MERIT-Infonomics Research Memorandum series

FDI spillovers, absorptive capacities and human capital development: evidence from Argentina

Rajneesh Narula & Anabel Marin

2003-016

MERIT – Maastricht Economic Research Institute on Innovation and Technology

PO Box 616
6200 MD Maastricht
The Netherlands
T: +31 43 3883875
F: +31 43 3884905

http://www.merit.unimaas.nl
e-mail:secr-merit@merit.unimaas.nl

International Institute of Infonomics

c/o Maastricht University
PO Box 616
6200 MD Maastricht
The Netherlands
T: +31 43 388 3875
F: +31 45 388 4905

http://www.infonomics.nl
e-mail: secr@infonomics.nl

FDI spillovers, absorptive capacities and human capital development: evidence from Argentina

Rajneesh Narula and Anabel Marin

Second draft 19 July 2003

Executive Summary

It is nowadays generally accepted that inward foreign direct investment (FDI) is crucial as a source of technological spillovers. One of the objectives of this paper is to review the evidence on the quantity and quality of human capital employed by domestic and foreign firms. We examine whether spillovers accrue from MNE activity, and provide a preliminary understanding of why MNE spillovers remain somewhat ambiguous, particularly in developing countries, paying particular attention to human capital development. Our analysis is supported by data from the Innovation Survey in Argentina. On the whole, MNE subsidiaries hired more professionals than domestic firms of the same size, possessed a more skilled labour force overall, and spent more on training than similar domestic firms. Subsidiaries in Argentina effectively have a higher labour productivity and pay higher wages. Yet, in terms of knowledge creation and utilisation, there was little to differentiate affiliates from domestic firms.

While there is little evidence of widespread FDI spillovers, where spillovers did occur, it was where domestic firms demonstrated high investment in absorptive capacities. Our analysis also suggests that much of MNE activity – particularly after liberalisation - has been of the kind that by definition has limited opportunities for linkages and spillovers. These are activities in which MNEs may simply be able to generate economic rent from their superior knowledge of markets, and their ability to efficiently utilise their multinational network of affiliates. These assets are not generally easily spilled over to domestic firms.

Corresponding address:
Professor Rajneesh Narula
Copenhagen Business School,
Department of Intl Econ and Mgmt,
Howitzvej 60,
2000 Frederiksberg, Denmark.
Fax: + 45 3815 2500
e-mail: rn.int@cbs.dk

Acknowledgements: we are grateful for comments provided by Isabel Alvarez, Anne Harrison, Kee Beom Kim and Evis Sinani on an earlier draft.

FDI spillovers, absorptive capacities and human capital development: evidence from Argentina

Rajneesh Narula and Anabel Marin

1 Introduction

It is nowadays generally accepted that attracting and embedding inward foreign direct investment (FDI) has important development effects because FDI represents an important source of technological spillovers. Although not the only means available, spillovers from FDI are regarded as one of the most practical and efficient means by which industrial development and upgrading can be promoted (Narula and Dunning 2000). Indeed, attitudes towards MNEs and their importance for economic growth have converged over the last two decades, so much so that inward FDI is actively sought by most developing countries.

Indeed, FDI is nowadays actively being promoted by the Washington consensus as a panacea for economic development. Structural adjustment programmes prominently integrate macroeconomic stabilization policies alongside policies to promote increased inward FDI. In 1998, for example, 103 countries offered special tax concessions to foreign corporations that set up production facilities within their borders (Hanson, 2001). Other popular policy tools include the extension of tax holidays, exemptions from import duties and direct subsidies.

While the *potential* for MNE-related spillovers is clear, as are the opportunities for industrial upgrading there from, it is increasingly acknowledged that the nature, level and extent of the benefits vary considerably. Indeed, under certain circumstances, FDI may not result in significant spillovers, and even where these occur, sometimes these spillovers may accrue to the foreign-owned sector rather than to the domestic sector (Katrak 2002).

One of the most significant aspects of *potentially positive* spillovers are those associated with and through human capital development. There are two modalities by which MNEs can influence human capital in the host country:

1. Spillovers can occur through *direct* means, as MNEs contribute to the generation of employment in the host country, which is to say they

increase the employment level *quantitatively*. At the same time, MNEs can also cause direct increases in the *quality* of the domestic workforce, by providing formal and informal training, as well as through the process of learning-by-doing to transfer their superior technological knowledge to their domestic employees.

2. Spillovers can occur through *indirect* means, also both quantitatively and qualitatively. On a quantitative level because domestic suppliers and customers are expected to increase their own employment as a direct consequence of the increased economic activity due to MNE participation in the economy. On a qualitative level, firstly because MNEs affiliates are expected to provide training and technical assistance to domestic suppliers and, secondly, because domestic firms are expected to have access to more productive pools of potential employees who have been trained by MNE affiliates in newer and more productive technologies.

One of the objectives of this papers is to review the evidence on spillovers accruing from MNE activity, and provide a preliminary understanding of why MNE spillovers remain somewhat ambiguous, particularly in developing countries, paying particular attention to human capital development. Our analysis is supported by data from the Innovation Survey in Argentina (1992/1996). Argentina is a particularly interesting example for this study given that (as a result of rapid FDI growth in the 1990s) its manufacturing industry has become heavily dependent on foreign firms: 49.6 % of the largest industrial firms in 2002 were MNEs. When joint ventures are included, this figure rises to 77%. Moreover, Argentina has had a historical dependence on MNEs, and is regarded to have achieved a threshold level of absorptive capabilities. The Innovation Survey in Argentina, following the broad framework of the Oslo Manual, covers numerous aspects of the economic and technological behaviour of 1533 firms (283 of which are MNEs). The survey sample is representative of the universe of industrial firms in the country, and includes 50% of the total industrial firms, which account for 53% of total sales, 50% of total employment, and 61% of total exports (Annex 1 describes the firms and information covered by the dataset).

The structure of the paper is as follows. Following this introductory section, section 2 discusses some of the reasons why MNEs are considered a key agent for human and technological development. In section 3 we investigate direct and indirect effects from FDI in the case of Argentina. Different possible determinants or factors explaining diversity of results are explored in section 4. Finally, section 5 discusses broader conclusions.

2. The role of MNEs in global human capital: why the fuss?

Despite the importance given to MNEs, they do not account for a dominant or even a major share of the world's economic activity. As table 1 shows, in terms of employment, the world's top 100 non-financial MNEs employed 14.3 million of the total 1.8 billion people employed worldwide in 2000, which represents less than 1% of total employment. Examining the same ratio for the entire universe of MNEs worldwide in the same year, MNEs employed only 3% of the total world economically active population (EAP) and 6% of total people employed around the world.

*****Table 1 about here*****

As table 1 also illustrates, MNEs play an even less significant role in the developing regions, where MNEs are estimated to represent less than 2% of total employment. Thus, the contribution to domestic employment from FDI does not seem very impressive, from a quantitative point of view at least.

Despite the relatively small role of MNEs on an aggregate level, the situations differ substantially across countries. As table 2 shows, MNEs account for less than 5% of the total employment in countries such as Japan and Indonesia, but this figure rises to well over 40% in countries such as Malaysia, Argentina and Ireland.

*****Table 2 about here*****

In addition, MNEs tend to have two characteristics that make them stand out. First, MNEs have been found to be concentrated in the more 'dynamic' sectors of the economy (Harrison, 1999). Thus, even though they play a relatively small role in most economies in terms of level of total employment, MNEs often play a disproportionately large role in two very different types of industrial sectors. On the one hand, they tend to concentrate their activities in the more competitive or dynamic sectors typified by high growth rates and the use of new and emerging technologies (e.g., electronics, communication equipment, and industrial machinery). On the other, MNEs tend to dominate in mature sectors where economies of scale, branding and advertising determine market share (e.g., petroleum products, chemicals, automobiles, food and beverages and consumer goods). In such sectors, while the technology underlying these industries may be diffused and codified, capital limitations and marketing capabilities have meant that just a few MNEs maintain a large share of the global market. Based on data from Argentina, Table 3 illustrates this trend well.

*****Table 3 about here*****

In Argentina, foreign firms have a very strong participation in sectors such as electronics (78% sales and 65% of total employment), communication equipment (49% of sales and 50% of total employment) and machinery and equipment (46% of sales and employment). They also dominate sectors such as petroleum (89% of sales and 79% of employment), chemicals (66% of sales and 57% of employment) and rubber and plastic products (66% of sales and 56% employment).

The second reason why MNE activity has significant policy implications is that the share of MNEs in both types of sectors have been seen to be increasing, largely due to the policies associated with the so-called new economic model (NEM). The increased role of MNEs in certain sectors is in part a result of aggressive liberalisation of FDI regimes and privatisation programmes. Indeed, the greatest change has been the reduction in state ownership and the subsequent privatisation of assets. Between 1988 and 1999, $107.3 billion worth of privatised firms in the developing countries had been acquired through cross-border M&A. The share of Latin America and the Caribbean was roughly 79.8%

(UNCTAD 2000). In other words, during this period, about 20% of the total inflows to this region were associated with privatisation. During the period 1999-2000 alone, privatisations totalled US$ 19.5 billion (ECLAC 2001).

Argentina is again a good example of this phenomenon, as it liberalised its economy along the lines of the NEM in the 1990s[1] and the role of FDI increased most significantly in those sectors most affected by liberalisation, deregulation and new investment incentives to attract foreign capital. Table 4 shows changes in FDI participation in total sales by sector of activity between 1990 and 1998. For example, FDI participation in the telephony services sector increased from less than 1% before 1990 to 100% in 1998. The same can be said for utilities, which include electricity, gas and water services, and the informatics and communications equipment sectors. Also, sectors such as minerals, fishing, chemicals, petroleum, and pharmaceuticals benefited by liberalisation to external capital after the structural reforms at the beginning of the 1990s.

*****Table 4 about here*****

The growth of MNEs and their dominance of certain sectors is often associated with their pre-eminent position in the creation and ownership of technological assets. That both developing and developed countries alike can benefit from spillovers accruing from MNE activity is not disputed, as these assets are proprietary and are not easily duplicated. 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 among countries and specially, from developed to developing countries.

3. Examining direct and indirect effects of FDI in Argentina

There is considerable evidence to indicate that spillovers may not occur in as efficient a manner as the neo-classical economic theory might suggest. Indeed, much of

[1] As an example, in 1969 tariffs in Argentina averaged 61% with a dispersion of 103%, in 1990 this average dropped to 17% with a dispersion of only 31%, and tariffs were further reduced later on (a very limited number of sectors escaped full liberalisation, such as automobiles).

the evidence on developing countries points to very limited indirect benefits from FDI. Non-significant or negative spillovers have been obtained previously also by Haddad and Harrison, (1991 and 1993) (Morocco), Aitken and Harrison (1999) (Venezuela), Braconier *et al,* (2001) (Sweden) Chung, 2001 (USA), Konings, (1999) (Bulgaria and Romania), Djankov and Hoekman (2000) on the Czech Republic. We examine below the evidence for Argentina.

