Foreign Investments in Service Sectors as a Determinant of Local Development

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FIRST DRAFT

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Abstract

The issue of horizontal and vertical spillovers by foreign MNEs on domestic manufacturing firm has been largely investigated in recent years. While the literature has mainly focused on horizontal (i.e. intra-industry) spillovers or vertical (inter-industry) spillovers between manufacturing firms, the role of vertical spillovers stemming from MNEs in service sectors has been so far mainly neglected. Nonetheless, foreign direct investments in service sectors are acquiring growing relevance. This paper is one of the first attempts to size the relevance of this phenomenon. Using a database on 77964 manufacturing firms located in Italy, we estimate their Total Factor Productivity, and show that the entry of foreign firms in four different service sectors positively affects the productivity of manufacturing firms. We observe that spillovers are highly localized, but that results depend on the type of manufacturing firms considered.

Keywords: vertical spillover; productivity; services sector
JEL Codes: F23; L25

1. Introduction

Recent years have witnessed a huge debate on the issue of horizontal and vertical spillovers by foreign multinational enterprises (MNEs) on domestic manufacturing firms. The theory suggests that MNEs may affect domestic firms both in the same sector and in the others. In the first case, multinational enterprises, which are recognised to be more technologically advanced, increase competition in the sector they enter. The competitive pressure could produce either the exclusion of the least productive firms from the market, or a strong stimulus to improvements in productivity, which are possible thanks to the MNEs generated spillovers (Blomström Kokko, 1998). In the second case, MNEs could positively affect domestic firms in other sectors by selling higher quality intermediate inputs, or by the reduction in intermediate inputs prices due to the higher competition induced by MNEs entrance.

While the literature has mainly focused on horizontal or vertical spillovers between manufacturing firms, the role of vertical spillovers stemming from the presence of foreign MNEs in service sectors to domestic manufacturing firms has been so far mainly neglected. Nonetheless, services are the most relevant sector in developed economies, with respect to both absolute dimension and growth rates (UNCTAD, 2007). Moreover, foreign direct investments in service sectors are a growing phenomenon, especially because privatization and deregulation policies are opening up new opportunities for foreign investors (UNCTAD, 2007). It is thus interesting to investigate the effects that these changes have on local firms' productivity.

So far, empirical analysis at firm level has not found robust evidence for horizontal spillovers from MNEs on domestic firms (Lipsey Sjöhlm, 2005), while there seems to be positive evidence for vertical spillovers (e.g. Smarzynska, 2004; Nicolini Resmini, 2007). When considering spillovers originated by MNEs in service sectors, empirical evidence is scarce. Arnold, Smarzynska Javorcik and Matoo (2006), use firm-level data for the Czech Republic, in the period 1998-2003, and find

positive relationship between MNEs entrance in services sector and domestic firms' productivity. Arnold, Mattoo and Narciso (2006) use a database on 1000 firms in 10 sub-Saharan Countries, and reach the same conclusion.

The aim of the present work is to contribute to the literature on MNEs induced spillovers, by assessing the impact of the entry of foreign MNEs in service sectors on manufacturing firms located in Italy. Specifically, we regress a measure of total factor productivity (TFP) of local manufacturing firms on the presence of foreign MNEs in service sectors, in the period 1999-2005. Results show that the impact is generally positive and significant across different service sectors (namely, construction, energy, ICT, logistics and consultancy). We thus find a confirmation of the presence of vertical spillovers from MNEs. Moreover, we use the information on the location of MNEs, in order to asses whether these spillovers are localized. We find that spillovers from ICT, logistics and consultancy are highly localized, while this is not the case for energy.

The reminder of the paper is structured as follows: Section 2 reviews the literature on spillovers, Section 3 describes the data, presents the empirical model and discusses the econometric techniques applied, while Section 4 presents the results and concludes.

2. Related Literature

A large body of literature discusses the effect that MNEs presence may have on the host economy. These could be both direct and indirect, intra-sectoral and inter-sectoral (for an extensive survey, see Barba Navaretti Venables, 2004). Intra-sectoral effects are mainly due to specific characteristics of multinational enterprises, which are generally more efficient and productive than domestic firms, thanks to their ability to reap ownership advantages (Dunning, 1993), and transfer them easily within firm boundaries. MNEs may affect the efficiency of the markets in the host economies, and therefore domestic firms too, via externalities between the two groups of firms. These externalities can be classified into two types: technological and pecuniary. Technological externalities take place when firm's output depends not only on inputs, but also on other firms' production (Meade, 1952).

