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Summary

The paper analyses productivity spillovers from foreign MNEs on domestic manufacturing firms. Using a database on foreign MNEs in Italy, our results reveal that local firms do benefit from the presence of foreign MNEs, and the effect is higher when local and foreign firms in manufacturing sectors are co-located. However, spillovers benefiting domestic firms are likely to be less influenced by co-location when foreign MNEs are in services sectors as the latter are different from manufacturing industries under a number of aspects that overcome the effect of distance. Indeed, in these sectors, proximity and interaction are often obtained through professional mobility and temporary inter-organizational routines.

Keywords: Multinational Firms, Co-Location, Proximity, Spillover Effects, Customer-Supplier Interaction, Vertical Linkages

JEL Classification: D24, F23, O19, R30

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Productivity spillovers from foreign MNEs on domestic manufacturing firms:

Is co-location always a *plus*?

Sergio Mariotti,[a] *Marco Mutinelli,*[b] *Marcella Nicolini,*[c] *and Lucia Piscitello*[d]*

ABSTRACT: The paper analyses productivity spillovers from foreign MNEs on domestic manufacturing firms. Using a database on foreign MNEs in Italy, our results reveal that local firms do benefit from the presence of foreign MNEs, and the effect is higher when local and foreign firms in manufacturing sectors are co-located. However, spillovers benefiting domestic firms are likely to be less influenced by co-location when foreign MNEs are in services sectors as the latter are different from manufacturing industries under a number of aspects that overcome the effect of distance. Indeed, in these sectors, proximity and interaction are often obtained through professional mobility and temporary inter-organizational routines.

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1. Introduction

A large body of literature illustrates and discusses the effects that the presence of foreign multinational enterprises (MNEs) may have on the host economy. The fundamental idea is that MNEs are generally more efficient and productive than domestic firms, thanks to their ability to reap ownership advantages and transfer them easily within firm boundaries (Dunning, 1993). Therefore, they might generate spillovers through several interaction mechanisms (for recent surveys, see Kugler, 2006; and Spencer, 2008), both intra-industry (i.e. in their own sector) and inter-industry (i.e. in the other sectors they interact with).

Within this context, "spillovers are said to take place when the entry or presence of MNE affiliates lead to productivity or efficiency benefits for the host country's local firms, and the MNEs are not able to internalize the full value of these benefits" (Blomström and Kokko, 2001: 440). Thus, effects stemming from the presence of foreign MNEs on local companies have been generally measured through the impact on the latter's productivity, and the concept of productivity spillovers has been increasingly adopted (Smarzynska Javorcik, 2004).

Namely, productivity spillovers have been meant to embody technological externalities, referring to the well known competition, imitation, demonstration and worker mobility effects (Kokko, 1994; Blomström and Kokko, 1998), as well as the creation of linkages with local actors (Rodriguez-Clare, 1996).

The bulk of the literature has investigated the presence of spillovers in manufacturing sectors (e.g. Smarzynska Javorcik, 2004; Kugler, 2006; Blalock and Simon, 2009; Nicolini and Resmini, 2010). Although it is widely acknowledged that service sectors' growth is a crucial determinant of economic growth (Francois, 1990; UNCTAD, 2004; Eschenbach and Hoekman, 2006; Mattoo, Rathindran and Subramanian, 2006) and development of other sectors (Rajan and Zingales, 1998; Fernald, 1999; Markusen, Rutherford and Tarr, 2000; Alfaro, Chanda, Kalemli-Ozcan and Sayek, 2006), few contributions have investigated spillovers stemming from the entry of foreign MNEs in

services on local economies (e.g. Arnold, Mattoo and Smarzynska Javorcik, 2006; Arnold, Matoo and Narciso, 2008; Forlani, 2010).

The area of investigation of the present paper includes spillovers to local manufacturing companies stemming from foreign MNEs operating both in services and manufacturing sectors. In particular, we compare and contrast the two typology of sectors in terms of economic impact and geographical characters of the relevant spillovers. The paper relies on a rich panel set on foreign MNEs in Italy, along the period 1999-2005. Specifically, we consider those services sectors that are more likely to generate spillovers, namely knowledge intensive business services (KIBS) and network industries, which are both the most innovative services sectors (Wood, 2002; EC, 2004, 2010) and frequently characterized by the generation of important externalities (Shy, 2001). As far as manufacturing sectors, we consider foreign presence in 23 manufacturing sectors (2-digit NACE sectors). The impact upon local manufacturing firms has been modeled and estimated as a relationship between their total factor productivity (TFP) and the presence of foreign MNEs in the several sectors considered, weighted by the relevant input-output (IO) technical coefficient. This formulation allows capturing spillovers induced by foreign MNEs taking into account the intensity of the interactions they set with local firms.

Econometric results show that the relationship between the local manufacturing companies' TFP and the presence of foreign MNEs is positive and significant across different sectors, meaning that both local manufacturing customers and suppliers do generally benefit from spillovers. Moreover, using the information on the location of MNEs' operating units, we show that these effects are higher when local companies and foreign firms are co-located. However, co-location does matter most for foreign MNEs in manufacturing sectors while it is less relevant for foreign MNEs in service sectors. In fact, the latter differ from manufacturing industries under a number of aspects related to their production, supply and use, which help overcoming the moderating effect of distance. In these sectors the need for permanent co-location has been questioned (e.g. Crone, 2009) as proximity and interaction are often obtained through dedicated temporary inter-organizational

routines characterized by high professional mobility, irrespectively of the service company's geographical location.