3.1 Direct effects

Human capital development plays a crucial role in the dissemination of technological knowledge from MNEs to the domestic economy. Indeed, the labour market is one of the main ways in which new technological knowledge is expected to disseminate to the domestic economy through two means. First, there should be a tangible increase in the employment levels of workers in the host location. Second, there is expected to be an increase in the quality of the workers potentially available to work in other companies or start their own companies in the same country. This second opportunity for direct spillovers is through the (expected) provision of formal training and education to their workers or potential workers. However, there is no concrete evidence that MNEs always train employees, and where they do so, there is considerable variance in the quality of this training (for recent reviews, see e.g., Ritchie 2002, JIBICI 2002). Moreover, FDI in certain locations seek unskilled labour to perform simple assembly-type or resource extractive activities. Although the employment and training of unskilled labour also provides spillovers, these are regarded as being of a smaller magnitude, particularly in a middle-income country such as Argentina.

In this sub-section the evidence for the Argentinean case is used to evaluate subsidiaries' direct contribution to domestic human capital development relative to their domestic counterparts. Table 5 shows the results of the comparison. The variables evaluated are: the use of professional workers (engineers and other professionals in production and R&D activities), an index of skills (professionals/non-professionals workers), and the total expenditure in training activities.

Most measurements in Table 5 are reported as differences across foreign and domestic firms in percentage. Thus, for example a value of 27% in the first column for all

sectors indicates foreign firms hire 27% more professionals than domestic firms, even after adjusting for size (measured by total number of employees), which is significant at the 1% level.

*****Table 5 about here*****

On average for all sectors, subsidiaries hired more professionals than domestic firms with the same size, possess a more skilled labour force, and spend more in training than similar domestic firms. In addition between 1992 and 1996 they improved the skills ratio more than domestic firms did. There are however, some exceptions when each sector is evaluated individually[2]. For instance, there are 6 sectors (out of 19) where domestic firms spent more than subsidiaries in training (leather, printing, stone, clay, primary metal industries, fabricated metal products and precision), and 3 sectors where domestic firms employed more professionals (printing, stone and primary metal industries). Moreover, in the more dynamic sectors such as electronics, machinery and motor vehicles the differences are not significant (with exception of skills for machinery).

The next section discusses indirect effects and the possibilities for technological upgrading in other firms / domestic institutions derived from FDI.

3.2 Indirect effects on domestic firms and other external economic agents

MNEs subsidiaries need to interact with domestic external economic agents (in particular, firms and non-firms) in order to carry out their normal operations in the country, and these interactions constitute one of the ways in which skills and technological transfer are expected to disseminate to the rest of the economy.

While the most significant aspect of indirect spillovers occurs due to domestic firms, Linkages with domestic non-firm actors are another way in which technologies and skills introduced/developed by subsidiaries might disseminate to the rest of the economy.

[2] Annex Table A1 shows the number of foreign and domestic firms by sector. These are the base number of observations used to compare across sectors.

The non-firm sector consisting of public research institutes, universities, organisations for standards, intellectual property protection, etc that enables and promotes science and technology development (see Narula 2003a for a discussion). UNCTAD (1999) gives several examples of cases where MNEs give formal financial and technical support to domestic educational institutions in host countries. The Argentinean survey asked subsidiaries about their domestic linkages with institutions, specifically, the number and type of domestic institutions of science and technology they contact in the country, and how often they interacted with them. Subsidiaries interacted with domestic institutions of science and technology more often than domestic firms on average, therefore in this sense subsidiaries are not less embedded than domestic firms in the case of Argentina. Thus, this represents an alternative channel for technology transfer and human capital development. Indeed, through their linkages with domestic institutions foreign firms may transfer knowledge and know-how to workers in domestic institutions, and in this way domestic firms might also benefit indirectly to the extent they also use these same domestic institutions. However, data in the survey does not permit us to evaluate the extent and efficacy of this modality, and we must necessarily concentrate here on indirect effects to the domestic firm sector.

3.2.1 Spillovers to domestic firms

In many cases the transfer of technological knowledge to domestic agents might occur through backward and forward linkages when MNEs provide training and technical assistance to their local suppliers, subcontractors and customers. But local competitors might also benefit from subsidiaries presence when; 1) subsidiaries demonstrate new technologies and new ways to use them, or when 2) highly skilled staff, trained in the foreign firm move to incumbent domestic plants taking with them knowledge acquired in the affiliates.

The effects from increased competition due to FDI are not so clear. Ideally, increased competition resulting from FDI might induce domestic technological

improvements by contributing to the elimination of inefficient indigenous firms, encouraging the birth of new innovative firms and, inducing local firms to react to the foreign threats by assimilating foreign technologies and mobilising resources. But, as noted by Caves (1974) and Chung (2001) this effect should not be considered a spillover effect because it does not involve any flow of knowledge. In addition, as noted by Aitken and Harrison (1999), an increased competition associated with foreign presence might also reduce productivity of domestically owned firms if foreign firms draw demand from them and they have to cut production and increase costs [3].

Indirect effects are usually evaluated empirically by analysing the level or change in productivity of domestic firms that are in some way related with MNE affiliates. The assumption is that technological spillovers are reflected in productivity improvements of the domestic firms. The ideal way to evaluate these effects would require us therefore to identify domestic competitors and suppliers. But due to limitations on data about linkages between the two groups we follow common practice and analyse productivity improvements of domestic firms localised in the same 5-digit sectors as the subsidiaries[4].

We model MNE contribution to the technological change of domestic firms within the context of a production function[5]. The results of the externalities or spillovers from FDI are expected to affect domestic firms' productivity growth. FDI is treated as an additional "input" explaining productivity growth, and the coefficient of the FDI regressor is taken as evidence consistent with spillovers from FDI to the domestic sector. Variations of the following basic equation (equation 1') were used to investigate these effects:

$$\Delta \ln Y_{ij} = \lambda \Delta \ln Input_{i} + \delta \Delta FDI_{j} + \Delta \varphi FDIt_{i} + \eta Z_{ij} + G_{i} + I + \varepsilon_{i} \quad (1')$$

[3] Indeed there is no agreement about the relationship between FDI, competition and technical change in domestic firms. Conventional wisdom has mostly argued that FDI will introduce more competition in local market and therefore that local efficiency will be improved. However, some empirical works have found that FDI may increase concentration rather than competition, although it is also argued that some times concentration may promote innovation.

[4] Due to the lack of data we were not able to test for the possible presence of regional or inter-sectoral spillovers.

[5] Annex 2 explains the derivation of this model.

In equation (1') the subscripts *i* and *j* denote plant and industry, Δ represents changes in the variables between 1992 and 1996, and λ, δ, φ, and η the parameters to be estimated. *Y* denotes added value at plant level, *Input*, its use of normal inputs, FDI is a measure of FDI participation at industry level and plant level denoted by subscripts *i* and *j* respectively. *G* is a categorical dummy variable that distinguishes independent domestic firms from those that are part of an economic group, and *I* is the 2-digit industry where the firms operate.

For *Input* we use I/Y (instead of capital as explained in Annex 2), and total employment. *FDI* is the share of total employment in industry *j* accounted for by foreign owned plants. The participation in employment (rather than capital) by industry was chosen as an indicator of FDI participation as the turnover of workers seems the more obvious channel for intra-sectoral spillovers effects. MNE subsidiaries are those plants with at least 10% foreign equity. Finally, *Z* includes a set of additional variables that may affect TFP growth in domestic firms:

a) Δ Knowledge Capital[d] = Changes in R&D expenditures reported by the domestic firms plus changes in the expenditures on new equipment specifically oriented to products or process innovation[6];
b) Δ Skills = Changes in the ratio of professional/non-professional workers (professionals include engineers and other professionals in production, administration and R&D);
c) Δ Comp = Changes in competition.

We expect that increases in R&D expenditures and in skills will positively affect changes in total factor productivity since this affects domestic firms' knowledge capital (Griliches 1991). Consequently, we control for these variables in order to compare domestic firms with the same potential for increasing total factor productivity and to be able to isolate the effects of FDI into domestic firms' productivity growth.

[6] R&D expenditures are not a good indicator of the efforts made by firms in developing countries in knowledge capital augmenting, since these efforts are generally not formalised in R&D activities in these type of countries. Consequently we have included expenditures in equipments for product or process innovation as an additional indicator of these efforts.

As discussed earlier, FDI might also affect the level of competition in local markets, and through this channel, domestic firm's survival, behaviour and performance. To control for this effect, following Sjoholm (1997), Chung (2001), and Haskel et al (2002) we introduce in the regression four measures of potential competition: 1) the level and changes in mark-up or rents at firm level, 2) changes in market share at firm level, 3) changes in import penetration at the 5-digit industry level, and 4) changes in industry concentration measured by the changes in the Herfindahl index. Mark-up is calculated as the difference between sales and costs over total sales, so decreased mark-up indicates heightened competition, with firms' prices decreasing towards costs. Changes in market share is measured by increases in the firms' sales of own products as a proportion of the five digits industry sales, and changes in import penetration are the changes in total import over total sales by 5-digit industry. We expect that - to the extent that these indices reflect changes in the levels of competition- changes in allocative and technical efficiency produced by an increased FDI should be captured by the index. Additionally, these variables should also capture changes in other unobservable variables that affect competition and that might have disciplined the domestic industry to become more efficient. Improvements in the efficiency of domestic industry are particularly relevant, as Argentina undertook significant market reforms during the period in question.

By using a plant level specification and modelling in first differences -with a time lag of 4 years- we control for fixed differences in productivity levels across industries, which might affect the level of foreign investment. In this way, we address the identification problem observed by Aitken and Harrison (1999) who have shown that in industry level cross section studies a positive result might reflect the fact that foreign firms are attracted to the more productive industries rather than a spillover effect[7].

In addition, this specification and the inclusion of industry and group dummies correct for the omission of unobservable variables that might undermine the relationship between FDI and productivity growth of domestic firms. By observing changes over the time we remove plant-specific and industry and region fixed effects such as differences in the long-term strategy of the domestic firms, the regional infrastructure and differential

[7] We cannot completely rule out the possibility of spurious correlation if there are industry characteristics that change over the time and affect FDI localisation.

technological opportunity of the industries. The dummies control for characteristics of domestic firms that belong to an economic group or that operate within particular sectors, and that to the extent that they affect productivity growth of domestic firms, this might affect the relation between FDI increases and productivity growth in these firms[8].

The expanded equation is thus[9]:

$$\Delta \ln Y^{d}{}_{i} = \alpha_1 \Delta \ln L^{d}{}_{i} + \alpha_2 \frac{I_i}{Y_i} + \alpha_3 \Delta FDI_{j} + \alpha_4 FDI_{i} + \alpha_5 \Delta Skills_{i} + \alpha_6 \Delta CK_{i} + \alpha_7 \Delta MSh_{i}$$

$$+ \alpha_8 \Delta Markup_{i} + \alpha_9 Markup\ \eta_{i} + \alpha_{10} \Delta Concen_{j} + \alpha_{11} \Delta \mathrm{Im}\ pen_{j} + G_{i}^{d} + I_{j} + \varepsilon_{i}$$

Table 6 shows the results for two different specifications used in order to investigate the effects of FDI on productivity growth. Column (1) reports the results of the OLS estimation column (2) the results for the WLS estimation, controlling for size of firms. The coefficient for ΔFDIj measures indirect effects or spillovers and the coefficient for FDIi the direct effects. Thus, if the technology superiority of foreign firms spreads at industry level to domestic firms the coefficient of ΔFDIj should be positive, and if foreign ownership increases the productivity of the plants, then the coefficient for FDIi should also be positive.