They rise 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. They are generally defined as knowledge externalities or *knowledge spillovers* (Krugman, 1991). Pecuniary externalities (Scitovsky, 1956) take place when one firm's beaviour reduces the price of intermediate inputs employed in the production process of other firms, which then benefit form cheaper inputs and reduced unit costs. (Krugman, 1991; Aitken Harrison, 1999). Moving from this theoretical framework, many studies have investigated the impact of foreign MNEs on productivity of domestic firms. While the first attempts in the literature investigated the impact of MNEs on industry level data, it is now increasingly common to inspect this mechanism at the firm level. A large body of literature has investigated the presence of horizontal or vertical spillovers between multinational and domestic firms in manufacturing sectors. Overall, there is not clear evidence of horizontal productivity spillovers from MNEs in manufacturing to domestic firms (Görg and Greenaway, 2004). This could be explained by observing that MNEs have a strong incentive not to transfer their knowledge to local competitors. Viceversa, empirical literature on vertical spillovers suggests a positive effect on domestic firms' productivity, both in backward and forward sectors. These results are robust across different countries, e.g. United Kingdom (Driffield Munday Roberts, 2002), Lithuania (Smarzynska, 2004), Indonesia (Blalock Gertel, 2005), Hungary (Schoor Van der Tol, 2002), Czech Republic, Poland and Slovenia (Damijan et al., 2003), Bulgaria, Poland and Romania (Nicolini Resmini, 2007). In this case, foreign MNEs may intentionally transmit their superior knowledge to local suppliers and clients, in order to improve their standards. Thus, MNEs are an important channel for technological transfer.[1]

[1] Empirical literature has focused on the characteristics that favour the flow of externalities (mainly technological ones) to local firms. On one side, larger absorptive capacity in domestic firms should lead to larger expected benefits in terms of knowledge trasfer (Cantwell, 1989). On the other side, according to the technology gap approach, the potential for knowledge trasnfer increses with the gap between domestic and foreign firms (Findaly, 1978). Empirical analysis does not bring conclusive evidence in favour of one hypothesis or the other. Some studies find that a moderate technological gap and high absorptive capacity increase the probability of positive productivity spillovers on local firms (See Kokko Tansini Zejan (1996) for a study on Uruguay, Damijan et al. (2003) on ten transition countries and Barrios Strobl (2002) on Spain.)

Nonetheless, the effect of the entry of MNEs in service sectors on firm's productivity has not been investigated with the same emphasis. Again, this line of research is backed by the idea that entrance in the domestic market of foreign firms, which are larger, more productive, more technologically advanced, will necessarily increase competition. This in turn implies lower prices and/or improved quality for the services produced and, possibly, a crowding-out of the least productive firms. As a consequence, domestic (manufacturing) firms that buy intermediate inputs from MNEs in service sectors may benefit form the improvement in service quality and the likely price reduction. If this mechansim takes place, then we observe a productivity improvement in manufacturing firms.

Empirical evidence is scarce with this respect, because data are lacking, moreover this phenomenon has gained relevance only in recent years. The literature has inspected the impact of services on aggregate growth, highlighting the role of financial and intermediation services on economic growth in general (Francois, 1990; Hoeckman and Eschenbach, 2006; Matoo, Rathindran and Subramanian, 2006) and downstream sectors in particular (Rajan Zingales, 1998; Fernald, 1999; Markusen, Rutherford Tarr, 2000; Alfaro, Chanda, Kalemi-Ozcan, Sayek, 2006; Arnold, Smarzynska Javorcik and Matoo, 2006; Arnold, Mattoo and Narciso, 2006)

Service liberalization (and MNEs entrance in particular) has generally positive effects, which stem from the increases in productivity of firms in downstream sectors which buy services as intermediate goods. Liberalization allows a larger number of firms into the service market, which in turn implies larger choice, and better services available for local clients.

Therefore, we formulate our first hypothesis:

Hypothesis 1: The presence of foreign MNEs generates positive productivity spillover for local manufacturing firms.

