structure characterized by a large number of firms, each with a relatively small market share and profits, such firms probably have little to lose from unintentional knowledge outflows and more to gain from inflows stemming from a strong clustered location. The public good aspect of knowledge would appear to dominate here, with the local knowledge outflows being viewed as generally positive both for the firms themselves and for the local region (Jaffe et al., 1993; Saxenian, 1994).

In an oligopolistic industrial structure, firms realize that unintentional knowledge outflows to industry rivals can be extremely costly in terms of lost competitive advantage, because the private good aspect of knowledge is their dominant consideration. Any unintentional information outflows from a firm are more valuable to its competitors than any potential information outflows from these competitors to the firm, so the overall effect of the knowledge outflows is perceived to be negative.

If the clustering of oligopolistic firms appears to jeopardize their proprietary knowledge assets by exposing themselves to the possibility of unintentional outward knowledge spillovers, such firms will decide not to locate in clusters, unless they can find a way of avoiding unintentional knowledge outflows. These problems of information revelation and opportunism, and the impacts on location behaviour, are similar in nature to the moral hazard issues in the contracting-versus-FDI dilemmas faced by the MNEs (Markusen, 2002). We can therefore use this argument concerning the avoidance of unintentional knowledge outflows, to reconsider the attractiveness of a cluster for an MNE firm, most of which are oligopolistic.

In terms of our cluster typologies in the previous section, the possibility of unintentional knowledge outflows is associated most obviously with the model of pure agglomeration. Tacit knowledge can be shared between two parties, but if there is little or no inter-firm loyalty within the system, this knowledge can also be passed on to third parties who are beyond the control of the originator of the information. As such, pure agglomerations will create information problems for

an oligopolistic MNE establishment. Similarly, in the case of a social network, where non-opportunistic relations between the firms are built upon longstanding mutual trust and shared experience, an immigrant oligopoly MNE firm will benefit little, as these trust systems are based primarily on networks of small firms aiming to help one another. It is very difficult to conceive of such two-way relations developing between a major MNE source of the FDI and local small firms, because the dominance in any such relationships will be skewed according to the size of the firms. Although our knowledge of the relationship between business networks and the FDI is currently very limited (Rauch, 2001), it is very difficult to conceive of a large MNE investor benefiting in any way from locating within a region characterized by such social network features, wherever they may exist.

Applying Akerlof's (1970) market-for-lemons model, many industrial clusters which include large oligopolistic competitors will generally be plagued by adverse selection and should either fail to form, or become concentrations of mediocrity. This will be particularly so in the case of clusters characterized by pure agglomeration or social network relations. The information internalization logic favouring the MNE is largely inconsistent with either the externality argument, favouring the pure agglomeration, or the inter-personal relations of the social network. Similarly, the clear organizational boundaries of large firms of an oligopoly are inconsistent with the organizational forms assumed by either pure agglomeration or social networks.

This provides a powerful counter-argument to the simple Porter or Saxenian (1994) logic of industrial clustering, and appears to explain the empirical observation that many of the largest firms do *not* co-locate their knowledge creation activities with those of their competitive rivals (Cantwell & Santangelo, 2002; Simmie, 1998). Moreover, in situations where they do so, the organizational aspects of the firms are designed specifically to avoid the sharing of knowledge (Arita & McCann, 2002; McCann et al., 1993). As yet, the Porter school has failed to address or even acknowledge these counter-arguments (Martin & Sunley, 2003).

On the other hand, the industrial clusters form of industrial organization is consistent with oligopolistic MNEs. In some situations, inward investing MNE firms will find it optimal to locate facilities close to similar firms, in order to effect particular types of long-term inter-firm transactions. In these cases, the intentional sharing of information between the firms is a mutually planned process with knowledge inflows and outflows being carefully managed within a system of bilateral monopoly frameworks. This type of clustering is commonly observed in industries such as chemicals and automobile manufacturing, as well as in high technology manufacturing sectors, such as the Scottish Electronics industry (McCann, 1997). Yet, the inter-firm relations embedded within thus type

of system are entirely different from the types of relations assumed to operate in the clusters models based on information spillovers.

A further analytical problem raised by this issue is that these industrial complex-types of organizational arrangements can exist across much wider geographical scales than individual metropolitan areas. Given the lack of geographical specificity and definition in the simple Porter clusters literature, observations of MNE clustering of a type consistent with an industrial complex model may often be misinterpreted as a cluster, based on an agglomeration-information spillovers model. Recent apparently more sophisticated work (Devereux & Griffiths, 1998; Barrell & Pain, 1999) has fallen into this trap, by simply assuming that groupings of FDI investments by the MNEs within an individual country must be clear evidence of agglomeration economies, irrespective of the geographical location and spatial scale of either the country or its internal urban system. It appears we are repeating many of the mistakes of the original international business literature.

7. Conclusions

The reasons why MNE firms locate particular facilities in other countries can be analysed initially by employing orthodox international business methodologies and international trade theories. However, at the more disaggregated spatial scale of the sub-national regional level, the location of the individual plant must be analysed by discussing more explicitly spatial and organizational issues, while taking account of the characteristics of the region itself (Hood & Young, 1979; Phelps, 1997). Our analysis here has not been on issues of location and labour supply, but rather on the question of the importance of inter-firm knowledge spillovers. In terms of our clustering typologies described in Table 4.2, the spatial organization of many MNEs is primarily characterized by the 'industrial complex' model. In other words, although social networks exist within the firm (Rauch, 2001), primarily stable and predictable relations exist between both the various parent and subsidiary plants of the MNE group, and also between the subsidiary and local suppliers and customers. Informal and external information spillovers between local firms are not the primary rationale for such clustering behaviour. Although it may be argued that trust relations of the 'social network' type may be enhanced by proximity between plants, the clustering logic of many MNEs is primarily a function of hierarchy organization and information internalization. The observed information internalization behaviour of the MNEs across a range of locations (McCann, 1997) and sectors (Simmie, 1998) implies that the geographical behaviour of these vertically-integrated MNE firms often has much

more in common with the industrial complex model of organization and location than with a pure agglomeration or social network type of cluster. Our observations therefore suggest that the opportunities for MNE firms to benefit from inter-firm local information spillovers are also rather more limited than many other authors assume (Saxenian, 1994). The reason is that the ability to benefit from such spillovers also depends on organizational issues. Unless the MNE is willing and is able to decentralize its organizational structures, almost to the point of complete hierarchy fragmentation, the MNE will neither benefit from, nor contribute to, such local externalities. The hierarchical MNE and the pure agglomeration or social network, are to a large extent mutually exclusive phenomena.

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Chapter 5

Exploring the Characteristics of Technology Spillovers Using Patent Citation Data

John Cantwell and Camilla Noonan

1. Introduction

This chapter examines the geography of *technology spillovers* in the context of Germany. We use patent citation data and present a descriptive analysis of the technological activities between 1975 and 1995 of foreign-owned firms located in Germany. In addition to examining whether spillovers are localized within this location, we investigate the importance of indigenous German firms (i.e. a major component of the local infrastructure) as owners of this localized knowledge. Germany provides a particularly useful testing bed for examining this issue, because unlike prior studies that use the US as the unit of analysis for example, Germany boasts a very long tradition of technological activity in a relatively small geographic area. This renders it a very interesting context within which to investigate knowledge localization and the role of regional borders in inter-firm interactions within technology space.

Although the role of spillovers in economic growth has been the subject of empirical testing for quite some time (Romer, 1986, 1990; Grossman & Helpman, 1991), more recent work has been centred on more micro-based examinations of this phenomenon with a shift in focus to where these spillovers actually go. The central assumption in the growth literature is that knowledge spills over to other firms and individuals within a nation but not to potential recipients located

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elsewhere. Many scholars have questioned this wisdom and using patent citation data have examined the degree to which *spillovers* are indeed localized. Following the paper trail that enables the tracking of these spillovers, Jaffe, Trajtenberg, and Henderson (1993) presented the first statistically significant finding of geographic localization. Their results confirmed that citations were more likely to come from the same metropolitan area, the same state and the same country as the originating citing patent but that this localization fades over time. Further citation-based studies confirmed this initial finding (Jaffe & Trajtenberg, 1998; Almeida & Kogut, 1999; Maurseth & Verspagen, 2001), adding that public research bodies play an important role (Jaffe, Fogarty, & Banks, 1998) and technological proximity is of moderate importance in localization processes (Jaffe & Trajtenberg, 1999).

2. Technology Spillovers and the Multinational Enterprise

International Business scholars have examined localized knowledge spillovers as constituting an important centrifugal supply side force that attracts corporate R&D activities to foreign locations. Up until the mid-1980s, most R&D was highly centralized and took place in the headquarters of the parent firm. The advantages of maintaining R&D at the centre have been well-rehearsed in terms of *inter alia*, economies of scale in the R&D effort, indivisibilities and corporate secrecy. Since the mid-1980s (and earlier in the case of European MNEs (Cantwell, 1995)), large firms have been increasingly decentralizing various aspects of the R&D function to an ever-expanding network of globally dispersed subsidiaries and external agencies. This has been referred to as the move from *asset* (or *home base*)-*exploiting* activity to *asset* (or *home base*)-*creating* activity at subsidiary level (Dunning & Narula, 1995; Kummerle, 1996). It has been underpinned *inter alia*, by an increased pressure on firms to understand and build capabilities across a growing range of technologies (Granstrand et al., 1997). As countries have become more technologically specialized and differentiated from each other through time (Cantwell, 1989; Archibugi & Pianta, 1992; Patel & Vega, 1999), MNEs decentralize their R&D function in an attempt to *breathe in the air of* (foreign) *invention* (Marshall, 1890/1920) and access this highly localized (or embedded) technological knowledge from various regions internationally (Cantwell, 1989, 1992, 1993). Subsidiaries have become the interface between the multinational network and indigenous infrastructures within these international centres of technological excellence.

Much of the early research that supports this *asset-seeking* thesis has been based on case studies (oftentimes of Japanese MNEs in the US). Notwithstanding

the consequent problems of generalizability and sample selection bias, results generally confirm that the activities of foreign-owned subsidiaries are increasingly associated with gaining access to research intensive activities within this host. Larger sample studies reported mixed results (Cantwell, 1992; Zander, 1999; Dunning & Narula, 1995). Studies that use patent citation data have been more conclusive around these issues confirming that foreign-owned subsidiaries draw from the knowledge pool of the host country/region in fields of local technological strength (Almeida, 1996; Frost, 2001; Criscuolo et al., 2005) but these subsidiaries also contribute to this local pool depending on the expertize available in the host economy (Singh, forthcoming). This chapter offers a more granular analysis of some of these issues.

3. Data

A sample of 12,721 *citing* patents granted by the United States Patent and Trademark Office (USPTO) to the research facilities of large foreign-owned firms located in Germany was collected between the years 1975 and 1995. All references to prior art was extracted from these patents and used as a proxy for (potential) knowledge flows between these firms and their local environment. These foreign-owned patents cited 67,142 technologies that were developed by firms (or inventors) that resided both within and outside Germany.

Each of the 12,721 *citing* and 67,142 *cited* patents were coded by technology, location and institutional affiliation.

(i) Technology. Each patent and patent citation was classified using the University of Reading classification scheme. This disaggregates the 401 US patent classes into 56 more workable *technology fields*.

(ii) Location. Each patent and patent citation is coded according to the residence of the first named inventor (or the location of the research facility responsible). To facilitate a sub-national analysis of German level citation activity, a NUTS code was attributed to each citing and cited patent.[1] In the cases of inventors located outside of Germany, we differentiate between:

(a) those located in the home country of the parent firm and
(b) those located in another foreign country.

[1]NUTS or *Nomenclature of Territorial Units for Statistics*. This classification system was established by Eurostat to provide a uniform breakdown of territorial units for the production of regional statistics for the European Community in 1988. Under this system, Germany consists of 16 NUTS, 1 region (*Bundeslaender*); 38 NUTS, 2 regions; (*Regierungsbezirke*) and 445 NUTS, 3 regions (*Kreise*). For the purposes of this study, each patent and patent citation was given a NUTS 3 code.

(iii) Institution (or assignee). In addition to the technology and location code, each *citation* is also classified according its assignee (or owner). Here, we differentiate cases where:

(a) the assignor is the same firm as that of the citing patent (i.e. self cites),[2]
(b) the assignor is another large firm in the same industry,[3]
(c) the assignor is another large firm in a different industry, and
(d) the assignor is a 'smaller firm' i.e. a firm not listed in the large firm data set.

Patents that result from collaborative research activity are assigned to the first named assignor.

4. Using Citation Data

The reliability of using citations as an indicator of technology spillovers between agents has been questioned. For example, in addition to the citations added by the inventor, additional citations may be included by the patent examiner and this may result in biased results. A number of researchers have explored this issue in depth and conclude that although citations might be added by these agents and that the data is a *noisy but valid measure of spillovers* (Jaffe et al., 1998, 2000). In a further examination of this issue, Alcacer and Gittelman (2006) note that additional citations may not be of concern depending upon the hypotheses being examined. In terms of issues pertaining to geography for example, they note how there is a close tracking in geographic space between these two citation streams which suggests that inventors and examiners have similar citation patterns at a spatial level (*ibid*., p. 778).

Regardless of who was responsible for actually adding the references to prior art, one might also take the view that these additional citations actually add objectivity to the process since the patent document now includes all knowledge flows

[2]The *firm* refers here to the corporate group and not to any individual affiliate in isolation.

[3]In total, there are 867 firms in the database. These have been consolidated into one of 284 corporate groups. Births, deaths, mergers and acquisitions as well as movement of firms between corporate + groups (sometimes associated with historical changes in ownership) have been accounted for in the database. Adopting an approach similar to Scherer (1965), each corporate group has been allocated to an industry on the basis of its primary field of production. These industries were then classified into four major industrial groups based on the types of technologies that have been most characteristically developed by the firms in question. The database has been therefore constructed in recognition of the fact that while firms may be separated into broadly defined and distinct industrial areas, the range of technologies these firms are active in, may be far more diverse.

(conscious or otherwise) that have influenced the inventor. This is the position taken in this study. Since we are primarily concerned with analysing the overall spatial characteristics of technological development, it is important to identify all influential sources of knowledge, regardless of whether these were consciously (or otherwise) tapped into by the inventor in question.

As noted above, by now, a number of studies have used patent citations to examine technology spillovers. In general, these studies have taken particular groups of frequently 'cited' patents (usually within a particular technology family) and analysed the citation patterns to these inventions. In adopting this approach, authors have encountered what is referred to as a *truncation bias*. This refers to difficulties encountered when deciding upon the appropriate cut off points for the citation window. Stated simply, in undertaking such analyses, the researcher is confronted with the difficulty of trying to ascertain the correct time frame within which inventions receive their maximum number of citations. In terms of invention, identifying the window within which maximum citation activity is likely to occur is extremely challenging. It is virtually impossible to be totally confident that what may be perceived to be relatively unimportant inventions today (i.e. as evidenced by low citation activity) will not become hugely important in the future.[4] Hall et al. (1998) highlight the skewed nature of the distribution of patent citations. Examining the citations made to the inventions of 4800 publicly traded manufacturing firms 1975–1995, the authors draw attention to the fact that citations are often made more than 10 years after the original patent is granted.

In marked contrast to the aforementioned traditional citations literature, this analysis adopts a distinctly different approach. This analysis commences with the 'citing' patent, which means that this approach is backward-looking and historical. This is useful because it means that the number of citations is fixed and definitive at the point of issue rather than being forward-looking and open-ended, as was the case in previous studies.

As can be seen from Figure 5.1, the distribution of these 'citing' patents is much less skewed than the distribution of 'cited' patents (evidenced in Hall et al., 1998). The modal values are 3 and 4, which is in marked contrast to the equivalent for cited patents (where the modal value is 0).

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[4]Consider Coases's 1937 article for example. This was almost never cited before 1975, but then cited massively after that date. If one was to fix the citation window at 20 years, one might be tempted to conclude that this seminal piece of work really had little impact upon the academic work that followed. Of course, we know that this was not the case — it just took the academic world a little longer to recognize the significance of this piece of work.

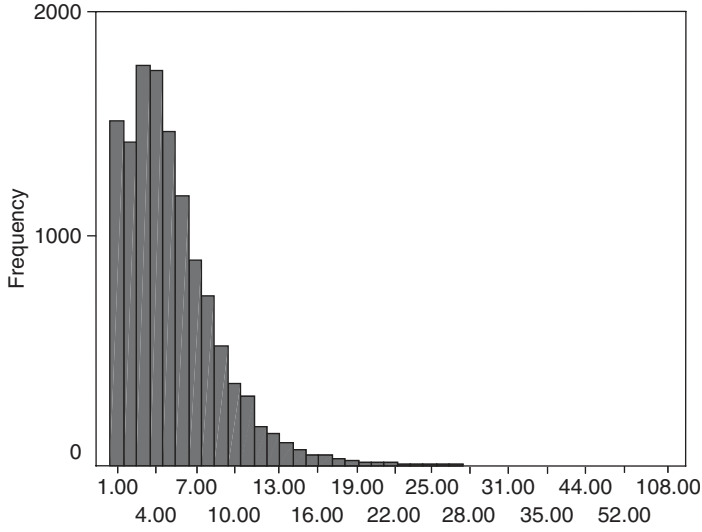

Figure 5.1: Distribution of patent citations.

5. The Regional Characteristics of Technology Sourcing

Germany is composed of 16 states or regions (*Bundesländer*). Table 5.1 reports the regional origin of the patent citations. By examining the location code of the original invention (citing patent), and the citations contained therein, we can examine how many citations are associated with originating patents in each region. The fourth column in this table provides information on the regional distribution of patents granted to foreign-owned firms in Germany from the year 1969 to 1995. The second column takes each of the 67,142 citations associated with patents granted to foreign facilities (1975–95) and links them back to the regional origin of the patent that cited them.

From the fourth column, it is clear that technological activity is highly concentrated in this country. Between 1969 and 1995, approximately 78% of total US patents granted to large firms based in Germany resulted from research located in just four regions. These *core* regions within Germany are the two southern states of *Bayern* and *Baden Württemberg*, the more centrally located *Hessen* and *Nordrhein-Westfalen* to the west.[5]

[5]Comparing this result against population and industrial employment statistics, we find that while patenting activity is far more concentrated than population across these regions, it is relatively close

Table 5.1: The regional origin of foreign firm patent citing patents 1975–1995.

Region	**Cited patents (1975–1995)**	**%**	**Cited patents (1969–1995)**	**%**
Baden Württemberg	21,351	31.8	4828	31.1
Bayern	9058	13.5	2158	13.9
Hessen	9843	14.7	2158	13.9
Niedersachsen	3371	5.0	792	5.1
Nordrhein-Westfalen	14,064	20.9	2965	19.1
Rheinland-Pfalz	3594	5.4	745	4.8
Others	5861	8.7	1878	12.1
Total	67,142	100.0	15,523	100.0

Reflecting the regional distribution of total (citing) patents, it is unsurprising to find that approximately 53% of citations are made by originating patents from two regions of *Baden Württemberg* (31.8%) and *Nordrhein-Westfalen* (20.9%). It is interesting to note that Nordrhein-Westfalen and Hessen are associated with more citations than their overall distribution of patents might suggest. While the former hosts 19.1% of total foreign-owned patents and these patents are associated with 20.9% of all citations, the latter hosts 13.9% and is associated with 14.7% of all citations. In other words, given that the distribution of citing and cited patents mirror each other across the other regions, the types of technologies being developed in these regions — because they are associated with more citations — are associated with more cumulative types of research or are relatively more relevant to other fields of search.

6. Sourcing of Technological Knowledge

As noted above, analysis in the international business (IB) field has emphasized the central role played by the parent company in the development of technological know-how. If this thesis were correct, one would expect to see technological expertize disseminating in an outward direction from the parent company to all overseas subsidiaries. Using the patent citation activity of foreign firms located

to the regional concentrations of industrial employment in the cases of *Nordrhein-Westfalen* and *Baden Württemberg*. In contrast, innovative activity is far more concentrated than industrial employment in Bayern and Hessen (Noonan, 2002).

Table 5.2: Knowledge sources for foreign firms located in Germany, 1975–1995.

Knowledge source	Citation frequency	% of total
Home country of the parent firm	19,391	28.9
Another foreign country	34,687	51.7
Germany	12,580	18.7
Baden Württemberg	2698	4.0
Nordrhein Westfalen	2363	3.5
Bavaria	2103	3.1
Hessen	1277	1.9
No location code	484	0.7
Total[a]	67,142	100.0

[a]This represents the total citations that emanate the 16 German regions.

in Germany as a proxy for technology communication between these subsidiaries and their parents, one would therefore expect to observe that the majority of the citations lead us back to the parent firm. If overseas technological activity is merely *exploiting* what has been developed within the research labs of the parent firm, the majority of citations should reference the prior technological activities of the parent. The results of this examination are reported in Table 5.2.

It is apparent from these findings that over the 1975–1995 period, foreign firms located in Germany sourced approximately 29% of their technological knowledge from the home country of the parent firm. This suggests that the technological activities of foreign subsidiaries located in Germany are not heavily concentrated in home base exploiting (HBE)-type activities. In line with the more contemporary IB literature that relegates the role of the parent firm in the technological activities of overseas subsidiaries, it is interesting to note the proportion of knowledge sourced at local level (19%) and the high proportion sourced from other foreign countries (~52%).[6] This suggests that the technological endeavours of these firms may be more accurately referred to as strategic asset seeking (Dunning & Narula, 1995) or home base augmenting (HBA) (Kummerle, 1996) — type activities. Rather than merely adapting the extant technologies of the parent firm (or acting

[6]Controlling for the global distribution of patenting, of course one might expect this proportion to be less striking. Given the central location of Germany within Europe, one might expect extensive international citation across bordering European countries. This would support Jaffe and Trajtenberg's (1996) study of citations to US-based invention. They found that the extent to which patents granted to foreign residents were likely to cite US patents depended upon geographic and cultural proximity.

as a substitute for activities the MNE may have wished to undertake at home (Zander, 1999), these subsidiaries seek to enhance the technological base of the parent firm by developing completely new (though complementary) lines of search. In addition to drawing from the highly developed local German knowledge base, foreign subsidiaries located in this country also build upon technologies that have been developed at a variety of other international locations.

Although self-citations are a vital element in any analysis of regional development or technological embeddedness across space, it is important to differentiate this type of citation activity when studying potential knowledge interactions within versus between firms (intra versus inter-firm activity). In their study of international knowledge flows, Jaffe and Trajtenberg (1998, p. 11) emphasize this point noting that since self-citations come more quickly on average and are more geographically localized, they bias the study of knowledge localization in an upward direction.

By extracting the proportion of self cites (i.e. cases in which the assignor (or owner) of the cited patent is the same as the citing patent), we arrive at a proxy for technological communication between the subsidiary and the parent (Table 5.3).[7] In doing this, we find that just 29% of total citations to the home country were made to inventions undertaken by members of the corporate group located there. This finding clearly questions the historic importance attributed to the parent firm and confirms the appropriateness of reinvestigating the role played by the parent firm in the technological activities of overseas subsidiaries.

Results from this investigation suggest that while 23% of citations are made to other large firms within the same industry, that the majority of citations (48%) to the home country reference the technological activities of other large firms in *different* industries.

By once again examining the proportion of self-citations (within the overall citations to the knowledge infrastructures of *other foreign locations*), we find that 4% of total citations reference the technological activities of the multinational group in foreign locations. This suggests that the majority of the technologies under development in Germany do not build upon the technological activities of other parts of the international corporate network. This may however reflect activities undertaken by means of external networks (constituting the virtual organization) at other locations. In referencing to the prior inventions of other foreign countries, these firms cite the technological activities of other large firms

[7]Self-citations capture all references to prior technological activity undertaken by the entire corporate group. This is not a strict measure of citations to the parent firm but rather to members of the corporate group that are located in the home country of the parent firm.

Table 5.3: Knowledge sources for foreign firms (by patent assignee).

Assignor	Cites to home country of parent firm		Cites to other foreign countries		Cites to local knowledge	
	Frequency	% of total	Frequency	% of total	Frequency	% of total
(i) Is the same for citing and cited patent	3078	29.0	785	4.2	4380	42.0
(ii) Is another large firm in the same industry	2459	23.2	8368	44.5	1788	17.1
(iii) Is another large firm in a different industry	5073	47.8	9625	51.2	1831	17.5
(iv) To another (smaller) firm	2	0.0	2	0.0	1648	15.8
(v) Other	0	0.0	5	0.0	788	7.6
Total sample	10,612	100.0	18,785	100.0	10,435	100.0
Missing observations	8779		15,902		2145	
Total cites	19,391		34,687		12,580	

from the same industry (45%) and other large firms from different industries most frequently (51%).

In terms of the local knowledge infrastructure, it is apparent from these results that foreign firms source almost 19% of their knowledge (i.e. 12,580 citations) from the local sources. Considering that the total share of US patents granted to Germany-based technological activity was 8.5% between 1975 and 1995 (and 7.8% between 1963 and 1995), this is a significant finding. It demonstrates that the propensity of foreign firms to use local sourcing is far greater than what might be expected if one were to follow a random distribution of technological activity. It highlights the importance of the host economy and suggests that (at least across certain technologies) foreign firms are aware of the difficulty of learning from afar and therefore use their subsidiaries to upgrade their technological ability within certain fields of exploration (Almeida, 1996).

A high proportion of self-citations to local invention are apparent in Table 5.3. This is unsurprising since knowledge creation is a cumulative process, and so builds up within each local context (even if what is being done is largely of an adaptive kind). Care should be taken, however, when interpreting results where self-citations might constitute almost 50% of a sample, i.e. it is important to differentiate between inter- and intra-firm activity. Therefore, throughout this study, we make it clear whether self-citations have been included or excluded from the analysis.[8]

It is unsurprising to note that the majority of patents citing local knowledge sources reference prior art that is attributed to the efforts of inventors in the *Baden Württemberg* region (4.2%). This region not only hosts the greatest concentration of patenting activity by foreign firms in Germany, but is also an important location for indigenous firms, particularly within the transportation technologies. The next most frequently cited region by foreign firms is *Nordrhein-Westfalen* — the hub of the German chemical industry and the favoured location for indigenous firm technological activity. Foreign firms that locate in this region are highly specialized across the mechanical technologies.

7. Age Distribution of Technology Sourcing

It has been suggested that geographical proximity may be the most important for absorption of recently developed technologies. By 'recent' technologies, we mean further development of both extant fields of research as well as the creation of whole new areas through fusion or novel combination. The more novel (or new) is the technology, the more likely it is that the tacit component constitutes a significant barrier to further development from afar. Knowledge takes time to diffuse due to the difficulties of communicating its inherent characteristics that are frequently quite intimately bound up with context. Cultural barriers to transmission may also impede this. Co-location therefore becomes a crucial prerequisite to the development of these highly tacit technologies. The importance of the tacit component in technological activities is believed to have escalated in recent times, due mainly to the growing relatedness of technologies, which has been largely fuelled by the pervasive qualities of the science based technologies (Dosi, 1982; Freeman & Perez, 1988; Cantwell & Fai, 1999; Von Tunzelmann & Wang, 1999; Cantwell & Santangelo, 2000). Firms that wish to research at the technological frontier in fields/sectors that are non-core to their business must co-locate

[8]While other analysts of citation data also make this distinction, the proportion of self-citations generally goes unreported.

alongside the international leaders within that particular technological field/sector or in other words, within that appropriate international centre of excellence.

In marked contrast, geographical proximity is not seen to be as important a consideration in the case of older inventions (Jaffe et al., 1998). Through time, codification of early inventions takes place, which serves to reduce the tacit dimension involved in such activities. This in turn means that these older inventions (or the basis for contemporary invention) can be drawn or built upon, without any need to co-locate.

Following this discussion, we investigate the age profile of the technologies cited at local level. By subtracting the issue date of the cited patent from that of the citing patent, one can ascertain the 'age' of the knowledge being acquired from the various locations. A large difference between the two means that the technological know-how upon which the current inventor builds, was created at a much earlier point in time. In contrast, a smaller age difference signals that more contemporary knowledge is being drawn upon.