The paper contributes to the literature in several ways. Insofar, only few studies disentangle the vertical linkage effects stemming from the entry of foreign MNEs. To the best of our knowledge, most of them focus on one direction of linkage effects, either backward (Blalock and Gertler, 2009; Blalock and Simon, 2009) or forward (Arnold, Mattoo and Smarzynska Javorcik 2006; Miozzo and Grimshaw, 2008). The few studies investigating the twos simultaneously refer only to manufacturing industries (Driffield, Munday and Roberts, 2002; 2004; Smarzynska Javorcik, 2004; 2008; Kugler, 2006; Blalock and Gertler, 2009; Nicolini and Resmini, 2010). Instead, the recent liberalization of service sectors in many countries[1], and the subsequent entrance of foreign MNEs in the local markets, constitutes an ideal testbed for the investigation of the inter-industry effects on local firms.

At least to the authors' knowledge, this is also among the first empirical works comparing the impact of the entry of foreign MNEs in services sectors vs. manufacturing sectors upon the productivity of local manufacturing firms, which are at the same time customer of and supplier to foreign MNEs. In fact, the bulk of the empirical studies refer to inter-industry spillovers among manufacturing industries, while those considering foreign MNEs in services look only at their local downstream manufacturing counterparts (Arnold, Mattoo and Javorcik 2006; Miozzo and Grimshaw, 2008).

Finally, this is among the few empirical attempts distinguishing the role of co-location on spillovers stemming from MNEs according to the characteristics of the latter's sectors (Girma and Wakelin, 2007). Namely, we show that the inherent nature of services and the relevant characteristics of the interaction with manufacturing customers and suppliers make the role of geographical permanent proximity less relevant in this case.

[1] Privatization and liberalization processes burst around the world at the beginning of the '90s, also due to imitative behaviour among countries (Levi-Faur, 2002).

The reminder of the paper is structured as follows. The following section presents the related literature on the impact of MNEs on the local companies' productivity, and develops the theoretical framework on the backward and forward influence of MNEs in services sectors upon the local manufacturing firms. Additionally, it illustrates the different meaning (and need) of geographical proximities in services vs. manufacturing sectors. Section 3 describes the methodology adopted for the empirical investigation, presents the data and illustrates the econometric techniques applied, while Section 4 discusses the results. The last Section discusses the main contribution and implications of the paper and indicates directions for future research.

2. Spillovers, linkages and co-location

Productivity spillovers from foreign MNEs to local firms can originate from several sources, like competition, imitation and demonstration effects allowing the local firms to learn, and stimulating them to search for greater efficiency (Blomström and Kokko, 1998). However, these mechanisms mainly impact on direct competitors of foreign MNEs (i.e. local firms within the same sector). Other related studies suggest that vertical (i.e. customer-supplier) relationships involving local and foreign firms (Rodriguez-Clare, 1996) are also a mechanism for productivity spillovers and technology diffusion[2] (Driffield, Munday and Roberts, 2004; Smarzynska Javorcik, 2008), and local development (Markusen and Venables, 1999).

[2] Other studies focus instead on technological and pecuniary externalities (Caballero and Lyons, 1989; 1990). The former arise from informal interaction and discussions between employees from different firms, and manifest themselves in new managerial and organizational practices, new or improved products or processes (Meade, 1952). They are generally defined as knowledge externalities or knowledge spillovers (Krugman, 1991). Pecuniary externalities (Scitovsky, 1954) take place when one firm's behavior reduces the price of intermediate inputs employed in the production process of other firms, which then benefit from cheaper inputs and reduced unit costs (Aitken and Harrison, 1999).

As far as the intra-industry effect is concerned, empirical evidence has not yet provided convincing results: they vary according to the unit of observation used, as well as with the methodology and the indicators employed (Görg and Greenaway, 2004; Meyer, 2004; Lipsey and Sjöhlm, 2005). On the one hand, MNEs are strongly motivated to minimize the knowledge transferred to local competitors; on the other, competition stimulates the local companies' search for greater efficiency but it also originates market stealing effects, crowding out less efficient local competitors (Aitken and Harrison, 1999).

On the contrary, the evidence about the positive impact of foreign MNEs upon the productivity of local firms in supplier and/or customer sectors, which enjoy vertical linkages with MNEs, is rather unanimous and robust across different countries like the United Kingdom (Driffield, Munday and Roberts, 2002), Lithuania (Smarzynska Javorcik, 2004), Indonesia (Blalock and Gertler, 2005), Hungary (Schoors and Van der Tol, 2002), Czech Republic, Poland and Slovenia (Damijan, Knell, Majcen and Rojec, 2003), Bulgaria, Poland and Romania (Nicolini and Resmini, 2010).