*****Table 6 about here*****

[8] There might still be a bias in the estimators if there are important unobservable variables that change across firms and over the time (such as managerial abilities). However, corrections for this possible bias as noted by Griliches and Mairese (1995) require restrictive assumptions about markets and might introduce additional biases.

[9] Where:

$\Delta \ln Y_{i}$	=The log change in total sales
$\Delta \ln L_i$	=The log change in total employment
I/L_i	=Total investment over total product 1992
$\Delta FDIpart_j$	=The change in FDI participation by industry measured by the change in the share of foreign employment over the total employment of the industry at the five-digit level
$\Delta Skills_i$	=The change in the ratio professional/non professional workers
ΔKC_i	=The log change in R&D expenditures plus the log change in the expenditures in new equipment for product and process innovation
ΔMSh_i	=The change in market share
$\Delta Markup_i$	=The change in mark-up measured by the difference between sales and costs over total sales–firm level
$Markup_i$	=The level of mark-up in 1992
$\Delta Concenj$	=The change in Herfindahl index- industry level
$\Delta Impen_j$	=The change in import penetration –industry level
ε_i	$= \Delta u_i$

As can be seen in table 6, the added value of the firms in Argentina increases with changes in the employment of domestic firms, their knowledge capital, skills, market share and the import penetration at the industry level. In addition, the OLS estimations indicate that foreign ownership contributes to productivity growth of the firms. However, changes in FDI participation at industry level seem not to contribute to productivity improvements of the firms in the same industry: in both cases the coefficient is positive but not significant. In addition, when using WLS instead of OLS in order to control for firm size (column 2), the coefficient for FDIi becomes insignificant. So, for firms of similar size foreign ownership does not seem to contribute to productivity growth.

In line with previous studies that have used panel data therefore, we find no evidence of technological spillovers (or dynamic externalities) from FDI in Argentina between 1992 and 1996. Benefits of foreign firms' activities in the Argentinean economy are not reflected in domestic firms' value added growth, even when these activities have in theory a high potential for technological spillovers. This is somewhat surprising, since we earlier found foreign firms on average develop domestic human capital to larger extent than domestic firms. However, the impact on domestic firms value added growth of these "superior" activities and performance is not reflected in domestic firms' value added growth.

There are several possible explanations for these results. Foreign firms' activities might affect other qualitative dimensions rather than value added growth of domestic firms, and these effects may not be captured by the traditional production functions approach. It might also be that the time lag used (4 years) is not appropriate to capture the effects of the foreign firms activities on domestic firms' value added [10].

However, as we will discuss in section four, there are two other possible explanations for this apparent absence of spillovers. First, it may be a result of MNEs type of operations in this host country, such that there are very limited spillovers, and

[10] However, according to Mansfield and Romeo (1980), this time lag seems adequate. In their study, US MNEs reported that the technologies deployed to their affiliates abroad reached host country competitors anywhere from zero to 6.5 years with a model response of 0.5 to 1.5 years and a mean of about 4 years.

second, it might reflect an insufficient absorptive capacity on the part of domestic firms such that they are unable to internalise the benefits of foreign firm's superior activities.

4. What determines the extent of the benefits from FDI?

The evidence in the case of Argentina confirms much of the literature in that the benefits from MNE spillovers are not always positive or tangible, and that the extent to which spillovers and linkages occur is intermediated by a number of factors. These factors can be classified into two categories:

1. Those associated with the MNE;
2. Those associated with the absorptive capacity of firms and countries.

These two factors are themselves highly interdependent. It needs to be acknowledged that the ability of the domestic economy to benefit from MNE investment crucially depends on the relative technological capabilities of the recipient and the transmitter. And at the same time, those MNE investments will depend on domestic capabilities.

4.1 MNE-specific factors.

The previous sections have demonstrated that FDI does not automatically lead to positive externalities. It is important to realise that MNEs are not in the business of economic development, and rarely interested in the explicit transfer of knowledge. *Ceteris paribus*, they prefer to use technologies that are suited (first and foremost) to their own needs, *and the purposes for which they have made the investment*. MNEs do not make available their proprietary assets at the whims of governments; rather they tailor their investment decisions to the existing market needs, and the relative quality of location advantages, especially skills and capabilities in which the domestic economy has a comparative advantage (Lall 2002: 17).

4.1.1. The nature MNE firm-specific assets

There are two points we wish to make: First, that while it is a reasonable assumption that MNEs are in possession of superior firm-specific assets, the assets that they bring to any given location are not always those which domestic firms necessarily seek to acquire- or even – *are able to acquire*. Keep in mind that the MNE's competitive advantages derive from two types of firm-specific assets: First there are those associated with technological assets in the traditional sense of being technological/engineering assets, such as machinery and equipment, and in the personnel who operate and maintain them. These are asset-specific ownership advantages, and it is these that the neo-classical and neo-technology economics literature concentrate on as being the source and basis for spillovers (see e.g., Markusen 1998, Carr et al 2001). The second type of firm-specific assets are those associated with conducting transactions efficiently, that derive from being able to generate rent by virtue of superior use of intra-firm hierarchies, both within and across national borders. In addition there are those that derive by virtue of the multinationality of the firms and can be termed 'advantages of common governance'. These are transaction-type firm-specific assets (see Dunning 1993, Cantwell and Narula 2001). Although the economics literature does not acknowledge this, *MNEs can exist in the absence of technology type ownership advantages, generating rent simply from its superior knowledge of markets and hierarchies.* Thus, MNEs may possess the same (or even 'inferior') technology-type assets relative to its domestic counterparts, yet still out-compete them. For instance, simply a privileged access to a market, or the possession of entrepreneurial skills. In such cases, technological spillovers - *in the conventional way they are understood* - will not occur. However, other types of spillovers might occur, and they will affect other dimensions rather than the technological ones in domestic firms.

Second, it is an unreasonable assumption that domestic firms will automatically benefit from MNE assets, either because the domestic firms do not have the capacity to do so (discussed in the next section), or because the assets are strongly firm-specific in nature as is the case with transaction-type ownership advantages. That is, such transaction-type firm-specific assets cannot be acquired easily or through direct means, since they are highly tacit, firm-specific and largely uncodified.

This makes quantitatively measuring such spillovers incredibly difficult, and we must resort to an 'anti-monde' argument. That is to say, we must project what might occur 'in another world'. Let us begin with the fundamental assumption that the MNE must possess some kind of advantage over domestic firms. Let us further assume that there are two types of firm-specific assets which allow the generation of economic rent. If we can demonstrate that MNEs do not possess technology-type advantages over domestic firms then the MNE must be in a position to utilise the second type of asset to generate economic rent.

In order to explore these issues for Argentina we evaluate the relative performance and behaviour of both groups of firms. In table 7 the following indicators are considered: imports of inputs; exports controlled by size (sales); and real wages. Most performance measurements in table 7 are reported as differences across foreign and domestic firms in percentage terms. Thus, for example a value of 69 in the first column for all sectors indicates foreign firms on average pay their workers 69% more than domestic firms, and this difference is significant at 1%.

*****Table 7 about here*****

In general the differences indicate that foreign firms in Argentina pay higher salaries and import more in the aggregate even after controlling for size. Subsidiaries on average import significantly more inputs than domestic firms, even when the differences by size of the firms are controlled. However, they do not export significantly more than local firms. The differences in imports are significant for both years at the aggregate level (28% and 42% in 1992 and 1996 respectively)[11]. But the differences in exports are not significant on average when the size is considered[12].

---

[11] Note that when the sectors are considered individually the number of firms that import inputs in most sectors are not enough to provide statistical significance. The only sector where the difference is important and significant (and only in 1996) is petroleum refining and related industries (313%). At the same time, the difference in 1996 is significant but negative –that favour domestic firms- in the sector miscellaneous manufacturing industries (-181%). For the remaining sectors the differences are not significant in any direction.

[12] Nevertheless, for some sectors the difference is significant. In rubber and miscellaneous plastic products the difference is positive, favouring subsidiaries. In both years, in food and kindred products, precision, photographic, medical and optical goods the difference favoured subsidiaries only in 1992, and only in the

The difference in wages is an especially interesting indicator because it indicates differences in the quality of the human capital. Additionally, higher salaries for professional workers are thought to reflect improved quality of labour by introducing incentives in the labour market[13]. At the aggregate level, the difference is significant for both periods: 69% for 1992 and 70% for 1996. Additionally, in 12 out of the 20 sectors the difference is positive and significant favouring subsidiaries[14].

Turning to technological knowledge creation and use, the differences between domestic and foreign firms are not quite as large. In order to evaluate technological creation and use the following variables are used: imports of capital goods, other acquisitions of embodied technologies, investments in equipment for innovations, R&D expenditures, and use of R&D labs**.** Table 8 and 9 show the results of the comparison for these variables.

Most measurements in Table 8 and 9 are reported as differences between foreign and domestic firms in percentage. Thus, a value of -17% in the first column indicates foreign firms invest less in imported capital goods than domestic firms, even when they have similar size (measured by total number of employees).

*****Table 8 and 9 about here*****

The data suggests that subsidiaries in Argentina might be more productive than domestic firms (table 8) and pay higher wages than domestic firms. However, MNE affiliates are not head-and-shoulders ahead of domestic firms when indicators of technological knowledge creation and use are evaluated, there is little to differentiate affiliates from domestic firms. In other words, there is little evidence to suggest that superior technological assets explain their superior performance.

---

case of petroleum refining and related industries does the difference favour domestic firms in 1996 (-209%).

13 In a recent review, Lipsey (2002) concluded that, "the evidence seems to be overwhelming that foreign-owned firms in all kinds of economies pay higher wages than domestically owned firms". But he suggests at the same time that is it is not as yet clear whether these higher salaries reflect higher skills or some other effects, such as higher capital intensity or "retention salary".

14 These sectors are food and kindred product, paper, printing, chemical, rubber, stone, primary metal industries, electronic, communications, precision, photographic and medical instruments and miscellaneous manufacturing industries.

On average, subsidiaries spend more on R&D and more on the imports of disembodied technologies, but they do not use more R&D labs than domestic firms, they do not expend more resources in order to acquire embodied technologies (as measured by imports of capital goods and total investments in capital goods) and they do not invest more in equipment and machinery. Moreover, the tables show a very high frequency of situations where domestic firms perform better in all these dimensions.

The evidence would therefore suggest that some MNEs operating in Argentina are able to generate rents not based exclusively on the local exploitation of their own superior technological assets, but also as a result of superior transaction-type ownership advantages. Moreover, as we have suggested before, this might be one of the explanations for the absence of clear evidence on technology spillovers despite the increased participation of FDI in Argentina.

The literature on spillovers also tends to ignore another important factor*: that not all MNE subsidiaries will provide spillovers and linkages to the same extent.* By way of example, the potential for spillovers and linkages from a warehouse and distribution facility are fundamentally different from a manufacturing affiliate. Furthermore, not all subsidiaries are embedded in the local economy: some affiliates are weakly embedded (say in the case of an affiliate in an export processing zone). The extent of embeddedness of a subsidiary is a function of many factors. The next subsection discusses this issue.