Figure 5.2 reports the results from this exercise. The three location categories are again examined. Part (i) of the chart reports the age distribution for the citations that reference inventions undertaken in the home country of the parent firm. While a considerable proportion of the citations references relatively recent inventions (~29% of the citation data reference inventions that were between 1 and 6 years old — modal values equalling 3 and 4 years), the rather skewed nature of this age distribution is nonetheless apparent. It suggests that quite a large proportion of the citations made by foreign firms to home country inventions refer to older innovations and as such supports the thesis that older inventions are more easily diffused across space.

Lower modal values (2 and 3 years) are found for references to inventions occurring in other foreign countries and approximately 40% of citations to inventions originating from these locations fall within the 6-year window (see part (ii) of the chart). Relative to the home country therefore, we can conclude that knowledge accessed by these subsidiaries from overseas locations is more recent.

Finally, part (iii) of the chart reports the age distribution of the knowledge being sourced by these subsidiaries from local (Germany-based) sources. The result is quite dramatic. While the modal value drops to 2 years, the proportion of citations that reference prior art within the 6-year window rises to over 50%. In contrast to the results in parts (i) and (ii), the distribution is a lot more skewed for local sourcing of knowledge with the vast proportion of citations referencing work that was invented within a 12-year window. This lends further support to the suggestion that Germany is a centre of technological excellence for large foreign-owned firms who are attracted to this location to access and absorb cutting-edge knowledge within certain technological areas.

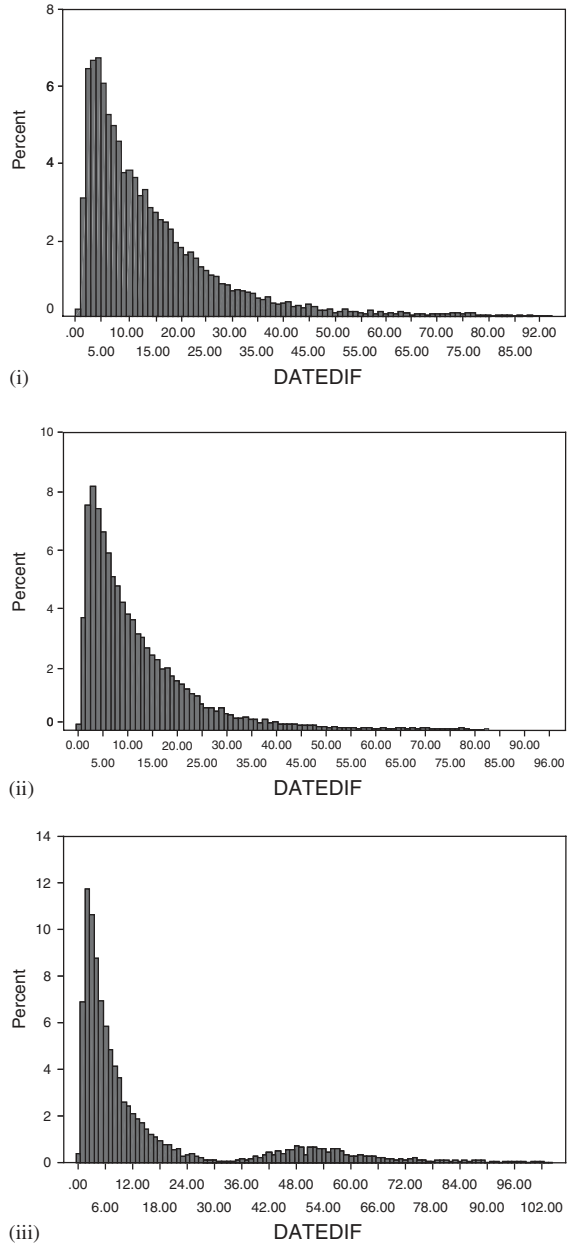

Figure 5.2: Age distribution of technology sourcing. Citations to (i) home country; (ii) other foreign countries; (iii) local knowledge sources.

The increase in citation activity that takes place around inventions that are approximately 45–60 years old is also interesting and deserves comment. Although the percentage of citations that fall into this category is quite small, taken together, they exert a significant impact on the overall distribution. These citations, which are much older inventions, highlight the strong historic research base in Germany and points to the path-dependent nature of technological development at this location.[9] In other words, although foreign firms primarily locate their R&D at this location to access recent (or frontier-type) inventions, in doing so, they also draw from the country's historic pool of technological expertise.[10]

In what follows, we focus solely upon the local sourcing of technological know-how by foreign-owned firms.

8. The Regional Characteristics of Local Sourcing of Technological Knowledge

Table 5.4 reports the regional distribution of all references to the local knowledge base in Germany. As noted above, total citations to local knowledge corresponds to approximately 19% (or 12,580) of the total citations sample. Taking the regional distribution of total citations as an indicator of the relative attractiveness of each region's pool of technological expertize, it is clear that *Baden Württemberg* and *Nordrhein-Westfalen* emerge as the most popular regions (accounting for 26% and 23% (respectively) of total citations). The type of technological activities taking place at these locations could of course bias this finding. To control for the high incidence of patenting that takes place across certain technologies, the proportion of citations made to each region's technological infrastructure is divided by each region's share of total corporate patents. Allowing for this regional specificity of technological specialization, it is clear that while two of the six regions attract an expected proportion of total citations (following the distribution of foreign-owned patenting activity), *Bayern* and *Nordrhein-Westfalen* receive 50% and 20% more citations than one might expect.

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[9]This also highlights continued importance or relevance of older inventions that emanated from this location. In their examination of international knowledge flows, Jaffe and Trajtenberg (1998, p. 4) draw attention to the diffusion and obsolescence processes at play in knowledge-flow processes. The authors note that 'while the probability that the inventor will know of a given antecedent increases (...) the probability that the antecedent will actually be helpful declines on an average'.

[10]The 'older' technologies (i.e. >40 years) sourced by foreign subsidiaries are concentrated in mechanical technologies — particularly, miscellaneous metal products (14), other general industrial equipment (29), metal working equipment (17), other specialized machinery (28), chemical and allied equipment (16), other instruments and controls (53) and assembly and material handling equipment (20).

Table 5.4: Ratio of citations to patents, by region.

Region	Total citations to local innovation 1975–1995[a]	% of Total	Total Foreign patents 1969–1995[b]	% of Total	Ratio (citations/ patents)
Baden Württemberg	2698	26.3	4828	31.1	0.8
Bayern	2103	20.5	2158	13.9	1.5
Hessen	1277	12.4	2158	13.9	0.9
Niedersachsen	493	4.8	792	5.1	0.9
Nordrhein-Westfalen	2363	23.0	2965	19.1	1.2
Rheinl and-Pfalz	508	5.0	745	4.8	1.0
Others	816	8.0	1878	12.1	0.7
Total	10,258	100.0	15,523	100.0	1.0

[a]This column details total patents granted to the research facilities of large foreign-owned firms based in Germany 1969–1995.
[b]A total of 12,580 citations are made to local invention. Of this, location codes for 2322 citations are missing from the sample.

In previous work (Cantwell & Noonan, 2000), we examined the technology profiles of foreign and indigenous firms at regional level and suggested that the potential for intra-regional technological flows across similar lines of technological search was quite low. Since foreign and indigenous firms tended to specialize across different technology sectors at regional level, our regression analysis rejected the hypothesis that regionally bound inter-firm flows involved interactions within particular sectors of technological development.[11] Evidence pointed to the fact that such forms of technological exchange were more likely to be found at the inter-regional level. Of course, this analysis failed to acknowledge the fact that inter-firm exchange might well occur across different technologies that are somehow complementary to one another.

Using the citation data set, we explore this issue. By examining the proportion of citations that reference 'within region' research (i.e. the proportion of citing and cited patents that have been attributed the same NUTS regional code), we can

[11]Since this analysis was done at an aggregate level, there was still the possibility that exchange may have occurred across certain technology fields. For example, both foreign and indigenous firms are specialized in other transport equipment (47) in *Baden Württemberg* and *Niedersachsen*, other general industrial equipment, (29) in *Nordrhein-Westfalen* and *Niedersachsen*, metal working equipment, (17) in *Nordrhein-Westfalen*, and printing and publishing, (26) in *Hessen*.

ascertain the relative importance of regionally-bound knowledge exchange. The results from this investigation are reported in Table 5.5.

The regional locations of the 'citing' patents are listed vertically in this table. It is *from* these regions that references to the knowledge pools of other ('cited') regions emanate. Because the firms located within these regions reference the prior invention that occurred elsewhere, they may be considered to be the benefactors of technologies developed outside of their region. Other authors have referred to these 'citing' regions as *spillover recipients* (Maurseth & Verspagen, 2002, p. 536). The generators of corporate technological expertise are represented along the horizontal of this table (the 'cited patents'). In addition to the six main regions, this list aggregates the remaining 10 regions into 'other' to facilitate an examination of technology sourcing by foreign firms located in these regions. It is clear, for example, that foreign firms located in these 'other' regions source the greatest proportion of technology from the southern region of *Bayern* (34.4%). Closer examination of the data reveals that it was foreign firms located in the northern regions of *Hamburg* and *Schleswig Holstein* that lay behind this figure.

In terms of the absolute number of citations to the knowledge pool of the host economy, it is clear that foreign firms located in *Baden Württemberg* and *Nordrhein-Westfalen* hold the leading position — they account for 2896 (30%) and 2098 (22%) respectively, of the total references to the knowledge infrastructure in Germany.

The diagonal of this table refers to the proportion of total patent citations that reference activity that takes place within the region. It is clear from these results that a large proportion of knowledge sourcing is regionally bound. For example, if we consider the citation patterns of foreign-owned firms located in *Hessen*, it is apparent that approximately 42% of the local knowledge is sourced from within the region. A further 25% is sourced from *Baden Württemberg*. Indeed, with one exception (*Nordrhein-Westfalen*), it is striking how important *Baden Württemberg* is as a source of knowledge for foreign firms located across Germany. Next to the more proximate intra-regional knowledge sources, *Baden Württemberg* hosts the most important pool of knowledge for foreign-owned firms located in Germany. One possible explanation is that congestion effects in this core region may have forced firms to relocate elsewhere and tap into the region's knowledge pool from a distance.

The results suggest that in relative terms, knowledge is most regionally bound in the cases of *Nordrhein-Westfalen* (62%) and *Bayern* (59%) and less so in the case of *Rheinland Pfalz* (21%). By dividing the proportion of intra-regional knowledge sourcing by the proportion of total patents attributed to the research activities of each region, we can ascertain the degree to which '*own region*' sourcing coincides with what might be termed a *random geographic draw*. This is

Table 5.5: Percentage of citations to regional versus outside knowledge.

	Regional location of 'cited' patents							
Regional location of 'citing' patents	**Baden Württemberg**	**Bayern**	**Hessen**	**Nieder-sachsen**	**Nordrhein Westfalen**	**Rheinland-Pfalz**	**Total (%)**	**Absolute number of citations to local knowledge[a]**
Baden Württemberg	**53.1**	17.5	7.8	2.4	15.1	4.1	100	2896
Bayern	16.4	**59.4**	6.8	1.5	12.7	3.3	100	1416
Hessen	20.5	13.5	**41.5**	3.3	14.2	7.0	100	
Niedersachsen	24.5	10.3	8.4	**41.7**	11.6	3.4	100	549
Nordrhein-Westfalen	11.2	13.1	6.5	3.0	**62.0**	4.2	100	2098
Rheinland-Pfalz	24.2	12.4	20.0	6.7	16.2	**20.5**	100	524
(Others)	27.2	34.4	9.4	5.8	18.5	4.7	100	447

[a]Since we are interested in investigating the degree to which knowledge sourcing might be considered regionally bound, these figures correspond to the 9442 citations that reference the knowledge bases of the 6 core regions.

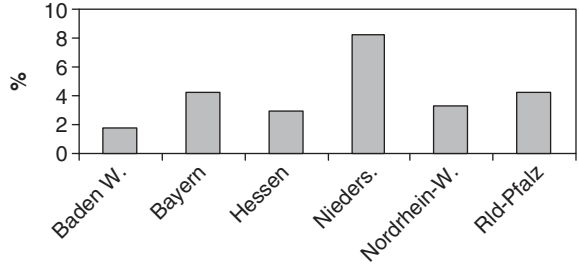

Figure 5.3: Patterns of intra-regional of technology sourcing.

reported in Figure 5.3. It is quite evident that in all cases, the 'within region' sourcing is far greater than what might be expected if one were to follow a random distribution of corporate technological activity. This is most noticeable in the case of *Niedersachsen* where regionally bound citations are far greater than what one might have expected, given the proportion of technological activity taking place in this region.

Focusing solely upon inter-firm technology flows i.e. extracting all self citations (Table 5.6), it is unsurprising to find that the proportion of regionally-bound knowledge sourcing declines in all cases — by 18% in *Baden Württemberg*; 33% in *Bayern*; 21% in *Hessen;* 23% in *Nordrhein-Westfalen*; and 18% in *Rheinland Pfalz* and the ranking of the regions alters. While *Nordrhein-Westfalen* continues to host the greatest proportion of inter-firm technological activity, *Baden Württemberg* now replaces *Bayern* as hosting the second highest degree of inter-firm activity. A dramatic decline is recorded in the case of *Niedersachsen* (35%) and together with the low relative degree of intra-regional sourcing in *Rheinland-Pfalz*, these regions may be described as having an above average reliance on the technologies being developed extra-regionally.

Regions that record relatively low degrees of locally bound sourcing may be referred to as *satellite* locations for foreign firms, i.e. firms locate their R&D in these regions but source the requisite technological know-how from the knowledge pools of other German regions. Although firms located in *Baden Württemberg* and *Nordrhein-Westfalen* source more than 30% of their knowledge from within the region, as a general observation, one might conclude that the vast majority of knowledge sourcing by foreign-firms is not regionally bound.[12]

[12]Given that the greatest distance in Germany (from Northeast to Southwest) is approximately 600 miles and this country boasts a highly developed research infrastructure, this result is perhaps unsurprising.

Table 5.6: Percentage of citations to regional versus outside knowledge (no self cites).

	Regional location of 'cited' patents							
Regional location of 'cited' patents	**Baden Württemberg**	**Bayern**	**Hessen**	**Niedersachsen**	**Nordrhein-Westfalen**	**Rheinland-Pfalz**	**(%) Total**	**Absolute Number of self citations (% of total citations to local knowledge)**
Baden Württemberg	**34.8**	17.0	14.3	4.9	24.3	4.6	100.0	1332 (46)
Bayern	28.2	**26.9**	15.4	3.9	22.2	3.4	100.0	560 (40)
Hessen	32.9	13.8	**20.3**	7.3	18.5	7.1	100.0	666 (44)
Niedersachsen	43.3	10.4	18.6	**6.7**	18.0	3.1	100.0	264 (48)
Nordrhein-Westfalen	23.5	14.5	12.1	7.0	**38.6**	4.3	100.0	866 (41)
Rheinland-Pfalz	31.5	9.7	28.9	8.6	19.0	**2.3**	100.0	302 (58)
(Others)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

The relatively strong reliance on intra-regional technology sourcing within *Nordrhein-Westfalen* persists when intra-firm activity is controlled for. Approximately 39% of inter-firm activity is localized, which suggests that this region might be classified (at least in relative terms) as being *technologically self-contained* within the German context. Firms located in *Nordrhein-Westfalen* extract additional sources of knowledge from *Baden Württemberg* (24%). Taken together, approximately 63% of the inter-firm knowledge sourced by firms located in *Nordrhein-Westfalen* is accounted for flows occurring within the region and between this region and *Baden Württemberg*. Indeed, the importance of *Baden Württemberg* becomes even more striking when focusing solely upon these inter-firm technological activities. With the exception of *Nordrhein-Westfalen* (and *Baden Württemberg*) itself, it is apparent that firms located in all other regions source a greater percentage of technological know-how from the *Baden Württemberg* region than they do from their 'home' regions – *Bayern*, 28%; *Hessen*, 33%; *Niedersachsen*, 43% and *Rheinland Pfalz*, 32%. As such, the knowledge reservoir embedded within the firms and infrastructures of *Baden Württemberg* may be viewed as an important centripetal force for attracting inward investment in R&D in Germany.[13] Substantial reliance (i.e. >20%) on extra-regional sources is also apparent in the cases of *Baden Württemberg* and *Bayern* (whose firms' access a significant amount of knowledge from firms located in *Nordrhein-Westfalen*) and *Rheinland-Pfalz*, where firms interact with their counterparts in *Hessen* when sourcing knowledge.

9. Characteristics of Intra- versus Inter-Regional Sourcing of Knowledge

This section investigates the degree to which the regionally bound sources of technology for foreign firms are related to local areas of strength. A Citations Revealed Technological Advantage index (RTA^*) is calculated as

$$\frac{P_{ij}^* \Big/ P_{iw}^*}{\sum_i P_j^* \Big/ \sum_i P_w^*}$$

[13]Since Baden *Württemberg* is the source of much technological knowledge for foreign-owned firms within Germany, they may be seen to be forging *common architectural conceptions of knowledge* between this region and their regional homes in Germany (Henderson & Clarke, 1990).

where i = Technology 1, …, 56
j = Region 1, …, 6
P^* = Cited patent
P^*_w = Global citations[14]

Two different 'Citations RTA' indices are calculated. The first captures the technology sources tapped into by foreign-owned firms located within a region (i.e. intra-regional sources or in other words, the activities undertaken by 'insiders'). The second captures the technology sources availed of by foreign-owned firms located outside of any particular region (i.e. that undertaken by 'outsiders'). This differentiation is made as a prerequisite to examining the characteristics of intra- versus inter-regional communication within technological space. Results from this exercise are reported in Table 5.7.[15]

Looking at the results of the Pearson correlation, it is clear that little relationship exists between the profiles of intra-versus inter- regional technology sourcing. In other words, the technologies being accessed by firms located within a region are in different fields to those being accessed by firms located outside the region. The one exception is *Hessen*, which is located in the centre of Germany and borders the five other regions. Regardless of location, firms seem to tap into similar lines of technological expertise embedded in this region. Technologies accessed by both 'insiders' and 'outsiders' are spread across all macro groups — mechanical technologies (14, 29, 27 and 31), chemical technologies (6 and 9), transport technology (43) and electronic technology (36).[16]

To ascertain whether the technology sourcing profiles of these 'insiders' and 'outsiders' are related to technology specialization profiles of foreign and indigenous firms located in each region, a regression analysis is undertaken:

where
j = Region 1, ..., 6
i = Technology 1, ..., 56

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[14]Global citations are represented here by those emanating from the technological activity of foreign-owned firms in Germany.

[15]As noted above, the proxy for 'world' citations in this formula is generated by the citation activity of foreign firms in Germany only. This 'Citations RTA' therefore captures each region's relative attractiveness within the German context (and not within the global context, which is what the RTA usually captures).

[16]Examples where both 'insiders' and 'outsiders' tap into the same fields of technology are of course evident from Table 5.7. In the case of *Baden Württemberg*, for example, although the sourcing indices are in general uncorrelated for these two groups of firms, they both source know-how within electronic technologies 35, 36 and 39 from this region.

Table 5.7: Citations revealed technological advantage.

Technology	Baden Württemberg		Bayern		Hessen		Niedersachsen		Nordrhein-Westfalen		Rheinland-Pfalz		Macro group
	Sourcing from within the region	Sourcing from outside the region	Sourcing from within the region	Sourcing from outside the region	Sourcing from within the region	Sourcing from outside the region	Sourcing from within the region	Sourcing from outside the region	Sourcing from within the region	Sourcing from outside the region	Sourcing from within the region	Sourcing from outside the region	
2	0.0	0.0	0.0	0.8	0.8	2.2	0.0	0.0	5.6	0.4	0.0	6.0	Chemical
3	0.1	0.4	0.0	0.3	0.8	2.6	3.7	0.9	2.3	1.1	3.4	4.8	
4	2.6	0.0	0.0	0.0	0.6	0.6	17.5	1.5	0.0	7.1	0.0	2.0	
5	0.5	0.4	0.7	1.3	0.5	1.0	0.3	0.3	1.7	1.0	0.0	0.9	
6	0.7	0.1	0.0	0.8	8.8	2.9	0.0	0.0	0.3	1.2	0.0	3.9	
7	0.4	0.3	0.3	0.6	2.6	0.4	1.9	0.2	1.1	1.2	1.2	0.3	
8	0.0	0.0	0.0	0.0	0.0	3.3	0.0	0.0	0.0	0.0	0.0	0.0	
9	0.5	0.6	0.9	0.5	1.3	1.8	0.1	0.4	0.8	2.5	0.5	2.4	
10	4.0	0.4	1.1	0.4	0.4	3.9	0.0	0.0	0.2	3.2	2.1	2.3	
11	1.2	0.4	5.7	0.5	1.0	2.0	5.1	0.3	0.3	2.1	0.2	3.1	
12	2.2	1.1	1.1	0.8	0.2	1.5	11.7	0.7	0.5	2.4	0.0	1.8	
51	0.0	0.2	1.7	0.2	0.4	0.7	1.0	0.0	0.9	0.0	0.0	2.9	
55	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.3	0.0	0.0	0.0	
1	0.7	0.4	0.0	0.8	0.2	0.7	0.0	1.1	0.1	0.3	0.0	0.0	Mechanical
13	0.7	0.3	0.5	0.9	0.9	0.3	0.0	0.7	0.4	1.2	0.0	0.4	
14	0.3	0.7	0.2	0.7	1.9	1.5	0.2	0.9	1.7	1.0	3.2	0.8	
15	0.2	0.9	0.0	0.5	3.7	1.0	0.0	11.2	0.5	0.9	0.0	3.3	
16	0.9	0.6	0.2	0.9	0.2	0.9	0.0	1.5	1.4	1.6	0.0	0.9	
17	0.7	1.4	4.9	0.9	0.8	0.5	0.0	0.8	0.9	1.4	0.0	0.3	
18	3.9	0.7	0.1	1.1	0.0	0.3	0.0	1.0	0.1	0.7	0.0	0.4	
19	0.0	0.0	1.0	0.0	0.0	0.4	0.0	2.0	2.7	0.5	0.0	0.7	
20	1.2	1.0	0.1	1.0	0.2	0.3	1.7	1.2	3.2	0.8	0.0	0.4	
21	0.2	1.4	0.0	0.6	0.8	1.5	0.0	0.0	2.0	0.4	0.0	0.0	
22	0.0	0.0	0.0	2.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
23	0.0	0.2	0.3	0.0	0.0	0.0	3.7	1.1	1.1	0.3	0.0	0.0	

24	1.0	0.0	0.0	2.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
25	1.9	1.1	0.3	1.6	0.9	0.8	0.0	0.5	4.1	0.7	0.4	1.9	
26	0.7	0.0	0.0	0.3	3.9	0.0	0.0	1.3	0.1	0.2	0.0	0.0	
27	0.8	0.0	0.0	0.0	2.0	2.0	0.0	0.0	0.0	3.6	0.0	6.4	
28	1.4	0.5	0.3	0.5	1.4	0.6	0.5	0.9	1.0	2.2	2.6	0.4	
29	0.8	2.7	1.2	0.7	1.8	1.8	2.7	1.6	0.8	0.7	5.1	1.5	
31	1.2	3.4	0.0	0.1	2.5	2.9	0.0	0.0	0.0	0.1	2.7	2.1	
50	0.5	0.5	0.9	0.7	0.2	0.7	0.1	0.9	3.0	0.8	0.2	1.2	
53	1.4	1.0	0.4	1.8	0.2	0.8	0.4	0.6	0.6	0.5	0.3	0.5	
30	0.3	0.9	0.7	3.5	0.0	0.6	0.0	3.2	0.5	0.4	0.0	0.5	Electronic
33	0.9	0.7	1.8	0.8	0.1	0.1	0.0	1.9	0.1	0.3	0.0	0.3	
34	0.7	0.3	0.2	0.6	0.1	0.0	0.0	0.3	0.0	0.1	0.0	0.4	
35	1.2	1.9	10.2	2.1	0.0	0.0	0.0	0.0	0.5	0.1	0.0	0.0	
36	1.4	1.2	0.4	0.8	1.3	1.5	1.5	3.0	0.0	0.1	0.0	0.0	
7	0.9	0.6	0.1	1.7	0.3	0.1	0.0	0.9	2.2	0.9	0.0	0.0	
38	0.7	0.7	0.9	1.3	0.4	0.4	0.1	0.8	0.3	0.5	0.3	0.1	
39	1.4	1.1	0.2	0.9	0.6	0.7	0.0	0.1	0.8	0.6	0.2	0.6	
40	1.5	0.6	0.6	1.5	0.3	0.2	0.0	0.3	0.1	0.0	0.0	0.2	
41	1.1	0.4	0.3	0.8	1.1	0.8	0.9	1.5	0.1	0.1	0.0	0.2	
52	1.0	0.2	0.0	2.2	1.2	0.4	0.0	2.9	0.0	0.2	0.0	0.0	
42	0.6	5.2	1.0	0.8	0.7	0.0	0.0	0.0	0.2	0.4	0.0	0.5	Transport
43	0.4	2.8	0.7	4.7	6.0	1.6	0.4	1.8	1.7	0.7	1.8	1.7	
44	0.7	0.0	0.0	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
45	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	
46	0.7	0.9	0.6	1.6	0.0	0.8	0.0	0.0	2.4	1.4	0.0	0.0	
47	2.8	0.0	0.3	1.2	0.4	1.2	0.0	1.7	0.4	0.9	0.0	0.8	
49	0.1	0.4	0.2	0.8	0.9	0.5	0.0	4.3	0.9	1.7	0.6	2.0	
32	3.2	0.0	0.0	2.2	0.3	2.3	0.0	0.4	0.2	6.9	3.0	2.4	
48	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Other
54	2.6	3.5	0.0	2.3	1.8	0.0	0.0	10.9	0.0	1.6	0.0	1.4	
56	0.2	0.5	0.0	1.4	0.9	0.0	0.0	0.0	0.7	0.9	1.8	0.0	
Total	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
Pearson correlation	0.083		0.077		0.339*		−0.014		−0.138		0.217		

α, β and λ are the regression coefficients
ε_i = a residual
RTA_f = Technology specialization of foreign firms (1969–1995)[17]
RTA_g = Technology specialization of indigenous firms (1969–1995)
RTA^*_j = Technology sourcing profile for firms located in region j (1975–1995)
RTA^*_{jo} = Technology sourcing profile for firms located outside region j that source technologies from region j (1975–1995)

The following hypotheses are then tested for each of the six regions:

$$RTA^*_j = \alpha + \beta RTA_{fj} + \lambda RTA_{gj} + \varepsilon_i \quad (1)$$

$$RTA^*_{jo} = \alpha + \beta RTA_{fj} + \lambda RTA_{gj} + \varepsilon_i \quad (2)$$

The results from these regressions are reported in Table 5.8. These results suggest that while intra-regional sourcing by foreign-owned firms tends to follow the local technology specialization patterns of foreign-owned firms, sourcing by firms located outside the region tends to emulate the specialization profiles of indigenous German firms within each region. This former result may be unsurprising, given the fact that a large percentage of intra-regional citations are *self cites.*[18] However, even if all incidences of self-citation are omitting from the sample and the regressions re run, it is clear that (with the exception of Rheinland Pfalz) these relationships continue to hold (see Table 5.9).[19]

The patterns of local-technology sourcing that emerge from this analysis are represented in Figure 5.4.

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[17]This was calculated using total patents granted to foreign-owned (RTA_f) and indigenous German firms (RTA_g) 1969–1995.

[18]Approximately 43% of the 9442 citations under study are self cites and of these, approximately 78% are regionally bound.

[19]As can be seen in Table 5.9, there are a number of exceptions to this overall finding. While the former result (i.e. intra-regional citations are correlated to the technology specialization of foreign-owned firms at regional level) holds in all regions but *Nordrhein-Westfalen* and *Rheinland-Pfalz*, exceptions to the latter result (i.e. that citation from outside the region are correlated to the technological specialization of indigenous firms) are found in the *Niedersachsen* and *Bayern* regions.

Table 5.8: Results from regression analysis (citations RTA with self cites).