As far as domestic suppliers, they might benefit from spillovers stemming from the entry of foreign MNEs through several mechanisms (Lall, 1978; Blalock and Gertler, 2009; Blalock and Simon, 2009; Smarzynska Javorcik and Spatareanu, 2009). Foreign MNEs can be a source of new technology transferred to local firms selected as local suppliers (Caves, 1974; Crone and Roper, 2001). Indeed, MNEs may provide them with technical assistance, employees training, quality control, assistance in purchasing raw materials, help in management and organizational practices. In fact, MNEs have no incentive to prevent technology diffusion to upstream sectors as they may benefit from improved performance of input suppliers. Additionally, a supplier is generally proactive in setting up information channels and interactive mechanisms with customers in order to better match their requirements, customize the product, and gain market competitive advantages. Thus, domestic companies benefit from spillovers due to knowledge transfer and to higher requirements for product quality and on-time delivery, leading them to upgrading their production management or technology (Brash, 1966). Previous empirical evidence (Blalock and Gertler, 2009;

Blalock and Simon, 2009; Smarzynska Javorcik, 2004) has largely shown that local suppliers are likely to benefit from voluntary knowledge transmission as well as involuntary knowledge leakages from MNEs.

Forward linkages also impact on domestic (customer) firms as the latter potentially benefit from the greater scale and scope efficiencies, competency, innovative capacity and technology of foreign MNEs (Driffield, Munday and Roberts, 2004). Previous empirical studies (e.g. Arnold, Mattoo and Smarzynska Javorcik 2006; Arnold, Matoo and Narciso, 2008; Miozzo and Grimshaw, 2008) show positive returns on manufacturing sectors that use services as intermediate inputs, the rationale being that the presence of a more variegate pool of service providers allow local manufacturing firms to access more services and competencies that are not otherwise available on the local context. This is even truer when foreign MNEs bring new know-how and competencies, innovative and higher quality services, as well as internationally successful best practices.

As spillovers rely on the interaction among actors, the intensity of the effects induced by the presence of foreign MNEs on local firms should increase with geographical proximity, which indeed is crucial for the effective transmission of knowledge (Jaffe, Trajtenberg and Henderson, 1993). Indeed, previous empirical studies reveal that both intra-industry and inter-industry spillovers from foreign MNEs have a strong regional dimension, mainly due to the possibility of maximizing the direct linkages between customers and suppliers (Twomey and Tomkins, 1996), and to the idea that agglomeration makes learning and demonstration effects more effective (Driffield, 2006). In other words, as spillovers are not simply “in the air” but they do require both the generation of knowledge and the opportunities and the ability to absorb it (Mariotti, Piscitello and Elia, 2010), there are several reasons one would expect spillovers to be confined to the locality of the investment.

However, while this has been shown to be generally true for manufacturing sectors (e.g. Driffield, Munday and Roberts, 2004; Girma and Wakelin, 2007), the same does not necessarily hold for

services sectors. Services are different from manufacturing industries under a number of aspects related to their production, supply and use, which help overcoming the moderating effect of distance. Indeed, physical interaction plays an important role in most of service industries, where an increasingly number of services is co-designed and co-produced by providers, users and/or suppliers. This applies especially to KIBS as well as to network industries, which are characterized by a relevant shift from commodity and standard services to personalization and customized services (e.g. e-services, energy management services, etc.). However, as an emerging literature has recently observed (Crone, 2009; Gertler 2008; Rallet and Torre, 2008; Torre, 2008), in these sectors the need for co-presence and face to face interactions frequently does not require permanent co-location (i.e. physical proximity) but only temporal geographic proximity which is founded on the possibility of satisfying needs for face to face contact by travelling to different locations. This travelling generates opportunities for moments of geographical proximity which vary in duration, but which are always limited in time. Indeed, proximity is temporarily obtained through professional mobility and inter-organizational routines (e.g. periodic meetings, short and medium term visits, project teams), and it does not refer to the service company's geographical location. Accordingly, we expect local companies (either suppliers and customers) to be less influenced by spillovers stemming from foreign MNEs in services sectors that are located in their same region, while the effect being higher for spillovers stemming from foreign MNEs in manufacturing sectors.

3. Empirical methodology

3.1. Data

Data refer to the presence of foreign MNEs in both manufacturing and services sectors, in the period 1999-2005. This time span allows us to capture also the effects of privatization and liberalization processes of services that occurred in Italy in the first half of the '90s, and opened up local markets to the entry of foreign MNEs. Specifically, data on foreign MNEs in Italy are drawn from the database Reprint, which contains yearly information about the Italian affiliates of MNEs

and the location of their operating units (for further details, see Mariotti and Mutinelli, 2010). As already mentioned in the Introduction, we consider the presence of foreign MNEs in the two services sectors that are more innovative[3] and, therefore, more likely to originate spillovers upon local companies, and precisely:

- Knowledge intensive business services (computer and related activities, research and development and business activities – corresponding to NACE[4] 64, 73 and 74, respectively);
- Network industries (electricity, gas and water, and telecommunications – corresponding to NACE 40, 41 and 64, respectively).

As far as manufacturing sectors, we considered the presence of foreign MNEs in 23 manufacturing industries (2-digit NACE codes, from 15 to 37).

Table 1 reports the dynamics of the presence of foreign MNEs (in terms of local operating units) in Italy in the two services sectors considered as well as in the manufacturing sector as a whole, throughout the period considered[6].