The literature has inspected the localized nature of *spillovers* (Driffield, 2006): direct interaction, and thus physical proximity, is fundamental for knowledge transmission. While this is true for manufacturing sectors, the issue is even more crucial when considering service sectors, which rely

by their very nature on the competences and knowledge of their employees. Thus, service firms tend to locate close to their clients. Some studies (e.g. Markusen, Rutherford and Tarr, 2000) suggest that the presence of firms operating in services is a catalyst for agglomeration and economic growth. Marshall (1988) considers three regions in the United Kingdom, and shows that almost 80% of the services are supplied from firms located in the same region. Moreover, manufacturing firms show better performances, thanks to the presence of local service suppliers. Therefore, our second hypothesis is:

Hypothesis 2: Spillovers induced by MNEs of local manufacturing firms are localized.

3. The empirical investigation

Empirical research on the impact of MNEs on host economies can be organized into two broad areas. First, the role of MNEs as a source of backward and forward linkages, of cooperations with other firms and research centres, spin-offs, imitation and demonstration effects (among others Lim Fong, 1982; Portelli Narula, 2004) has been inspected via case studies. This type of qualitative analysis allows to inspect the mechanisms of transmission of spillovers. Nonetheless, this analysis does not allow to quantify the relevance of spillovers. Therefore, a second type of study, namely econometric analysis based on large samples of firms, is necessary to identify the general impact of spillovers. We follow the second approach in the subsequent analysis.

3.1. Data

The data employed in the econometric analysis come from two different sources. Balance sheet data, necessary to construct a measure of total factor productivity, are derived from AIDA database

that is maintained by Bureau van Dijk Electronic Publishing (BvDEP). We obtain annual information on 79752 manufacturing firms located in Italy for the period 1999-2005.[2]

Data on foreign MNEs in services come from the database REPRINT that has been developed by Politecnico di Milano and ICE. This database collects information on almost 2000 foreign MNEs, as in 2005 (See Mariotti and Mutinelli, 2007). Specifically, the database provides a census of the foreign MNEs' subsidiaries in service sectors, and can be classified into four broad macro-sectors: ICTs (including postal services, information and telecommunications); logistics (referring to land, sea, air transport and auxiliary services); consultancy (corresponding mainly to R&D and professional activities), and finally, energy (including electricity and water management). The variables considered refer to the number of subsidiaries owned by foreign MNEs cumulated in the period ($MNEserv_{s,t}$). Additionally, as we also aim to investigate the localised nature of spillovers induced by foreign MNEs, we consider their presence in the same region and province where the domestic firm is located ($MNEserv_{s,r,t}$ and $MNEserv_{s,p,t}$).[3] The rationale is that whenever spillovers present a highly localised nature, their impact is stronger on the local companies that are geographically closer.

3.2. The model and the variables

As a first step, we have to obtain a measure of firm's total factor productivity. Following the existing empirical literature, we assume a two factor Cobb-Douglas production function. Therefore, taking logarithms we have:

$$\ln Y_{it} = \alpha_0 + \alpha_l \ln L_{it} + \alpha_k \ln K_{it} + \omega_{it} + \eta_{it} \qquad (1)$$

[2] It might be worth noting that we do not distinguish between domestic and foreign manufacturing firms, as we are interested in the impact that the entry of foreign MNEs in services has on the whole local manufacturing sector. However, as we are considering only vertical spillovers from services to manufacturing, we are not incurring any endogeneity problem: multinationals in services do not appear on the left hand side of our regression.

[3] Italian regions correspond to the NUTS 2 level of geographical classification, while provinces correspond to NUTS 3 level.

where Y_{it} is output, L_{it} is labour, and K_{it} is capital for firm *i* observed at time (year) *t*. ω_{it} represents the (unobserved) productivity level and η_{it} is either a measurement error or an unobserved productivity shock (idiosyncratic shock). Olley and Pakes (1996) have demonstrated that OLS estimates are biased. This is due to the endogeneity of input choices, which are determined, at least in part, by the firm's beliefs on ω_{it}. This implies a correlation between inputs and the error term, which biases OLS coefficient estimates. Their solution to this problem is a semi-parametric technique that uses firm's investment decisions as a proxy for unobserved productivity shock. Alternatively, one can apply Levinsohn and Petrin methodology (2003), which refines Olley and Pakes (1996) by suggesting that material inputs may be a better proxy for the firm's reaction to productivity shocks.[4]