Region		**Insiders RTA***				**Outsiders RTA***			
		Standard coefficients	***t*-statistics**	**Significance**	**Adjusted R^2**	**Standard coefficients**	***t*-statistics**	**Significance**	**Adjusted R^2**
Baden	RTA_g	−0.106	0.128	0.899	0.187	0.662	6.343	**0.000**	0.041
Württemberg	RTA_f	0.463	3.774	**0.000**		−0.109	−1.045	0.301	
Bayern	RTA_g	0.308	−1.655	−104	0.153	0.003	0.023	0.982	−0.350
	RTA_f	0.242	3.392	**0.001**		−0.051	−0.357	0.723	
Hessen									
	RTA_g	0.115	0.981	0.331	0.269	0.349	2.702	**0.009**	0.107
	RTA_f	0.514	4.407	**0.000**		0.089	0.689	0.494	
Niedersachsen	RTA_g	−0.252	−1.863	0.068	0.215	0.072	0.467	0.642	−0.030
	RTA_f	0.557	4.125	**0.000**		−0.091	−0.589	0.559	
Nordrhein-	RTA_g	−0.106	−0.783	0.437	0.025	0.528	4.441	**0.000**	0.244
Westfalen	RTA_f	0.24	1.781	0.081		−0.089	−0.746	0.459	
Rheinland-	RTA_g	0.083	0.909	0.367	0.575	0.266	2.01	**0.049**	0.041
Pfalz	RTA_f	0.738	8.07	**0.000**		0.064	0.483	0.631	

Table 5.9: Results from regression analysis (citations RTA omitting self cites).

Region		Insiders RTA*				Outsiders RTA*			
		Standard coefficients	***t*-statistics**	**Significance**	**Adjusted R^2**	**Standard coefficients**	***t*-statistics**	**Significance**	**Adjusted R^2**
Baden	RTA_g	0.158	1.309	0.196	0.214	0.791	9.202	**0.000**	0.601
Württemberg	RTA_f	0.446	3.699	**0.001**		−0.070	−0.810	0.421	
Bayern	RTA_g	−0.099	−0.963	0.340	0.469	-0.008	−0.055	0.956	−0.033
	RTA_f	0.724	7.002	**0.000**		−0.065	−0.451	0.654	
Hessen	RTA_g	0.192	1.627	0.11	0.255	0.54	4.595	**0.000**	0.258
	RTA_f	0.467	3.961	**0.000**		−0.074	−0.633	0.529	
Niedersachsen	RTA_g	−0.163	−1.111	0.272	0.076	0.074	0.480	0.633	−0.027
	RTA_f	0.373	2.547	**0.014**		−0.115	−0.744	0.46	
Nordrhein-	RTA_g	−0.54	2.153	0.036	−0.034	0.575	5.020	**0.008**	0.299
Westfalen	RTA_f	−0.016	−0.114	0.910		−0.152	−1.324	0.191	
Rheinland-	RTA_g	0.028	0.203	0.840	−0.024	0.359	2.800	**0.007**	0.097
Pfalz	RTA_f	0.111	0.812	0.420		0.022	0.171	0.865	

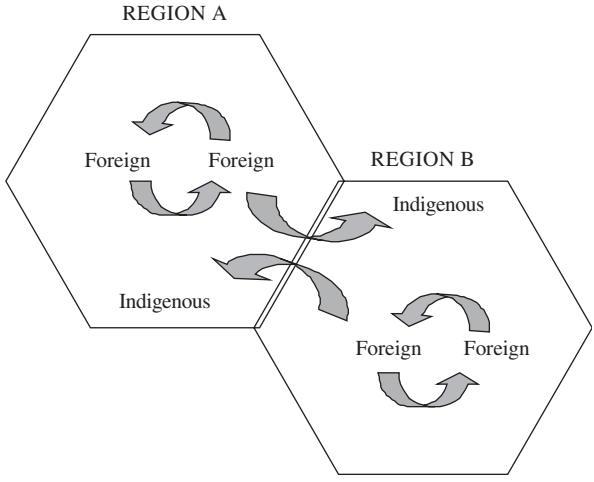

Figure 5.4: Patterns of inter-/intra-regional technology sourcing.

10. Conclusions

This chapter presented a descriptive analysis of the technology sourcing activities between 1975 and 1995 of foreign firms located in Germany. From this initial examination of the citation activity of foreign-owned firms, a number of issues emerge. First, relative to a random distribution of international patenting activity, it is clear that foreign firms source a high proportion of knowledge from this host country (∼19%). This highlights the importance of Germany as an international source of technological know-how. Further, support is found when one considers the nature of technological activity undertaken at this location. Since relatively few citations lead back to the knowledge pool of the parent firm, the technological activities undertaken in Germany may be categorized as *home base augmenting* — rather than building upon prior research of the parent, new lines of technological search are pursued at this location. The age profile of the knowledge sourced from this location provides further evidence. In contrast to that sourced from the home location and indeed from other foreign locations, technologies accessed locally in Germany may be classified as 'younger'. This underscores the importance of physical presence at locations that host cutting edge research — because the tacit component is likely to be higher across recently developed technologies, firms must locate within the appropriate international centre of excellence to *breathe in the air of innovation*.

While a high degree of regionally bound sourcing was found, this was essentially due to the inclusion of self-citations. Removing these from the analysis reduced the overall degree of knowledge localization at regional level (as expected) and the regional rankings changed. While intra-region sourcing continues to be relatively strong within *Nordrhein-Westfalen*, *Baden Württemberg* replaces *Bayern* as the second most important location for regionally bound inter-firm activity. Attention was also drawn to *Baden Württemberg* since firms located in *Bayern*, *Hessen*, *Niedersachsen* and *Rheinland-Pfalz* source a greater proportion of technology from their counterparts in this region than they do locally. A very low reliance on intra-regional sources of inter-firm technology exchange occurs in *Niedersachsen* and *Rheinland Pfalz*, which seems to support the suggestion that firms use these locations as satellite positions from which to access knowledge elsewhere in Germany.

Examining the nature of technology sourcing by foreign firms, the regression analysis suggests that while indigenous firms provide knowledge that can be accessed from any part of Germany, knowledge provided by the foreign firms themselves seems to be more regionally bound. A number of potential explanations lie behind this finding. For example, it is possible that indigenous firms perceive the foreign-owned firms located within the same region as a competitive threat and are therefore slow (or unwilling) to allow them access to their in-house knowledge infrastructures. In contrast, foreign-firms that seek to tap into indigenous knowledge from afar (i.e. outside the region) are not seen to pose as large a threat. This focuses attention upon the *emitting capacity* of indigenous firms within their regions and highlights how this can be used to weaken (or indeed prevent) technology flows between firms.[20]

While the degree of inter-firm knowledge spillovers (or technology interaction) depends upon both the nature of the technology and the *absorptive capacity* of recipient firms, the importance of the *emitting capacity* in such contexts has not received much attention in this literature (Amesse & Cohendet, 2001). This latter concept relates to the producers of knowledge and their ability to successfully communicate this knowledge to the outside world. The quality of the knowledge transfer process is seen to be highly dependent upon such considerations. Just as firms display high variation in their absorptive capabilities, they also record substantial differences in their ability to communicate with agents lying outside their organization.[21] Cohendet and Meyer-Krahmer (2001, p. 1575)

[20]This is consistent with the fact that one of the major weaknesses within the German system is the relatively poor linkages, that exist between indigenous industries (Temple, 1998, p. 275).

[21]Of course, the codified element of the newly created knowledge that is reported within the patent document is publicly available, but successful replication (and understanding) of this knowledge requires the replicating firm to establish contact with the highly complementary tacit component of this knowledge. His ability to do this is first and foremost determined by the *emitting capability* of the patentee (or owner of the knowledge).

further explain how this emitting capacity may be associated with *intentional selectivity* on the part of the firm:

> The producer of knowledge has emitting capacities. An agent producing new knowledge will generally operate a selection between communities: on the one side, he will consider to which communities the new knowledge is addressed, and on the other side, whose communities that he chooses to exclude.

The authors (*ibid*. p. 1584) explain how firms that provide assistance to their strategic partners (through investment in knowledge-sharing routines, for example) are thereby engaged in a process of deliberately enhancing the absorptive and emitting capacities of their partners:

> In other words, the management of the technology process is essentially bi-directional. What matters is more the co-evolution of the mutual absorptive and emitting capacities between partners, than the mere observation of the technology flow between an emitter and a receiver.

Results from the citation analysis may be interpreted in the context of this contribution. Since the technologies drawn on by foreign firms do not reflect local technological expertise of indigenous firms, one might conclude that a co-evolution of the *mutual absorptive and emitting capacities* between large foreign- and German-owned firms has simply failed to be developed at regional level in Germany.

In marked contrast, these capabilities appear to have successfully amassed between the large foreign-owned firms. While it is beyond the remit of this study to adequately examine this issue in further detail, one might suggest that it reflects the mature stage of regional technology clusters within Germany. Rather than attributing the dynamism of regional technology clusters to the expertise of large indigenous firms (as has tended traditionally to be the case in the literature), one might reassess this idea and acknowledge the role played by the foreign-owned firms in such considerations. At least within the German context, the results from this analysis suggest that the knowledge embedded within foreign-owned firms is what drives the regionally-bounded technology activity of foreign-owned firms within these clusters.

In addition to the possibility that indigenous firms view foreign firms as constituting a threat within the region, perhaps foreign-owned firms manage to communicate more effectively with one another since they are faced with similar sets of issues. Operating as subsidiaries of larger companies and being located in a

(relatively) unfamiliar environment, it is likely that they are confronted with (broadly) similar sets of concerns — how to deal with local laws and legislation; challenges — how to access the local networks and infrastructures and opportunities. They share the common goal of knowledge-seeking activity and may be seen to employ a common framework that enables them to operate within the German environment. They therefore manage to simultaneously build both their absorptive and emitting capacities at local level. In a similar vein (and drawing on Henderson and Clarke (1990)), Phene and Tallman (2002) refer to the importance of cluster specific *architectural knowledge* that:

> (...) develops through common experiences, regular formal and informal interaction, exchange of personnel, alliances, buyer and supplier relationships, personal friendships and a variety of other economic and social relationships. By providing similar concepts of 'how the world works' to firms in a region, shared architectural knowledge makes the exchange and interpretation of component or technical knowledge easier.

While the authors emphasize the varying nature of this *architectural knowledge* across different national clusters (owing to language differences, cultural and ideological concerns (*ibid*., p. 6), we suggest that such variations may also exist within a national context — but between the foreign and indigenous firm groupings at regional level. Although these German-owned firms are multinational enterprises and have exposure to international business, their activities are greatly influenced by their common domestic business culture/infrastructure. In other words, through time, these firms are likely to have developed shared meanings about business; technology and the indigenous/foreign divide within the local market.

Because they are less likely to have developed similar sets of shared meanings with their foreign counterparts from an early stage (and accepting that this constitutes a foundation stone for deeper inter-firm interaction), one might suggest that indigenous firms thereby reduce the possibility of creating networks that facilitate intra-regional exchange.[22] In doing so, they (intentionally?) fail to co-develop the capabilities needed to interface with their foreign neighbours across the more tacit dimensions of technological activity that exhibit a distinctly regional character.

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[22]Sternberg (2000, p. 111) reports a similar finding in the case of regional research institutes in Germany. In his survey of intra- and inter-regional linkages between these institutes and foreign firms, the author finds that cooperation with foreign enterprises is on an average quite rare.

These results may also be consistent with the notion that foreign firms locate within particular regions to facilitate interaction within the indigenous *Mittelstand* sector. Many authors have highlighted the importance of these small- and medium-sized firms within the technology/innovation domain in Germany. Rather than seeking explanations through foreign firm interaction with their (large firm) German counterparts, perhaps interaction with indigenous firms takes place at this level (data in Table 5.3 show that approximately 16% of local citations are to another (smaller) firm).

One final point — while the intra-regional picture suggests that large firm interaction is dominated by technology flows between foreign-owned firms themselves, the analysis at inter-regional level points to the potential for inter-firm flows between foreign and indigenous multinational firms. This is consistent with the recent conceptualization of the *learning region* presented by Boekema et al. (2000). The authors conclude that the *learning region* refers to plural 'regions' rather than to any singular region and emphasize that a high level of mutual learning between regional agents (i.e. inter regional exchange) is what characterises economically successful regions. Following this, it is clear that while large indigenous firms do not constitute the most proximate source of technological know-how for foreign-owned firms within the regions, their technological expertise is nonetheless an extremely important input into the knowledge activities of these firms. Perhaps these technologies are older and more easily sourced from afar?

A more micro examination of the nature of these localized and more dispersed inter-firm technology flows is an important path for future research.

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Chapter 6

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

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1. Introduction

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

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

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

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

2. Conceptual Discussion

2.1. Background: The Importance of Heterogeneous Subsidiaries for Knowledge Diffusion

There is a relatively widespread view about the way and the reasons why MNEs can contribute to technological development in industrialising countries, a contribution that is supposed to occur mainly via spillover effects. This view rests on three main assumptions about how MNEs operate: first, that MNEs possess and exploit technological assets — an ownership advantage seen as the main reason for the MNE's existence; second, that knowledge is a kind of 'public good' within MNEs, i.e. mobile, and with a joint character within firms;[1] and third, that the MNE is a tightly integrated organisation, with the behaviour of subsidiaries

[1]It means that can be supplied to additional production facilities at very low cost (Markusen, 1995, p. 174).

closely shaped by central strategies and decisions. The combination of centrally accumulated technological assets, knowledge that is easily transferable between units of the MNE, and tightly integrated organisational behaviour provides the basis for a 'pipeline' that delivers spillovers of superior technology from the parent MNEs to domestic firms, without the active intervention of local MNE subsidiaries (Caves, 1974; Blomstrom & Kokko, 2003; Gorg & Greenaway, 2004; Haskel et al., 2002). Such effects are presumed to follow-on almost inevitably from the centrally driven technological advantage of the MNE.

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

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

Alongside these changes a number of studies within the business literature started to focus on subsidiaries as a separate unit of analysis, and emphasised several types of heterogeneities in their capacities and roles. Thus, they developed several typologies emphasising different aspects related with this heterogeneity. The most well-known of these typologies is that developed by White and Poynter (1984), who identified five types of subsidiaries according to the "scope" of three

dimensions characterising their activity in the host economy: product (product scope is the breadth of the subsidiary's product line); market (market scope is the subsidiary spread of markets); and value-added (added-value scope is the capacity of the subsidiary to add value to its products or services in the host economy): (a) The *marketing satellite* is a subsidiary that merely markets locally, products manufactured elsewhere; (b) The *miniature replica* is a subsidiary that produces and markets locally, some of the parent's product lines for the local country; (c) The *rationalised manufacturer* is a subsidiary that produces a designated set of component parts or products (inputs) for a multi-country or global strategy; (d) The *product specialist* is a subsidiary responsible for developing, producing and marketing a limited range of products for the global market and (e) The *strategic independent* is a subsidiary free to develop lines of business for either local or global markets.

More recently, other scholars have advanced in the direction of identifying typologies of subsidiaries (e.g. Barlett & Ghoshal, 1989; Jarillo & Martinez, 1990; Gupta & Govindarajan, 1991; Roth & Morrison, 1992; Taggart, 1996; Birkinshaw & Morrison, 1998; Papanastassiou & Pearce, 1998, 1999). For the purpose of this study, an interesting classification is the one developed by Gupta and Govindarajan (1994), who emphasise the importance of an operational aspect of the MNE, which is the intra-group flows of knowledge. These authors classify subsidiaries in four ways, along intra-group flows of knowledge: (a) *global innovators*, when they are responsible for high outflows of knowledge but receive low inflows from the group; (b) *integrated players*, when they both send and receive high flows of knowledge; (c) *implementers*, when they have low outflows of knowledge but receive high inflows; and finally, (d) *local innovators*, when they both receive and send low flows of knowledge.

Regardless of whether the typologies focus more on the strategic motives for establishing the MNE subsidiaries (cf. White & Poynter, 1984) or on the operational aspects, most of them tend to confine their attention to the implications of subsidiaries' differences for the MNE as a whole, rather than to the host economy. Furthermore, the few that have explored the implications of subsidiaries heterogeneity on the host economy have focused almost exclusively on how the behaviour of subsidiaries themselves were affected, rather than on other aspects of the domestic economy (see e.g. Jarillo & Martinez, 1990; Taggart, 1996).

In our study here, we are interested in the impact on host economies of diverse types of subsidiaries. Our work is different from previous works in two respects. First, we go one step further in the analysis, in that we do not only analyse the effect of the different types/roles of subsidiaries on their own technological activities, i.e. the activities within subsidiaries. We also analyse the association between different types/roles of subsidiaries and the extent to which they establish knowledge linkages with domestic agents — one of the main channels for knowledge diffusion in the host economy. Second, we base our typology of subsidiaries on

one particular aspect, characterising the local activity of subsidiaries: the extent and nature of their global linkages. In this respect, our typology can be related to the one developed by Gupta and Govindarajan (1994), discussed above. However, in contrast with Gupta and Govindarajan's typology, we distinguish between intra-corporative and extra-corporative linkages, a distinction that, as it will be seen later, is very meaningful in our analysis.

2.2. An Original Classification of MNE Subsidiaries for Developing Countries

The different types of linkages (networks) in which subsidiaries are embedded can be considered a very important resource for the subsidiary. This is in line with network theories (e.g. White, 1970; Granovetter, 1985, 1992), which have argued that firms' performance is tied to the positioning of firms in the networks in which they are embedded. This is due to the fact that the structural position of a subsidiary in a network may affect the way knowledge is accessed and therefore potentially exploited. For example, a position that is considered to significantly influence the internal capabilities and the success of a firm is centrality (Freeman, 1979), which depends on the number of direct linkages formed by a firm with the rest of the firms in its network. Ahuja's (2000) study on the innovativeness of firms in the chemical industry found that the number of direct collaboration linkages a firm maintains, affects its innovative output positively. The positive effect of direct linkages is related to the fact that, first, they enable the sharing of knowledge among firms, without the risk that knowledge is downgraded by a third firm. Second, a high number of direct ties enable a firm to have access to a vast array of differentiated and complementary skills from different firms. In this way, a central firm is able to compare knowledge coming from these different sources, and this may enhance its innovation potential and performance (Bell, 2005). This can be applied to MNE subsidiaries: the extent to which they are centrally positioned in a global knowledge network, which may or may not include the MNE headquarters and the other subsidiaries, is likely to be positively related with the subsidiary's process of accumulation of knowledge and technology, and therefore with its internal capabilities.

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

In principle, therefore, four types of subsidiaries can be identified:

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

We interpret subsidiaries' development of global linkages as an important means by which those subsidiaries can acquire externally developed technological knowledge and resources. Furthermore, when these linkages are strong within the MNE (i.e. with HQs or other affiliates) they can be interpreted as reflecting good channels for accessing the common technological resources from the MNE, or as reflecting the operation of a 'common resource model' within the MNE. In this chapter, we explore whether there is a relationship between the typology of subsidiaries identified above and (i) the innovative activity of subsidiaries and (ii) their likelihood of generating knowledge linkages in the host economy. We explore these relations more in detail in the following section.

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

2.3.1. Globally diversified subsidiaries Globally Diversified (GDiv) are subsidiaries that use both linkages with the MNE headquarters and other subsidiaries, and linkages with other international firms or institutions. Our exploratory idea is that GDiv subsidiaries may have established a more horizontal relationship with the MNE, which means that the MNE has moved from an ethnocentric to a polycentric organisational model (Perlmutter, 1969). They source knowledge from a vast array of external actors (suppliers, clients, etc.), and when they acquire knowledge resources from the MNE, they tend to establish horizontal and cooperative linkages with both headquarters and the rest of the subsidiaries.

We argue that this combination of knowledge sources should be associated with an active innovative behaviour on the side of subsidiaries for two reasons. First, because the high intensity of interactions with the MNE, reflects a situation where subsidiaries have privileged access to the resources and support from the MNE. Second, the fact that this type of subsidiary is also looking for other external

sources of knowledge reflects a high intra-subsidiary absorptive capacity (Cohen & Levinthal, 1990). This leads us to advance the following proposition: *GDiv subsidiaries can be associated with strong innovative activity.*

In order to maintain such a highly diversified array of global knowledge linkages, this type of subsidiary needs to be very entrepreneurial and it is therefore conceivable that it would seek to exploit any knowledge resource available, even at close geographical proximity in the host country. Accordingly, we argue that this type of subsidiary is more likely to develop dense knowledge networks with local actors.

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

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

2.3.2. Globally dependent subsidiaries The GDep subsidiaries are engaged in linkages only with the MNE headquarters or other subsidiaries of the enterprise, whereas they show strikingly low levels of interactions with other international agents. While the first aspect can be expected to have a positive effect on the innovative activity of the subsidiary, the second one can be interpreted as a reflection of poor absorptive capacity and low innovative activity. In consequence, this type of subsidiary is expected to have lower innovative capability than GDiv subsidiaries. This is explained more in detail below.

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

On the other hand, however, the strong links with the MNE in the context of a lack of links with other firms outside the corporation can be interpreted as reflecting a situation of tight integration within the MNE, which implies high levels

of control by the MNE headquarters. It is probable, therefore, that GDep subsidiaries have both low absorptive capacity and less opportunity for learning, and will therefore have a more limited innovative activity than it is observed in the GDiv subsidiary.

This leads us to advance the following proposition: *GDep subsidiaries can be associated with relatively strong innovative activities, which are nevertheless more limited than those observed for the GDiv subsidiaries.*

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

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

What follows from these propositions is that this type of subsidiary could potentially generate knowledge spillovers in the host country — because of their privileged access to MNE technological resources — but fail to do so due to its strong dependence on the HQ, which inhibits the formation of local knowledge linkages.

2.3.3. Globally independent subsidiaries The GInd are the subsidiaries that have developed knowledge linkages with other agents in the international markets, but not with the MNE group.[2] This reflects a situation of strong independence from the headquarters. We argue that MNE subsidiaries interacting with international partners, quite autonomously from the headquarters, need to have a significant degree of initiativeness and dynamism in looking for external sources of knowledge — e.g. rather than passively acquiring knowledge from the headquarters.

In our conceptual model, GInd subsidiaries are characterised by a rather active innovative behaviour at the local level, because, as suggested by Cohen and Levinthal (1990), the activity of looking for external sources of knowledge requires that the subsidiary has accumulated a certain degree of knowledge (i.e. absorptive capacity) in order to be able to search and exploit commercially the

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

absorbed knowledge. However, unlike the GDep subsidiary, the GInd subsidiary lacks the access to the MNE's tacit and complex knowledge, which means that its innovative activity may be based solely on the access of codified knowledge available in the market (Kogut & Zander, 1993). For this reason, we can plausibly argue that the GInd subsidiary has weaker innovative capabilities than the GDiv subsidiary, although we cannot predict a difference with the GDep subsidiary. The latter certainly has access to a more tacit and complex form of knowledge coming from the MNE, but the GInd subsidiary has access to a more varied array of knowledge sources, which is also important for the innovative activity of the subsidiary.

Therefore, in principle, it is conceivable that: *GInd subsidiaries can be associated with relatively strong internal innovative activities, which are more limited than those observed for the GDiv subsidiary but not necessarily different from those of the GDep subsidiary.*

The key difference with the GDep subsidiary becomes visible when we look at the formation of local linkages. Given the openness of GInd subsidiary to global sources of knowledge other than the MNE, it is conceivable that it operates under a certain degree of autonomy from the HQ, and has the freedom to establish knowledge linkages in the host country, especially with domestic firms, which are geographically and/or cognitively proximate to the subsidiary.

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

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

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

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

This type of subsidiary, totally isolated from the MNE and showing no particular interest in networking with other sources of knowledge — both domestic and foreign, is likely to behave in isolation from the local context.

Hence, we expect that: *GIso subsidiaries are highly unlikely to develop knowledge linkages at the local level.*

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

3. Methodology

The empirical analysis is based on two different types of data and methodology. First, we use secondary data from the Argentinean National Innovation Survey (1998–2001) and apply standard statistical inference. Second, we use primary data from an original survey to MNE subsidiaries, carried out in Argentina during the period August–October 2005, and this allows us to run a qualitative analysis and apply network visualisation techniques.

3.1. Analysis Based on Innovation Survey Data

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

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

The survey was carried out by the National Statistical Office and is representative of the population of manufacturing firms in the country. It interviewed 333 subsidiaries. The representative manufacturing subsidiary has been established in Argentina for 35 years. However, 25% of the subsidiaries have been in the country less than 7 years whilst a substantial 10% were established more than 100 years ago. These subsidiaries employed, on an average, 400 personnel (range, 16–6000 personnel); average annual sales amounted to approximately 125 million Argentinean Pesos (in 1998, when one Argentinean Peso was equivalent to US$1) (range, 694 thousand to 4400 million), of which 9% was exported (range, 0–99%). Europe is the home country of 46% of subsidiaries, 25% were owned in USA and

25% in other Latin American countries. The remaining 3% have home countries spread around other parts of the world. Two industries account for 39% of subsidiaries: chemicals and allied products (21%) and food kindred products (17.5%). Motor vehicles and equipment have 9% of the subsidiaries and the rest distribute fairly evenly across the remaining industries.

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

3.1.2. Indicators

3.1.2.1. Indicator of global linkages — An indicator capturing differences in the structure of global linkages of the subsidiaries was calculated by combining two types of information about the subsidiaries' behaviour: (a) their use of knowledge interactions with international agents and (b) the importance attributed by the subsidiaries to these agents as possible sources of information for innovation activities.[3] A more detailed explanation of how this indicator was constructed is reported in the Appendix.

On these bases, four types of subsidiaries were identified:

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

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

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

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

We use 15 indicators to evaluate different intensities of technological activities of subsidiaries. These can be grouped into four categories: (a) investments in disembodied knowledge, (b) investments in embodied technology, (c) human capital and (d) outputs. These are explained below.

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

I Intensity of expenditures on R&D
II Intensity of expenditures on innovation-related industrial design
III Intensity of expenditures on innovation-related management
IV Intensity of expenditures on innovation-related consultancy
V Intensity of payments for technology transfer contracts and licence.

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

VI Intensity of expenditures on capital goods for innovations
VII Intensity of expenditures on IT hardware and software for innovation tasks
VIII Intensity of imports of capital goods

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

IX Skill intensity, measured as the number of engineers, other professionals and technicians employed in production as a proportion of total employment
X 'Specialised' Innovative Labour, measured as the proportion of employees exclusively dedicated to innovation tasks: R&D, design tasks, etc.
XI Intensity of expenditures on innovation-related training.

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

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

XII Number of patents: number of patents granted by each firm
XIII Product innovations accomplished during the period[4]

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

XIV Process innovations accomplished during the period[5]
XV Percentage of total sales — to local and/or external markets — explained by innovative products.[6]

Tables 6.1 and 6.2 report basic summary statistics of our data set with respect to these indicators.

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

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

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

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[5]The Innovation Survey asked the firms about the type of process innovations introduced during the period, giving the firms different four different options. To calculate an indicator of intensity of process innovation, we simply added the 'yes' answer to each option.
[6]This indicator only used data of the second Innovation Survey (1998–2001).

Table 6.1: Indicators of technological activity: Basic statistics.

Indicator [a]	Type of indicator	Mean	Standard deviation	Minimum	Maximum
Indicators of input					
Aggregated indicators					
Investments in embodied technologies[b]	Continuous (%)	2.41	5.9	0	32
Investments in disembodied technologies[c]	Continuous (%)	0.74	1.7	0	22
Selected individual indicators					
Investments in capital goods	Continuous (%)	0.06	0.2	0	1.9
R&D expenditures	Continuous (%)	0.27	0.8	0	9.2
Labour in innovation activity	Continuous (%)	4.1	6.9	0	78
Skills intensity	Continuous (%)	30	63	0	80
Indicators of output					
Patents	Continuous	0.27	1.9	0	33
Percentage of truly innovative products sold by the company					
To internal market	Continuous (%)	12	24	0	100
To external markets	Continuous (%)	7	21	0	100
Indicator of local linkages					
Linkages with local agents	Continuous	3.3	3.3	0	15
Linkages with local suppliers and clients	Continuous	1.4	0.5	0	2

[a]All the continuous measures are intensities, over total sales or total employment.
[b]Calculated as the sum of the items under category (b) in Section 4.1.2.
[c]Calculated as the sum of the items under category (a) in Section 4.1.2.