4.1.2 Motives of investment as a determinant of spillovers

The motive of an investment helps to determine (in conjunction with the host-country specific factors) the kind of MNE affiliate and therefore the potential for spillovers. It is generally acknowledged that there are four main motives for investment: to seek natural resources; to seek new markets; to restructure existing foreign production through rationalisation, and to seek strategically related created assets (Narula and Dunning 2000). These in turn can be broadly divided into two types. The first three represent motives which are primarily asset-exploiting in nature: that is, the investing company's primary purpose is to generate economic rent through the use of its existing firm-specific assets. The last is a case of asset-augmenting activity, whereby the firm wishes to acquire additional assets, which protect or augment their existing created assets

in some way. In general, developing countries are unlikely to attract much asset-augmenting FDI. In general, developing countries have tended to receive FDI that is primarily resource-seeking, market-seeking or efficiency seeking, and the relative importance of each is a function of the stage of economic development which itself is a function of the quality of its absorptive capacity (Narula and Dunning 2000, Narula 2002). Least developed countries will tend to have a predominance of resource-seeking FDI, while in countries such as Argentina, which can be regarded as being in the catching-up stage, a majority of FDI might be directed towards market-seeking, while efficiency seeking investments would be the exception rather than the rule. Resource-seeking FDI would still be important, but of less significance than market-seeking FDI. As countries approach the frontier (e.g., NICs), efficiency seeking FDI will tend to dominate.

Once the decision to enter a given market through FDI is taken, the kinds of activity and the level of competence of the subsidiary are co-determined by the nature of the location advantages of the host location. That is to say, while MNE internal factors such as their internationalization strategy, the role of the new location in their global portfolio of subsidiaries, and the motivation of their investment are pivotal in the structure of their investment, they are dependent on the available location-specific resources which can be used for that purpose. Indeed, the host country's location advantages play an important role in determining the level of embeddedness of the subsidiary (Benito et al 2003), and this is the primary determinant of the quality of the FDI. This is for two reasons. First, the level of competence is a function of the quality of the location advantages that the host location can provide. High competence levels require complementary assets that are non-generic in nature, and are often associated with agglomeration effects, clusters, and the presence of highly specialized skills. In other words, firms are constrained in their choice of location of high competence subsidiaries by resource availability. For instance, R&D activities tend to be concentrated in a few locations because the appropriate specialized resources are associated with a few specific locations. Second, MNEs have been shown to prefer to engage in sequential investment in locations that provide sub-optimal returns but with which they have prior experience, because firms are known to be boundedly rational. Furthermore, while the scope of activities undertaken by a subsidiary can be

modified more or less instantly, developing competence levels takes time. MNE investments in high value-added activities (often associated with high competence levels) have the tendency to be 'sticky'. Such subsidiaries tend to be embedded with the local milieu in terms of linkages with suppliers, customers and domestic institutions. The linkages are both formal and informal, and will probably have taken years – if not decades – to create and sustain. As such, the embeddedness of firms is often (but not always) a function of how long the MNEs have been present, since firms tend to build incrementally. This has been observed to be the case in East Asia (See e.g., Rasiah 1994, 1995), but it is to be noted that firms build on location advantages *that already exist* in the host economy (Ritchie 2002), and increases in embeddedness are generally in response to improvements in the domestic technological and absorptive capacity (see section 4.2 for a discussion of absorptive capacity).

4.1.3 The Case of Latin American FDI

The point that we are trying to highlight is that not all affiliates provide the same opportunity for spillovers. A sales office may have a high turnover, employ a large number of staff, but the technological spillovers will be relatively fewer than, say, a manufacturing facility. Likewise, resource seeking activities such as mining, can be capital intensive, but also provide fewer spillovers than say, a market-seeking type of FDI. During the import substitution era, most MNE affiliates in developing countries were either of the truncated miniature replica (TMR) variety (market-seeking) or single activity affiliates (focused on resource seeking activity) (Narula 2003b). MNEs responded to investment opportunities primarily by establishing miniature replicas of their facilities at home, although the extent to which they were truncated varied considerably between countries. The extent of truncation was determined by a number of factors, but by far the most important determinants of truncation- and thereby the scope of activities and competence level of the subsidiary - were associated with market size, and capacity and capability of domestic industry[15]. Countries without a domestic sector and with low demand were host to the most truncated subsidiaries, often to the point of

[15] The determinants of truncation are discussed in greater detail in Narula (2003b) upon which much of this discussion is based.

being single-activity subsidiaries. Activities were primarily in sales and marketing, and natural resource extraction. Larger countries with domestic technological capacity (such as Brazil and India) were host to the least truncated subsidiaries, often with R&D departments.

With liberalisation, the strategies of MNEs were affected vis-à-vis their affiliates' competence and scope in four different ways (Narula 2003b). First, there was some investment in new affiliates resulting in new (greenfield) subsidiaries that did not exist previously, and secondly through sequential investment as firms upgraded the scope and competence of existing subsidiaries. Third, there was also a downgrading of subsidiaries, whereby MNEs divested their operations in response to better location advantages elsewhere, or reduced the intensity of operations by lowering the level of competence and/or scope of their subsidiary, and shifting from truncated replicas to single activity affiliates. Fourth, there was a redistribution effect as a result of privatisation activity, That is, sectors that were dominated by domestic capital were transferred to foreign ownership. This also, in many cases led to a downgrading of activities from truncated replica to single activity affiliates.

In general, greenfield investments in new affiliates in Latin America have tended to be more specialised, single or multiple activity investments associated with efficiency-seeking or resource seeking strategies, with relatively little sequential FDI. Most of the truncated miniature replicas that served small captive markets during the import substituting era were downgraded, as part of a regional rationalisation particularly in sectors where the low productivity of affiliates' production was supported through trade barriers-induced market distortions. MNEs have taken advantage of liberalisation to exploit production capacity in fewer locations to exploit economies of scale, especially where local consumption patterns are not radically different to justify local capacity and where transportation costs are not prohibitive. This has meant that some TMRs have been downgraded to sales and marketing affiliates, which can be expected to have fewer opportunities for spillovers. It is ironic that the countries that receive the kinds of FDI that has the highest potential benefits vis-à-vis human capital development are those that already have a highly developed domestic absorptive capacity. In other words, domestic capacity – whether in the form of knowledge infrastructure or efficient domestic

industrial sector - is a primary determinant of high competence foreign affiliates. Some countries have succeeded in attracting such FDI, notably Mexico, and the Caribbean Basin (ECLAC 2000, 2001, Mortimore 2000). In addition to providing domestic capabilities and a threshold level of infrastructure, these countries have invested in developing knowledge infrastructure (although to a lesser extent in the case of Mexico). Mortimore (2000) argues persuasively that much of this FDI has have resulted in creating export platforms for the MNEs, with limited benefits for the host countries involved (for a more in-depth discussion, see ECLAC 2001).

4.2 Absorptive capacity as a determinant of linkages

Kokko (1994) suggests that spillovers depend on the MNEs having a higher productivity level than domestic firms. That is, a tangible technology gap must exist. It bears emphasising that this presumes two preconditions. First, that domestic firm in the industry exist, and second, they possess the capacity to usefully internalise the knowledge being made available by the MNE (indirectly or directly). In other words, the domestic industry must possess the absorptive capacity to efficiently exploit spillovers.

It is essential that we take a systems view of an economy, and that in doing so we acknowledge that all the economic firm and non-firm actors within an industry are indivisibly interlinked. If the institutions and organisations are absent or underdeveloped, economic actors within the system will be unable to absorb and efficiently internalise knowledge. Absorptive capacity includes the ability to internalise knowledge created by others and modifying it to fit their own specific applications, processes and routines. It is worth noting that absorptive capacity is a subset of technological capability, which in addition to absorptive capability includes the ability to generate new technologies through *non-imitative* means. This does not imply that absorption is purely about imitation. Firms cannot absorb outside knowledge unless they invest in their own R&D, because it can be highly specific to the originating firm, since it has a partly tacit nature. The extent to which a firm is able to exploit external sources of knowledge thus depends on its absorptive capacity which is assumed to be a function of its R&D efforts, and the degree to which outside knowledge corresponds to the firm's needs as well as the general

complexity of the knowledge. An important component of absorptive capacity is the availability of an appropriate supply of human capital, which in turn is not always specific to firms, but associated with the capabilities of the non-firm sector. Non-firms determine the knowledge infrastructure that supplements and supports firm-specific innovation. They account for a certain portion of the stock of knowledge at the national level which may be regarded as 'general knowledge' in the sense that it has characteristics of a public good, and is potentially available to all firms that seek to internalise it for rent generation.

Thus, even where technological assets are made available – either through licensing, or indirectly through spillovers from inward FDI – the domestic sector may not be in a position to internalise these assets. Borenzstein *et al* (1998) and Xu (2000) have both shown that FDI has a positive impact on economic growth only in those developing countries that have attained a certain minimum level of absorptive capacity. Knowledge accumulation is much more rapid once the initial threshold level of absorptive capacity exists. Simply put, technology absorption is easier, once they have 'learned-to-learn' (Criscuolo and Narula 2002). The cost of imitation increases as the follower closes the gap with the leader and the number of technologies potentially available for imitation reduces. *This implies that there are diminishing returns on marginal increases in absorptive capacity as firms approach the frontier of knowledge*.

Table 10 deals with the issues technology gap and absorptive capabilities and technology spillovers from FDI in the case of Argentina. In this table we report the results of two additional estimations, based in equation (1') described in section 3 in order to evaluate how the technology gap and absorptive capabilities of domestic firms affect spillovers from FDI.

*****Table 10 about here*****

Column (1) shows the estimation of spillovers for all domestic firms. Column (2) shows estimates for those firms in sectors characterised by a high technology gap between subsidiaries and indigenous firms, while column (3) shows estimates for those

located in sectors with low technology gap[16]. This classification still suggests – as in section 3 - that spillovers for all domestic firms are positive but not significant[17], as shown by the coefficient of dFDIj in column (1). The distinction of sectors according different levels of technology gap also does not provide us with significant results.

However, when we run the same regressions but only include firms with 'high absorptive capacity', we get very different results, as shown by column (4) and (5) in the table 10. The 'high absorptive capacity' group are defined as those firms that have invested more in new equipment oriented to product/process innovation or those that have invested more in training activities, For such domestic firms, spillovers from FDI are positive and significant. In other words, only those domestic firms that have invested in absorptive capacities receive positive spillovers from FDI[18].

Domestic firms which have more efficiently internalised spillovers have a larger investment in appropriately qualified and trained employees. Because technologies – no matter how generic – have a certain firm-specific aspect to them, any form of knowledge spillover needs to be decoded from the transmitter's firm-specific context to that of the receiver's (Cantwell 1991). In other words, *absorption is not purely about imitation*. Firms cannot absorb outside knowledge unless they invest in their own R&D, because it can be highly specific to the originating firm and be partly tacit in nature. In addition, absorptive capacity is assumed to be a function of the firm's R&D efforts, as well as the degree to which outside knowledge corresponds to the firm's needs, and the general complexity of external knowledge.

[16] We calculate technology gap by regressing the value added per employee of all firms in 1992 across different industries after controlling for capital intensity, scale and knowledge capital of the firms. In this regression the coefficient of a dummy variable with the value 1 for foreign firms, and 0 for domestic firms, indicates the average gap by industry. On this basis industries in Argentina were divided in two groups: with high technology gap (an average difference higher than the median) industries 34, 26, 36, 21, 32, 23, 22, 27, 15 and 29, or with high technology gap (an average difference lower than the median) 19, 31, 25, 24, 17, 28, and 33.