We expect that labour and capital intensities will be different across sectors, therefore, in order to allow for different elasticities, we apply the LP methodology on a sectoral base.[5] In this way, we obtain coefficients for capital and labour elasticities which are sector *j* specific. We fit equation (1) and construct the residuals, which are the logarithm of the estimated firm level TFP:

$$\ln TFP_{it} = \ln Y_{it} - \alpha_{lj} \ln L_{it} - \alpha_{kj} \ln K_{it} \qquad (2)$$

Specifically, our data allow us to produce an estimate of total factor productivity (TFP).[6] We can classify our firms at NACE 4-digits level of disaggregation. Although we choose to apply the LP methodology on a 2-digit NACE classification,[7] nonetheless, some sectors needed further

[4] We implement the LP method in Stata 9.2 using the levpet routine available on the Stata website. For further information on this command see Petrin, Poi, Levinsohn (2004).

[5] Due to data constraint, we had to aggregate the 23 two digit manufacturing classes into 20.

[6] See next Section for the methodology applied to estimate TFP. See Appendix for details on data employed in TFP estimation.

[7] See Appendix for the full list of manufacturing industries included in the analysis.

aggregation due to their small number of firms[8]. Table 1 reports coefficient estimates for capital and labour. These are generally positive and significant, as expected, with two exceptions.[9] Table 2 reports some descriptive statistics for TFP indexes by industry. We observe that the standard deviation for TFP index is always lower than 1% in the aggregated sectors. This suggests that we are aggregating firms which actually share similar production functions. Looking at the estimated TFP index over the period, reported in Figure 1, we observe a decline in TFP levels, especially in the period 2001-2004. This result is coherent with findings by Altomonte, Barattieri e Rungi (2008) and 2006 OECD Factbook.

Our dependent variable will be regressed on a number of indicators of the presence of foreign MNEs in upstream service sectors.

The presence of foreign MNEs in each sector *s*, at time *t* has been proxied by the total number of foreign units set up over the period considered. Additionally, in order to take into account sectoral interdependencies, we weighted the presence of foreign MNEs with the technical coefficients for upstream industries that can be derived for each manufacturing sector *j* from input-output tables.[10]

Therefore, the proxy for the foreign MNEs-induced spillovers is the following:

$$MNEserv_{s,t} = \alpha_{s,j} \cdot local\_units_{s,t} \qquad (3)$$

Additionally, as we also aim at investigating the localised nature of spillovers stemming from foreign MNEs, the measure of the presence of foreign MNEs in service sector has been also calculated both at the region *r* and province *p* at time *t*.

It is worth observing here that, while the technical coefficients $\alpha_{s,j}$ from the input-output table are fixed over time in our analysis, the number of foreign firms operating in each sector changes. Thus,

[8] Namely, we choose to 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). This is not a strong assumption, as the NACE classification itself suggests these aggregations.

[9] Paper and publishing (NACE 21-22) present a negative coefficient for capital elasticity, while Coke, refined petroleum products and nuclear fuel (23) present a positive, although not significant coefficient.

[10] We use Input-Output table for 2001.

the variables capturing downstream linkages are time-varying sector-specific variables. Specifically, $MNEserv_{s,t}$ measures spillovers to firms in sector *j* induced by foreign MNEs in services; $MNEserv_{s,r,t}$ and $MNEserv_{s,p,t}$ measure spillovers to firms in sector j from foreign MNEs localised in the same region or province.

We have information on four different service sectors: energy, logistics, ICTs and consultancy. Therefore, in order to identify the impact that the entry of foreign multinational firms in service sectors has on the productivity of manufacturing firms, we refer to the following specification:

$$TFP_{it} = \alpha_0 + \beta \cdot MNEserv_{tot,t-1} + \gamma \cdot markup_{s,t-1} + \delta \cdot W_i + \phi \cdot Z_t + \eta_{i,t} \qquad (6)$$

There is a number of unobservable firm-, sector-, region- and time-specific factors that could affect the correlation between firm productivity and foreign presence in services. Typical examples are the quality of the management, or the infrastructure endowment of the region in which the firm is located. The standard solution to this problem (see Haskel et al. (2002) or Smarzinska (2004)) is to adopt time differencing plus a set of time- industry- and region-dummies. Alternatively, one could include a set of time-dummies and firm fixed effects. We follow this second option as the latter incorporate all sector and location dummies, but additionally allow to take into account each firm specific characteristic that does not change over time, but may affect TFP[11]. Time dummies are included to control for any time-varying external factor that could affect productivity (e.g. technological changes or business cycle).