Table 6.2: Product and process innovation.

Indicator	Type of indicator	Frequency	Percentage
Product innovation[a]	Ordinal (between 1 and 4)		
Category IV[b]	Continuous (number firms)	70	21
Category III	Continuous (number firms)	83	25
Category II	Continuous (number firms)	128	38
Category I	Continuous (number firms)	52	16
Process innovation[a]	Ordinal (between 1 and 4)		
Category IV[b]	Continuous (number firms)	34	10
Category III	Continuous (number firms)	58	17
Category II	Continuous (number firms)	190	57
Category I	Continuous (number firms)	51	15

[a]Four categories of product and process innovation were defined: the value IV corresponds to product and process innovators that introduced innovations new for the world economy, the value III to product and process innovators that introduced innovations new only for the country, the value II to product and process innovators whose innovations were new only for the company, and the value I to companies declaring that they did not introduce product and process innovations.
[b]The cells show the percentage of firms that introduced product (or process) innovations new for the world economy within each type of subsidiaries. So, for instance, cell.

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

In this paper, we analyse only four cases of MNE subsidiaries, selected among the sample of 38 subsidiaries to illustrate each one of the type of subsidiary derived from our framework. Each case falls in one of the four typology of subsidiaries identified. These cases are used here purely for descriptive and exploratory purposes, with no pretence to test causal relationships. Instead, the aim of these case

studies is to provide qualitative insights to understand what underpins the relationship between global and local linkages, in a complementary way with respect to the Innovation Survey's data (Section 3.1). The selected subsidiaries operate in mature industries such as: the bakery oven, the tubes and pipes, the food and press industry. According to OECD classification, these industries fall into different categories of technological intensity, being medium high-tech (oven industry), medium low-tech (tubes and pipes) and low-tech (food and press industry). As previously mentioned, these cases are illustrative and do not pretend to have any statistical representativeness of the Argentinean industry.

4. EMPIRICAL RESULTS

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

4.1.1. The typology: some general features of each type of subsidiary Table 6.3 shows the distribution of subsidiaries according to the type of global linkages they maintain. The distribution is not significantly biased. However, the two more important groups are GDiv (34%) and GIso (31%), and a relatively smaller number of subsidiaries engaged in international linkages independently from the MNE group (12%). Finally, there are 22% of subsidiaries that rely exclusively on the MNE group for their international interactions.

Table 6.3: General features of each type of subsidiary.

	GDiv (I)	**GDep (II)**	**GInd (III)**	**GIso (IV)**
Number of subsidiaries	115	74	41	103
Percentage	34	22	12	31
Sales/employee — 000 Pesos				
Sales/employee — 000 Pesos (mean)	506	383	425	271
Export intensity — (%) (mean)	10	8.04	11	7
Import intensity — (%) (mean)	11	12	7	7
Market share[a]— (%) (mean)	3.03	3.07	3.04	3.03
Age	32	41	32	35
FDI %	92	92	67	83

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

Table 6.4: Distribution of types of subsidiaries across industry OECD.

	GDiv (I)	**GDep (II)**	**GInd (III)**	**GIso (IV)**	**Total**
Low-tech	32 (28%)	17 (23%)	**22 (54%)**	**42 (41%)**	113 (34%)
Medium low-tech	**27 (23%)**	16 (22%)	8 (20%)	14 (14%)	65 (20%)
Medium high-tech	46 (40%)	**35 (47%)**	8 (20%)	37 (36%)	126 (38%)
High-tech	10 (9%)	6 (11%)	3 (7%)	10 (10%)	29 (9%)

Table 6.3 also shows some general features of the different types of subsidiaries. The distribution of the types of subsidiaries in terms of firm size (number of employees) is roughly what one might expect. GDiv and GInd subsidiaries, the two more entrepreneurial groups, are, not surprisingly, the largest firms. They also have, on an average, the highest export-intensity within the sample. Conversely, the GDep and the GIso are the smallest. GDep subsidiaries have on an average the highest domestic market share, import intensity, age and FDI participation. However, with respect to the last indicator, they do not differ from GDiv. It is not surprising either that GInd subsidiaries have the smallest FDI participation.

Finally, Table 6.4 shows the distribution of the different types of subsidiaries across categories of industries with different technological intensity — grouped according to the OECD classification of industries.

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

4.1.2. Global linkages and innovative activities of subsidiaries In this section, we explore the relevance of these different types of MNE subsidiaries for the patterns of innovative activity of the subsidiaries in the host economy. We are interested in how the diverse structure of the subsidiaries' global linkages relates to their effective technological activities in the host countries. Table 6.5 shows the

Table 6.5: Types of subsidiary and innovative activity: Inputs.[a]

Indicators	Type of subsidiary				ANOVA test	Post-hoc test[e]
	GDiv (I)	**GDep (II)**	**GInd (III)**	**GIso (IV)**		
	(Mean value per type)					
Aggregated indicators						
Investments in embodied technologies[b]	**2.7**	**3.5**	2.6	0.9	Significant***	II > IV***
Investments in disembodied technologies[c]	**0.9**	**0.8**	0.8	0.4	Significant***	I > IV***
Selected individual indicators[d]						
Investments in capital goods	0.06	**0.09**	**0.09**	0.01	Significant***	II, III > IV ***
R&D expenditures	0.26	**0.31**	**0.35**	0.18	Not significant	
Labour in innovation activity	**5.9**	3.9	3.9	2.4	Significant***	I > IV, II ***
Skills intensity	**39**	34	13	24	Significant***	I > IV, III***

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

results of the analysis obtained when indicators of inputs of the innovative activity are analysed and Table 6.6 shows the results of the analysis of differences in innovative outputs.

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

Table 6.6 shows a similar pattern, but with a clearer superiority of GDiv subsidiaries. In effect they are by far the most innovative ones, having granted more patents by firm, and launched more innovative products to domestic and foreign markets (16% and 11% respectively). They have also introduced more significant product and process innovations, i.e. of the type that are novel for the world economy or the country. GInd subsidiaries and GDep subsidiaries also perform well in some particular indicators. The former, especially with respect to patents and the introduction of significant product and process innovations — novel for the world economy — and the latter, with respect to the percentage of truly innovative products sold in internal and external markets. Finally, GIso subsidiaries have very poor innovative outputs: the average number of patents granted by each firm is strikingly low (0.06), especially if compared with GDiv subsidiaries (0.54). Similarly, the percentage of truly innovative products sold by GIso subsidiaries is quite low, even when one considers only the products sold in the internal market (6%).

In sum, two common observations cut across the results in Tables 6.5 and 6.6.

First, the analysis of the data clearly supports the exploratory propositions discussed in Section 2.3. On the one hand, it seems clear that GIso subsidiaries perform significantly more poorly than the other three groups with respect to all indicators of innovative behaviour. On the other hand, GDiv subsidiaries perform better with respect to almost all indicators.

Second, however, the analysis does not allow us to draw clear conclusions about the relative innovative activity of the other two types of subsidiary: namely the GDep and GInd groups. In other words, the analysis done here does not allow

Table 6.6: Types of subsidiary and innovative activity: Outputs.

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

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

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

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

us to disentangle the contradictory effects of dependence on the innovative activity of the subsidiaries. In effect, on the one hand GDep subsidiaries ranked second (a better position than GInd subsidiaries), in several indicators of innovative activity — e.g. total investments in embodied and disembodied technologies and the percentage of truly innovative product. This result could be interpreted as reflecting the advantages associated with better access to the technological resources of the MNE. On the other hand, with respect to some indicators, such as patents, introduction of significant innovations or R&D, the group of GInd subsidiaries is the one that performed better, immediately following the GDiv group. In some cases, therefore, it seems to be more important for the innovative activity of a subsidiary to be independent from headquarters and to have an active entrepreneurial attitude, rather than to be fully supported by the MNE. Therefore, the question about the circumstances in which dependency provokes a positive effect on the innovative activity of the subsidiaries, or alternatively, the circumstances in which the independence or an entrepreneurial attitude in subsidiaries can compensate for the lack of access to the technological resources of the MNE, remains open.

4.1.3. Global and local linkages In this section, we explore the relationship existing between our typology and the intensity of local knowledge linkages. We analyse two types of local linkages: linkages with local agents in general and linkages with local suppliers and clients. The results suggest that an important association may exist between the typology of MNE subsidiaries and their likelihood to generate local linkages, as predicted in Section 2.3.

With respect to the patterns discussed, Table 6.7 shows that, not surprisingly, the GIso subsidiaries are also locally isolated. They have developed linkages with

Table 6.7: Global and local linkages.

Indicators	GDiv (I)	GDep (II)	GInd (III)	GIso (IV)	ANOVA test	Post-hoc test[a]
Linkages with local agents	**6**	2.4	**4**	1.2	Significant***	I, III, II > IV I, III > II I>IV
Linkages with local suppliers and clients	**1.64**	1.28	**1.46**	1.13	Significant***	I, III, II > IV I, III > II I > III

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

local agents much less intensively than the other types (linkages with local agents is 1.2, while linkages with local suppliers and clients is 1.13). At the same time, in line with the results from the previous section, and also with the discussion of Section 2.3, GDiv subsidiaries are again the group that use local linkages more intensively (6 and 1.64). In principle, these results are consistent with the exploratory propositions discussed in Section 2.3.

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

4.1.4. Summary of results A particularly interesting result regards *GDiv subsidiaries*, which (i) rely on a highly differentiated set of international knowledge sources, (ii) have strong internal knowledge resources and innovative capabilities and (iii) have developed substantial knowledge linkages at the domestic level. This may be due to two concurrent factors. First, as shown in Section 4.1.1, this type of subsidiary has strong internal resources and high innovative capabilities, an aspect that also suggests that the knowledge that they are likely to transfer is of valuable content. Second, as explained in Section 2.3.1 and corroborated in Sections 4.1.2 and 4.1.3, GDiv subsidiaries may be characterised by a prominent entrepreneurial attitude that leads its managers to be willing to construct knowledge networks not only internationally, as demonstrated by their diversified global sourcing, but also with firms — both foreign and domestic — operating in Argentina. According to our data, GDiv subsidiaries are valuable channels of international knowledge into the host economy.

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

GInd subsidiaries are characterised by (i) the development of linkages with other agents in international markets, which are independent from the MNE group, (ii) moderate (to high) internal resources and innovative capabilities and

(iii) quite intensive local knowledge linkages. The formation of linkages may be due to the entrepreneurial and dynamic behaviour of this type of subsidiary, which may actively seek collaborations, both at the international and domestic level. However, because it does not benefit from technology transfer by the MNE headquarters, GInd subsidiaries' internal capabilities are slightly less advanced than in the cases of GDiv, as indicated in Section 4.1.2. In consequence, although the formation of linkages is high, the value of the knowledge transferred may not be as high as in the case of the GDiv subsidiary.

Finally, as predicted, *GIso subsidiaries* are in a condition in which they (i) do not establish significant international linkages, (ii) have weak internal knowledge resources and innovative capabilities and (iii) have formed poor domestic knowledge linkages. This case, quite consistent with our conceptual discussion in Section 2.3.4, highlights the fact that subsidiaries with poor internal resources are less likely to establish knowledge linkages (Giuliani & Bell, 2005). This is because they are either unable to generate valuable knowledge to transfer or because they have poor absorptive capacities (Cohen & Levinthal, 1990).

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

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

This section presents four cases of MNE subsidiaries, which were each selected to provide anecdotal evidence for each type of subsidiary derived from our framework. The first case is that of a subsidiary operating in the tubes and pipes' industry that is connected to a highly diversified array of international sources of knowledge, including the subsidiary's headquarters and the MNE's other subsidiaries, as well as a number of foreign suppliers and/or clients (**GDiv**). The second case is about a subsidiary specialising in the production of bakery ovens, whose only source of knowledge is represented by the headquarters (**GDep**). The third case is about a firm operating in the food industry, which acquires knowledge from several international sources but not from the headquarters or the MNE's subsidiaries (**GInd**). Finally, we leave the **GIso** subsidiary as the last case, which is about a subsidiary operating in the press industry, which has not established any relevant linkages with external sources of knowledge at the international level. We give here a detailed account of each of these cases and address the issue of the formation of linkages at the domestic level.

4.2.1. The case of a globally diversified subsidiary in the tubes and pipes' industry ('A') This is an informing case about an MNE characterised by horizontal and collaborative relationships between subsidiaries and the headquarters.

The group operates in the production of tubes and pipes for agriculture and civil infrastructures and, since 2003, the property has become fully Latin American with subsidiaries in several Latin American countries, including Brazil, Chile, Mexico, Costa Rica, Venezuela, Colombia and most of the Central American countries.[7] The salient characteristics of this MNE is that it has adopted an organisation model such that the headquarters is 'shared', that is, it is rotating over time across the different countries (and subsidiaries) according to the specific requirements of the MNE. For example, our respondent in the Argentinean subsidiary 'A' declared that "at the beginning the headquarters was in Costa Rica because it had a more 'foreign style' in doing business, now it is moving downwards (i.e. to the Southern Cone), closer to where most of the production is done". Very interestingly, the respondent describes this process in the following way: "it is like a father who has sons living in different countries and moves to live with each of them, changing over time". And then he adds, "what we want to achieve is the elimination of a legal boundary, where what matters is the Latin American region as a whole, not a particular country". Each subsidiary is thus highly participative in the strategic decision making of the whole MNE.

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

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

In addition to the MNE's knowledge resources, 'A' searches for a wider array of international sources of knowledge. A critical source in this case is represented by a North American leading company in the production of tubes and pipes. They basically adapt and imitate this company's product because, during the convertibility period, they had a licensing agreement with this company to sell its products in Argentina. Although this type of activity is no longer sustainable (this product in Argentinean Pesos is unaffordable for the local market), they still have a strong relationship with the US company and they are allowed to visit their plants.

Three other international suppliers are particularly important for the transfer of knowledge and technology in 'A'. All of them are producers of machinery from Italy, the Netherlands and China. As we can see, this is a very dynamic subsidiary, very actively sharing knowledge with the rest of the MNE and also very entrepreneurial in establishing other international linkages — which eventually benefit the whole MNE.

At the domestic level, 'A' collaborates intensively with several local suppliers (raw materials, metalworking) (see Figure 6.1). More interestingly, 'A' has

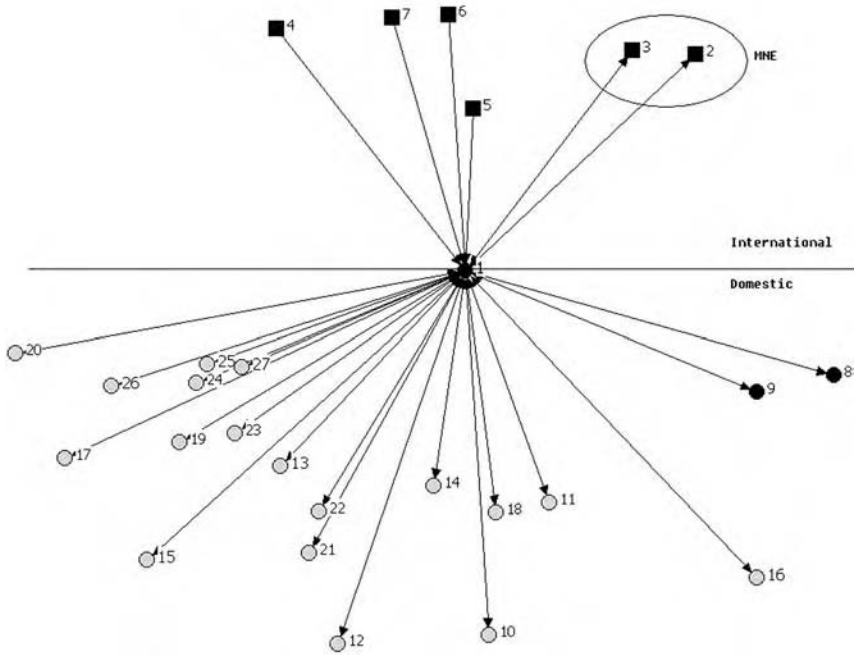

Figure 6.1: The case of a globally diversified subsidiary.
Source: Own data. Graph based on Netdraw.

established numerous linkages with domestic firms aimed also at the development of new materials for tubes and pipes (e.g. materials that comply with environmental standards and mechanic standards for the final product to be resistant). This behaviour is in line with the subsidiary's dynamic and entrepreneurial attitude, and it is likely to have a much higher developmental impact than the other subsidiaries presented in the rest of this section ('B', 'C' and 'D'). Domestic linkages formed by 'A' are much higher and also of a higher quality (interactive, oriented to develop new products, very highly innovative), than that in the other cases.

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

Our respondent in 'B' quite frankly admitted that the subsidiary's technological inputs came almost entirely from the headquarters and he described 'B' as a purely 'technology taker' subsidiary, with very limited R&D being carried out within the subsidiary. As the respondent put it "in this field the best technologies are produced by industrialised countries and Argentina is isolated from the rest of the world". More specifically, the respondent claimed that the headquarters operate on the technological frontier and therefore 'B' "is not able to invent anything" because the technological gap is considered to be too wide. 'B' does indeed have a technical laboratory, but it is used just to adapt the imported designs to the Argentinean market and the respondent claims that adaptations are very minor. In the case of 'B', the dependence on the headquarters is very high and the relationship is strongly hierarchical and unidirectional.

At the intra-subsidiary level, therefore, 'B' accesses frontier technologies and operates with a high technological sophistication, but this is entirely due to the high dependence from the headquarters rather than to its internal effort. In fact, 'B' follows a quite passive learning behaviour with no initiative to undertake an innovative path different from what has been transferred by the headquarters.

In line with our argument in Section 2.3 and with the results of the Argentinean Innovation Survey (Section 4.1), we find that this subsidiary develops very limited linkages at the domestic level (see Figure 6.2). The only linkages that are

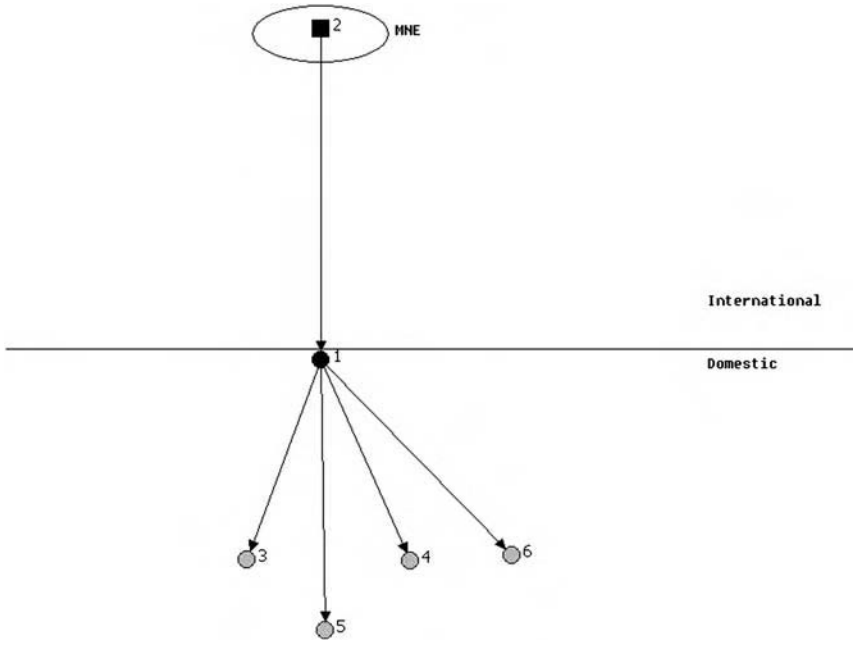

Figure 6.2: The case of a globally dependent subsidiary.
Source: Own data. Graph based on Netdraw.

formed are with a few, very small artisan firms, which do some metalworking for 'B'. 'B' transfers some technical knowledge through the interaction, but the impact of this type of linkage in terms of generation of technological externalities in the host economy is likely to be limited because: (i) the relationship between 'B' and the artisans is unidirectional, and no process of interacting and learning is promoted through these types of linkage; and (ii) the artisans have themselves very limited potential to amplify the knowledge that they have received from 'B' and diffuse it to other firms in the country. In contrast, the incoming knowledge is much more likely to run into the 'dead-end' of firms that diffuse little to other firms in their economic context (Giuliani & Bell, 2005).

4.2.3. The case of a globally independent subsidiary in the food industry ('C')
Thirty-five years ago, 'C' started as a national firm for the production of bakery products and grew in a market where the only competitor offered products for the lower-end of the bread market. It entered the market by targeting a very specific market-niche, oriented towards production of high quality and fresh products.

Today, the firm is the leader in the domestic market, retaining more than 50% of the market share. It became part of a multinational group in 1997, when it was acquired by a foreign investor. However, the foreign property has only a financial interest in the firm and no specific expertise or tradition in the production of bakery products.

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

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

In Argentina, 'C' has formed relationships with a number of domestic suppliers (wheat, yeast, sunflower juice, etc.) and these relationships are also based on joint product development (Figure 6.3). It is interesting to note that 'C' has established particularly strong linkages with three large suppliers, one of which is Argentinean. Being connected to large suppliers is important as it may generate a multiplying effect in the generation of externalities, and the impact of these linkages on other firms in the economy may be more important than that of linkages with other smaller domestic firms (i.e. the dead-ends observed in the case of subsidiary 'B'). This is because, large suppliers may amplify the knowledge received from 'C' and transfer it to a wider array of other domestic firms.

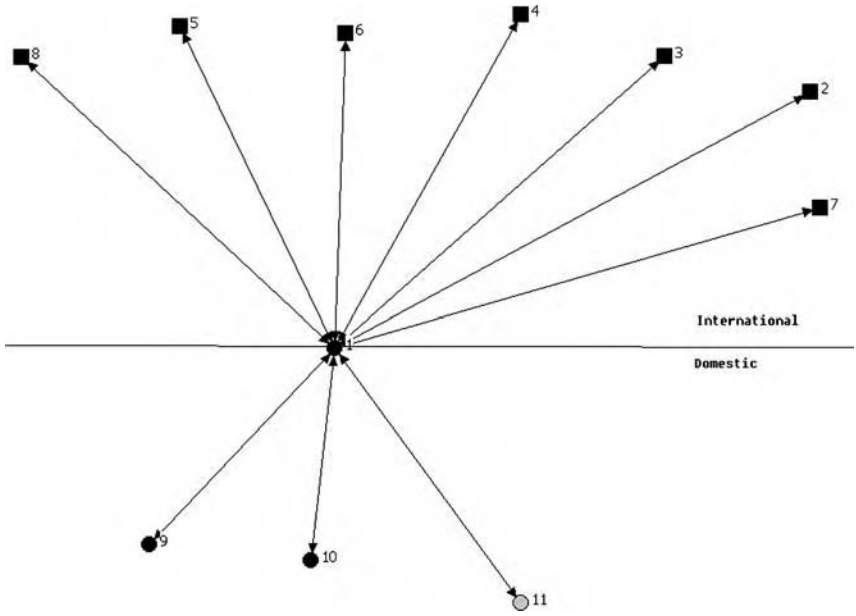

Figure 6.3: The case of a globally independent subsidiary.
Source: Own data. Graph based on Netdraw.

Figure 6.4: The case of a globally isolated subsidiary.
Source: Own data. Graph based on Netdraw.

4.2.4. The case of a globally isolated subsidiary in the press industry ('D') Finally, the example of an isolated subsidiary proposed here is that of a company working in the press industry ('D') (see Figure 6.4). This choice may seem quite bizarre, as firms operating in the press industry need necessarily to be connected to international press agencies (e.g. Reuters). However, our focus here was not directed to this type of codified knowledge (i.e. news), but to the acquisition of knowledge in the way business is run and the journal is managed and produced. For example, knowledge about how to develop a new format, how to change the newspaper's marketing strategies, how to target new market niches, etc. In this

respect, this company is determined as GIso because it is totally independent from international sources of knowledge. It was set up some 130 years ago and more recently has been acquired by a North American press agency. Also, the newspaper is managed and the decision-making process is carried out exclusively in Argentina and, as said, the subsidiary is completely independent from the headquarters. It is only during severe financial crises that the headquarters intervene in supporting the journal but only from a financial side, never from a knowledge-centred one. The subsidiary managers seemed to be quite independent and to operate in isolation from the domestic and international context. For this reason, we considered this subsidiary to have absolutely no impact on the generation of knowledge spillovers in the host country.

5. CONCLUSIONS

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

The paper has discussed and empirically explored the relationship between three important dimensions characterising the MNE subsidiaries' potential for knowledge spillover effects in host countries: (i) the nature of subsidiaries' global linkages, (ii) their local innovative activities and (iii) their knowledge linkages with local firms. In order to explore these relationships, we have discussed how subsidiaries, which differ in terms of their global linkages, do also differ in terms of their innovative activities and of their propensity to establish local knowledge linkages.

In order to explore this issue, we used both secondary data from the Argentinean National Innovation Survey (1998–2001), and the anecdotal evidence on MNE subsidiaries in Argentina. The empirical analysis has suggested that MNE subsidiaries engage in very diverse types of global networking, and that, in connection with these networking activities, they develop different internal capabilities and have different potentials for establishing knowledge linkages locally. This is especially relevant in the context of industrialising countries, since, as said, 'conventional theories' presume that subsidiaries are passive recipients of headquarters' generated knowledge. More specifically, we have identified

four different types of subsidiaries, characterised by distinct behaviours in terms of their innovative activity and of formation of knowledge linkages in the host economy.

In our analysis, we find that only a certain typology of MNE subsidiary is in a condition to transfer valuable knowledge into the host country. This occurs in the case of GDiv and GInd subsidiaries. In contrast, when subsidiaries are dependent on the MNE group, they seem less likely to develop dense networks at the local level, leading these types of subsidiaries to be considered as dead-ends in the global knowledge pipeline. Finally, GIso subsidiaries tend to behave in isolation also at the local level, not representing a valuable source of knowledge for other firms in the host country.

The findings of this work also have several interesting implications, more in general, on the issue of innovation in MNEs subsidiaries. More specifically, we have provided arguments and empirical evidence that contribute to understanding reasons that could explain the underlying heterogeneity of innovative activity by the MNE subsidiaries in host industrialising countries. First, we have shown that the intensity and nature of global linkages is associated with the intensity of innovative activity of subsidiaries. This is a very well-known fact in the industrialised world (e.g. Ahuja, 2000). However, it has been less studied in the case of firms operating in industrialising countries and even less in the case of subsidiaries of MNEs in these types of countries. Second, we have raised a set of new interesting questions about the influence of different MNEs' typologies on the formation of local knowledge linkages — an issue that remains open for investigation, but that may provide an important contribution to the literature on the FDI and knowledge spillovers.

Finally, this analysis was set within specific empirical and methodological limits. The first is that, this study has not directly tested the relationship between the four different types of subsidiaries and the generation of spillovers. Instead, it has looked at the factors that are associated with the presence of knowledge spillovers: the innovative activities of the subsidiaries and their knowledge linkages in the host country. This is an issue that we are going to explore in future research. The second limitation is related with the qualitative analysis, and refers to the fact that the four case studies used in this analysis were selected among a number of MNE subsidiaries on the basis of the quality of the information collected, which allowed the behaviour of each type of subsidiary to be illustrated in detail and in a complementary way to the statistical analysis. For this reason, the selection was done *ad hoc* and only provides anecdotal evidence to illustrate how MNE subsidiaries may differ in terms of their internal operations, and in this specific case, in terms of the key variables explored: global linkages, innovative activity and local linkages. Finally, in relation with the quantitative part, it should

be borne in mind that our analysis has not explored in detail the influence of industry effects on the behaviour of MNE subsidiaries. This relationship, as shown in Table 6.2 of this chapter, is not so strong as to affect our results. Nevertheless, there is some kind of weak association between our typology of subsidiaries and the type of industry present in the data. In consequence, this is an aspect that could be analysed in more detail in future research.