[17] It should be noted that in this case we are only considering domestic firms for the regression, so all variables described in section three such as value added growth, employment, skills, etc are introduced only for domestic firms.

[18] The regressions for domestic firms with low levels of absorptive capabilities in this respect provide insignificant spillovers again. The results are not included in this paper for space, but are available upon request from the authors.

4.3 The non-firm sector

It should be noted that the internalisation of spillovers depends not just on domestic firms having a high absorptive capacity, or that MNEs provide spillovers, but that the host country also be able to provide appropriately educated employees to both domestic firms and MNEs. It is important to stress that while human capital represents a 'core' location advantage and a primary determinant of FDI (most recently confirmed by Noorbaksh et al 2001), not all of FDI is associated with the presence of a skilled work force. Indeed, studies have shown that certain kinds of FDI is directed to locations where absorptive capacity is low, in that firms seek untrained labour to perform simple assembly-type or resource extractive activities. Indeed Narula and Wakelin (1998) find that indicators of skilled human capital not to be a significant determinant of FDI or trade in developing countries, although significant in developed countries. Indeed, it may be that MNEs seek locations with low-skilled workers (Narula 1996). In other instances, MNEs seek trainable employees (i.e., personnel who have 'learned to learn'), and then through training to provide the necessary skills to perform specialised tasks. As we have discussed in the previous section, the motive of investment plays a significant role in determining what kinds of human resources firms seek, and to what extent MNEs will undertake training of employees.

The non-firm sector is also important in providing appropriate training and education to generate potential employees of foreign and domestically owned firms, but also to undertake the provision of quasi-public goods in the form of innovative output and capacity. Progress towards more technology-intensive manufacturing activities depends on the existence of 'high tech infrastructure' (Rasiah 2002). This type of infrastructure is key if firms are to be able to internalise and absorb externally generated technologies, and to create their own. Such infrastructure plays an important role in promoting the innovatory and absorptive capacity of firms. It also acts as a mechanism to 'direct' technology strategy and as a mechanism to overcome market failure. It is important to understand that while learning and absorption takes place at the firm level, the success or failure of individual firms occurs in orchestration with an entire 'system'. Within any system, there exists a broader non-firm-specific knowledge base by non-firm actors that is crucial to a country-level understanding of the process of technological accumulation.

Non-firm actors determine the knowledge infrastructure that supplements and supports firm-specific innovation. They account for a certain portion of the stock of knowledge at the national level which may be regarded as 'general knowledge' in the sense that it has characteristics of a public good, and potentially available to all firms that seek to internalise it for rent generation.

In the scenario where the necessary absorptive capacity is not present, instead of learning from inward FDI, domestic investment may be 'crowded out' where the domestic innovation system is too weak to compete with the foreign sector (see e.g., Agosin and Mayer 2000).

How the non-firm-specific knowledge base in Argentina contributes to or limits the diffusion of technological spillovers in the country is a complex matter, since this is a country characterised by very contrasting features in this subject.

It is striking for instance that Argentina is the only Latin American country whose scientists have received Nobel Prizes in Science (three Nobel prizes were conferred to Argentinean researchers in biosciences since the 1950s). By 1992 the country had nearly attained universal primary education. Secondary school enrolment was 59%, 40% was in tertiary education and about 20% of the age group between 20 and 25 was in higher education (Censo de Poblacion 1992). In comparison, in 1992, Brazil had only 19% and 12% of enrolment in secondary and tertiary education, Chile 52% and 26% and Korea 85% and 15%. According to the World Bank, Argentina in 1995 had an illiteracy rate of 3.8% % while the same proportion for Brazil was 16.7%, for Mexico 10.4% and for Korea 4.2%. Between 1975 and 1990 the number of university students grew by 43.5% in Argentina. By 1993, 8.6% of the working population had reached higher education, 27.1% secondary education and 54.9% primary level (Censo de Poblacion 1992).

Indeed, all evidence points to a well developed system as a result of considerable efforts devoted by the government from the 1950's to develop a strong science and technology infrastructure, but that has recently started to decline as a results of diverse factors. In 1997, for instance total expenditures on education represented only 1.5% of GNP, well below that of Brazil (4.6%). Moreover, even when the number of university students has been growing, the public expenditures devoted to universities decreased since 1975 from US$1094 to US$808 million, and as a result the expenditures per student

fell considerably (to $1500), below the level of Brazil universities (around $10,000 (Correa, 1998).

R&D expenditures as a percentage of GDP are well below the average in developed regions and even below the levels reached by the more "successful" developing countries. It was only 0.29% of GDP in 1993 while countries such as Taiwan expended 1.3% of GDP in S&T (in 1988) and Brazil 0.89% in 1990.

5. Conclusions

The evidence reviewed in this paper would indicate that the story regarding spillovers from FDI in the case of Argentina is similar to that of many other developing countries. On the whole, MNE subsidiaries hired more professionals than domestic firms of the same size, possessed a more skilled labour force overall, and spent more on training than similar domestic firms. Subsidiaries in Argentina effectively have a higher labour productivity and pay higher wages. Yet, when measured in terms of knowledge creation and utilisation, there is little to differentiate affiliates from domestic firms. In other words, there is little evidence to suggest that superior technological assets explain their superior performance. Furthermore, the benefits of MNE activities in the Argentinean economy are not reflected in domestic firms' value added growth, even when these activities have in theory a high potential for technological spillovers. At the same time, our results also indicate that domestic firms which have more efficiently internalised spillovers have a larger investment in absorptive capacity.

Although these results might appear to be contradictory, they reflect different aspects of a complex tapestry. The fact that FDI activities do not demonstrate significant spillovers to the economy at large indicates that not all FDI provides the same opportunities for spillovers and linkages. For instance, resource-exploiting investments (say, in mining) seek to provide unprocessed raw materials (a relatively low value adding activity) which act as inputs to other affiliates that may be located elsewhere. It is in traditional, more 'mature' sectors that foreign firms seem to have significantly influenced domestic productivity, and where foreign firms seem to out-perform domestic firms significantly. In the so-called 'dynamic and new technologies' sectors which are typically regarded as

providing the highest potential for spillovers, domestic firms tend to outperform foreign affiliates in most measures of technological and absorptive capabilities. Our results confirm the opinion expressed by Mortimore (2000) that although Latin American countries have succeeded in attracting a large quantity of FDI, it has thus far ignored the issue of quality of FDI.

At the same time, our analysis also points to a common oversimplification made by researchers in the field: that MNEs tend to possess technological assets superior to domestic firms. While this may be true in some instances, it is by no means always the case. MNEs may possess firm-specific assets that are associated with transaction-efficiencies and the benefits of common governance. That is to say, MNEs may simply be able to generate economic rent from their superior knowledge of markets, and their ability to efficiently utilise their multinational network of affiliates. These assets are not generally easily spilled over to domestic firms, or at least, cannot be measured through conventional means.

It seems an obvious conclusion that spillovers need to be internalised if they are to provide tangible benefits to domestic firms. At an aggregate level Argentina is well-endowed with technological and scientific infrastructure. This has been a partial explanation for many of the other countries for which similar results have been found. Argentina represents a country with a fairly highly developed level of absorptive capabilities. However, at the firm level, there is considerable variation, and our results indicate that firms that have invested more heavily in training and new equipment for innovation have benefited from FDI spillovers.

Our results – although tentative – indicate that FDI *per se* is not necessarily the most effective way to promote technological upgrading and industrial development, especially where domestic firms are not equipped with the capacity to absorb and internalise spillovers. . Although FDI is an important means by which domestic firms can be made more competitive, this should be part of a more holistic development strategy. The work of Lall (see for instance 1996, 2002) points to the need of a holistic approach that includes governments, firms and non-firms.

It should be recalled that MNEs are unwitting development tools: their primary objective is to generate profits. MNEs do not provide training and other opportunities for

human capital development because they are philanthropic; they do so because they need to do so to optimize their profit making potential (Kapstein 2002, Slaughter 2002). MNEs seek to optimise their return on investment, and this logically requires that they minimize their costs. By definition, any investment in human capital development is an additional cost. When MNEs find that they have to provide basic education and skills to their workers - what should ordinarily be a public good (a case of hierarchies having to overcome government failure)– they are less inclined to invest. MNEs do not do so lightly, or without consideration of the benefits. MNEs are creatures of the market *par excellence*, responding efficiently to supply and demand conditions, and changes in these. They do not make such investments unless there is an opportunity for rent-seeking.

Our final point is this: It is wrong for governments or institutions associated with the Washington consensus to assume that FDI will substitute for domestic investment. Governments have a responsibility for policies to promote linkages, to encourage the development of domestic firms, and the development of important infrastructure and the maintenance of essential non-firm sector activities which provide the raw material for absorptive capacity.

It should be noted that the under-investment in public infrastructure will likely have considerable long-term consequences. While the NEM model has helped correct many inefficiencies, *inter alia*, improve important macro-economic fundamentals, and reduce the excessive role of the state in domestic industrial activity, it has also led to a rapid and overzealous reduction in the state's involvement in the provision of public and quasi public goods which are necessary conditions for industrial development (Ramos 2000, Katz 2001, Alcorta and Peres 1998, Alcorta 2000).

References

Agosin, M. and Mayer, R. (2000) 'Foreign investment in developing countries: does it crowd in domestic investment?' UNCTAD Discussion Papers No. 146.

Aitken, B. and Harrison, A. (1999) 'Do domestic firms benefit from direct foreign investment? Evidence from Venezuela', *American Economic Review,* 89(3): 605-18.

Alcorta, L. (2000) 'New economic policies and the diffusion of machine tools in Latin America', *World Development*, 28:1657-72.

Alcorta, L. and Peres, W. (1998) 'Innovation systems and technological specialization in Latin America and the Caribbean', *Research Policy,* 26: 857-81.

Benito, G., Grogaard, B. and Narula, R. (2003) 'Environmental influences on MNE subsidiary roles: economic integration and the Nordic countries', *Journal of International Business Studies*, forthcoming.

Blomstrom, M. and Sjoholm, F. (1999) 'Technology transfer and spillovers: Does local participation with multinationals matters?', *European Economic Review,* 43: 915-23.

Borensztein, E., De Gregorio, J. and Lee, J.W. (1998) 'How does FDI affect economic growth', *Journal of International Economics,* 45: 115-35.

Braconier, H., Ekholm, K. and Midelfart Knarvik, K. (2001) 'Does FDI work as a channel for R&D spillovers? Evidence based on Swedish data', IUI, The Research Institute of Industrial Economics, Working Paper No 553, Stockholm.

Cantwell, J. (1991) 'The theory of technological competence and its application to international production', in D. McFetridge (ed.), *Foreign Investment, Technology and Economic Growth*, Calgary: University of Calgary Press.

Cantwell, J. and Narula, R. (2001) 'The eclectic paradigm in the global economy', *International Journal of the Economics of Business*, Vol 8, pp 155-172,

Carr, D., Markusen, J. and Maskus, K. (2001) 'Estimating the knowledge-capital model of the multinational enterprise', *American Economic Review* 79(5):693-708.