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Table 1 approximately here

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[3] According to Istat (2008), the share of innovative firms in the two services sectors considered is about 40%, while the average in manufacturing industries is about 38%. Other services sectors (like transportations, logistics, and construction services) record instead much lower values (about 20%).

[4] NACE is the industrial classification provided by EUROSTAT. In this paper, data are classified according to NACE revision 1.1.

[6] It is worth observing the extraordinary expansion of MNEs operating in the Italian network industries, due to the privatization and liberalization process occurred in period considered.

Data on domestic manufacturing firms come from the AIDA-Bureau van Dijk database, which contains balance sheet data for about 500,000 firms in Italy. For our purposes, we include in the panel all domestic (i.e. Italian-owned) firms belonging to manufacturing industries (2-digit NACE codes, from 15 to 37) and for which annual information is available throughout the period considered. Our panel thus includes 76,507 domestic manufacturing firms.

3.2. The model and the variables

Following recent empirical studies (e.g. Blalock and Gertler, 2009; Haskel, Pereira and Slaughter, 2007; Smarzynska Javorcik, 2004) we test the impact of the presence of foreign MNEs on local firms, by regressing the latter's total factor productivity (TFP) against the stock of MNEs, measured by the number of local operating units.

Specifically, we estimated TFP for each firm i in manufacturing sector j at time t (TFP_{ijt}) through the Levinsohn and Petrin (2003) semi-parametric estimation procedure.[7] Thus, in order to identify industry-specific technological coefficients correctly, we estimate the production function separately by 2-digit NACE industries (coefficients are reported in Table A in the Annex).[8] Specifically, the output is measured by value added, deflated by a sectoral deflator; labor is measured by the workforce total cost, deflated by the annual GDP deflator; capital is measured by the total tangible fixed assets, deflated by a sectoral deflator[9].

[7] There are a number of alternative means of measuring TFP, including index numbers, data envelopment analysis, stochastic frontier analysis, instrumental variables estimation techniques and semi-parametric estimation techniques. For an exhaustive description of the advantages of using the Levinsohn and Petrin (2003) estimation procedure in the context of spillovers from FDI and linkages with MNEs, see Liu (2008) and Altomonte and Pennings (2009).

[8] Due to the small number of firms present in few sectors, we are forced to aggregate them. Namely, we aggregate food and tobacco industries (15 and 16), paper products and printing and publishing (21 and 22) and manufacturing n.e.c. and recycling (36 and 37). It is worth observing that these aggregations are those suggested by the NACE classification.

[9] The sectoral deflator and GDP deflator are available on the Eurostat website.

As far as explanatory variables, the presence of foreign MNEs (measured by the number of local operating units[10]) has been weighted by vertical linkages, which are generally proxied using the relationships among industries summarized in the Input Output (IO) Tables (e.g. Blalock and Simon, 2009; Driffield, Munday and Roberts, 2004). Considering k as being the sector in which foreign MNEs are present, and j the manufacturing sector of the focal domestic company, linkages can be defined as follows. As the columns of the IO Tables[11] report the amount of input that each industry buys from other industries, the coefficient α_{jk} measures the share of input from sector k purchased by sector j. Thus, forward linkages have been proxied by the variable MNE_forw_{kt} defined as the foreign presence in sector k at time t, MNE_{kt}, weighted by the coefficient α_{jk}. Namely:

$$MNE\_forw_{jkt} = \alpha_{jk} \cdot MNE_{kt}$$

Conversely, the rows in the IO Table report the amount of output that each industry sells to other industries. Thus, the coefficient ω_{jk} measures the share of output of sector j sold to sector k. The variable MNE_back_{jkt} is defined as the foreign presence (measured by the number of local operating units) in sector k at time t, MNE_{kt}, weighted by the coefficient ω_{jk}. Namely:

$$MNE\_back_{jkt} = \omega_{jk} \cdot MNE_{kt}$$

Thus, our spillovers variables are the followings:

$$MNE\_NetwInd\_forw_{jt} = \alpha_{jNetInd} \cdot NetwInd_t$$

[10] It is worth observing that although it is quite common using the share of foreign firms in a given sector, we prefer referring to the presence of foreign firms as measured by the total number of local operating units. Indeed, we claim that spillover on local firms is a function of the potential contacts they might have with foreign MNEs, which in turn depend on the latter's number (see also Altomonte and Pennings, 2009).

[11] We use the 1999 IO Table published by the Italian National Institute of Statistics (Istat) in order to avoid the endogeneity that could arise from the adoption of contemporaneous weights.

defined as the foreign presence in network industries at time *t*, $NetwInd_t$, weighted by the coefficient $\alpha_{jNetwInd}$. Likewise, for the backward linkages:

$MNE\_NetwInd\_back_{jt} = \omega_{jNetwInd} \cdot NetwInd_t$

is defined as the foreign presence in network industries at time *t*, $NetwInd_t$, weighted by the coefficient $\omega_{jNetwInd}$.

Similarly, for the foreign presence in KIBS, we built the variables $MNE\_Kibs\_forw_{jt} = \alpha_{jKibs} \cdot Kibs_t$ and $MNE\_Kibs\_back_{jt} = \omega_{jKibs} \cdot Kibs_t$.