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Appendix: Indicators of Global and Local Linkages

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

- Question (1): Main sources of information for innovation activities
  The survey asked firms about the importance of alternative sources of information for innovation activities. They had to rank each source according to its importance for the firms. The possible importance varies from 1 (no importance) to 4 (very important source). Headquarters and other subsidiaries were 2 options among 11 possible sources offered by the survey. Others included: internal sources, public institutions, competitors, suppliers, consultants, journals, conferences, etc.
- Question (2): Knowledge Interactions with other agents
  Firms were asked: first, whether they used knowledge interactions with any of the 11 types of organisations for their current activities: (a) Universities,

(b) Technology Research Centres, (c) Laboratories, (d) Institutions of Technological Co-operation, (e) Suppliers, (f) Clients, (g) Headquarters, (h) Other subsidiaries, (i) Competitors, (j) Consultants and (k) Public Agencies. Second, they were asked to indicate the geographic area where the identified organisations were located. They were given the following options: (1) Local, (2) Regional, (3) National, (4) Latin-America, (5) The European Union, (6) USA or Canada, (7) Asia and (8) Others.

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

Indicator of Global Linkages

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

First, we selected those sources/agents from Questions (1) and (2) that coincide. In this way we combine the information contained in Question (1), about the importance of the source/linkage, and the information contained in Question (2), about the localisation of the linkage/interaction. So we end up working only with seven possible agents/sources: (1) Headquarters, (2) Other subsidiaries, (3) Clients, (4) Competitors, (5) Suppliers, (6) Consultants, (7) Public agencies.
Second, we eliminated those sources that did not come from foreign countries in Question (2) (i.e. the ones that have not indicated this specific source to come from either the Region, Latin America, European Union, USA or Canada, Asia, Others).
Third, we created **(var A) by** adding up, by subsidiary, the number of international linkages/sources mentioned in Questions (1) and (2).
Finally, we calculated the indicator of 'Global Linkages' as the product of the number of international linkages/sources (**var A**) and the importance of each possible source/linkage, which according to Question (1) could vary from 1 to 4. Accordingly, the value of 'Global Linkages' of firm *x* ranges from 0 to $(7 \times 4) = 28$ (seven, is the maximum number of global linkages that the subsidiaries might have.

Then, we classified the firms into four groups.

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

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

Indicator of Local Linkages

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

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Impact on Home Competitiveness

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Chapter 7

The Impact of Knowledge Transfer on MNEs' Parent Companies. Evidence from the Italian Case

Lucia Piscitello and Larissa Rabbiosi

Abstract

This paper investigates the following research questions: (i) does the occurrence of knowledge transfer from foreign subsidiaries to parent companies (RKT) affect the receiving units' innovativeness? (ii) How and to what extent does the use of different knowledge transfer mechanisms affect the receiving units' innovativeness? We resort to econometric analyses of 84 Italian multinational corporations and their relevant 307 foreign subsidiaries. Empirical findings confirm that RKT positively affects the parent company's innovativeness. Moreover, subsidiary's knowledge transferred through person-based mechanisms exhibits a stronger positive impact on the parent company's innovativeness than knowledge transferred through ICT and written mechanisms.

1. Introduction

Over the last decades, there has been an upsurge of interest in the importance of knowledge management in multinational enterprises (MNEs) as a crucial source of strategic competitive advantage. This is reflected in the conceptualization of the modern MNE within the 'geocentric' (Perlmutter, 1969), 'heterarchical' (Hedlund, 1986), and 'transnational' (Bartlett & Ghoshal, 1989) models. Indeed, the very reason why MNEs exist and succeed is that they are efficient vehicles

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for creating and transferring knowledge across borders (Birkinshaw, Hood, & Jonsson, 1998; Gupta & Govindarajan, 1991; Kogut & Zander, 1992).

Increasing work has been devoted to the analysis of changes in the MNEs' structure, and to the relevant changes in knowledge flows direction (Gupta & Govindarajan, 2000; Pearce, 1999): MNEs undertake foreign direct investm ents (FDIs) not only to exploit their ownership advantages abroad, but also to tap into local sources of excellence, thus augmenting their existing stock of knowledge (Cantwell, 1995; Fors, 1997; Kuemmerle, 1999). Therefore, although the parent company continues to serve as the most active creator and diffuser of knowledge within the corporation, foreign subsidiaries may also engage in knowledge transfer (KT) with both their internal and external networks (Frost, 1998; Håkanson & Nobel, 2000, 2001). Empirical research has investigated many aspects of such a process, namely: (i) how KT occurs within the MNEs, generally looking at control and communication mechanisms (Criscuolo & Narula, 2005; Egelhoff, 1988; Gupta & Govindarajan, 1991, 2000; Nobel & Birkinshaw, 1998); (ii) how KT depends on the characteristics of knowledge, knowledge sources, knowledge senders, knowledge receivers, their relationships, etc. (for an exhaustive survey, see Minbaeva, 2005); and (iii) how KT affects the MNE's performance and innovativeness (Ambos, Ambos, & Schlegelmilch, 2006; Frost, 1998; Iwasa & Odagiri, 2004; Persaud, 2005; Subramaniam & Venkatraman, 2001; Yamin & Otto. 2004). However, we still have a limited understanding of the following.

- How and to what extent the use of different mechanisms for transferring knowledge affects the receiving unit's innovativeness?
- How MNEs transfer and integrate foreign competences within their knowledge base in order to improve their innovativeness?

Within this context, the paper aims at investigating the role of KT from foreign subsidiaries to their parent companies (reverse knowledge transfer — RKT), and the ability of the parent company to integrate and convert such knowledge in innovativeness. Specifically, the purpose is twofold:

(1) to detect whether the occurrence of RKT affects the parent company's innovativeness;
(2) to evaluate if and how the use of different mechanisms for transferring knowledge differently, influences the parent company's innovativeness.

In order to fulfill these objectives, we developed an empirical analysis based on 307 parent company-foreign subsidiary pairs. Data collection was based on face-to-face structured interviews with 84 Italian MNEs, and the key respondents to the questionnaire were the parent company's top managers.

It might not be out of place here to specify that (a) according to Amit (1993, p. 35), we mean knowledge as a set of know-how and capabilities that "refer to a firm's capacity to deploy resources, usually in combination, using organizational processes, to effect a desired end. They are information-based, tangible or intangible processes that are firm specific and are developed over time through complex interactions among the firm's resources"; therefore, we identify knowledge that exists in the subsidiary in the form of know-how, such as product design, business practices, quality issues, distribution expertize, customer handling, and so on; (b) according to Szulanski (1996, p. 28), the concept of knowledge transfer "connotes the firm's replication of an internal practice that is performed in a superior way in some part of the organization and is deemed superior to internal alternate practices and known alternatives outside the company"; (c) the word 'transfer' emphasizes the movement of knowledge within the organization, and this movement may take place through the MNE in at least five different forms (Gupta & Govindarajan, 2000): (i) flows from parent company to subsidiaries, (ii) flows from subsidiaries to parent company, (iii) flows from local environment to subsidiary, (iv) flows from subsidiary to local environment, and (v) flows to peer subsidiaries. It is therefore worth highlighting that we focus on case (ii) and following previous approaches (Foss & Pedersen, 2002; Gupta & Govindarajan, 2000), we mean RKT as the use of the foreign subsidiary's knowledge by the parent company.

The rest of the chapter is organized as follows. In the next section, we review prior literature on KT and competitive advantage, and we put forward our hypotheses. Section 3 describes the database RITMO (Research on Innovation and Technology in Multinational Organizations), and discusses the econometric analysis. Section 4 concludes the chapter.

2. The Changing Role of Subsidiary, Knowledge Transfer and Innovativeness: The Hypotheses

2.1. Subsidiary Knowledge, Knowledge Transfer and Innovativeness

Within the traditional approaches to the firm's multinational growth (Buckley & Casson, 1976; Caves, 1974; Dunning, 1992; Hymer, 1960; Vernon, 1966), firms going abroad must possess ownership advantages (like technological knowledge, brand name, capital and organizational capabilities) allowing them to overcome their "liability of foreignness". MNEs undertake the FDIs to exploit abroad their knowledge-based assets developed at home. However, most recent approaches highlight that the firms' international growth might be considered not only as a

consequence of their endowment of exclusive advantages exploitable also on foreign markets, but also as a means to access new competitive resources and competences. In other words, as clearly explained by the seminal work of Bartlett and Ghoshal (1989), innovations can be developed on a joint basis, at both headquarters and subsidiary level, thanks to the integration of resources and capabilities of diverse worldwide units within the MNE. The re-assessment of the role played by foreign subsidiaries emphasize their ability to create an interface between the major localized knowledge and the internal network (Birkinshaw, 1996; Enright, 2000; Sölvell & Birkinshaw, 2000; Sölvell & Zander, 1998). Accordingly, foreign subsidiaries can themselves enhance the innovativeness of their corporate group. In particular, qualitative differences in the characteristics of the foreign subsidiary might have different implications in the MNE creation and development of new knowledge (Cantwell & Mudambi, 2005).

The idea that MNEs might enjoy the important advantage of accessing country- and firm-specific knowledge available in multiple locations, has stimulated research on the process through which knowledge is managed by and within the MNE, and how this affects its innovativeness, productivity, and competitive advantage (Chakravarthy, McEvily, Doz, & Rau, 2003; Grant, 1996). In particular, several studies have addressed the impact of the access to new knowledge developed by other units on the changes observed in performance of the receiving unit.[1] From a theoretical point of view, the literature on KT in MNEs has implicitly (positively) related it to the ability to integrate new geographic dispersed competences and knowledge in the existing knowledge base, that consequently fosters technological and managerial innovation and creates synergies that can significantly leverage the MNE's competitive advantage (Bartlett & Ghoshal, 1989; Cantwell, 1995; Gupta & Govindarajan, 2000; Hedlund, 1986; Kogut & Zander, 1992).

Accordingly, empirical evidence has variously shown that the impact of KT on specific MNEs' activities is strictly connected to their ability to perform well. Generally, relying on the patent citations analysis, where citations are interpreted as knowledge flowing from the inventor/applicant of the cited document to the inventor/applicant of the citing one (Jaffe, Trajtenberg, & Henderson, 1993), these studies show that MNEs appear to be more innovative, thanks to the subsidiaries' access to a larger stock of ideas and to the extent that they are

[1]See for example, Darr, Argote, and Epple's (1995) findings on changes in productivity of fast food stores due to the experience of the other stores in their franchise, the study of Baum and Ingram (1998) on effects on hotels' survival due to the experience of other hotels in their chain, Mansfield (1984) that highlighted changes in manufacturing productivity due to the used of technologies utilized by other connected plants.

able to draw upon knowledge pool in their local environment (Almeida, 1996; Almeida & Kogut, 1999; Frost, 1998). Foreign affiliates, transferring knowledge to their parent companies and sister units, become a conduit for technological diffusion of localized knowledge (Håkanson & Nobel, 2000, 2001), thus contributing to the receiving unit's innovativeness (Ambos et al., 2006; Frost, 1998; Iwasa & Odagiri, 2004; Persaud, 2005; Subramaniam & Venkatraman, 2001; Tsai, 2001; Yamin & Otto, 2004). The following hypotheses can thus be formulated:

HP1: Knowledge transfer from the foreign subsidiary to the parent company (RKT) is positively related to the parent company's innovativeness.

2.2. Mechanisms for Transferring Knowledge and Innovativeness

Organizational theory suggests that the effectiveness of KT relies on mechanisms through which knowledge is managed and transferred within the organization (Argote, 1999). With reference to the MNE, the literature has variously emphasized the role of formal organizational structures generally based on control mechanisms (Nohria & Ghoshal, 1994; O'Donnell, 2000) as well as the role of communication and coordination mechanisms (Gupta & Govindarajan, 2000; Pedersen, Peterson, & Sharma, 2003). However, although these studies give us a clear picture of which organizational design can enhance the transfer of knowledge within MNEs, they do not conclusively address which mechanisms (or combinations of them) could strengthen the impact of KT on the receiving unit's innovativeness.

The social capital theory suggests that MNE integration needs inter-firm and intra-firm linkages that facilitate knowledge sharing and transfer (Nahapiet & Ghoshal, 1998). Specifically, person-based mechanisms, such as inter-unit trips and visits, international committees, teams, task forces, and training involving participants from multiple units, facilitate the development of interpersonal ties in the MNE, thus favoring KT (Björkman, Barner-Rasmussen, & Li, 2004; Bresman, Birkinshaw, & Nobel, 1999; Edwards & Ferner, 2004; Ghoshal, Korine, & Szulanski, 1994; Gupta & Govindarajan, 2000; Håkanson & Nobel, 2001; Pedersen et al., 2003; Persson, 2006). The efficient sharing of tacit knowledge is typically characterized by tight coupling between people from different MNE's units, and to enhance this transfer it is important that each person involved know each other beforehand (Bresman et al., 1999). Moving members is generally seen as a powerful mechanism for facilitating the transfer of both tacit and codified knowledge within organizations. The transfer of knowledge through moving technology has been shown to be more effective when it is

accompanied by moving personnel (Galbraith, 1990; Zander & Kogut, 1995). Therefore, the movements of people, routines or technologies become predominantly complementary rather than substitutes (Argote & Ingram, 2000).

Knowledge can be transferred also by written media as reports, publications, written instructions, and blueprints (Pedersen et al., 2003), as well as by ICT-based mechanisms (Howells, 1995; Persaud, 2005; Sambharya, Kumaraswamy, & Banerjee, 2005). The role of ICT and effects of ICT in KT has also been celebrated as fundamental in the international transfer of knowledge (Almeida, Song, & Grant, 2002). Likewise, the use of ICT-based mechanisms, enabling communication among managers from different countries, and assisting the integration of diverse insights in the MNE, across time and space, enhances knowledge creation and positively affects the MNE's performance (Andersen & Foss, 2005). Nevertheless, recent empirical evidence indicates that 'codified communication' based on impersonal source such as publications and reports, database or firm's extensive intranet, is a much less effective way of transferring knowledge than the 'personal communication' (Buckley & Carter, 2004; Cross & Sproull, 2004, Haas & Hansen, 2005). The transfer of knowledge through ICT and documents works only when supplemented by more complex mechanisms that allow for the exchange of qualitative, indefinite, and uncertain knowledge, such as frequent direct contacts between people belonging to the different MNE's units (Almeida, Anupama, & Grant, 2003).

Mechanisms such as intranet, e-mail, file transfer, database, and reports, can efficiently transfer codified knowledge about products, operations, tangible assets, and so on (Daum, 2003). The transfer of such knowledge mainly stimulates exploitation processes, increasing the overall efficiency in the receiving unit (Nonaka, Reinmöller, & Toyama, 2001). However, ICT and written mechanisms do not allow for the additional transfer of tacit and experience-based knowledge critical to enhance new knowledge combinations. The 'rich' communication media[2] may overcome the limits of electronic media (Daft & Lengel, 1986). Thus, the following hypotheses can be formulated:

> **HP2:** The effect of RKT on the parent company's innovativeness is greater when it occurs through person-based mechanisms than through ICT-written mechanisms.

[2]"Information richness is defined as the ability of information to change understanding within a time interval. Communication transactions that can overcome different frames of references or clarify ambiguous issues to change understanding in a timely manner are considered rich. Communications that require a long time to enable understanding or that cannot overcome different perspectives are lower in richness. In a sense, richness pertains to the learning capacity of a communication. Communication media vary in the capacity to process rich information" (Daft & Lengel, 1986, p. 560).

3. Empirical Analysis

3.1. The RITMO Dataset

Data has been gathered through face-to-face structured interviews. The key informants were the parent company's top managers, variously titled as president, managing director, or general manager.

The following steps guided the development of the questionnaire submitted during the interview. First, in order to understand and clarify the phenomenon of interest, we chose to use a case-study methodology; accordingly, we conducted interviews with top managers in four Italian MNEs.[3] Second, we reviewed previous research to sharpen our research questions and to choose, wherever possible, measures that would appropriately capture the constructs under study. Finally, we pre-tested the questionnaire for clarity and relevance with academics and through face-to-face interviews with some parent companies' top managers. These interviews helped to refine the research instrument and to realize how managers understand the concept of knowledge transfer, what is knowledge for them, and the meaning to them of different mechanisms utilized for transferring knowledge. The diverse answers allowed us to develop some examples that we used for the purpose of illustration during the interviews to foster a better understanding of the respondents.

In December 2004, we began the data-collection process by contacting parent companies' top managers through telephone and by sending them a personalized letter with the description of the project, the assurances regarding the confidentiality of collected data and a formal request for a face-to-face interview. The sample of parent companies to address was drawn from the Database Reprint[4] that provides the picture of foreign activities of the Italian firms as at the beginning of 2004. Then, out of the population of 2343 Italian MNEs operating into manufacturing industry, we

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[3]These firms operate in medium- and high-technology-intensive-sectors (such as chemical, biomedical, synthetic fiber, and automotive components) and they have production and R&D facilities in several countries all over the world. The reason to start the process with these firms had to do with the fact that we had strong *a priori* expectations of them being involved in RKT. Accordingly, we found that these firms would serve as a good benchmark in the subsequent analysis of the wider sample.

[4]The Dataset Reprint is developed and updated annually at Politecnico di Milano (Mariotti & Mutinelli, 2005). It provides a census of the Italian firms with foreign activities from the beginning of 1986 to the beginning of 2004, and the information available are the following: (i) corporate name and address of the head office, for both the Italian parent companies and their foreign affiliates; (ii) the code of the industrial activity, and other relevant economic variables (the dimensional class in terms of employees and turnover) for the Italian parent companies; and (iii) the year and the type of participation in each foreign affiliate participated by Italian firms (e.g. *greenfield* vs. acquisition, wholly/control/minority ownership).

contacted only those with at least one majority-owned subsidiary located in advanced countries and involved in "primary upstream activities" such as R&D and/or manufacturing. Additionally, we excluded the very small Italian MNEs (those with less than 50 employees). Therefore, our population consisted of 358 Italian MNEs.

The interviews, which lasted 120–180 min each, were conducted in February–June 2005. During the interviews, the respondents went through a pretested questionnaire and notes were taken by two interviewers to ensure accurate recording of the responses. While the structured questionnaire was important for making comparisons across the parent company-foreign subsidiary pairs, a significant strength of the 'face-to-face survey' was that each questionnaire's answer was clarified by the respondent with detailed information and examples. In order to minimize response bias, the participants were interviewed at their office, wherever localized in Italy.[5] Such a process allowed the construction of the RITMO database, the first dataset that provides primary information on Italian MNEs, their foreign subsidiaries' technologies and competences, organizational mechanisms employed in RKT, and the effects of RKT on the parent company's innovativeness.

Our final sample consisted of 84 Italian MNEs (corresponding to a response rate of about 24 percent), and their relevant 350 foreign subsidiaries located in about 48 countries.

The sampled firms operate in diverse industries (food products, industrial machinery, computers, telecommunications, pharmaceuticals, auto vehicles, chemicals, electronics, consumer durables, consumer nondurables, etc.); they vary also by size, stage of internationalization, growth strategies, and so on. Concerning non-response bias, we compared the two subsets of respondents and non-respondents in terms of size (class of number of employees), sectors, and area of location of the parent company in Italy (see Table 7.A.1, in Appendix). Regarding size and parent company's location area, no statistically significant differences between respondents and non-respondents were found, with the exception of firms with 500–5000 employees that are overrepresented in our sample and parent companies located in central regions that are underrepresented. The two groups differ in terms of sector: our sample is overrepresented by science-based and specialized supplier firms and underrepresented by traditional firms (or 'supplier dominated', see Pavitt, 1984). One reason for the small number of firms in the supplier dominated sector could be that most of the MNEs investing abroad in that sector, do not consider the possibility to transfer back knowledge from their subsidiaries, an important issue. This consideration could have

[5]Instead of running the interviews at the University, we chose to directly visit firms' top managers to their offices in order to avoid a greater likelihood of the participation of those located closer to the University in the project.

prevented their interest in participating in the RITMO project. Indeed, during the first phone conversations with firms in the traditional sectors this reason for not wanting to participate was confirmed.

3.2. Econometric Model

The empirical analysis is organized on two levels. First, through a simple probit analysis, we investigate whether specific typologies of foreign subsidiaries are likely to affect the parent companies' innovativeness. In particular, we test if the occurrence of RKT enhances the subsidiaries impact on their parent companies' ability to innovate. In the second step, through an ordered probit model run on the subset of the parent company–foreign subsidiary dyads where RKT occurred, we analyse how different mechanisms utilized for transferring knowledge, act to foster the parent companies' innovativeness.

The data are drawn from the 350 parent company–foreign subsidiary dyads sampled in the RITMO database. Specifically, in order to estimate the econometric models[6] properly, we had to drop all the observations with missing values;[7] thus, the final usable sample consists of 307 observations (parent company–foreign subsidiary dyads).

In order to test our first hypothesis, we define the dependent variable INNOVATIVENESS. For each parent company–foreign subsidiary pairs, INNOVATIVENESS equals 1 if the respondent has indicated that the foreign subsidiary induced some kind of positive effect on the parent company R&D activities, and zero if the parent company's R&D has not been influenced at all by the subsidiary. In our data, 49.2% of the foreign subsidiaries participated at the improvement of their parent companies' innovative activities, while 156 subsidiaries out of 307 did not impact the parent companies' INNOVATIVENESS.

In the second step of the analysis, focussing on the subset of parent company–foreign subsidiary dyads where RKT occurred,[8] we define the dependent variable INNOVATIVENESS-DEGREE. Specifically, we asked the respondent to rate — on a 7-point Likert scale, where 1='no impact at all'; 7='a very high positive impact' — the extent to which the knowledge transferred from the subsidiary to the parent firm affected the latter's innovative activities. In order to reduce complexity in the

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[6]STATA8 has been used as econometric software package.

[7]In some cases the respondents did not answer to one or two single questions, usually due to the impossibility of disclosing precise information. This lack of data has generated about 43 missing values.

[8]It might be useful to clarify that we found that some kind of knowledge was actually transferred from 88 subsidiaries (corresponding to about the 29% of the total number of foreign subsidiaries) to their relevant 45 Italian parent companies (54%).

interpretation of results, we moved from a 7-point scale to a 3-point scale; namely, if the parent company does not acknowledge any effects due to the knowledge transferred, the variable takes the value 0; when the RKT's impact on the parent company's ability to innovate is low or medium-low (scores from 2 to 4), the variable takes the value 1; when that impact is medium-high or high (scores from 5 to 7), our dependent variable equals 2.

As far as the occurrence of RKT is concerned, following previous approaches (e.g. Gupta & Govindarajan, 2000), we consider the use of a foreign subsidiary's set of know-how and capabilities by the parent company. In particular, the dummy variable RKT equals 1 if any subsidiary's knowledge/competence (in R&D, manufacturing, marketing and sales, logistic and distribution, purchasing, human resource management, general management, and quality management), has been used by the parent company.

In order to disentangle whether other specific foreign subsidiary's characteristics affect the parent company's innovativeness, we define the following variables. First, to account for the fact that the traditional subsidiary role of adopting technology transferred from the parent company could actually be displaced by the creation and development of local technological competences complementary to the rest of the MNE (Bartlett & Ghoshal, 1989; Birkinshaw, 1996; Gupta & Govindarajan, 1991; Kuemmerle, 1997), we build the dummy variable COMPETENCE CREATING. This variable equals 1, if the parent company acknowledged such a role to the subsidiary and 0, when the subsidiary had a competence-exploiting role. Specifically, the respondents were asked to indicate (1 = yes, 0 = no) whether 'the foreign subsidiary *j* has introduced to the MNE new and/or better technology and/or technological competence' (product know-how, process know-how, etc.). This measure achieves our intention of recording those subsidiaries that were competence-creating and recognized by the parent company.[9] As far as firm size is concerned, it has been widely recognized as an important factor in explaining innovative performance (e.g., Geroski, 1990). Therefore, we control for the RELATIVE SIZE as measured by the difference between the natural logarithm of the subsidiary's number of employees and the natural logarithm of the MNE's number of employees, as in 2004.

The literature has shown that the level of the MNE integration in terms of trust as well as of system embeddedness is likely to increase significantly over time; consequently, we control for the foreign investment's age. Specifically, FDI_AGE is calculated as the difference between the current year (2004) and the year when

[9]Researchers have also measured the subsidiary's role comparing the overall knowledge inflow and outflow from subsidiaries (e.g. Chini, 2004). However, this operationalization is not applicable here, because we consider only the subset of parent company–foreign subsidiary pairs where RKT occurred.

the subsidiary became a part of the Italian MNE. We also control for the entry mode: although acquisitions and joint ventures have been traditionally seen as a common way the MNE may adopt to access local competencies and skills (Bresman et al., 1999; Kogut & Zander, 1993; Lane, Salk, & Lyles, 2001; Simonin, 1999), empirical studies also found that the incidence of technology transfer from subsidiaries to parent companies is higher for greenfield subsidiaries than for acquisitions (Frost, 1998; Zhou, 2002). Therefore, we built the following dummy variables: ACQUISITION, GREENFIELD, and JV.

As far as mechanisms for transferring knowledge — KT mechanisms — are concerned, we include eight dummy variables, each pertaining to a different mechanism through which knowledge can be transferred. Specifically, they refer to: FORMAL COMMITTEES, VISITS/MEETINGS, TEAM WORK, MANAGERS' TRANSFER, PROFESSIONALS' TRANSFER, REPORTING SYSTEM, MANUAL/DATABASE EXCHANGE, and corporate INTRANET. The less utilized was instead the use of corporate intranets (13.6%). Further, we considered also the use of ICT and written media as KT mechanisms (see, Persaud, 2005 and Haas & Hansen, 2005), while researchers interested in studying KT in MNEs, do not usually take them into account, although researchers have recognized electronic media as a crucial topic (e.g. Gupta & Govindarajan, 2000).

Finally, to avoid picking up spurious effects it is important to control for other likely predictors of the parent company's innovativeness. In particular, we control for the industry, as foreign subsidiaries operating in different industries may be facing different technological opportunities to enhance knowledge creation and development. Therefore, using the taxonomy developed by Pavitt (1984), we define the dummy HIGH-TECH that equals 1 if the subsidiary operates either in science-based or specialized suppliers sectors. In order to control for region-specific effects, we inserted the dummy variable ADVAREA that equals 1 if the foreign subsidiary is located in an OECD[10] country, and 0 otherwise.

Table 7.1 shows descriptive statistics for all the explanatory variables.

4. Empirical Findings and Discussion

Results from the econometric estimations are reported in Tables 7.2 and 7.3, while — for the sake of space — the relevant marginal effects[11] are reported in

[10]Unfortunately, our sample census only one FDI located in Japan.

[11]The marginal effect for dummy variable is calculated by comparing the probabilities that result when the variable takes its two different values with those that occur with the other variables held at their sample means (see, for details, Greene, 2000).

Table 7.1: Descriptive statistics.

Variable	Observations	Mean	Standard deviation	Variable typology
Reverse knowledge transfer				
RKT	307	0.287	0.453	Binary variable
Subsidiary's characteristics				
Competence-creating	307	0.345	0.476	Binary variable
Relative size	307	−3.116	1.330	Continuous variable
FDI-age	307	9.531	6.949	Discrete variable
Acquisition	307	0.557	0.498	Binary variable
jv	307	0.104	0.306	Binary variable
KT mechanisms[a]				
Formal committees	88	0.398	0.492	Binary variable
Visits/meetings	88	0.875	0.333	Binary variable
Team work	88	0.659	0.477	Binary variable
Managers' transfer	88	0.545	0.501	Binary variable
Professionals' transfer	88	0.284	0.454	Binary variable
Manual/database	88	0.341	0.477	Binary variable
Report system	88	0.295	0.459	Binary variable
Corporate intranet	88	0.341	0.477	Binary variable
Industry and geographic characteristics				
High-tech	307	0.365	0.482	Binary variable
Advarea	307	0.687	0.464	Binary variable

[a]Descriptive statistics calculated on the subset of parent company–foreign subsidiary pairs, where KT occurred.

the appendix, Table 7.A.2 and 7.A.3. Numbers in parentheses represent standard errors. In order to obtain robust variance estimates, the Huber/White/sandwich estimator of variance is used in place of the traditional calculation. Likewise, we correct the estimated standard errors and the variance–covariance matrix of the estimators for the fact that the observations are independent across MNEs, but not necessarily within the MNE. In other words, we control for observations of parent–subsidiary dyads belonging to the same MNE that are not expected to be independent, although they must be independent between different MNEs.[12]

[12]This correlation is due to unobserved MNE-specific effects that influence the overall occurrence of RKT in the parent–subsidiary dyad.