Caves, R. (1974) 'Multinational firms, competition and productivity in host-country markets', *Economica*, 41(162).

Chudnovsky D. and Lopez, A. (1995) 'Politica tecnologica en Argentina: Hay algo mas que laissez faire?', CENIT, Buenos Aires, Argentina, Documento de Trabajo No 20.

Chudnovsky D. and Lopez, A. (2001) *La transnacionalizacion de la economia Argentina*, Eudeba

Chung, W. (2001) 'Identifying technology transfer in foreign direct investment: influence of industry conditions and investing motives', *Journal of International Business Studies*, 32(2): 211-29.

Cohen, W. and Levinthal, D. (1989) 'Innovation and learning: the two faces of R&D', *The Economic Journal,* 99: 569-96.

Correa, M. (1998) 'Argentina's national innovation system', *International Journal of Technology Management,* 15(6/7): 721-57.

Criscuolo, P. and Narula, R. (2002) 'A novel approach to national technological accumulation and absorptive capacity: aggregating Cohen and Levinthal', MERIT Research Memorandum 2002-16.

Djankov, S. and Hoekman, B. (2000) 'Foreign investment and productivity growth in Czech enterprises, *World Bank Economic Review,* 14 (1).
Dunning, J. (1993) *Multinational Enterprises and the Global Economy*, Wokingham: Addison-Wesley.
ECLAC (2000) 'Foreign Investment in the Latin American and the Caribbean 1999', United Nations, Santiago.
ECLAC (2001) 'Foreign Investment in the Latin American and the Caribbean 2000', United Nations, Santiago.
Findlay, R. (1978) 'Relative backwardness, direct foreign investment, and the transfer of technology: a simple dynamic model', *Quarterly Journal of Economics*, 92: 1-16.
Griliches, Z. and Mairesse, J. (1995) 'Productions Functions: The search for identification", Working Paper No. 5067.
Griliches, Z. (1991) 'The search for R&D spillovers', NBER Working Paper No. 3768.
Haddad, M. and Harrison, A. (1991) 'Are there dynamic externalities from direct foreign investment? Evidence from Morocco', Industry and Energy Department Working Papers: Industry Series Paper No. 48.
Haddad, M. and Harrison, A. (1993) 'Are there positive spillovers from direct foreign investment? Evidence from panel data for Morocco', *Journal of Development Economics,* 42: 51-74.
Harrison, A. (1996) 'Determinants and effects of direct foreign investment in Cote d'Ivoire, Morocco and Venezuela', in Mark J. Roberts and James R. Tybout (ed) *Industrial Evolution in Developing Countries, New York*, Oxford University Press.
Hanson, G. (2001) 'Should countries promote foreign direct investment?', G 24 Discussion Paper Series No 9, February.
Haskel, J., Pereira, S. and Matthew, S. (2002) 'Does inward foreign direct investment boost the productivity of domestic firms?' National Bureau of Economic Research, Working Paper No. 8724.
INDEC (1992) Censo de Poblacion, Argentina.
JIBICI (2002) 'Foreign direct investment and development: where do we stand?', Japan Bank for International Cooperation Research Paper No 15.
Kapstein, E. (2002) 'Virtuous circles? Human capital formation, economic development and the multinational enterprise', OECD Technical Papers No 191.
Katrak, H. (2002) 'Does economic liberalisation endanger indigenous technological developments? An analysis of the Indian experience', *Research Policy,* 31: 19-30.
Katz, J. (2001) 'Structural reforms and technological behaviour. The sources and nature of technological change in Latin America in the 1990s', *Research Policy*, 30: 1-19.
Kokko, A. (1994) 'Technology, market characteristics, and spillovers', *Journal of Development Economics,* 43: 279-93.
Konings, J. (1999) 'The effect of direct foreign investment on domestic firms: evidence from firm level panel data in emerging economies', LICOS, Centre for Transition Economics, Economic Department, Catholic University of Leuven, Belgium and CEPR London.
Lall, S. (1996) *Learning from the Asian Tigers*, Basingstoke: Macmillan.

Lall, S. (2002) 'Foreign direct investment, technology development & competitiveness: issues and evidence', mimeo.
Lipsey, R. (2002) 'Home and host country effects of FDI', NBER Working Paper No. 9293.
Mansfield, E. and Romeo, A. (1980) 'Technology transfer to overseas subsidiaries by U.S. based firms', *Quarterly Journal of Economics*, 95(4).
Markusen, J. (1998) 'Multilateral rules on foreign direct investment: the developing countries stake', draft prepared for the World Bank.
Mortimore, M. (2000) 'Corporate strategies for FDI in the context of Latin America's new economic model', *World Development*, 28(9): 1611-26.
Narula, R. (2002) 'Switching from import substitution to the 'New Economic Model' in Latin America: a case of not learning from Asia', MERIT Research Memorandum 2002-32.
Narula, R. (2003a) *Globalisation and Technology: Interdependence, Innovation Systems and Industrial Policy*, Cambridge: Polity Press.
Narula, R. (2003b) 'Multinational firms, regional integration and globalising markets: implications for developing countries', in R. Devlin and A. Estevadeordal (ed.), *Trade and Regional Integration in the Development Agenda*, Washington DC: Inter-American Development Bank.
Narula, R. and Dunning, R. (2000) 'Industrial development, globalisation and multinational enterprises: new realities for developing countries', *Oxford Development Studies,* 28(2): 141-67.
Narula, R. and Wakelin, K. (1998) 'Technological competitiveness, trade and foreign direct investment', *Structural Change and Economic Dynamics,* 9: 373-87.
Narula, R. (1996) *Multinational Investment and Economic Structure*, London: Routledge.
Noorbaksh, F., Paloni, A. and Youssef, A. (2001) 'Human capital and FDI inflows to developing countries: new empirical evidence', *World Development*, 29(9): 153-161
Ramos, J. (2000) 'Policy directions for the New Economic Model in Latin America', *World Development*, 28: 1703-17.
Rasiah, R. (1994) 'Flexible production systems and local machine tool subcontracting: electronics component multinationals in Malaysia', *Cambridge Journal of Economics,* 18: 279-98.
Rasiah, R. (1995) *Foreign Capital and Industrialization in Malaysia*, London: Macmillan.
Rasiah, R. (2002) 'Infrastructure and domestic patents in developing Asia', UNU/INTECH, Maastricht, mimeo.
Ritchie, B. (2002) 'Foreign direct investment and intellectual capital formation in South East Asia', OECD Technical Papers No 194.
Sjoholm, F. (1997) 'Technology gap, competition and spillovers from direct foreign investment: evidence from establishment data', Stockholm School of Economics, Working Paper Series in Economic and Finance No. 211.
Slaughter, M. (2002) 'Skill upgrading in developing countries: Has inward foreign direct investment played a role?' OECD Technical Papers No 192.
UNCTAD (1999) *World Investment Report 1999*, Geneva and New York: United Nations.

UNCTAD (2000) *World Investment Report 2000*, Geneva and New York: United Nations.

Xu, B. (2000) 'Multinational enterprises, technology diffusion, and host country productivity growth', *Journal of Development Economics*, 62: 477-93.

TABLES:

Table1: The role of MNEs in global employment, 2000 (in thousands)

Regions	*Total Population*	*Economically active population (EAP)*	*Total Employed population*
World	6056307	2947598	1825629
More developed regions	1191021	601011	393976.2
Less developed regions	4865286	2346586	1431652
Top 100 MNEs		14300	14300
% Over world		0.5%	0.8%
All MNEs		102140	102140
% Over world		3.5%	5.6%

Source: LABORSTA database (ILO) and World Investment Report 2001

Note:

The information on employment is not complete for developing countries. ILO provides information on employment in the1990s for 127 of 242 countries. Nevertheless, as all the major recipients of FDI are included, the estimations can be considered to be largely accurate.

Table 2:FDI participation in total employment by country

Country	*Year*	*Percentage of workers employed by MNEsl*	
		Manufacturing	**All industries**
DEVELOPED COUNTRIES			
Austria	1988	NA	9.8
	1996	19.8	9.9
Finland	1992	5.3	1.8
	1997	12.5	6.7
France	1987	16.8	NA
	1992	16.9	NA
Germany	1985	6.6	NA
	1996	13.0	5.1
Ireland	1985	40.9	NA
	1990	45.6	NA
Italy	1985	16.0	NA
	1993	17.4	NA
Japan	1985	0.6	0.3
	1995	1.2	0.5
Netherlands	1985	15.2	4.9
	1994	19.1	NA
Norway	1985	7.4	NA
	1994	9.0	NA
Sweden	1985	7.7	2.7
	1996	18.0	7.0
U Kingdom	1985	13.7	NA
	1992	18.2	NA
United States	1985	7.0	2.7
	1996	10.8	3.9
DEVELOPING COUNTRIES			
Brazil	1987	24.3	16.2
	1995	13.4	3.5
China	1987	NA	0.2
	1997	NA	4.1
Hong Kong	1985	10.2	NA
	1994	16.0	12.8
Indonesia	1992	3.3	0.5
	1996	4.7	0.9
Malaysia	1985	29.8	NA
	1994	43.7	NA
Mexico	1985	42.7	NA
	1993	17.9	3.3
Nepal	1998	1.9	NA
Singapore	1980	52.0	NA
	1996	52.1	NA
Argentina	1992	39.0	NA
	1996	41.0	NA

Source: UNCTAD 1999, Argentinean Innovation Survey 1992-1996

Notes: The participation of foreign employment for Argentina was estimated using the information provided by the Innovation Survey.

a All industries mean whole economy.

Table 3: FDI participation in the Argentinean industrial sector (1996)

Sectors	Share of foreign firms, 1996 (%)		
	Total employment	Total sales	Number of firms
Tobacco Industries	100	100	100
Petroleum refining and related industries	79	89	46
Electronics	65	78	19
Stone clay glass and concrete products	55	68	27
Chemicals and allied products	57	66	44
Rubber and miscellaneous plastic products	56	66	22
Primary metal industries	62	62	22
Paper and allied products	43	55	18
Motor vehicles and equipment	54	54	34
Communication equipment	50	49	29
Machinery and equipment	46	46	15
Food and kindred products	31	42	13
Precision, photographic medical optical	22	38	20
Lumber and wood products except furniture	25	29	7
Textile mill products	28	28	8
Leather and leather products	23	26	11
Miscellaneous manufacturing industries	17	25	6
Fabricated metal products	22	20	15
Printing publishing and allied products	14	14	13
Transportation equipment	1	1	5
Apparel and other finished products	0	0	0
Computer and office equipment	0	0	0

Source: Argentinean Innovation Survey 1992-1996

Table 4 FDI participation in Manufacturing and Services in Argentina: 1990-1998

Sector	*1990*	*1992*	*1997*	*1998*
Sectors	***Participation on total sales (%)***			
Manufacturing				
Motor vehicles and equipment	92	94	99	100
Computer and communication equipments	94	96	98	98
Chemicals and petrochemicals	57	66	88	88
Paper and allied products	0	1	69	75
Other manufacturing industries	48	31	60	64
Pharmaceuticals	62	43	60	63
Rubber and miscellaneous plastic products	69	66	62	58
Oils and cereals	50	37	61	57
Printing publishing and allied products	0	13	19	54
Petroleum Refining and related industries	32	37	48	49
Others Food, kindred products and tobacco	34	39	50	49
Electronics	40	25	53	48
Stone clay glass and concrete products	21	24	46	44
Fabricated metal products and machinery	26	28	37	37
Leather and leather products	35	29	30	37
Textile mill products	6	2	9	17
Refrigerating	18	10	18	15
Primary metal industries	0	0	2	4
Other industries				
Telephone Communications	93	95	100	100
Electric and gas services and water transportation	0	0	99	98
Mining	27	36	31	66
Wholesale Trade (Imports)	100	59	54	65
Fishing	36	59	50	57
Transportation and storage	34	36	50	53
Retail Trade	20	19	43	53
Communication (TV services)	0	0	72	45
Other services	13	17	38	41
Trading of primary products	23	33	34	37
Construction, building and engineering work	13	15	7	15