For the inter-industry spillovers effects stemming from foreign MNEs in manufacturing industries (other than the focal company's one), we considered the following variables:

$MNE\_Manuf\_forw_{jt} = \alpha_{jManuf} \cdot Manuf_t$

$MNE\_Manuf\_back_{jt} = \omega_{j\ Manuf} \cdot Manuf_t$

where $Manuf_t$ is measured by the total foreign presence (in terms of the number of MNEs' local operating units) in the manufacturing sector but the focal company's one (i.e. excluding sector *j*). Likewise, the presence of foreign MNEs in the focal firm's manufacturing sector *j*, i.e. the intra-industry spillover effect, has been measured by the number of local operating units in sector *j* at time *t*. Namely:

$MNE\_Intra_{jt} = MNE_{jt}$

Descriptive statistics and the correlation matrix for the variables considered are reported in Table 2 and Table 3, respectively.

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Tables 2-3 approximately here

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The specification used to test the role of the presence of foreign MNEs in the different sectors considered on the local companies' productivity is the following:

$$lnTFP_{it} = \beta_0 + \beta_1 MNE\_NetwInd\_back_{(t-1)} + \beta_2 MNE\_NetwInd\_forw_{(t-1)} + \beta_3 MNE\_Kibs\_back_{(t-1)} + \beta_4 MNE\_Kibs\_forw_{(t-1)} + \beta_5 MNE\_Intra_{(t-1)} + \beta_6 MNE\_Manuf\_back_{(t-1)} + \beta_7 MNE\_Manuf\_forw_{(t-1)} + \zeta_j + \varphi_i + \varepsilon_{it} \quad \textbf{(1)}$$

It is worth observing that all the explanatory variables have been lagged to avoid possible endogeneity problems.

In order to test the role of co-location on the local companies' productivity, we divide variables accounting for the presence of foreign MNEs in Italy in two complementary components: the first referring to the presence of foreign MNEs in the same province[12] *p* of the focal local company, MNE_p, and the second one accounting for the presence of foreign MNEs elsewhere in Italy, MNE_{-p}. Thus, the second specification is the following:

$$lnTFP_{it} = \beta_0 + \beta_1 MNE\_NetwInd\_back_{p(t-1)} + \beta_2 MNE\_NetwInd\_back_{-p(t-1)} + \beta_3 MNE\_NetwInd\_forw_{p(t-1)} + \beta_4 MNE\_NetwInd\_forw_{-p(t-1)} + \beta_5 MNE\_Kibs\_back_{p(t-1)} + \beta_6 MNE\_Kibs\_back_{-p(t-1)} + \beta_7 MNE\_Kibs\_forw_{p(t-1)} + \beta_8 MNE\_Kibs\_forw_{-p(t-1)} + \beta_9 MNE\_Intra_{p(t-1)} + \beta_{10} MNE\_Intra_{-p(t-1)} + \beta_{11} MNE\_Manuf\_back_{p(t-1)} + \beta_{12} MNE\_Manuf\_back_{-p(t-1)} + \beta_{13} MNE\_Manuf\_forw_{p(t-1)} + \beta_{14} MNE\_Manuf\_forw_{-p(t-1)} + \zeta_j + \varphi_i + \varepsilon_{it} \quad \textbf{(2)}$$

4. Empirical findings

As a first test, we investigate the impact of MNEs in manufacturing and service sectors present in the whole country on the total factor productivity of manufacturing firms, through backward and forward linkages. Namely, Table 4 reports the results from the heterosckedasticity-robust regression panel data estimation for the productivity of local manufacturing firms. Standardized beta

[12] It may be not out of place here to highlight that Italian provinces correspond to NUTS 3 level. The Eurostat scheme of classification - the Nomenclature of Territorial Units for Statistics (NUTS) - is based on the institutional divisions currently in force in the member states, according to the tasks allocated to territorial communities, to the sizes of population necessary to carry out these tasks efficiently and economically, and to historical, cultural and other factors. Italian provinces define quite narrow areas, and range from 212 (Trieste) to 7400 (Bolzano) squared Kms.

coefficients are reported in order to make it easier to interpret estimated coefficients and make them comparable. The estimates include firm fixed effects, which account for all time-invariant firm characteristics.

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Table 4 approximately here

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It is interesting to observe that we obtain positive and statistically significant coefficients for all the explanatory variables included in the model. However, by means of standardized beta coefficients we are able to compare the relative magnitude of the different effects identified.

Looking first at services sectors, we observe that the main effect is given by KIBS, which through the forward channel (proxied by the variable *MNE_Kibs_forw*) exert the largest impact of all. Thus, whenever domestic manufacturing firms buy services from foreign MNEs in KIBS, they experience a large positive effect on their productivity. More precisely, an increase of one standard deviation of the *MNE_Kibs_forw* variable determines an increase of 0.868 standard deviations in the dependent variable. However, also the backward channel (*MNE_Kibs_back*) is statistically relevant. Indeed, as expected, domestic supplier firms of foreign MNEs enjoy positive productivity effects, due to higher quality requirements and knowledge transfers from MNEs.

As regards manufacturing, we observe that the horizontal effect is stronger than the vertical linkages. Indeed, the coefficient of the variable *MNE_Intra* is always higher (0.303) than the estimated coefficients for *MNE_Manuf_forw* and *MNE_Manuf_back* (0.225 and 0.135).