Table 7.2: Subsidiary effect on parent company's innovativeness: The role of RKT.

Variable	**Model 1**
Reverse knowledge transfer	
RKT	0.832 (0.384)**
Subsidiary's characteristics	
Competence-creating subsidiary	0.711 (0.279)**
Relative size	−0.057 (0.101)
FDI-age	0.044 (0.017)**
Acquisition	−0.535 (0.244)**
Jv	−0.106 (0.340)
Industry and geographic characteristics	
High-tech	0.594 (0.323)*
Advarea	−0.272 (0.226)
Observations	307
Wald χ^2	35.05***
Log pseudo-likelihood	−169.753

*$p < 0.10$; **$p < 0.05$; ***$p < 0.01$. Probit regressions, heterogeneity robust, and cluster estimation.

Our hypotheses, put forward in Section 2, seem to be generally confirmed. In particular, as far as Hypothesis 1 is concerned, the estimated coefficient in Model 1 strongly supports it: the variable RKT is positive and significant at $p < 0.05$. It is also worth observing that the estimation obtained for coefficients of the other variables (Model 1) identify specific characteristics of foreign subsidiaries that mediate their impact on parent companies' innovativeness. In particular, the impact induced by the foreign subsidiary on the dependent variable INNOVATIVENESS is stronger when the subsidiary operates in high-technology sectors, as shown by the coefficient of the variable HIGH-TECH that is positive and statistically significant at the conventional level ($p < 0.1$). As captured by the variable FDI-AGE ($p < 0.05$), a longer experience of the parent company with the foreign subsidiary enables the parent to learn the availability of subsidiary's knowledge and technological resources, and to establish mechanisms generally based on trust and personal reciprocity that help the exploitation of that knowledge. The negative and significant ($p < 0.05$) coefficient of the dummy ACQUISITION suggests that newly established foreign subsidiaries appear to be more relevant in affecting their parent companies' innovativeness compared to the

Table 7.3: KT mechanisms and parent company's innovativeness.[a]

Variable	Model 2	Model 3
KT mechanisms		
Formal committees	−1.112 (0.383)***	
Visits/meetings	0.677 (0.341)**	0.815 (0.332)**
Team work	1.126 (0.459)**	1.123 (0.439)**
Managers' transfer	0.388 (0.357)	0.491 (0.357)
Professionals' transfer	−0.073 (0.484)	−0.306 (0.446)
Manual/database exchange	−0.198 (0.475)	−0.212 (0.466)
Reporting system		−0.938 (0.541)*
Corporate intranet	0.843 (0.443)*	1.087 (0.568)*
Subsidiary's characteristics		
Competence-creating subsidiary	1.220 (0.501)**	1.057 (0.520)**
Relative size	−0.114 (0.141)	0.011 (0.145)
FDI-age	0.057 (0.027)**	0.035 (0.026)
Acquisition	−0.244 (0.406)	−0.587 (0.439)
Jv	0.384 (0.955)	−0.205 (0.916)
Industry and geographic characteristics		
High-tech	0.820 (0.396)**	0.886 (0.465)*
Advarea	−0.311 (0.421)	−0.099 (0.429)
Observations	88	88
Wald χ^2	59.82***	60.37***
Log pseudo-likelihood	−55.354	−57.816

*$p < 0.10$; ** $p < 0.05$; *** $p < 0.01$. Ordered probit regressions, heterogeneity robust and cluster estimation.

[a]Estimates calculated on the subset of parent company–foreign subsidiary pairs, where KT occurred.

acquired subsidiaries.[13] Although the acquisition may provide new technological capabilities for the MNE, the parent company might not be willing, or able, to use them. Additionally, communication and integration between parent company and acquired subsidiaries may be less dense than that between parent and greenfield subsidiary. RKT from greenfield subsidiaries may be easier than that from acquired subsidiaries, also due to the cumulativeness and the path dependency characteristics of knowledge (Nelson & Winter, 1982). In fact, as existing

[13]Using a patent citation analysis on U.S. patent data, Zhou (2002) finds similar results on the effect of acquisition on knowledge flows from foreign subsidiary to parent firms.

knowledge is the base to develop new ideas, and as new knowledge depends upon knowledge available in the previous period, parent firms may face difficulties to understand and transfer knowledge of their acquired subsidiary.

It has been suggested that there is qualitative difference in the nature of competence-creating and competence-exploiting subsidiaries (Cantwell & Mudambi, 2005), and accordingly they are expected to affect differently the effect induced by the foreign subsidiary on the parent company's innovativeness. The coefficient of COMPETENCE-CREATING is positive and statistically significant ($p < 0.05$), supporting the idea that competence-creating subsidiaries are likely to possess high–quality, knowledge-based resources, and they contribute to introduce distinctive knowledge, which is new to the parent company.

We do not find any support for the parent company's innovativeness from the other control variables.

In order to test Hypothesis 2, i.e. to what extent the use of different KT mechanisms affects the impact of RKT on the parent company's innovativeness, the models have been run only on the subset of foreign subsidiaries (88 out of 307) responsible for any sort of RKT, and the dependent variable is INNOVATIVENESS-DEGREE.

As the correlation matrix (see Table 7.A.4, in the appendix) shows, the two variables FORMAL COMMITTEE and REPORTING SYSTEM are highly correlated (0.54, $p < 0.01$), and further investigations revealed that they suffer from multicollinearity problems.[14] Therefore, following a classic approach for dealing with problems of multicollinearity (Kennedy, 1998), we present the Models 2 and 3 (Table 7.3) in which: (i) FORMAL COMMITTEE is included, but REPORTING STSTEM is not and (ii) REPORTING SYSTEM is included, but FORMAL COMMITTEE is not.

The results show that only selected KT mechanisms, such as TEAM WORK ($p < 0.05$), VISITS/MEETINGS ($p < 0.05$), and CORPORATE INTRANET ($p < 0.1$) are individually effective channels to transfer knowledge. They are effective in the sense that knowledge transferred through these mechanisms induce a greater positive impact on the parent company's innovativeness. In fact, the use of unsuitable transfer mechanisms may cause loss of knowledge in the transmission process or may induce high communication costs (Pedersen et al., 2003) that consequently reduce the possible exploitation of knowledge transferred.

We found a partial support for Hypothesis 2. The results show that the transfer of knowledge through visits/meetings and teamwork has a stronger positive effect on the parent company's ability to improve its innovative activities. However, the transfer of knowledge through formal committees appears inefficiently: the

[14]Although REPORTING SYSTEM and CORPORATE INTRANET are fairly correlated (0.59), further investigations do not reveal any problems of multicollinearity.

coefficient of FORMAL COMMITTEES is negative and statistically significant at $p < 0.01$. The coefficients of the other person-based mechanisms come out to be not statistically significant at any conventional level.

Concerning the use of written media for transferring knowledge, the coefficient of MANUAL/DATABASE EXCHANGE comes out being not statistically significant at any conventional level. On the contrary, the results seem to suggest that when RKT occurs through ICT-based mechanisms, it has some effect on the parent company's innovativeness. The variable REPORTING SYSTEM ($p < 0.01$) presents a negative and significant coefficient, meaning that it is ineffective as a means for transferring knowledge.

The above results suggest further considerations. First of all, the use of person-based mechanisms appear to be more likely to affect the parent company's innovativeness than the use of ICT-written mechanisms. However, it is important to recognize that a *selective* use of KT mechanisms can be observed. As far as the person-based mechanisms are concerned, competences transferred through face-to-face visits are valuable sources of innovation, teamwork appears to be a crucial way of combining in a new manner different skills and knowledge that hitherto existed separately, allowing the creation of unique resources that enhance innovativeness. Instead, too formal structures could slacken and harness the opportunity of the parent and the subsidiary company to learn from each other. With respect to this, it is interesting to note a similar negative effect of RKT through formal committee and reporting systems on the parent company's innovativeness.

On the other hand, subsidiary's knowledge transferred through corporate intranet is likely to be used by the parent company to improve and develop its innovative activities; nevertheless, the exchange of manuals, blueprints, and databases does not directly affect the parent company's innovativeness.

5. Concluding Comments

This study contributes to the research on the relationship between knowledge transfer and MNE's innovativeness. As far as we know, it is among the first studies attempting to explore empirically, the consequences upon the parent company's innovativeness of the transfer of subsidiary's knowledge. Specifically, our aim was threefold: to detect whether the foreign subsidiaries play a positive role affecting the parent company's innovativeness; to detect whether that positive relationship is associated to the occurrence of RKT (knowledge transfer from the foreign subsidiary to the parent company); to evaluate if and how the use of different mechanisms for transferring knowledge differently affects the parent company's R&D activities.

We argued that the multinationality improves the parent company's innovativeness and that mainly occurs through RKT. This provides further evidence on recent developments in the IB field, where the creative role of foreign subsidiaries is increasingly taken into account when assessing the competitive advantage of the MNE as a whole.

Moreover, we argue that how the knowledge transferred affects the parent company's innovativeness could be expected to depend on the means applied to transfer the subsidiary's knowledge. Our findings confirm that parent companies innovate their activities drawing on their subsidiaries' knowledge. When that RKT occurs through person-based mechanisms, in particular through teamwork, visits and meetings, it is more effective, i.e. it induces a greater impact on parent company's innovativeness. The results also indicate that the parent company's innovativeness is partially influenced by the use of ICT and written mechanisms. While the RKT effect on the parent company's innovativeness is negatively related to the use of formal KT mechanisms such as formal committees and reporting systems.

The hypotheses developed in this paper have been tested with a unique data set created to personally interview the top managers of 84 Italian MNEs with regard to their 307 relevant FDIs located in more than 48 countries. Our choice to collect data through personal interviews helped us ascertain that each question was perfectly understood by the respondents and that they did their best to provide us with high-quality information. Still, the study remains subject to certain limitations that need to be considered. First, the use of perceptual instruments to measure the extent of RKT and its effects on parent companies' innovativeness, and the fact that the same person provided all the answers to the questionnaire, are aspects that may entail potential general common method bias. We reduced this risk through the face-to-face interviews. In fact, a significant strength of the face-to-face contact is that each questionnaire's answer has been clarified through interaction between the respondent and the interviewer, while using detailed information and examples. This approach is expected to reduce similar pattern of answers — made by the same individual — when similar scales are used for many of the items. Moreover, the Harman's single-factor test (Harman, 1967; Podsakoff & Organ, 1986) was performed. If common-method bias exists in the data, a single factor will emerge from a factor analysis of all measurement items included in the study, or one general factor that accounts for most of the variance, will result. The factor analyses reported good properties, supporting the validity of the results. Precisely, considering the sample of the parent company–foreign subsidiary dyads, the test found eight factors, where the maximum variance explained by a single factor was 14%. However, given the limitation of self-reported data, the complexity, and multi-dimensional nature of the phenomenon under consideration, future research should observe not only the parent companies' point of view, but also the perception of the same phenomenon from the subsidiaries' side.

Although this study analyzed RKT at the dyadic level, that is recognized to be better than the nodal one (e.g. Gupta & Govindarajan, 2000), a superior approach would be an analysis at the 'systemic' level. This approach would allow the study of the occurrence of KT and its effect on the receiving unit within all the multinational network relationships. It can also be noted that, like most social science models, some potentially important factors may be excluded. For instance, among the potential other forces that might be at work in our analyses, corporate control mechanisms may have an effect on RKT. Likewise, the subsidiary's access to diverse sources of knowledge, in the local context, might affect both the availability of new knowledge and — when it is transferred — its effect on the receiving unit. Therefore, future research should investigate how parent companies can influence the occurrence and the effectiveness of RKT by implementing different combinations of control mechanisms with integrative mechanisms, taking into account the subsidiary's autonomy. Likewise, it can be fruitful to analyze whether transferred knowledge, developed through external relationships, affect the parent companies' innovativeness.

Appendix

Table 7.A.1: Sample's representativeness.

	MNEs	**Non-respondent**	**Respondent**	χ^2 **test**
Sectors				
Science based	44	29	15	0.0757*
Specialized suppliers	65	42	23	0.0122**
Scale intensive	163	125	38	0.9765
Supplier dominated	86	78	8	0.0003***
Size				
50–249	98	80	18	0.1624
250–499	81	66	15	0.2325
500–5000	145	102	43	0.0225**
>5000	34	26	8	0.9924
Parent company's location area				
North West	202	149	53	0.1587
North East	109	82	27	0.6994
Centre	40	36	4	0.0330**
South–Island	7	7	0	0.1390

*p < 0.10; **p < 0.05; ***p < 0.01

Table 7.A.2: Marginal effects from Table 3, models 2 and 3.

Variable	**Model 2**			**Model 3**		
	***Y* = 0**	***Y* = 1**	***Y* = 2**	***Y* = 0**	***Y* = 1**	***Y* = 2**
KT mechanisms						
Formal committees	0.178	0.179	−0.357			
Visits/meetings	−0.135	−0.099	0.235	−0.206	−0.096	0.302
Team work	−0.213	−0.176	0.388	−0.252	−0.167	0.419
Managers' transfer	−0.067	−0.089	0.156	−0.092	−0.102	0.194
Professionals' transfer	0.019	0.025	−0.044	0.060	0.061	−0.121
Report system				0.040	0.044	−0.084
Manual/database exchange	0.089	0.097	−0.186	0.213	0.141	−0.354
Corporate intranet	−0.133	−0.229	0.362	−0.163	−0.245	0.408
Subsidiary's characteristics						
Competence-creating subsidiary	−0.235	−0.169	0.404	−0.243	−0.152	0.394
Relative size	0.018	0.025	−0.044	−0.002	−0.002	0.005
FDI-age	−0.008	−0.011	0.019	−0.006	−0.008	0.014
Acquisition	0.035	0.049	−0.084	0.103	0.127	−0.231
Jv	−0.036	−0.064	0.100	0.041	0.040	−0.081
Industry and geographic characteristics						
High-tech	−0.127	−0.223	0.350	−0.135	−0.204	0.339
Advarea	0.051	0.084	−0.135	0.017	0.022	−0.039

Table 7.A.3: Correlations matrix.

	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
(1) RKT	1.000							
(2) Competence creating	0.464	1.000						
(3) Relative size	0.118	0.084	1.000					
(4) FDI-age	0.037	−0.120	0.089	1.000				
(5) Acquisition	−0.015	0.193	0.124	−0.191	1.000			
(6) Jv	−0.075	−0.113	−0.042	−0.063	−0.383	1.000		
(7) High-tech	−0.047	−0.038	0.028	0.039	−0.073	−0.059	1.000	
(8) Advarea	0.055	0.180	0.153	0.173	0.304	−0.253	−0.014	1.000

Table 7.A.4: Correlations matrix, subset of parent company–foreign subsidiary pairs, where KT occurred.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
(1) Formal committees	1.000														
(2) Visits/meetings	−0.184	1.000													
(3) Team work	−0.150	0.163	1.000												
(4) Managers' transfer	−0.098	0.138	0.066	1.000											
(5) Professionals' transfer	0.209	−0.143	0.294	0.069	1.000										
(6) Manual/database	−0.291	0.272	0.366	0.368	−0.081	1.000									
(7) Report system	0.542	−0.132	−0.322	0.091	−0.021	−0.151	1.000								
(8) Corporate intranet	−0.144	−0.018	0.264	0.368	−0.240	0.595	0.060	1.000							
(9) Competence creating	−0.164	−0.028	0.613	−0.014	0.146	0.219	−0.379	0.271	1.000						
(10) Relative size	−0.040	−0.112	−0.159	−0.289	0.180	−0.289	0.066	−0.309	−0.251	1.000					
(11) Fdi-age	−0.021	−0.156	−0.243	−0.176	0.011	−0.163	−0.155	−0.057	−0.046	0.171	1.000				
(12) Acquisition	0.276	−0.138	0.258	−0.238	0.423	−0.403	0.041	−0.355	0.234	0.292	−0.129	1.000			
(13) Jv	−0.036	0.102	0.004	−0.115	−0.170	0.186	−0.076	0.091	−0.113	0.049	−0.040	−0.296	1.000		
(14) High-tech	0.171	−0.247	0.045	−0.331	0.041	−0.198	0.235	−0.096	0.152	0.205	0.065	0.349	−0.190	1.000	
(15) Advarea	0.028	−0.154	0.044	−0.457	0.159	−0.206	−0.051	−0.259	0.035	0.418	0.220	0.466	−0.037	0.321	1.000

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Chapter 8

Home Country Effects of Investing Abroad: Evidence from Italy

Anna Maria Falzoni and Mara Grasseni

Abstract

Following the recent literature on firm heterogeneity, we investigate whether the impact of investing abroad on the performance of parent firms might differ according to their level of productivity or their size. Using quantile regressions and a data set for Italian multinationals, this chapter shows that the impact of international expansion on parents' performance (measured in terms of labour productivity and of employment) varies across firms in different quantiles of the performance distribution and across foreign affiliates' geographical locations.

1. Introduction

In the past years, home country effects of domestic firms investing abroad have been a highly debated issue. A number of empirical studies have tried to investigate whether it is justified the concern that outward FDI causes production and employment that would have taken place in the home country to instead take place abroad, reducing home economic activities. Overall, the results seem not to support the fear that MNEs are exporting domestic production and/or jobs; however, the issue should be examined more deeply. Following the recent literature on firms' heterogeneity, an important point to be investigated is whether the impact of outward FDI on the performance of parent firms might differ according to their level of productivity or their size.

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The empirical research on the effects of outward FDI on home activities has primarily addressed the issue of whether employment or production abroad complement or substitute for employment in parent companies.[1] Using industry or firm level data, these studies do not find evidence of the fear that MNEs are substituting foreign jobs for domestic jobs, particularly to low-wage countries; the activities in these areas broadly seem to be complements to the activities carried out at home (Braconier & Ekholm, 2000; Brainard & Riker, 1997a, b; Bruno & Falzoni, 2003; Konings & Murphy, 2006; among others). However, international delocation of production is not simply a matter of substitution of foreign activities for home activities, but it may induce a reorganisation of the different operations within the MNE. The labour and the skill intensity of domestic activities may change depending on the relative factor intensity of the activities transferred abroad and on the factor endowments of the home and foreign countries.[2] Also, domestic productivity may rise or decline, depending on whether foreign operations strengthen or deplete domestic ones.[3]

A different strand of theoretical and empirical research has recently argued that firm heterogeneity leads to self-selection in the strategies to serve domestic and foreign markets. Within the same industry, only the most productive firms find it profitable to expand abroad through FDI, while the less productive firms choose to reach the foreign markets through exports or decide to serve only domestic markets (Helpman, Melitz, & Yeaple, 2004; Head & Ries, 2003; Girma, Kneller, & Pisu, 2005). Firm heterogeneity may be an interesting issue to be investigated also from a different perspective: within the same internationalization strategy, i.e. outward FDI, the impact of the international expansion on the performance of the parent firm might be different depending on the level of productivity or the size of the firm. We might expect that the opportunities to exploit firm and plant level economies of scale or to adjust factors of production at home will vary according to the characteristics of the parent in terms of performance.

The main aim of this chapter is to investigate whether the extent of foreign activities help to explain parents' performance at home and whether the different

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[1]See Barba Navaretti, Venables et al. (2004), Chapter 9, for a survey on home country effects of FDI.
[2]On the labour intensity of home activities see, among others, Blomstrom, Fors, and Lipsey (1997) and Lipsey (1999). On the skill intensity, see Slaughter (2000), Hansson (2005) and Head and Ries (2002).
[3]Differently from inward FDI, the empirical literature on the relationship between productivity and outward FDI is not so large. On one hand, the studies focus on whether outward FDI may channel technological spillovers to parent firms (Van Pottelsberghe de la Potterie & Lichtenberg, 2001; Braconier, Ekholm, & Midelfart-Knarvik, 2001); on the other hand, the attention is on whether investing abroad enhances the productivity of investing firms compared to domestic ones (Barba Navaretti & Castellani, 2004; Barba Navaretti, Castellani, & Disdier, 2006).

characteristics of the parents, in terms of number of employees and labour productivity, matter when we consider the impact of these foreign operations. Using a panel of Italian firms investing abroad, we allow for different effects of outward FDI on firms located at different quantiles of the performance distribution by using conditional quantile regressions. Moreover, we take into account an additional source of diversification of the effects of the international expansion: the geographical area where affiliates are located.

Knowledge of whether and how the extent of the international production differently affects the performance of parent firms belonging to different quantiles is particularly interesting in the case of Italy. In fact, in comparison with other leading industrial countries, Italian FDI is characterised by the presence of a high share of "small and medium MNEs", it shows a bias towards traditional sectors, and towards less developed countries (LDCs) (in particular Eastern European Countries) (Mariotti & Mutinelli, 2003).

Our results indicate that the impact of the multinational activity, measured as the share of employment in foreign affiliates on MNE's total employment, varies across firms in different quantiles of the performance distribution and across foreign affiliates' geographical locations. In particular, quantile regressions seem to show that firms throughout the productivity distribution do not benefit from the FDI in LDCs. Differently, parent firms in the upper quantiles of productivity seem to be positively affected by foreign expansion in developed countries (DCs). As for employment, only small firms seem to be negatively influenced by outward FDI. Finally, measures of multinational experience influence positively and significantly parent firms across quantiles of productivity and employment.

The chapter is structured as follows. In the next section we present the empirical framework; Section 3 illustrates the data set and some descriptive statistics. Section 4 presents the estimation method. Section 5 discusses the empirical results and the final section concludes.

2. Empirical Framework

In order to investigate the impact of the multinational activity on the performance of the parent firms, we will regress firm-level labour productivity and employment on covariates, including the share of employment in foreign affiliates on MNE's total employment used as a proxy of multinational operations. Our empirical model will then be tested adopting a quantile regression approach that enables the estimation of the model coefficients at different quantiles rather than at the conditional mean, allowing the impact of the foreign activity to vary across firms according to their labour productivity or their size. In addition, the quantile

regression method allows us to take into account any potential bias due to unobserved heterogeneity among firms.

2.1. Labour Productivity

To test whether investing abroad influences parent firms' labour productivity, we assume that the production function of Italian multinationals can be approximated by a Cobb–Douglas specification:

$$Y_{it} = K_{it}^{\alpha} L_{it}^{\beta} \tag{1}$$

where Y_{it} is the output of parent i at time t, K_{it} and L_{it} are capital and labour respectively. Taking logarithms and subtracting lnL_{it} from both sides, we obtain the following expression for labour productivity:

$$\ln(Y_{it}/L_{it}) = \alpha_0 + \alpha_1 \ln K_{it} + \alpha_2 \ln L_{it} \tag{2}$$

where $\alpha_2 = \beta - 1$ allows for non-constant returns to scale in the production function.[4]

To incorporate the effect of investing abroad in such a framework, we add to equation (2) a variable measuring the extent of multinational activity. As a proxy, we construct the variable, FDI_{ijt}, computed as the share of employees in foreign affiliates, *FA*, located in area j at time t, over total employment of the MNE i, $L_{FAijt}/L_{FAijt} + L_{it}$. In this way, we are able to take into account the impact of outward FDI on parent productivity according to the different locations of the investment. In particular, we distinguish foreign affiliates located in: Europe, North America, Eastern Europe, Asia (Asia, New Zealand and Australia) and others countries (Africa, Middle East and South America).

One of the potential problems that may arise in our estimations regards the endogeneity of the FDI variable. For instance, it may be the case that the most productive firms are also more likely to expand the activities of their foreign affiliates. In order to take into account this issue, an instrumental variable estimation should be implemented. However, in our database we do not have good instruments, because the variables that could be used as instruments are correlated with productivity too. Therefore, the issue of endogeneity is addressed by including the FDI term at time $t - 1$.

In the empirical estimation we should deal with another issue: the presence of heterogeneity across parent firms. There are several sources of heterogeneity, and the literature suggests allowing some factors that determine them to be explicitly

[4]In our econometric analysis, we reject the null hypothesis of constant returns to scale.

included in the regression as exogenous shocks. Thus, we include in the empirical model two other variables: the number of foreign affiliates of parent i at time t, N_{FAit}, and since how many years the firm is an MNE, Age_{it}. Both these measures attempt to capture the relationship between the experience of the firm in investing abroad and its labour productivity. Moreover, to better isolate the impact of the multinational activity on the firm performance, we introduce a variable that picks up the R&D effort. The proxy adopted is the ratio of R&D expenditures and patents over total assets of the parent, $R\&D_{it}$; we expect a positive relationship between technological effort and firm's productivity. Finally, time dummies, $Time_t$, and sector dummies, $Sectors_z$, are included to capture macroeconomic shocks and sector-specific time-invariant effects.

The estimated equation is the following:

$$\ln(Y_{it}/L_{it}) = \alpha_0 + \alpha_1 \ln K_{it-1} + \alpha_2 \ln L_{it-1} + \alpha_3 \sum_j FDI_{ijt-1} + \alpha_4 R\&D_{it-1} + \alpha_5 Age_{it} + \alpha_6 N_{FAit-1} + \alpha_7 Time_t + \alpha_8 Sectors_z + e_{it} \quad (3)$$

where e_{it} is the error term. The production inputs are included at time $t-1$ in order to reduce the problems related to endogeneity in the choice of factors of production.

Estimation of equation (3) allows us to investigate the role of foreign activities on the level of labour productivity. In particular, we are interested in evaluating the coefficient α_3, as we expect that the extent of delocalisation of production abroad might affect firm's productivity at home.

2.2. Parent Employment

The existing theoretical and empirical literature does not provide clear evidence concerning the effect on home employment of outward FDI. We try to add some evidence on this issue. Our contribution is specifically given by the adoption of a different econometric method, the quantile regressions technique, allowing for different effects of the multinational activities on firms of different size.

As for the empirical model, we will follow a specification similar to the previous one on productivity. The estimated equation is the following:

$$\ln L_{it} = \alpha_0 + \alpha_1 \ln W_{it-1} + \alpha_2 \ln Y_{it-1} + \alpha_3 \ln K_{it-1} + \alpha_4 \sum_j FDI_{ijt-1} + \alpha_5 Age_{it} + \alpha_6 N_{FAit-1} + \alpha_7 Time_t + \alpha_8 Sectors_z + e_{it} \quad (4)$$

where all the variables are defined as in equation (3) and W_{it-1} is the average wage of parent i.

If the value of the coefficient related to foreign activities in a given location is negative, we interpret it as the presence of a substitution effect between parent and foreign affiliates employment. If the coefficient is positive, it means that an increase in the share of employment in foreign affiliates is associated with an increase in parent employment.

3. Data Description

The data used in this chapter come from the "Centro Studi Luca D'Agliano-Reprint" database (DAR henceforth), which provides information on Italian multinational firms and their foreign affiliates. The database is the result of the merging of the Reprint database of Politecnico of Milan, which contains information on Italian MNEs (and foreign owned firms operating in Italy) and the AIDA database of Bureau Van Dijck, which contains balance sheets and other economic data of Italian companies.

To perform our analysis, we use data for all the manufacturing firms that own at least one foreign affiliate for at least one year during the 1994–1998 period. We have identified and linked each parent to each of its foreign affiliates. Doing so, we are able to aggregate the data of foreign affiliates distinguishing among the various geographical areas in which they are localised. For each foreign affiliate we have information on employment, sales, localisation, industry of activity, starting date of the foreign participation and type of control. Unfortunately these data are collected only once every two years. Therefore, in our analysis, we use the data on Italian parent firms for the years from 1994 to 1998, and we relate this information with those of foreign affiliates in 1995 and 1997.