Source: Chudnovsky and Lopez (2001)

Table 5: Human capital development: difference between foreign and domestic firms (in percentages) (1996)

Sectors	*Professional Employees*[a]	*Professional Employees*[b]	*Skills*[c]	*Changes in Skills* [b]	*Training expenditures*
All sectors	27***	1.30	97***	3**	85***
Food and kindred products	45**	6.90	117***	6***	115***
Textile mill products	5	8	112***	0	167
Leather and leather products	62	2	7	1**	-174
Lumber and wood products	50	2	169*	-5	164
Paper and allied products	34	-11	105	-11	20
Printing, publishing and allied prod	-67**	24**	35	6	-20
Petroleum refining and related	9	8*	101**	1	136
Chemicals and allied products	6	1	62***	4	53
Rubber and miscellaneous	22	-13**	43*	1	110
Stone clay glass and concrete p	-3	11	78***	0	-16
Primary metal industries	-30	-3	10	0	-62
Fabricated metal products	12	5	38	1	-33
Machinery and equipment	21	-1	67***	-5*	16
Electronic	23	-6	47	-3	129
Communication equipments	37*	13	81	43	1
Precision, photographic medical, op	57	7	178**	7%*	-64
Motor vehicles and equipment	4	-2	31	1	56
Transportation equipment	35	49**	36	6	
Miscellaneous	32	8	72	0	132

Source: Authors calculations based on the Argentinean Innovation Survey 1992-1996

Notes:

The differences are controlled by size

[a] As a percentage of the total employment

[b] Measured in first differences and express changes in the variable analysed, changes in the use of professionals between 1992 and 1996 and changes in the index of skills.

[c] Skills is calculated as the ratio of professionals non professionals workers by firm

*Significant at the 10 percent level

** Significant at the 5 percent level

*** Significant at the 1% level

Table 6: Indirect effects: Technological spillovers towards domestic firms: Regressing added value at the plant level on inputs, knowledge capital (R&D and skills) and the share of foreign firms at the industry level[a]

Variables	*All sample*	
	Coefficients	
	OLS[b] (1)	**Weighted Least Squares[b] (2)**
I/Y	0.031	0.045
	(1.17)	(1.27)
ΔlnL	0.63	0.61
	(14.54)***	(14.28)***
ΔFDI_j	***0.03***	***0.11***
	(0.1)	***(0.36)***
ΔlnCK	0.026	0.023
	(3.3)***	(3.02)***
ΔSkills	0.13	0.12
	(2.87)***	(2.87)***
Markup92	-0.2	-0.19
	(-4.56)***	(-3.93)***
ΔMarkup	-0.0003	-0.00027
	(-4.53)***	(-4.13)***
ΔMarket share	4.12	4.1
	(9.41)***	(9.68)***
ΔImppen	0.0000006	0.0000006
	(2.79)***	(-2.37)**
ΔConcentration	-0.6	-0.66
	(-2.13)**	(-2.37)**
FDI_i	0.00069	0.00048
	(1.97)**	1.44
Constant	0.091	0.11
	1.3	(1.87)*
Observations	1300	1300
R2	47%	48%

Source: Authors calculations based on the Argentinean Innovation Survey 1992-1996

Notes: [a] All standard errors, in parenthesis, are corrected for heteroskedasticity. *significant at 10 % level, **significant at 5% and *** at 1% level.

The dependent variable is the difference of the natural log added value. Changes in employment and knowledge capital (L and CK) have been also introduced in natural logs, so their coefficients express elasticities. Investment over product is for 1992. Mark-up, the changes in mark-up and the changes in market share are firm level, changes in import penetration and concentration, at industry level. All estimations include a group dummy and 21 industry dummies. ΔFDI_i measure changes in foreign employment participation at the 5-digits industry, and FDI_j the participation of foreign capital at firm level, which might vary between 0 and 100.

[b] In column 1 and 2 the estimations are for all firms, including domestic firms and subsidiaries. The coefficient for FDIj reflects the effects of foreign ownership in the plants' productivity growth and the coefficient of ΔFDI_i participation at industry level the indirect effects or spillovers. Column 1 reports the results of the OLS estimation and column 2 the GL, weights being the firms' size.

Table 7: Subsidiaries' performance relative to domestic firms; Sales per worker, wages, exports and imported inputs: Differences between foreign firms and domestic firms

	Wages		*Exports*		*Imported Inputs*	
	1992	1996	1992	1996	1992	1996
Industry	% Diff	% Diff	%Diff	%Diff	%Diff	%Diff
All sectors	69***	70***	1	8	28%**	42***
Food and kindred products	54***	67***	42**	55	-5	64*
Textile mill products	30	28*	0	56	-98	-104*
Leather and leather products	41	48	0	-16	-35	83
Lumber and wood products, except furniture	73*	66	0	-15		-57
Paper and allied products	47*	73**	0	6	136	131
Printing, publishing, and allied industries	68**	68**	0	-129	-1	-78
Petroleum refining and related industries	47	35	-1	-209**	55	313*
Chemicals and allied products	48***	49***	0	25	43	22
Rubber and miscellaneous plastics products	62***	54***	54**	106**	42	36
Stone, clay, glass, and concrete products	85***	90***	-29	-44	15	29
Primary metal industries	56**	51**	6	61	51	-4
Fabricated metal products	27	22	-19	89	-9	-22
Machinery and equipment	50***	31**	-30	-66	14	69
Electronic and other electrical equip/components	75***	61***	3	131	123	99
Communication equipment	53*	82***	40	-94	60	139
Precision, photographic, medical, etc	109***	95***	22	81	-381*	-114
Motor vehicles and motor vehicle equipment	17	26	61**	20	-16	-29
Transportation equipment	20	76				201
Miscellaneous manufacturing industries	113***	96***	118*	42	-68	-181**

Source: Authors calculations based on the Innovation Survey in Argentina 1992-1996

Notes:

Tobacco products, apparel; and computer and office equipment are not included because there are not enough observations

The differences are controlled by size

*Significant at the 10 percent level

** Significant at the 5 percent level

*** Significant at the 1% level

Table 8: Subsidiaries' technological behaviour relative to domestic firms; Imports of capital goods, technology imports, investment in equipment for innovations and investments in capital goods: Differences between foreign firms and domestic firms

Variables	*Capital goods Imports*		*Technology Imports*[a]		*Investments in equipment for innovations*		*Investments in capital goods*	
Sectors	1992	1996	1992	1996	1992	1996	1992	1996
All sectors	-17	-10	7	29**	5.80	22	4	17
Food and kindred products	57**	44*	82**	56*	67*	41	57*	36
Textile mill products		-92**	-119*	-142**	6	-85	-23	10
Leather and leather products	-37	72	-52	110		173	-2	100
Lumber and wood products	-15	209**	139	389**	190	-277**	196	97
Paper and allied products	-39	-17	-53	67	-138	132	-7	70
Printing, publishing, allied industries	-89	-117	-27	-93	37	-70	-44	-78
Petroleum refining, related industries	177	-77		11	-369	-596	-94	-151*
Chemicals and allied products	65	21	45	37	83*	60	10	21
Rubber, miscellaneous plastics products	-21	12	15	8	-384	-3	-124**	-5
Stone, clay, glass, and concrete products	-32	-33	-47	22	148	73	38	96
Primary metal industries	32	-89	61	49	-171	104	-57	84
Fabricated metal products	-37	-39	21	34	-558	34	52	-6
Machinery and equipment	-8	46	3	50	-104	-31	-30	-8
Electronic, electrical equip. components	132	184*	156	284**	-87	249*	-15	198**
Communication equipment	-24	6	-162	14	-151	31	-15	11
Precision, photographic, medical, etc.	47	-460**	52	-484**			-82	-71
Motor vehicles and equipment	29	-18	25	-1	-232	-56	-21	-65
Miscellaneous manufacturing industries	-211	-217*	-226**	-205*	-89		-5	3

Source: Authors calculations based on the Argentinean Innovation Survey 1992-1996

Notes:

Tobacco products, apparel, computer and office, and transportation equipments are not included because there is not enough observation

[a] Includes imports of disembodied technologies and payments for licences

The differences are controlled by size

*Significant at the 10 percent level

** Significant at the 5 percent level

*** Significant at the 1% level

Table 9: Subsidiaries' technological behaviour relative to domestic firms; R&D expenditures and use of R&D laboratories

Sectors	*R&D expenditures*[a]	*Number of firms that possess R&D labs*	
	1996	**1996**	
	Difference	**Chi square test (Observed/expected)**	
		Subsidiaries	**DF**
All sectors	30%**	0.99	1.00
Food and kindred products	43	1.07	0.99
Textile mill products	155**	0.71	1.03
Leather and leather products	-106		
Lumber and wood products	-253	1.36	0.97
Paper and allied products	108	0.44	1.12
Printing, publishing and allied products	151*	0.35	1.10
Petroleum refining and related	-89	1.30	0.74
Chemicals and allied products	-36	0.98	1.02
Rubber and miscellaneous	-51	0.78	1.06
Stone clay glass and concrete p	-24	1.21	0.92
Primary metal industries	-78	1.53	0.85
Fabricated metal products	-4	1.10	0.98
Machinery and equipment	-9	0.72	1.05
Electronics	-41	0.74	1.06
Communication equipments	34	1.17	0.93
Precision, photographic medical,	14	1.02	1.02
Motor vehicles and equipment	132***	1.10	0.95
Transportation equipment			
Miscellaneous		0.97	0.97

Source: Authors calculations based on the Argentinean Innovation Survey 1992-1996

Notes:

Tobacco products, apparel, and computer and office equipments are not included because there are not enough observations.