Moving to the focus of our empirical exercise, namely the estimates for the localized versus non-localized spillovers, Table 5 reports econometric findings obtained from the estimation of equation (2). Our dependent variable (again the TFP of domestic manufacturing companies) is now explained by the lagged values of the weighted measures of foreign presence, distinguishing between those MNEs' local operating units that are co-located within the focal domestic company's province, and those located elsewhere (i.e. outside the province).

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Table 5 approximately here

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Column (1) reports the full model; however, due to the high correlation between foreign presence within the same province in the two service sectors considered (see Table 3), we replicate the model excluding in turn network industries or KIBS at the provincial level (Column 2 and 3, respectively). This correlation is indeed responsible for the puzzling result of a negative and significant coefficient for network industries at provincial level obtained in the full model. In fact, this result is not robust, and when removing the KIBS presence at provincial level (as in column 3), the presence of MNEs in network industries within the same province does not extern any positive and significant spillover whatsoever (i.e. neither the variable *MNE_NetwInd_forw* nor the variable *MNE_NetwInd_back* referred to the co-located foreign presence does come out significant[13]). On the other side, measures of foreign presence in network industries in the rest of the country are still positive and significant, and the magnitude of these effects is close to the one reported at the national level in Table 4. Therefore, co-location is not relevant for spillover transmission in network industries sector.

As for knowledge-intensive business services, we observe a positive and significant coefficient for the foreign presence in the same province, however this finding is robust for backward spillovers only. Indeed, while *MNE_Kibs_back* is positive and significant in both model 1 and model 2 (at $p<.01$), *MNE_Kibs_forw* is positive and significant (at $p<.01$) only in the full model while it becomes not significant in model 2. This is in line with the hypothesis on the minor role of proximity in KIBS, where temporary inter-organizational routines make co-location less necessary (Torre, 2008). However, when manufacturing firms are considered as suppliers, co-location may

[13] It is worth observing that manufacturing customers might be mainly interested in the price of services and its trade-off with quality. This behavior weakens the potential spillover stemming from foreign services providers and may impair the relationship between the innovativeness of the supply and the amount of spillover benefits.

still help knowledge transmission and sharing on aspects such as the customization of inputs required by KIBS companies. In fact, the effect of KIBS in the rest of the country is still positive and significant, and the size of the coefficient mirrors the results in Table 4. Thus, our results confirm that domestic firms do not necessarily need to be co-located with foreign MNEs in KIBS to get access to, and to benefit from the relevant spillovers.

Focusing instead on the presence of foreign MNEs in manufacturing sector, we observe that foreign presence in the same manufacturing sector and in the same province yields a much larger effect than foreign presence in the same sector, but in the rest of the country (the estimate coefficient for the variable MNE_Intra_p is greater than 1 when considering foreign MNEs co-located in the focal domestic firm's province, while it is around 0.2 when foreign MNEs are located elsewhere). Therefore, according with empirical evidence on manufacturing industries (e.g. Driffield, 2006) co-location is a fundamental driver for the realization of positive spillovers within the same manufacturing sector.

Concerning the vertical linkages between manufacturing firms, we obtain the same result: co-location is a strong vehicle of spillover transmission. Indeed, both backward and forward linkages are much larger when considering MNEs operating within the same province (the coefficients obtained for both $MNE\_Manuf\_back_p$ and $MNE\_Manuf\_forw_p$ are always greater than 1 and significantly different from zero, at $p<.01$). Results for the rest of the country are confirmed when considering forward linkages (the coefficients of the variable $MNE\_Manuf\_forw_{-p}$, is always significant at $p<.01$ although definitely lower than that obtained when foreign MNEs are co-located with domestic customers); instead, backward linkages from outside the province do not seem to impact on local suppliers' productivity ($MNE\_Manuf\_back_{-p}$ does not come out significantly different from zero).

5. Discussion and conclusion

Overall, our results suggest that geographical proximity matters, although in different ways according to the inherent characteristics of the sectors. In fact, while in manufacturing sectors (where production needs immobilized assets) geographical co-location is crucial for the effective transmission of knowledge, the proximity needed in services sectors is only temporary and it might be obtained through professional mobility and temporary inter-organizational routines. Thus, in the latter case, geographical co-location is not a *plus* as it does not seem to contribute much to more effective spillover transmission.

We believe our results provide some contribution to the existing literature on spillovers under different perspectives. However, we are also aware that several research directions could be further explored. First of all, one could allow for MNEs' different motives for investing abroad (Dunning, 1993). Namely, MNEs might expand abroad to exercise existing capabilities, but also to build new capabilities by accessing knowledge located abroad (Chung, 2001). Recognizing this heterogeneity would help to take into account that knowledge spillovers are not unidirectional (from foreign MNEs to local companies) but they may flow either ways (i.e. also from the local context to foreign MNEs) thus requiring a more complex framework to evaluate the net impact of knowledge spillovers, in terms of balance between knowledge inflows and knowledge outflows, upon local companies.

Additionally, one may distinguish foreign MNEs by nationality in order to assess whether different types of home country-specific advantages and/or cultural proximity plays a role in strengthening knowledge spillovers benefiting local companies (Buckley, Clegg and Wang, 2002, 2007; Girma and Wakelin, 2007).