The structure of the final sample is an unbalanced panel with a number of parent firms varying between 582 and 588.[5] The variables used are: value added, total tangible assets (used as a proxy of capital), wages[6] and number of employees. All these variables are deflated with the appropriate three-digit production price index provided by ISTAT (the Italian Institute of Statistics). Moreover, from the DAR database, we collect information to construct two other variables: the number of years in which each firm is an MNE and the number of foreign affiliates each parent owns. Both variables are used to control for heterogeneity among MNEs in terms of multinational experience.

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[5]In our estimations the total number of observations is further reduced because there are missing values in the employment of foreign affiliates.

[6]The wage variable includes wage and salary payments to employees as well as the contributions to Government funds.

Table 8.1: Descriptive Statistics — Years: 1996–1998.

	Labour productivity (in log)	**Number of employees (in log)**
Mean	4.636	5.041
Standard deviation	0.679	1.654
10%	4.095	2.996
25%	4.338	4.007
50%	4.603	5.011
75%	4.898	5.924
90%	5.232	7.108
Observations	1170	1170
Skewness	−0.086	0.322
Kurtosis	24.678	3.779
Test 1 *p*-value	0.000	0.000
Test 2 *p*-value	0.000	0.000

Test 1: Skewness and kurtosis test for normality.
Test 2: Shapiro and Francia test for normality.

Tables 8.1 and 8.2 present descriptive statistics of the variables used in the regression analysis.

Table 8.1 refers to our dependent variables, labour productivity and number of employees, showing that the log of labour productivity has a skewness value of approximately zero as a normal distribution, while the log of the number of employees exhibits a right-skewed distribution. Regarding the kurtosis, all the two variables seem to be leptokurtic, especially the productivity measure, whose distributions are "peaked" and have fat tails.

Looking at Table 8.2, we find that in 1998 about 38% of parent firms belong to the high returns to scale sectors, followed by the traditional ones. Only 5.8% of the parents belong to the high-tech sectors, confirming the weak role of Italian firms in these industries. Focusing on foreign affiliates, Table 8.2 shows that in 1997 employment in foreign affiliates accounts for almost 39% of MNE's total employment and this percentage is higher than that in 1995. Looking at the geographical distribution of foreign affiliates' employment, we find a higher and growing share in LDCs with respect to DCs. Among DCs, the largest share of employment is concentrated in European countries, followed by the Eastern European countries, which account for the widest increase in outward FDI for the period 1995–1997. This finding is not surprising and reflects the growing importance of the Transition Economies as destination of Italian FDI.

Table 8.2: Descriptive Statistics.

	Mean (standard deviation)	**Mean (standard deviation)**
	1996	**1998**
Number of parent firms	582	588
Number of parent firms in traditional sectors	187	187
Number of parent firms in specialised sectors	134	144
Number of parent firms in high returns to scale sectors	229	223
Number of parent firms in high-tech sectors	32	34
Age	4.90 (4.36)	6.94 (4.41)
	1995	**1997**
FDI_t	0.333 (0.297)	0.392 (0.29)
FDI_DC_t	0.155 (0.231)	0.165 (0.236)
FDI_LDC_t	0.179 (0.275)	0.227 (0.293)
FDI_Europe_t	0.130 (0.22)	0.137 (0.222)
$FDI\_North\ America_t$	0.025 (0.093)	0.028 (0.097)
$FDI\_Eastern\ Europe_t$	0.089 (0.213)	0.12 (0.245)
FDI_Asia_t	0.034 (0.134)	0.049 (0.155)
FDI_Others_t	0.055 (0.158)	0.058 (0.161)
Number of foreign affiliates$_t$	2.02 (4.365)	2.247 (4.009)
$R\&D_t$	0.005 (0.034)	0.028 (0.071)

Instead of just examining the average share of employment in foreign affiliates by geographical destination, one may be interested in evaluating whether the choice of the areas in which foreign activities are localised is different by parent's size, productivity or sector of activity. Additional information on this point is given in Figures 8.1 and 8.2.[7]

Figure 8.1 shows the relationship between the share of employees in foreign affiliates, parent size and the localisation of FDI. Small and medium parent firms have a higher average share of employees in foreign affiliates localised in LDCs,

[7]In Figures 8.1 and 8.2, parent firms are divided into intervals according to the quantiles of their number of employees and labour productivity distributions.

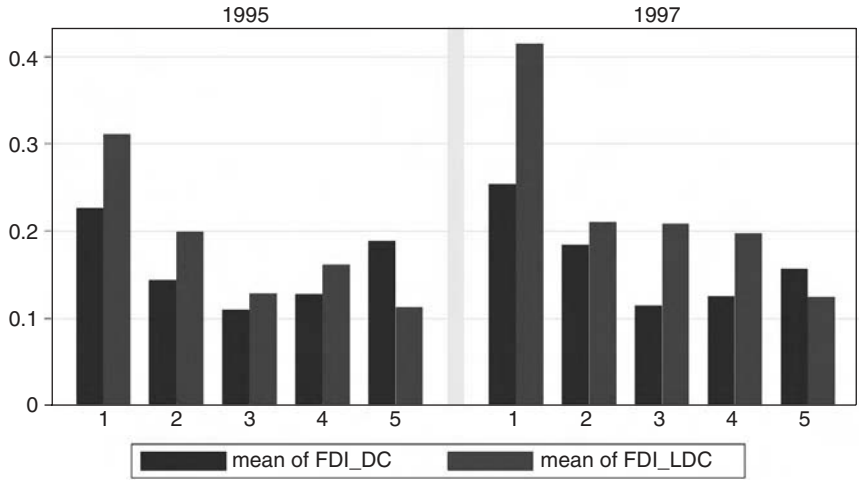

Figure 8.1: Average share of employees in foreign affiliates by parent size and destination.

FDI_DC: employment in foreign affiliates, localised in DCs, over total employment of MNEs.
FDI_LDC: employment in foreign affiliates, localised in LDCs, over total employment of MNEs.
Number of employees of parent firm at home*:
1: ≤ 39 (Number of parents: 120)
2: 40–101 (Number of parents: 110)
3: 102–198 (Number of parents: 116)
4: 199–426 (Number of parents: 117)
5: ≥ 427 (Number of parents: 123)
*The intervals are built according to the quintiles of the number of employees distribution.

than in DCs. On the contrary, the largest parent firms exhibit a higher average share of employees in foreign affiliates localised in DCs. Figure 8.2 shows the share of foreign employment by productivity of parent firms and the localisation of the FDI. The figure reveals that the least productive parent firms have a higher average share of employees in foreign affiliates localised in LDCs, whereas for the most productive firms the average share is higher in DCs. This evidence, confirmed in both years, seem to suggest the necessity to use an estimation method that takes into account the existence of a different impact of foreign activities on the performance of parent firms according to their different characteristics. At the same time, this evidence confirms the existence of heterogeneity among firms that have chosen the same internationalisation strategy.

Finally, Figure 8.3(a, b) gives a picture of the average share of employees in foreign affiliates by NACE2 sectors and destination.

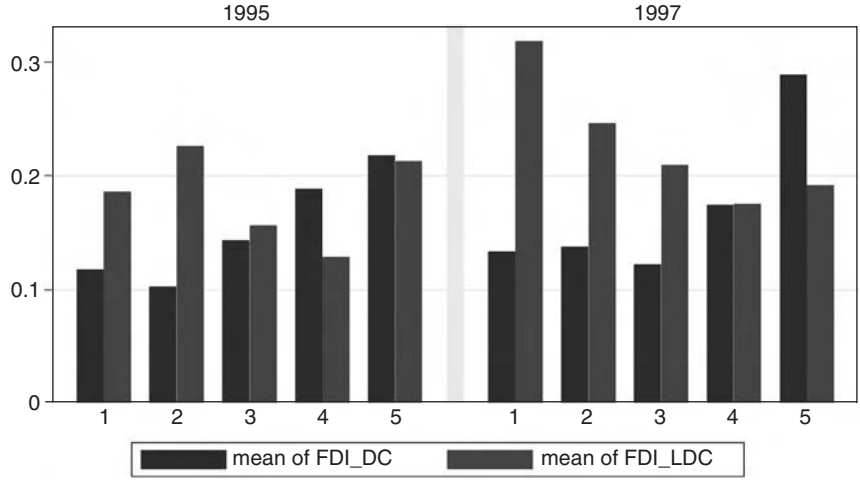

Figure 8.2: Average share of employees in foreign affiliates by labour productivity of parent firms and destination.
FDI_DC: employment in foreign affiliates, localised in DCs, over total employment of MNEs.
FDI_LDC: employment in foreign affiliates, localised in LDCs, over total employment of MNEs.
The numbers 1, 2, 3, 4, 5 refer to the quintiles of the labour productivity distribution.

As one might expect, the traditional sectors have the highest average share compared with other industries. In addition, comparing the years 1995 and 1997, it is worth noting that the average share of employees in foreign affiliates localised in LDCs increases in all sectors, confirming the growing role of these countries as destination of Italian FDI.

4. Estimation Method

Most previous studies based on micro-level data employ standard ordinary least square (OLS) or generalized method of moments (GMM) techniques that concentrate on the conditional mean function of the dependent variable. However, these methods may not be adequate if the unobserved heterogeneity across firms violates the assumption of normality for the performance measures. This is exactly what occurs with our data. As reported in Table 8.1, the assumption of normality is formally rejected for all our variables by the Shapiro–Francia test and the tests based on skewness and kurtosis. Hence, we may have some doubts that OLS estimators would be appropriate to examine the impact of outward FDI

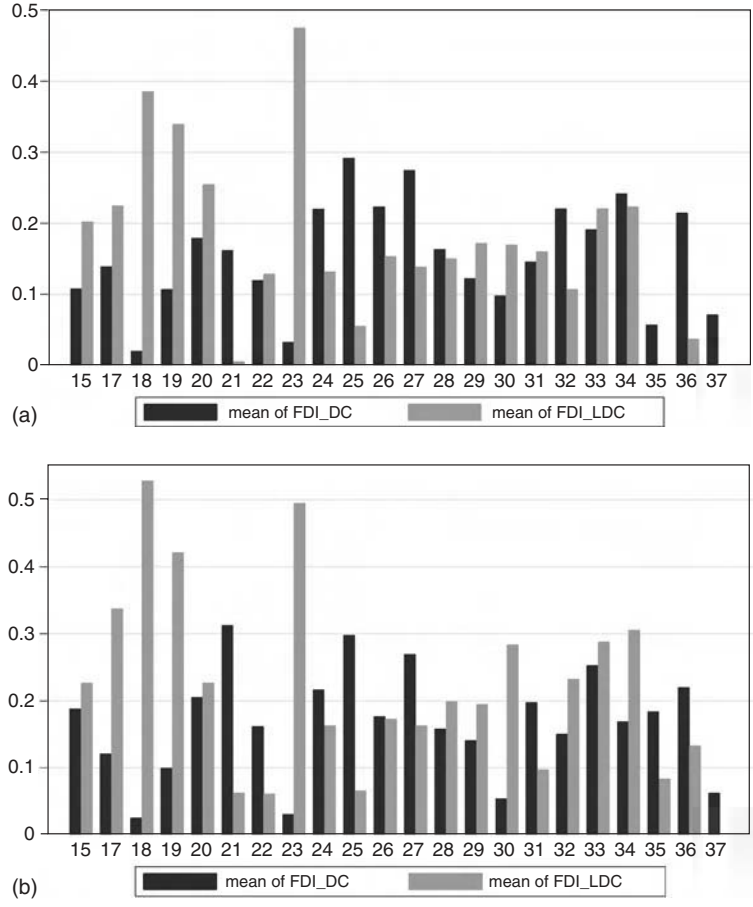

Figure 8.3: (a) Average share of employees in foreign affiliates by parent sector and destination — year 1995. (b) Average share of employees in foreign affiliates by parent sector and destination — year 1997.

FDI_DC: employment in foreign affiliates, localised in DCs, over total employment of MNEs.
FDI_LDC: employment in foreign affiliates, localised in LDCs, over total employment of MNEs.
Sectors:

15. Food & Drink
16. Tobacco
17. Textile
18. Apparel products
19. Luggage, Leatherwear & Footwear
20. Wood & Cork
21. Paper & Pulp
22. Printing & Publishing
23. Coke & Petroleum
24. Basic & Other Chemicals
25. Rubber & Plastic Products
26. Non metallic mineral products
27. Metal production
28. Metal products
29. Non electrical machinery
30. Office machinery & Computers
31. Electrical machines
32. Radio, TV & Communication Equipment
33. Precision instruments
34. Motor vehicles
35. Other transport
36. Other manufacturing
37. Recycling

on productivity and on employment. In addition, as mentioned in the introduction, we are specifically interested to study whether the different characteristics of the parents, in terms of performance, matter when we consider the impact of multinational operations. To address these issues we apply a quantile regression approach (QR). In presence of heterogeneity, this approach seems more interesting as well as more appropriate, because we are able to give a more precise picture of the dynamics of the dependent variable at different points of the distribution rather than at the conditional mean.[8] In our analysis we use both OLS and QR methods to provide a comparison.

Let $y_t\{t = 1 \ldots T\}$ be a random sample of a random variable Y having distribution F. Then, $Q_\theta(y \mid x)$ for $\theta \in (0,1)$ denote the θth quantile of the distribution of y, given a vector x of covariates. We model the conditional quantile by $Q_\theta(y \mid x) \equiv \inf\{y \mid F(y \mid x) \geq \theta\} = x'\beta(\theta)$, where $\beta(\theta)$ is a vector of quantile regression coefficients.

Koenker and Basset (1978), introducing this technique, show that $\beta(\theta)$ can be estimated by

$$\underset{\beta(\theta)}{Min}\left\{\sum_{t:y_t \geq x_t'\beta(\theta)} \theta\left|y_t - x_t'\,\beta(\theta)\right| + \sum_{t:y_t < x_t'\beta(\theta)} (1-\theta)\left|y_t - x_t'\beta(\theta)\right|\right\}$$

In this way, the estimation of quantiles is conducted giving different weights to positive and negative residuals. The median case, $\theta = 1/2$, is equivalent to minimising the sum of absolute value of the residual.[9]

One of the advantages of the QR approach is that it enables us not to concentrate only on a single central tendency measure, but to estimate different slope coefficients at different quantiles of the conditional distribution of the dependent variable. Therefore, these coefficients may be interpreted as differences in the response of the dependent variable to changes in the regressors at several points of the conditional distribution of y. Also, the QR approach is more robust than OLS to modest deviations of the residuals from normality, such as outliers or long tail situations. In addition, the QR approach is equivalent to monotonic linear and non-linear transformations of the dependent variable and finally, even if the residuals are independent and identically distributed (i.i.d.) and the estimates of the conditional mean give the same information, the QR estimates of the intercepts give a picture of the asymmetry of the conditional distribution.[10]

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[8]Recently, a few papers have applied this technique to analyse the productivity spillovers effects of inward FDI. See, in particular, Dimelis and Louri (2002), Girma and Gorg (2002) and Ito (2004).

[9]The estimation of the linear conditional mean function $E|y|x| = x'\beta$ is solved by $\underset{\beta}{Min}\sum_t \left(y_t - x_t'\beta\right)^2$.

[10]For more details on the advantages of QR estimation see, among others, Mata and Machado (1996).

Using this method in our regression analysis, we estimated the effect of the foreign operations localised in different countries on labour productivity and employment of parent firms at the bottom of the distribution (e.g., at the 10th percentile), at the median and at the top of the distribution (e.g., at the 90th percentile). In this way, we can evaluate whether the impact of investing abroad is different throughout the performance distribution, in terms of labour productivity. In the same way, the QR approach enables us to control whether outward FDI affects the parent's employment and if this effect is different depending on the size of the parent.

5. Results

5.1. Labour productivity

Tables 8.3 and 8.4 report the estimates of equation (3), in which our dependent variable is the labour productivity of the parent firm.

In specification (1) of Table 8.3, we introduce the aggregate proxy measuring the effect of multinational operations on the dependent variable: the share of employment in foreign affiliates on MNE's total employment. In this case, we implicitly assume that the effect of covariates on labour productivity is the same across foreign locations. In specification (2), we distinguish between FDI located in the DCs and the FDI located in the LDCs, as we want to investigate whether the impact of outward FDI varies according to the different geographical areas in which Italian multinationals invest. Table 8.4 shows the results allowing for the FDI located in Europe, North America, Eastern Europe, Asia and Other countries. We use the quantile regression estimator, QR and we report results for 10 percentiles of the labour productivity.[11] In addition, we present the corresponding estimated coefficients from OLS regressions for comparison. Overall, the QR estimator gives a more precise picture of the importance of our independent variables in explaining the performance of the parents.

Looking at specification (1) in Table 8.3, we find that the share of employment in foreign affiliates is not significant at each percentile, except for the 90th, where the coefficient is positive and significant. The OLS estimation confirms the not-significant results found using the QR approach.

A different pattern seems to be suggested by estimates reported in specification (2), in which we are able to analyse the effect of outward FDI located in DCs and LDCs. The results give evidence of a positive relationship between the FDI located

[11]The models are estimated as simultaneous equations across quantiles, using boostrapped standard errors.

Table 8.3: Effect of investing abroad on parents' labour productivity.

	QR									OLS
	10	**20**	**30**	**40**	**50 (Median)**	**60**	**70**	**80**	**90**	**Mean**
Specification (1)										
$\ln K_{t-1}$	0.100**	0.168***	0.191***	0.205***	0.186***	0.197***	0.205***	0.224***	0.236***	0.225***
	(0.042)	(0.029)	(0.028)	(0.023)	(0.020)	(0.020)	(0.026)	(0.031)	(0.050)	(0.036)
$\ln L_{t-1}$	−0.104**	−0.168***	−0.205***	−0.228***	−0.217***	−0.241***	−0.258***	−0.286***	−0.312***	−0.263***
	(0.047)	(0.035)	(0.036)	(0.027)	(0.025)	(0.027)	(0.034)	(0.036)	(0.064)	(0.048)
FDI_{t-1}	−0.101	−0.043	−0.025	−0.065	−0.039	−0.107	−0.026	0.139	0.312**	0.067
	(0.105)	(0.077)	(0.065)	(0.052)	(0.065)	(0.078)	(0.088)	(0.111)	(0.156)	(0.093)
$\text{R\&D}_{t-1}$	0.182	0.379	0.413	0.398	0.585*	0.548**	0.416	0.824*	0.527	0.277
	(1.054)	(0.3660)	(0.295)	(0.347)	(0.304)	(0.271)	(0.405)	(0.430)	(0.455)	(0.282)
Age_t	0.005	0.010***	0.010***	0.010***	0.010***	0.013***	0.012***	0.010*	0.003	0.013***
	(0.005)	(0.004)	(0.004)	(0.003)	(0.003)	(0.004)	(0.004)	(0.006)	(0.008)	(0.005)
$N_{\text{FA}t-1}$	−0.010	−0.006	0.003	0.002	0.006	0.009	0.007	0.009	0.020	−0.002
	(0.010)	(0.011)	(0.008)	(0.007)	(0.008)	(0.009)	(0.010)	(0.011)	(0.019)	(0.012)
$F(\beta_i = 0)$	2.79***	7.21***	10.48***	23.38***	16.58***	13.86***	9.55***	7.82***	5.78***	6.01***

Specification (2)

$\ln K_{t-1}$	0.105***	0.163***	0.188***	0.192***	0.181***	0.198***	0.197***	0.231***	0.279***	0.220***
	(0.042)	(0.028)	(0.028)	(0.025)	(0.021)	(0.018)	(0.024)	(0.029)	(0.052)	(0.035)
$\ln L_{t-1}$	−0.108**	−0.167***	−0.200***	−0.213***	−0.208***	−0.238***	−0.243***	−0.291***	−0.363***	−0.256***
	(0.047)	(0.034)	(0.036)	(0.030)	(0.026)	(0.024)	(0.033)	(0.035)	(0.066)	(0.046)
FDI_DC_{t-1}	0.014	0.065	0.132	0.143	0.215**	0.220*	0.289**	0.477***	0.520***	0.336**
	(0.123)	(0.110)	(0.107)	(0.090)	(0.101)	(0.118)	(0.142)	(0.145)	(0.182)	(0.138)
FDI_LDC_{t-1}	−0.120	−0.123	−0.074	−0.108**	−0.115**	−0.167***	−0.210***	−0.101	8.72e-07	−0.063
	(0.127)	(0.086)	(0.072)	(0.051)	(0.059)	(0.063)	(0.081)	(0.115)	(0.174)	(0.086)
$\text{R\&D}_{t-1}$	−0.445	0.318	0.426	0.460	0.642**	0.687***	0.705**	0.777**	0.346	0.356
	(1.059)	(0.390)	(0.313)	(0.351)	(0.329)	(0.263)	(0.315)	(0.339)	(0.396)	(0.262)
Age_t	0.003	0.007**	0.009**	0.009***	0.007**	0.010***	0.006	0.004	0.006	0.009**
	(0.006)	(0.004)	(0.004)	(0.003)	(0.003)	(0.004)	(0.005)	(0.006)	(0.008)	(0.005)
$N_{\text{FA}t-1}$	−0.010	−0.006	−0.0007	0.001	0.003	0.003	0.004	0.003	0.019	−0.003
	(0.010)	(0.010)	(0.008)	(0.006)	(0.007)	(0.008)	(0.010)	(0.013)	(0.018)	(0.011)
$F(\beta_i = 0)$	3.15***	6.45***	9.64***	18.35***	17.76***	19.85***	8.49***	9.62***	4.99***	5.88***
Observations	1028	1028	1028	1028	1028	1028	1028	1028	1028	1028

Bootstrapped standard error in parentheses. Robust standard error for the OLS method. The dependent variable is ln(value added/employees). Unreported regressors include constant, sector dummies and time dummies. *'s denote statistical significance at *10%, **5%, and ***1% levels.

in DCs and labour productivity for the most productive firms, from 50th upto the 90th percentile. For the least productive firms the coefficients are not significant. In addition, we test whether these coefficients are statistically different across quantiles using an *F*-test of equality. The results are reported in Table 8.1.A in the appendix and confirm that the magnitude of the coefficients is the same at the lower quantiles, but we reject the null hypothesis of equality between the lower and the higher quantiles, and between the median and the higher quantiles of the labour productivity distribution. As for the FDI located in LDCs, the results seem to show that an increase in the employment share of foreign affiliates located in this area decreases the labour productivity of parent firms. The related coefficients are significant and negative only in 4 out of 9 quantiles, from 40th upto the 70th percentile. The test of equality does not show differences among coefficients across quantiles.

To sum up, these results give evidence of a different impact of outward FDI according to the various levels of productivity that the firm exhibits. In particular, in the case of FDI localised in the DCs, it seems that this kind of investment benefits firms with higher productivity. The OLS estimations report a positive and statistically significant impact of the FDI located in DCs, while the coefficient on FDI_LDC_{t-1} is not significant, confirming, as mentioned above, that the traditional OLS regressions are not able to give a precise picture of the relationship between FDI and firm productivity.

In Table 8.4, we investigate the impact of outward FDI across the several geographical areas in which foreign affiliates are localised to study whether the role of foreign investments in explaining our measure of productivity is related to the different characteristics of the host countries. As can be seen, the positive impact of FDI located in DCs on the performance of the most productive firms seems due to foreign investment in Europe rather than in North America. The coefficients of FDI_Europe_{t-1} are positive but significant only for firms with medium-high labour productivity, from the 50th to the 90th percentiles, while the coefficients on $FDI\_\ NorthAmerica_{t-1}$ are positive and significant only at the 40th and the 50th percentile. The negative impact of the FDI localised in the LDCs seems to be driven only by investment in Eastern Europe: the coefficients on the FDI in the LD areas are not significant except for the case of $FDI\_EasternEurope_{t-1}$, where the coefficient is significant and negative in many quantiles.

The OLS estimation reports the same results in terms of statistical significance but only for investments in Europe and North America. However, in terms of the magnitude of the coefficients we find some differences. For instance, if we look at the coefficient on FDI_Europe_{t-1}, the OLS regression reports a significant and positive coefficient equal to 0.32, but in the QR estimation the same coefficient varies from 0.04 to 0.55. An interesting point is that, using OLS, outward FDI in

Table 8.4: Effect of investing abroad on parents' labour productivity.

	QR									OLS
	10	**20**	**30**	**40**	**50 (Median)**	**60**	**70**	**80**	**90**	**Mean**
FDI_Europe$_{t-1}$	0.078	0.039	0.066	0.127	0.185*	0.220*	0.376**	0.555***	0.479***	0.320**
	(0.146)	(0.111)	(0.111)	(0.091)	(0.099)	(0.131)	(0.162)	(0.150)	(0.177)	(0.146)
FDI_North America$_{t-1}$	−0.044	0.262	0.349	0.337**	0.331**	0.201	0.183	0.216	0.861	0.483*
	(0.298)	(0.347)	(0.220)	(0.159)	(0.138)	(0.155)	(0.177)	(0.346)	(0.813)	(0.277)
FDI_Eastern Europe$_{t-1}$	−0.265*	−0.181*	−0.094	−0.123*	−0.117*	−0.195***	−0.191*	−0.116	−0.174	−0.113
	(0.160)	(0.111)	(0.103)	(0.071)	(0.065)	(0.072)	(0.103)	(0.138)	(0.194)	(0.099)
FDI_Asia$_{t-1}$	0.180	−0.030	−0.065	−0.131	−0.167*	−0.160	−0.062	−0.054	0.018	0.016
	(0.173)	(0.111)	(0.110)	(0.088)	(0.103)	(0.134)	(0.197)	(0.283)	(0.443)	(0.156)
FDI_Others$_{t-1}$	−0.432	−0.001	−0.014	0.066	−0.104	−0.168*	−0.204	−0.034	0.056	−0.013
	(0.342)	(0.122)	(0.086)	(0.073)	(0.085)	(0.090)	(0.142)	(0.181)	(0.366)	(0.133)
R&D$_{t-1}$	−0.837	0.182	0.377	0.484	0.620**	0.685**	0.672**	0.663**	0.460	0.346
	(1.074)	(0.417)	(0.360)	(0.350)	(0.310)	(0.284)	(0.308)	(0.337)	(0.384)	(0.268)
Age$_t$	0.005	0.008**	0.008**	0.007*	0.006*	0.010***	0.006	0.004	0.003	0.008*
	(0.006)	(0.004)	(0.004)	(0.003)	(0.003)	(0.004)	(0.005)	(0.006)	(0.008)	(0.004)
$N_{\text{FA}t-1}$	−0.005	−0.007	−0.003	0.002	0.003	0.004	0.002	0.001	0.018	−0.003
	(0.010)	(0.011)	(0.008)	(0.006)	(0.006)	(0.008)	(0.010)	(0.012)	(0.017)	(0.011)
$F(\beta_i = 0)$	2.88***	5.04***	8.63***	14.63***	16.40***	15.62***	8.71***	7.08***	3.93***	5.01***
Observations	1028	1028	1028	1028	1028	1028	1028	1028	1028	1028

Bootstrapped standard error in parentheses. Robust standard error for the OLS method. The dependent variable is ln(value added/employees). Unreported regressors include constant, ln(capital), ln(employment), sector dummies and time dummies. *'s denote statistical significance at *10%, **5%, and ***1% levels.

Eastern Europe are not significantly correlated to labour productivity, while QR estimations report significant and negative coefficients in many percentiles.

Regarding the other explanatory variables, age and number of foreign affiliates, we find significant and positive coefficients but only for Age_t, suggesting that the more international experience the firms have, the higher is the probability of improving their performance at home. As for the R&D effort, the coefficient is positive and significant only for the most productive firms, from the median upto the 80th percentile.

5.2. Employment

Table 8.5 shows the estimates of equation (4) in which the dependent variable is the level of employment of the parent firm.

Overall, while the results in terms of the sign of the coefficients seem to be similar across quantiles, there seems to be heterogeneity in the magnitude of the coefficients. In fact, the coefficients on FDI_{t-1}, in specification (1), are negative and statistically significant only at the bottom and in the middle of the distribution. Moreover, their magnitude decreases from the lowest to the highest quantiles, and the null hypothesis of equality between coefficients can be rejected in many cases, as shown in Table 8.2.A in the appendix. These results suggest a different impact of foreign activities on parent employment between small and medium firms as well as between small and large ones.