[a] Average difference in R&D expenditures controlled by total sales

The differences are controlled by size

*Significant at the 10 percent level

** Significant at the 5 percent level

*** Significant at the 1% level

Table 10: Technology gap, absorptive capabilities and technology spillovers from FDI

	Domestic firms in sectors with:			*Domestic firms with high absorptive capabilities in respect of:*	
Variables	All domestic firms	High Technology Gap	Low Technology Gap	Investments in new equipment for product/process innovation	Training
I/Y	0.021	0.25	0.0005	0.52	0.2
	(1.02)	(2.63)***	(0.03)	(3.35)***	(1.57)
ΔlnL	0.64	0.62	0.65	0.45	0.58
	(13.6)***	(8.83)***	(9.27)***	(4.46)***	(5.18)***
ΔFDIj	0.24	0.38	-0.24	1.39	0.95
	(0.74)	(0.9)	(-0.46)	(1.97)**	(1.78)*
ΔlnCK	0.028	0.028	0.031	0.018	0.025
	(3.02)***	(2.18)**	(2.31)**	1.09	(2.09)**
ΔSkills	0.15	0.16	-0.13	-0.17	0.18
	(2.71)***	(3.18)***	(-0.79)	(-1.21)	(7.08)***
Markup92	-0.19	-0.25	0.4	0.25	0.21
	(-4.42)***	(-4.8)***	(3.9)***	(2.29)**	(199)**
ΔMarkup	-0.0003	-0.0003	0.58	0.58	0.14
	(-5.12)***	(-6.44)	(5.01)***	(5.17)***	1.3
ΔMarket share	4.41	4.21	4.8	3.8	3.8
	(8.02)***	(6.31)***	(4.1)***	(3.8)***	(3.79)***
ΔImppen	0.06	0.01	0.06	-0.84	0.027
	(2.92)***	(2.12)**	(1.7)*	(-1.18)	(0.67)
ΔConcentration	-0.67	-1.02	-0.35	0.088	-0.1
	(-2.11)**	(-2.31)**	(-0.66)	(2.54)**	(-0.13)
Constant	0.087	0.072	0.051	-0.031	0.086
	(1.15)	(0.98)	(0.53)	-0.69	(1.84)***
Observations	1073	608	3.72	200%	200
R2	46%	45%	53%	61%	53%

Source: Authors calculations based on the Argentinean Innovation Survey 1992-1996

Notes: [a] All estimations use OLS. Standard errors, in parenthesis, are corrected for heteroskedasticity. *significant at 10 level, **significant at 5% and *** at 1% level.

The dependent variable is the difference of the natural log added value for domestic firms. Changes in employment and knowledge capital (L and CK) have been also introduced in natural logs, so their coefficients express elasticities. Investment over product is for 1992. Mark-up, the changes in mark-up and the changes in market share are firm level, changes in import penetration and concentration, at industry level. All estimations include a group dummy and 21 industry dummies.

ANNEX 1: The Innovation Survey in Argentina: Firms and information collected

1-The firms

The National Survey on Technology Behaviour of Manufacturing Firms in Argentina (1992-1996) covers the technological behaviour and productivity performance of 1533 firms –283 multinational' subsidiaries and 1250 domestic firms. The Survey is representative of the universe of manufacturing firms in the country, including 50% of the total firms, which explain 53% of total sales, 50% of total employment and 61% of total exports in manufacturing activities.

The Survey was carried out in 1996, but the firms provided 4 types of information: 1) For the year 1996 (for instance participation of foreign capital refers to 1996), 2) for 5 points in time from 1992 to 1996, year by year (for instance expenditures in R&D employees is provided for the 5 years), 3) Referred to two points in time: 1992 and 1996 (for example sales, exports, and investments were provided for 1992 and 1996), and 4) Referred to all the period (for instance improvements introduced in products and processes covers all the period)

Table A1 shows the distribution of firms, sales and employment according ownership. An enterprise is considered to be an MNE subsidiary when the participation of foreign capital is higher than 10%.

Annex Table A1: Subsidiaries and domestic firms in the survey: sales and employment (1996)

Type of firm		***Number of firms***	***Total sales (in thousands)***	***Total employment***
Subsidiaries	Total	283	24600	132630
	%	18%	52%	41%
Domestic firms	Total	1250	22500	192325
	%	82%	48%	59%
Total	Total	1533	47100	394955
	%	100%	100%	100%

Source: Authors calculations based on the Argentinean Innovation Survey

Annex Table A2: Domestic and foreign firms by industry

	Industries	*Domestic Firms*	*Subsidiaries*
	All sectors	1245	283
15	Food and kindred products	300	45
16	Tobacco	0	2
17	Textile mill products	119	11
18	Apparel and other finished products	47	0
19	Leather and leather products	23	3
20	Lumber and wood products	42	3
21	Paper and allied products	27	7
22	Printing, publishing and allied products	60	9
23	Petroleum refining and related	7	6
24	Chemicals and allied products	81	64
25	Rubber and miscellaneus	64	18
26	Stone clay glass and concrete p	52	19
27	Primary metal industries	43	12
28	Fabricated metal products	67	12
29	Machinery and equipment	118	21
30	Computer and office equipment	2	0
31	Electronic	50	12
32	Communication equipments	15	6
33	Presicion, photographicm medical, op	18	5
34	Motor vehicles and equipment	47	24
35	Transportation equipment	18	1
36	Miscellaneus	45	3

2- The Information

The information covered by the database may be classified in 4 main areas: firms level indicators of performance and productivity, investments and efforts carried out in order to acquire external technologies, internal technological efforts and capabilities, and innovative output and strategy. Specifically, each area includes:

1. Performance, productivity

(a) Total sales, (1992-1996)[19]
(b) Total exports and composition (goods, services, technology and technical assistance)
(c) Total number of employees between 1992 and 1996 by activity and qualification.

2. Availability and acquisition of externally developed technologies

(a) Composition of investments in fixed assets

[19] The added value by firm for 1996 was obtained from other sources

(b) Characteristics of the main investments in fixed assets
(c) Automation and control, computation and technologies of information quantity and mount of central equipment, quantity and mount of PC in administrative, technical application, and other applications, quantity and mount of control systems and automation
(d) Acquisition of information technologies
(e) Total imports values and composition
(f) Total imports of capital goods and composition
(g) Main reasons to import capital goods
(h) Payments to national and foreign private enterprises for licences and technology transfer
(i) Type of consulting hired
(j) Characteristics of the consulting about production, organisation of the productive system, products, commercialisation, organisation and business management
(k) Type of agreements with other firms or institutions (1992/96)
(l) Linkages and contacts with Argentinean Institutions of Science and Technology

3. Internal technological efforts and capabilities

(a) Number of employees between 1992 and 1996 by activity and level of qualification
(b) Organisational structure of the R&D activities
(c) Expenditures in personnel (staff) devoted temporarily or permanently to innovation activities and main activities of the personnel: basic research, applied research, development of products or process, adaptation of products or processes, Technical assistance to production, engineering of projects, administrative reorganisation, general organisation, commercialisation of new products, total)
(d) Other expenditures in innovation activities (basic research, applied research, development of products or process, adaptation of products or processes, technical assistance to production, engineering of projects, administrative reorganisation, general organisation, commercialisation of new products, total)
(e) Sources of information for innovation (experimental own R&D, production, linked firms, headquarters or other subsidiaries, competence, reverse engineering, customers, enterprises of consulting, suppliers of equipment and materials, universities, public institutions of research, private institutions of research, licences and patents, conferences, seminars, fairs and expositions, journals, publications and other bibliography, centres of technological information and data bases)
(f) R&D joint ventures with other enterprises or institutions (with, local or external enterprises from the same group, customers, suppliers, competitors, other enterprises, experts and consulting firms, private institutions of research, public institutions of research, universities)
(g) Activities of training during the period 1992-1996 (Modes, costs and total hours)
(h) Motivations for training
(i) Productive, commercial and business agreements 1992/1996
(j) Implementation of organisational techniques

3. Innovative output

(a) Activities of technological innovation. 1992/1996 (innovation of product, innovation of process, design, development, automation and control, renewal of machinery and equipment, work re-organisation, reorganisation of productive flows, execution of continuous improvements, costs rationalisation, training of human resources.
(b) Improvements in products between 1992 and 1996 (technological improvement of current products, new products due to advances in the technological and scientific base, new product due to new productive process, new product due to novel inputs, differentiation of products).
(c) Improvements obtained in processes between 1992 and 1996 (technological improvement of current processes for equal products, machinery and equipment linked to new processes, new processes for new products, new process based on advances in the scientific and technological base)
(d) Patents granted between 1992 and 1996 (quantity), (granted in Argentina, granted abroad)
(e) Innovation's objectives (total or partial replacement of yours actual products, extend the range of products, development of products that do not affect the environment, improve the quality of yours products, introduction of new materials, development of new equipment, Improve the flexibility of the processes, reduction of the costs of production, improvements in the work conditions, adoption of productive process less pollutant, development of innovations based on scientific innovations, adaptation of products to the national market, adaptation of products to the external markets)
(f) Main factors hindering innovation

Annex 2: The model

Equation (1) is derived from a Cob-Douglas production function of the form:

$$Y_{it} = A_{it} L^{\alpha}{}_{it} K^{\beta}{}_{it} \quad (2)$$

Where Y is added value, L labour, K capital, A, and, α and β -the elasticities of output with respect to each input- are fixed parameters and the sub index i t indicate variation across firms, and time.

This function is linear in the logarithms of the variables, so after taking logarithms and adding a stochastic disturbance term u_{it} to account for variations in the technical or productive capabilities of the ith firm at the time t, we can write this relationship for t =1996 and t-4 =1992 as follow:

$$\ln Y_{it} = a_{it} + \beta \ln K_{it} + \alpha \ln L_{it} + u_{it} \, (a = \ln A) \, (3)$$
$$\ln Y_{ijt-4} = a_{it-4} + \beta \ln K_{it-4} + \alpha \ln L_{it-4} + u_{it-4} \, (4)$$

Then, differentiating (3-4) the change in added value for domestic firms between 1996 and 1992 can be expressed as follow:

$$\Delta \ln Y_{ij} = \Delta a_{ij} + \beta \Delta \ln K_{ij} + \alpha \Delta \ln L_{ij} + \varepsilon_{it} \quad (5)$$

Where α and β are the participation of capital and labour in value-added.

We do not have capital stock, so instead of β we estimate the marginal product of capital by using I/Y in 1996.

In effect $\Delta \ln Y_{ij} = \Delta a_{ij} + \beta \Delta \ln K_{ij} + \alpha \Delta \ln L_{ij}$ (5) can be written also as:

$$\Delta \ln Y_{ij} = \Delta a_{ij} + \frac{\Delta Y}{\Delta K} \frac{K}{Y} \frac{\Delta K}{K} + \alpha \Delta \ln L_{ij} \, (5`),$$

where $\frac{\Delta Y}{\Delta K} \frac{K}{Y} = \beta$.

So, after cancelling K in equation (5`), and given that $\frac{\Delta Y}{\Delta K} = \rho$ and $\Delta K = I$, equation 5` can be written as (6).

$$\Delta \ln Y_{ij} = \Delta a_{ij} + \rho \frac{I_{ijt}}{Y_{ijt}} + \alpha \Delta \ln L_{ij} + \varepsilon_{it} \quad (6)$$

The hypothesis that the changes in FDI participation by sector affect productivity growth of domestic firms is investigated by modelling the changes in *a* (or TFP growth) as:

$$\Delta a_{ijt} = \delta \Delta FDIpart_{jr} + \eta Z^{d}{}_{ijt} + I + G^{d} + \varepsilon_{it} \quad (7)$$

Where, the changes in *a* -or TFP growth- are assumed to vary across sectors, group, Z, and also following changes in FDI penetration by sector.

Finally, combining (6) and (7) we arrive to equation (1') in the text

$$\Delta \ln Y^{d}{}_{ij} = \lambda \Delta \ln Input^{d}{}_{i} + \delta \Delta FDI_{j} + \eta Z^{d}{}_{ij} + G^{d} i + I + \varepsilon_{i} \quad (1')$$

Where $\lambda \Delta \ln$ *Input* includes L and I/Y