These modifications would allow to account for several dimensions of heterogeneity, as the magnitude of these channels depend on host country conditions, home country specificities (Meyer and Sinani, 2009), the type of FDI inflows, the MNEs' motivations and the domestic companies' absorptive capacity (Cohen and Levinthal, 1990) and their technological gap (Blalock and Simon,

2009). Unfortunately, the small numbers involved in the Italian case, as well as the lack of detailed information on these issues currently hinder such empirical extensions. The opportunity of replicating the study across other countries would certainly provide a promising step forward in advancing our understanding of the mechanisms underlying knowledge spillovers stemming from MNEs in services towards local manufacturing companies, as well as of the role of heterogeneity in enhancing or hampering knowledge spillovers.

Finally, although the present exercise is based on a developed country, Italy, the results obtained are of the uttermost importance for developing countries as well. Indeed, the transmission of knowledge from foreign direct investments in services is more likely to happen in those sectors which are in an early stage of the internationalization process, which is the case of most developing economies (Smarzynska Javorcik, 2008).

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Table 1: Foreign MNEs in the Italian services and manufacturing sector, 1999-2005

Foreign MNEs (No. local operating units)							
Sectors	1999	2000	2001	2002	2003	2004	2005
- Kibs	1829	2124	2124	2383	2448	2474	2526
- Network Industries	268	370	370	666	906	997	1228
- Manufacturing	2093	2378	2416	2441	2451	2490	2535

Source: Reprint database, Politecnico di Milano.

Table 2: Descriptive statistics of the variables

	Obs	Mean	Std. Dev.	Min	Max
$Ln(TFP_t)$	530193	2.726	2.059	-7.096	13.039
$MNE\_NetwInd\_forw_{p, t-1}$	454149	0.403	0.814	0.000	7.907
$MNE\_NetwInd\_back_{p, t-1}$	454149	0.221	0.577	0.000	10.933
$MNE\_Kibs\_forw_{p, t-1}$	454149	4.743	10.184	0.000	49.097
$MNE\_Kibs\_back_{p, t-1}$	454149	1.620	5.908	0.000	77.699
$MNE\_NetwInd\_forw_{-p, t-1}$	454149	12.740	11.370	1.457	66.946
$MNE\_NetwInd\_back_{-p, t-1}$	454149	5.221	6.237	0.000	93.041
$MNE\_Kibs\_forw_{-p, t-1}$	454149	74.786	24.391	9.298	142.898
$MNE\_Kibs\_back_{-p, t-1}$	454149	19.381	26.955	0.000	222.376
$MNE\_Intra_{p, t-1}$	454149	8.609	18.095	0.000	117.000
$MNE\_Intra_{-p, t-1}$	454149	195.709	147.827	0.000	523.000
$MNE\_Manuf\_forw_{p, t-1}$	454149	2.575	4.852	0.000	40.422
$MNE\_Manuf\_back_{p, t-1}$	454149	3.008	5.652	0.000	30.645
$MNE\_Manuf\_forw_{-p, t-1}$	454149	69.359	33.313	16.482	189.268
$MNE\_Manuf\_back_{-p, t-1}$	454149	76.646	56.017	9.585	191.823

Table 3: Correlation matrix

		(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*	*(10)*	*(11)*	*(12)*	*(13)*	*(14)*	*(15)*
(1)	$Ln(TFP_{it})$	1.000														
(2)	MNE_NetwInd_forw $_{p, t-1}$	0.062	1.000													
(3)	MNE_Netwind_back $_{p, t-1}$	0.077	0.567	1.000												
(4)	MNE_Kibs_forw $_{p, t-1}$	0.053	0.767	0.742	1.000											
(5)	MNE_Kibs_back $_{p, t-1}$	0.061	0.455	0.612	0.652	1.000										
(6)	MNE_NetwInd_forw $_{-p, t-1}$	0.105	0.224	-0.037	-0.068	-0.058	1.000									
(7)	MNE_NetwInd_back $_{-p, t-1}$	0.117	0.045	0.335	0.050	0.070	0.102	1.000								
(8)	MNE_Kibs_forw $_{-p, t-1}$	0.032	-0.219	-0.106	-0.195	-0.076	0.175	0.325	1.000							
(9)	MNE_Kibs_back $_{-p, t-1}$	0.069	0.006	0.143	0.065	0.359	-0.048	0.274	0.279	1.000						
(10)	MNE_Intra $_{p, t-1}$	0.060	0.501	0.562	0.674	0.342	-0.065	0.124	-0.138	-0.051	1.000					
(11)	MNE_Intra $_{-p, t-1}$	0.022	-0.017	0.021	-0.035	-0.155	0.046	0.341	0.236	-0.221	0.310	1.000				
(12)	MNE_Manuf_forw $_{p, t-1}$	0.031	0.705	0.554	0.759	0.461	-0.027	0.042	-0.207	0.020	0.517	0.011	1.000			
(13)	MNE_Manuf_back $_{p, t-1}$	0.006	0.604	0.484	0.726	0.308	-0.049	0.029	-0.117	-0.070	0.431	-0.012	0.698	1.000		
(14)	MNE_Manuf_forw $_{-p, t-1}$	-0.012	-0.019	0.017	-0.031	-0.020	0.095	0.222	0.318	0.147	0.021	0.208	0.200	0.031	1.000	
(15)	MNE_Manuf_back $_{-p, t-1}$	-0.080	-0.015	-0.019	-0.007	-0.093	0.025	0.116	0.414	-0.116	-0.031	0.109	0.038	0.334	0.273	1

All correlations are significant at 1% level.