Examining specification (2), we find a negative effect of investing abroad on home employment for the FDI localised in DCs but only at the bottom of the distribution, from the 10th upto the 50th percentile, while for the FDI localised in LDCs the coefficients are statistically significant in 3 out of 9 quantiles, the 10th, 20th and the 30th percentile. This seems in line with previous results of the empirical literature on the subject, according to which the substitution effect on parent employment comes from the decision to allocate production to affiliates located in DCs (Bloomstrom, Fors, & Lipsey, 1997; Brainard & Riker, 1997a). However, our findings seem to show that there exists a substitution effect only between outward FDI, especially localised in DCs, and small parent firms. We do not find evidence of a negative relationship between foreign activities and parent employment for the large parents. The different impact on the dependent variable is confirmed by the tests of equality across percentiles reported in Table 8.2.A in the appendix. Finally, the estimated coefficients appear to be decreasing as we move up in the conditional distribution.

The results found in these regressions provide a more detail picture of the impact of foreign operations on parent employment as suggested also by the comparison with the OLS estimation. OLS tends to enhance the negative impact of

Table 8.5: Effect of investing abroad on parents' employment.

	QR									OLS
	10	**20**	**30**	**40**	**50 (Median)**	**60**	**70**	**80**	**90**	**Mean**
Specification (1)										
$\ln W_{t-1}$	−0.990***	−1.033***	−1.064***	−1.006***	−0.977***	−0.962***	−0.852***	−0.734***	−0.388**	−0.655***
	(0.077)	(0.074)	(0.068)	(0.067)	(0.069)	(0.081)	(0.102)	(0.127)	(0.166)	(0.146)
$\ln K_{t-1}$	0.010	0.005	0.001	0.002	−0.010	−0.023	−0.0009	0.033	0.069**	0.036
	(0.035)	(0.030)	(0.021)	(0.016)	(0.017)	(0.019)	(0.022)	(0.023)	(0.029)	(0.023)
$\ln Y_{t-1}$	0.954***	0.954***	0.961***	0.967***	0.979***	0.982***	0.955***	0.896***	0.832***	0.861***
	(0.045)	(0.040)	(0.029)	(0.022)	(0.023)	(0.026)	(0.033)	(0.034)	(0.037)	(0.039)
FDI_{t-1}	−0.447***	−0.294***	−0.194***	−0.112**	−0.080	−0.100**	−0.036	−0.003	−0.003	−0.285***
	(0.152)	(0.097)	(0.073)	(0.058)	(0.055)	(0.050)	(0.054)	(0.078)	(0.112)	(0.111)
Age_t	0.011	0.010**	0.010***	0.006*	0.004	0.005*	0.002	−0.0007	−0.006	0.0008
	(0.007)	(0.005)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.006)	(0.004)
$N_{\text{FA}t-1}$	0.012*	0.009*	0.006	0.006	0.007	0.009	0.008	0.012	0.037	0.038**
	(0.007)	(0.005)	(0.006)	(0.005)	(0.005)	(0.006)	(0.010)	(0.020)	(0.024)	(0.016)
$F(\beta_i=0)$	297.05***	647.17***	833.29***	1621.59***	2039.73***	1735.63***	1304.17***	866.64***	497.83***	616.60***

Continued

Table 8.5: Continued

	QR									OLS
	10	**20**	**30**	**40**	**50 (Median)**	**60**	**70**	**80**	**90**	**Mean**
Specification (2)										
$\ln W_{t-1}$	−0.996***	−1.005***	−1.045***	−1.002***	−0.961***	−0.948***	−0.848***	−0.713***	−0.346**	−0.646***
	(0.073)	(0.073)	(0.065)	(0.069)	(0.072)	(0.083)	(0.101)	(0.131)	(0.168)	(0.146)
$\ln K_{t-1}$	0.018	0.002	0.002	0.002	−0.002	−0.016	−0.006	0.033	0.073***	0.036
	(0.036)	(0.031)	(0.021)	(0.019)	(0.017)	(0.019)	(0.022)	(0.024)	(0.029)	(0.023)
$\ln Y_{t-1}$	0.946***	0.953***	0.963***	0.967***	0.969***	0.975***	0.956***	0.899***	0.818***	0.861***
	(0.046)	(0.041)	(0.029)	(0.025)	(0.024)	(0.026)	(0.034)	(0.036)	(0.039)	(0.039)
FDI_DC_{t-1}	−0.540***	−0.450***	−0.348***	−0.194**	−0.186**	−0.141	−0.076	−0.076	−0.170	−0.390**
	(0.159)	(0.135)	(0.110)	(0.097)	(0.079)	(0.088)	(0.093)	(0.109)	(0.156)	(0.161)
FDI_LDC_{t-1}	−0.436**	−0.240**	−0.151**	−0.078	−0.056	−0.051	−0.008	0.015	0.008	−0.233**
	(0.180)	(0.102)	(0.073)	(0.062)	(0.053)	(0.055)	(0.057)	(0.084)	(0.118)	(0.100)
Age_t	0.015**	0.013***	0.012***	0.008**	0.004*	0.004*	0.004	0.0004	−0.006	0.002
	(0.007)	(0.005)	(0.003)	(0.004)	(0.003)	(0.002)	(0.003)	(0.004)	(0.006)	(0.004)
$N_{\text{FA}t-1}$	0.010	0.010**	0.007	0.006	0.007	0.010	0.009	0.012	0.041*	0.038**
	(0.007)	(0.005)	(0.005)	(0.005)	(0.005)	(0.007)	(0.012)	(0.020)	(0.023)	(0.016)
$F(\beta_i=0)$	290.06***	536.72***	777.18***	1342.69***	1833.76***	1543.99***	1076.37***	867.47***	482.76***	557.38***
Observations	1026	1026	1026	1026	1026	1026	1026	1026	1026	1026

Bootstrapped standard error in parentheses. Robust standard error for the OLS method. The dependent variable is ln(number of employees). Unreported regressors include constant, sector dummies and time dummies. *'s denote statistical significance at *10%, **5%, and ***1% levels.

outward FDI on parent employment, especially for the FDI localised in the LDCs. Differently, the QR approach shows that the negative impact is only related to the smaller firms, up to the median, while the larger firms are not affected by the extent of foreign activities.

Focusing on the several geographical areas in which the FDI are localised, the QR estimations reported in Table 8.6 confirm the substitution effect between foreign affiliates' employment and parent employment, especially for small and medium firms.

The negative impact of the FDI located in the DCs seems due to investments in Europe and in North America. The substitution effect on parent employment in the case of the FDI located in the LDCs seems essentially given by the investments in Eastern Europe and in Asia, even if the coefficients on FDI_Asia_{t-1} are significant also for the larger firms.[12]

To sum up, our QR results imply that, up to the median, there exists a substitution effect between foreign employment and parent employment for outward FDI located in the DCs. For the largest firms the substitution effect is given only by investment localised in Asia. Differently, the OLS estimations show a negative impact of foreign affiliates' activities on parent employment across all different locations.

Finally, we find a significant role of the foreign experience of the firm in increasing parent employment, confirmed especially for small and medium firms.

6. Conclusions

The empirical analysis presented in this chapter focuses on the relationship between investing abroad and different measures of performance of Italian parents. In particular, we have considered the impact of foreign activity on labour productivity and employment of the parent firm. The econometric method used, the quantile regression, allows us to examine the whole distribution of firms rather than a single measure of the central tendency of the performance distribution. Consequently, we are able to evaluate the relative importance of explanatory variables at different points of the distribution of parents' performance.

Our results indicate that the extent of the international production, measured as the share of employment in foreign affiliates on MNE's total employment, has a significant impact on the explanatory variables, but this effect varies depending

[12]Table 8.2.A in the appendix shows the *t*-statistics for the hypothesis of equality of coefficients across quantiles. We reject the null hypothesis of equality of the coefficients for the FDI localised especially in Eastern Europe and in a few cases also for the FDI localised in Europe and North America.

Table 8.6: Effect of investing abroad on parents' employment.

	QR									OLS
	10	**20**	**30**	**40**	**50 (Median)**	**60**	**70**	**80**	**90**	**Mean**
FDI_Europe$_{t-1}$	−0.457***	−0.331**	−0.282***	−0.163*	−0.161*	−0.156	−0.055	−0.058	−0.142	−0.317*
	(0.175)	(0.154)	(0.110)	(0.100)	(0.084)	(0.098)	(0.109)	(0.111)	(0.173)	(0.167)
FDI_North America$_{t-1}$	−0.502	−0.611***	−0.545***	−0.503***	−0.365**	−0.365*	−0.238	−0.187	−0.154	−0.763***
	(0.547)	(0.205)	(0.161)	(0.163)	(0.181)	(0.198)	(0.185)	(0.201)	(0.410)	(0.276)
FDI_Eastern Europe$_{t-1}$	−0.472**	−0.292**	−0.193*	−0.055	−0.055	−0.042	0.011	0.029	0.049	−0.230**
	(0.244)	(0.128)	(0.105)	(0.085)	(0.070)	(0.071)	(0.078)	(0.101)	(0.152)	(0.112)
FDI_Asia$_{t-1}$	−0.664	−0.349	−0.211	−0.172	−0.191*	−0.196*	−0.136	−0.210**	−0.209	−0.454***
	(0.463)	(0.280)	(0.152)	(0.107)	(0.104)	(0.105)	(0.094)	(0.086)	(0.159)	(0.166)
FDI_Others$_{t-1}$	−0.032	−0.062	0.038	0.023	−0.018	0.028	0.081	0.191	0.095	−0.024
	(0.158)	(0.123)	(0.106)	(0.095)	(0.096)	(0.123)	(0.136)	(0.144)	(0.215)	(0.123)
Age$_t$	0.008	0.010**	0.013***	0.009***	0.004	0.005*	0.004	0.001	−0.004	0.002
	(0.007)	(0.005)	(0.004)	(0.004)	(0.003)	(0.003)	(0.003)	(0.004)	(0.006)	(0.004)
$N_{\mathrm{FA}t-1}$	0.007	0.008	0.007	0.006	0.006	0.010	0.009	0.014	0.041*	0.037**
	(0.007)	(0.005)	(0.006)	(0.006)	(0.006)	(0.008)	(0.013)	(0.020)	(0.025)	(0.016)
$F(\beta_i = 0)$	240.92***	388.85***	590.22***	1078.05***	1241.88***	1066.55***	857.41***	612.65***	322.07***	460.32***
Observations	1026	1026	1026	1026	1026	1026	1026	1026	1026	1026

Bootstrapped standard error in parentheses. Robust standard error for the OLS method. The dependent variable is ln(number of employees). Unreported regressors include constant, ln(capital), ln(value added), ln(average wage), sector dummies and time dummies. *'s denote statistical significance at *10%, **5%, and ***1% levels.

on two factors: the location of foreign affiliates and the different point of the firm performance distribution.

Quantile regressions seem to show that firms throughout the productivity distribution do not benefit from the FDI in the LDCs. Differently, parent firms in the upper quantiles of productivity seem to be positively affected by foreign expansion in DCs. These results might depend on the different nature of the FDI in these two areas. According to the theory, vertical FDI — principally driven by differences in factor endowments and factor costs — takes place when the multinational re-deploys only part of its production process. Shifting part of the value chain to foreign economies may reduce the productivity of the MNE when it is not able to perfect adjust its factors of production, at least in the short run (Hanson, Mataloni, & Slaughter, 2002; Yeaple, 2003). Horizontal investments replicate in a foreign country the production structure of the home country and are explained by the need to overcome trade barriers and transport costs. These investments are usually realised in order to gain some advantage in final markets (Markusen & Maskus, 2002); however, our results seem to show that are the most productive firms who benefit from this strategy.

As for employment, only small firms seem to be negatively influenced by outward FDI. Finally, measures of multinational experience influence positively and significantly parent firms across quantiles of productivity and employment.

Appendix

Table 8.1.A: Tests of equality between coefficients at different quantiles of Table 8.3 and Table 8.4.

Dependent variable: Labour Productivity	**Quantiles**									
Variables	10–50	20–50	30–50	10–90	20–70	20–80	20–90	50–70	50–80	50–90
FDI_{t-1}	0.55	0.96	0.81	0.018**	0.86	0.12	0.026**	0.86	0.07*	0.018**
FDI_DC_{t-1}	0.12	0.14	0.33	0.011***	0.12	0.006***	0.016**	0.48	0.038**	0.085*
FDI_LDC_{t-1}	0.96	0.92	0.51	0.54	0.35	0.86	0.50	0.15	0.90	0.49
FDI_Europe_{t-1}	0.48	0.17	0.19	0.066*	0.035**	0.001***	0.05**	0.11	0.003***	0.081*
$FDI\_NorthAmerica_{t-1}$	0.19	0.82	0.92	0.29	0.81	0.91	0.48	0.30	0.72	0.51
$FDI\_EasternEurope_{t-1}$	0.34	0.52	0.78	0.70	0.94	0.67	0.97	0.38	0.99	0.75
FDI_Asia_{t-1}	0.054**	0.23	0.30	0.72	0.87	0.93	0.91	0.50	0.65	0.66
FDI_Others_{t-1}	0.33	0.41	0.27	0.30	0.24	0.87	0.88	0.40	0.67	0.65

P-value of *F* tests. *'s denote statistical significance at *10%, **5%, and ***1% levels.

Table 8.2.A: Tests of equality between coefficients at different quantiles of Table 8.5 and Table 8.6.

Dependent variable: number of employees	**Quantiles**									
Variables	10–50	20–50	30–50	10–90	20–70	20–80	20–90	50–70	50–80	50–90
FDI_{t-1}	0.003***	0.012**	0.051**	0.013**	0.007***	0.008***	0.030**	0.35	0.27	0.47
FDI_DC_{t-1}	0.016**	0.05**	0.043**	0.078*	0.004***	0.011***	0.13	0.12	0.24	0.91
FDI_LDC_{t-1}	0.026**	0.035**	0.098*	0.029**	0.020**	0.025**	0.079*	0.33	0.35	0.57
FDI_Europe_{t-1}	0.070*	0.20	0.14	0.18	0.077*	0.093*	0.37	0.19	0.26	0.91
$FDI\_NorthAmerica_{t-1}$	0.80	0.25	0.25	0.60	0.100*	0.092*	0.29	0.39	0.36	0.59
$FDI\_EasternEurope_{t-1}$	0.071*	0.036**	0.094*	0.057*	0.019**	0.026**	0.059*	0.31	0.35	0.47
FDI_Asia_{t-1}	0.28	0.52	0.86	0.33	0.41	0.61	0.63	0.52	0.84	0.91
FDI_Others_{t-1}	0.75	0.72	0.84	0.81	0.34	0.12	0.50	0.33	0.093*	0.58

P-value of *F* tests. *'s denote statistical significance at *10%, **5%, and ***1% levels.

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Chapter 9

Globalization and Its Impact on Development: Policy Issues

Pervez N. Ghauri

1. Introduction

Over the past couple of decades, governments have been persuaded that adoption of liberal and pro-multinational enterprises (MNEs) policies are generally beneficial for their local economies. In addition, globalization of the world economy, pressures from international institutions such as World Trade Organisation (WTO) and the World Bank and increasing bargaining power of MNEs have had a weakening effect on the bargaining power of governments (Yamin & Ghauri, 2004; Ghauri & Buckley, 2002; Dunnning, 2000; Dunning & Narula, 1999). On the other hand, Buckley and Casson (1998) and Ghauri (1999) suggest that internal and external pressures on multinational enterprises in the 1990s are causing new challenges for the MNEs and are producing a new strategic imperative — flexibility. The search for flexibility is a reaction to external volatility (e.g. due to globalization) and to attempts to reduce monopolistic 'pinch-points' (e.g. single supply sources, tie-in to particular locations).

The search for flexibility leads to (vertical) disintegration and foreign direct investments (FDI) being seen as 'real options'. This results in a new ownership strategy with networks of loose relationships on the one extreme and a new locational strategy based on mergers and acquisitions (M&As) on the other. In most cases however, operations where central activities (e.g. R & D and marketing) are augmented by decentralized activities (e.g. manufacturing and distribution) is becoming the name of the game. These two strategies can

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be combined, so that wholly owned central facilities such as finance, marketing and R & D at head offices are combined with dispersed market-based activities such as manufacturing, distribution and warehousing that are performed at different but optimal locations. The concept of 'global factory' suggested by Buckely and Ghauri (2004), is already a reality, where some locations specialise in production of a particular product and can manufacture goods for all or most of the producers in that sector. Even in this case however, activities with high value-added industries/segments are finding their place in the developed world/regions, such as automobiles in Austria, while activities in low value-added industries are being located in the developing world/regions, such as shoes and textiles in India and China.

The ability of multinational firms to appropriate rent by adjusting their location and foreign market servicing strategies, partly in response to globalization and partly in response to national governmental policies, enhances their flexibility and their bargaining power (Ghauri & Buckley, 2002). Buckley (1996) shows that the range of policies open to multinational firms make broad-brush policies untenable, because in each policy cell (exporting, licensing, FDI), government policies will have both positive and negative effects. Targeted policies, moreover, are difficult to design, given the dynamics of the firm's evolving foreign market servicing strategies and the links between the different elements in the firm's global value chains.

The result of these strategies is to create uncertainty for the host countries. Locational policies create difficulties; in that, multinationals are becoming more 'footloose' and are liable to move 'offshore plants' in response to changing incentives, demand and supply conditions. The search for flexibility also means that multinationals may engineer internal competition between competing plants within the same firm with weaker plants being winnowed out by failures in internal tendering.

The arguments for policy intervention are weakening. Krugman (1987), in reviewing the arguments for interventionist policies based on externalities and strategic trade considerations, concluded that the optimal policy set is so sensitive to technological and behavioural parameters that the results of intervention are uncertain, even in areas where externality and monopoly arguments are strong. Further, the information available to government policy makers is likely to be partial, out-of-date and biased (not in the least by representations on the part of the rent-seekers). These extreme forms of liberalization with their advocacy for a minimal state are creating disenchantment with globalization and giving birth to a movement for global civil rights demanding state as well as corporate social responsibility (Yamin & Ghauri, 2004; Stiglitz, 2002).

2. MNE — Government Relationship

Privatization (the transfer of productive assets from public to private ownership) has been part of most structural adjustment policies in developed as well as in developing countries since the 1980s. It has been undertaken to achieve a variety of objectives, such as enhanced economic efficiency, reduction of financial deficits and reducing the role of the state. If we summarize experiences with privatization strategies showing that there is now a sufficient body of evidence to review its progress made and to assess what works and what does not, we end up with the cautionary point that privatization alone is unlikely to ease significantly, the burden of the state owned sector in many countries.

We are in a state where MNE–host country relations in middle-income countries have fully emerged onto the world stage, leaving behind a group of largely inert less developed countries which have so far been bypassed by globalization. Increasing location 'tournaments', to attract the FDI may have reduced the benefits to the host countries as have the increasing skill of the managers of the MNEs in making their investments more 'footloose'. Corresponding skills on the part of host countries to make the FDI sticky are not developing at the same rate (Oxelheim & Ghauri, 2004).

In both the advanced and less developed countries, the period from the mid-1970s to the millennium has generally been one where the activist functions of the state have declined. This has been more true in equity-related policies than in addressing market failure. Indeed, the role of the state should at the turn of the millennium be related to market-enhancing policies than heretofore. The prevailing fashion for 'competitiveness' has led to increasing attempts to go further than this in fostering 'dynamic comparative advantage' by subsidizing and otherwise encouraging clustering of industry (often in a fashion which is competitive with other states — even within a customs unions (the EU is a prime example) and encouragement of 'indigenous' research and development (Ghauri & Buckley, 2002; Cantwell, 1989). The MNE–government interaction and its impact on each other is illustrated in Table 9.1.

These market-enhancing state policies, fuelled by the rhetoric of competitiveness (Oxelheim & Ghauri, 2004; Porter, 1990) have encouraged competitive bidding for inward FDI and have led to escalation in the effective locational subsidy for multinational firms. To make things worse, there has been no effective international control, governance or even coordination of the process. As a result, international institutions (IMF, World Bank and WTO) are not capable of exercising global governance. Instead, they are perceived to be guarding the interest of the developed countries, "global governance without global government" (Stiglitz, 2002, p. 21).

Table 9.1: MNE/government interaction.

Government policies	**Impact on MNE strategies**
• Subsidizing industries • Educational improvements • Markets • Stronger markets and poverty reduction • Developing export processing zones • Regionalization	• Increased local competition • Potential to recruit managers, scientists and develop new technologies in developing countries • Development of new products specifically targeted at developing markets • Export platform opportunities • Decreased opportunities for investment tournaments
Strategies of MNEs	**Impact on government policies**
• Multiple sourcing • Reduced unskilled labour component in production and services • Risk management (shift away from political to financial risk) • "Flexibility" • Local sourcing	• Increased competition between different host countries • Reduce FDI in developing markets • Need to encourage local industries • Variable impact depending on financial "soundness" • Insourcing, create incentives • Danger of increasing "footloose" investments • Increased spillovers and linkages

Following the collapse of the state-dominated and centrally planned economies, firms are increasingly gaining monopoly powers; there is a general feeling that the functions of state require reformulating and refocussing. The main problem in redefining the state's role is that the basic conditions are constantly changing. Market failure and the concern for equality provide for economic rationale for government intervention. However, there is no guarantee that any such intervention will benefit the society. As we have seen in the Asian crisis, government failure is equally possible as is market failure (Ghauri, 1999). Thus, the challenge is to see that the political process and institutional structures get the incentives right, so that their interventions actually improve social welfare and economic development (Ghauri & Buckley, 2002; IBRD, 1997).

Table 9.2: Reinvigorating functions of state.

State capabilities	Handling market failure	Improving equality
Minimal functions	Providing basic public goods and services	Protecting the poorest
Intermediate functions	Management of environment; regulating monopolies; providing social benefits	Providing social insurance
Activist function	Coordinating markets and private activities	Redistribution of assets

Source: Based on IBRD (1997, p. 27).

The task of the state is first to match the state's role to its existing capability — to establish the institutional rules and norms that will enable the state to provide collective goods and services efficiently — and secondly, to reinvigorate the state's capability through rules, partnerships and competitive pressures from outside and within the state. According to IBRD, the functions of the state can be represented as a continuum from activities that should not be undertaken without state intervention, to activities in which the state plays an activist role in coordinating the market or redistribution of assets, as illustrated in Table 9.2.

Firstly, countries with low state capability need to focus on minimal basic functions such as provision of public goods, property rights, macroeconomic stability and basic infrastructure. Secondly, there are intermediate functions such as the management of environment, regulation of monopolies and provision of social benefits. Again, in these functions, it is not a question of whether the government should or should not intervene, but rather how best to intervene. In this case, government can work together with market and society. Thirdly, states with strong capabilities should play a more active role in dealing with problems related to market imperfections. Due to excessive and imposed liberalization and privatization (e.g. in basic services such as railways, post offices, health care and education), the state is loosing power and is unable to address externalities such as regulating monopolies, providing social insurance, redistribution of assets and attempting to redress information imperfections.

Rethinking the role of state also means that it has to explore alternative instruments and ways to enhance the effectiveness of its policies. The regulatory role of the state has become broader and more complex than before. The regulatory action needs to fit with the capabilities of state regulatory agencies and the sophistication of the market. The state's responsibility for providing basic services — education,

health, etc. — has become doubtful. The state's responsibility has to be based on its capabilities and the relative strength of the market and society. To protect the weaker part of society and to improve equality, it has to differentiate between insurance against the unexpected (unemployment, etc.) and provision of a minimum level of living conditions for the poorest.

3. Developed versus Developing Countries

In the discussion on developed versus developing countries, governments of developing countries are the most vulnerable. The role of the governments and government bodies of developing countries is relatively more crucial than the role played by these bodies in developed countries. The government bodies in developing countries regulate their economies not only to secure the best interest of their population, but also to safeguard local firms. Governments aim to plan their economies to seek goals which they believe a purely market outcome will not secure. Globalization and the imposed liberalization based on assumptions that market forces, free from government control, will automatically generate economic development has proven to be highly questionable. The disparity in the benefits of globalization is much greater now than 50 or 100 years ago. Almost half of the world population, 2.8 billions out of 6 billions, lives below poverty level, less than $2 per day. The distribution of prosperity and benefits of globalization and development are extraordinarily unequal (Ghauri & Buckley, 2006; Stiglitz, 2002).

In spite of all the hype about China and India, China with almost 21 per cent of the world population, has a share of less than 6 per cent of world exports (goods and services). While India, with more than 17 per cent of the world population, has only 1 per cent of the world exports (The Economist, 2005). On the other hand, United States and Germany have been the biggest exporters in the world for several decades without causing any worries or concerns for the advocates of globalization (The Financial Times, 2006). These facts thus take the stance of developing countries versus developed countries, or governments from developing countries versus MNEs to another level and shed a different light on the imbalances and discussion on development versus underdevelopment. It seems to be inherent in the present situation that we see an inharmonious conjunction of the strategies of MNEs and government policies, particularly in the developing world. For MNEs — government relationship in general, however, we need to consider the fact that markets are not perfect and both firms and governments are attempting to appropriate rents in a world of imperfect markets (Buckley & Ghauri, 2004). This opens up the possibility of collusion between

governments and MNEs in dividing rents and mitigating conflicts between them, contrary to the needs of the society or development.

It is a fact that as a result of globalization, however, government-induced market imperfections are declining in most developing markets and now there are some strong and competitive local firms that can beat off the entry of foreign firms. In the last decade, due to the changing conditions in the world economy discussed above, macro-economic determinants rather than the micro-economic determinants have become more important. Factors such as; the investments or capital flow to countries where it can achieve highest returns, the market size or potential for local sales and benefits which can be achieved through local sourcing, have become more important (Ghauri & Buckley, 2002; Brewer, 1993; Pfefferman & Madarassy, 1992; Contractor, 1991). In addition, it has been suggested that due to agglomeration effects the investments flow to the markets where a certain level of FDI is already in existence. This means that firms investing abroad go to countries with a good quality infrastructure, communication, transport, energy and a certain degree of industrialization, in other words, to relatively developed countries and regions.

The emergence of China and India as major players in the world economy has already had an impact equal to that of Japan in earlier decades of the Post War World. An initial, almost blanket acceptance of the FDI has now become more targeted in terms of priority sectors and regions. China and India are also developing their own brands and are quite active in investing in the developed economies; Lenova and Corus are just some examples of western firms that have been taken over by firms from these countries.

4. Conclusions

The dynamic process of globalization can be characterized by a sequential process running from macro developments in the world economy to MNE/policy interactions at regional and national levels which has a major impact on local development (see Figure 9.1).

The interaction between MNEs and national and regional governments can be similarly characterized as a sequential process heading from the policies of (developing) countries and regions to the impact on MNEs and through their strategies to an impact on (developing) markets. From the "black box" of MNE/Government interaction, we observe outcomes which impact on economic development, particularly in developing countries. Recursive elements and interaction between, international institutions, government policies and strategies of MNEs are main mechanisms to factors that influence development. Our analysis suggests that

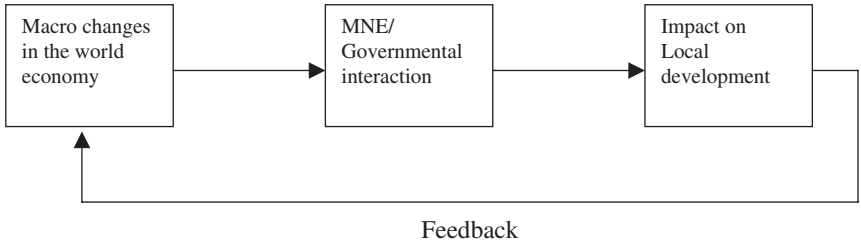

Figure 9.1: Globalization as a sequential process.

external impact of MNE strategies as they consolidate their control on the global economy through scarce knowledge and resources needs to be investigated. The impact of these strategies, combined with the state losing control, on development and society in general is rather detrimental. Moreover, in the age of abundance and prosperity in one half of the world is creating poverty, inequality, political instability and moral decay in the other half that need to be addressed.

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