Table 4: Results of the robust OLS regressions, MNE presence at the national level (dependent variable = lnTFP)

MNE_NetwInd_forw $_{t-1}$	0.056***
	(0.006)
MNE_NetwInd_back$_{t-1}$	0.088***
	(0.007)
MNE_Kibs_forw $_{t-1}$	0.868***
	(0.017)
MNE_Kibs_back $_{t-1}$	0.228***
	(0.026)
MNE_Intra $_{t-1}$	0.303***
	(0.052)
MNE_Manuf_forw $_{t-1}$	0.225***
	(0.040)
MNE_Manuf_back $_{t-1}$	0.135**
	(0.062)
costant	2.944***
	(0.002)
Number of observations	454149
Number of firms	76179
R^2 within	0.10

Notes: Estimates include firm fixed effects. Robust standard errors in parentheses.
* significant at 10%, ** significant at 5%, *** significant at 1%

Table 5: Results of the robust OLS regressions, MNE presence at the local level (dependent variable = lnTFP)

	(1)	(2)	(3)
MNE_NetwInd_forw $_{p, t-1}$	-0.032***		-0.001
	(0.012)		(0.011)
MNE_NetwInd_back $_{p, t-1}$	-0.043***		0.001
	(0.162)		(0.014)
MNE_Kibs_forw $_{p, t-1}$	0.199***	0.047	
	(0.055)	(0.042)	
MNE_Kibs_back $_{p, t-1}$	0.143***	0.146***	
	(0.052)	(0.052)	
MNE_NetwInd_forw $_{-p, t-1}$	0.064***	0.055***	0.057***
	(0.007)	(0.006)	(0.007)
MNE_NetwInd_back $_{-p, t-1}$	0.099***	0.087***	0.087***
	(0.008)	(0.007)	(0.008)
MNE_Kibs_forw $_{-p, t-1}$	0.874***	0.887***	0.880***
	(0.017)	(0.017)	(0.017)
MNE_Kibs_back $_{-p, t-1}$	0.192***	0.189***	0.237***
	(0.028)	(0.028)	(0.025)
MNE_Intra $_{p, t-1}$	1.096***	1.056***	1.104***
	(0.162)	(0.161)	(0.161)
MNE_Intra $_{-p, t-1}$	0.223***	0.218***	0.202***
	(0.051)	(0.051)	(0.051)
MNE_Manuf_forw $_{p, t-1}$	1.119***	1.107***	1.215***
	(0.211)	(0.210)	(0.211)
MNE_Manuf_back $_{p, t-1}$	1.224***	1.165***	1.119***
	(0.252)	(0.252)	(0.252)
MNE_Manuf_forw $_{-p, t-1}$	0.130***	0.139***	0.150***
	(0.041)	(0.041)	(0.041)
MNE_Manuf_back $_{-p, t-1}$	-0.005	0.002	0.013
	(0.067)	(0.067)	(0.066)
constant	3.005***	3.001***	3.001***
	(0.006)	(0.006)	(0.006)
Number of observations	454149	454149	454149
Number of firms	76179	76179	76179
R^2 within	0.10	0.10	0.10

Notes: dependent variable is TFPit. Estimates include firm fixed effects. Robust standard errors in parentheses. * significant at 10%, ** significant at 5%, *** significant at 1%

ANNEX 1

Tab. A1: Coefficients resulting from the Levinsohn-Petrin estimation for manufacturing industries

Two-digit sector (NACE)	Description	Labour	Capital
15-16	Food products and beverages; Tobacco products	0.29***	0.14***
17	Textiles	0.26***	0.26***
18	Wearing apparel; dressing and dyeing of fur	0.23***	0.18***
19	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear	0.28***	0.13***
20	Wood and products of wood and cork, except furniture; articles of straw and plaiting materials	0.37***	0.11***
21-22	Pulp, paper and paper products; Publishing, printing and reproduction of recorded media	0.42***	-0.05***
23	Coke, refined petroleum products and nuclear fuel	0.33***	0.06***
24	Chemicals and chemical products	0.37***	0.09***
25	Rubber and plastic products	0.38***	0.14***
26	Other non-metallic mineral products	0.36***	0.15***
27	Basic metals	0.42***	0.16***
28	Fabricated metal products, except machinery and equipment	0.38***	0.11***
29	Machinery and equipment n.e.c.	0.28***	0.16***
30	Office machinery and computers	0.38***	0.12***
31	Electrical machinery and apparatus n.e.c.	0.34***	0.11***
32	Radio, television and communication equipment and apparatus	0.27***	0.16***
33	Medical, precision and optical instruments, watches and clocks	0.33***	0.15***
34	Motor vehicles, trailers and semi-trailers	0.35***	0.30***
35	Other transportation	0.35***	0.20***
36-37	Manufacture of furniture; manufacturing n.e.c.; Recycling	0.33***	0.10***

Notes: * significant at 1%; ** significant at 5%; *** significant at 1%

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