Finally, to control for the degree of competition, which may in turn affect firm's productivity we include a proxy for sectoral mark-up, computed as the sector specific mean of firm's mark-up- The latter is obtained as operational turnover minus employment and material costs over operational

[11] We would *a priori* choose Fixed Effect estimator, as, unlike Random Effect estimator, it does not require orthogonality between the other regressors and the individual effects. Moreover, the choice of Fixed Effects is supported by Hausman test.

turnover. This variable is time-varying industry-specific and is therefore not absorbed by firm fixed effects.

4. Results and Conclusions

As a first step in our analysis, we test our Hypothesis 1, that the presence of foreign MNEs generates positive productivity spillover for local manufacturing firms. In order to do it, we regress TFP level on the lagged value of overall spillovers stemming from the presence of foreign MNEs in services. We estimate a fixed effects model with firm effects and time dummies. Results are reported in Table 3. We report standardized "beta" coefficients in order to allow for direct comparisons between different models. We find that the coefficient for the overall spillover variable, reported in column 1, is positive and significant. Thus, we can affirm that the overall impact of MNEs entry in service sectors on manufacturing firms' productivity is positive and statistically significant. We find that Hypothesis 1 is confirmed in the data.

Isolating the different service sectors we observe that they all positively affect the productivity of manufacturing firms. Column (6) shows the impact of the different services when all the variables are included in the analysis. Results are not robust, but the VIF (Variance Inflation Factors) suggests that there is mild collinearity between them. Thus, we can affirm that our data support Hypothesis 1: foreign MNEs in service sectors genrate positive productivity spillovers on local manufacturing firms.

In order to test Hypothesis 2, namely that spillovers from foreign MNEs are localized, we use a measure of MNEs presence computed at province (NUTS3) level. Table 4 shows that spillovers at provincial level are generally significant, apart from energy sector. This suggests that the benefits from foreign multinationals presence in energy sectors are present only at national level, while this is not true when considering the other service sectors. This reflects the different nature of the energy

sector, which relies on a nation-wide network and is subject to regulation. Thus, we find a general confirmation for Hypothesis 2, although with an interesting caveat: when considering local spillover, the characteristics of the industry considered are relevant.

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Table 1: Labour and Capital Elasticities Estimates

Sector$_j$	Labour Coefficient (α_l)	Capital Coefficient (α_k)
15-16	0.2948***	0.1432***
17	0.2646***	0.2646***
18	0.2291***	0.1803***
19	0.2797***	0.1324***
20	0.3690***	0.1081***
21-22	0.4152***	-0.0508***
23	0.331***	0.0587
24	0.3667***	0.0913***
25	0.3806***	0.1432***
26	0.3623***	0.1471***
27	0.4199***	0.1605***
28	0.3806***	0.1117***
29	0.2833***	0.1613***
30	0.3758***	0.1245***
31	0.3424***	0.1104***
32	0.2741***	0.1602***
33	0.3307***	0.148***
34	0.354***	0.2966***
35	0.3532***	0.2019***
36-37	0.3291***	0.1001***

Table 2: Summary statistics for TFP index by industry

Sector	Mean	Standard Deviation	Number of Observations	Minimum	Maxiumun
15-16	4.14	0.006	30694	-6.29	10.05
17	4.02	0.006	22999	-5.66	8.75
18	4.74	0.009	13736	-5.18	8.97
19	4.51	0.008	13921	-2.44	8.77
20	3.67	0.009	9610	-5.34	7.63
21-22	4.73	0.006	24342	-4.13	10.12
23	4.80	0.038	1273	-0.39	9.53
24	4.45	0.008	15355	-2.35	13.03
25	3.61	0.005	19697	-5.40	8.69
26	3.69	0.006	21020	-5.93	8.71
27	3.33	0.009	8947	-5.30	8.26
28	3.68	0.003	65144	-6.64	11.71
29	4.23	0.003	53242	-7.09	12.34
30	3.89	0.020	2602	-6.58	9.81
31	4.10	0.007	16489	-4.84	9.41
32	4.39	0.014	5383	-1.42	9.74
33	4.04	0.009	9252	-3.62	7.46
34	2.93	0.013	5354	-4.37	12.18
35	3.69	0.017	4601	-5.95	9.21
36-37	4.19	0.005	29029	-5.92	9.21

Figure 1: TFP index (mean) over the period 1999-2005

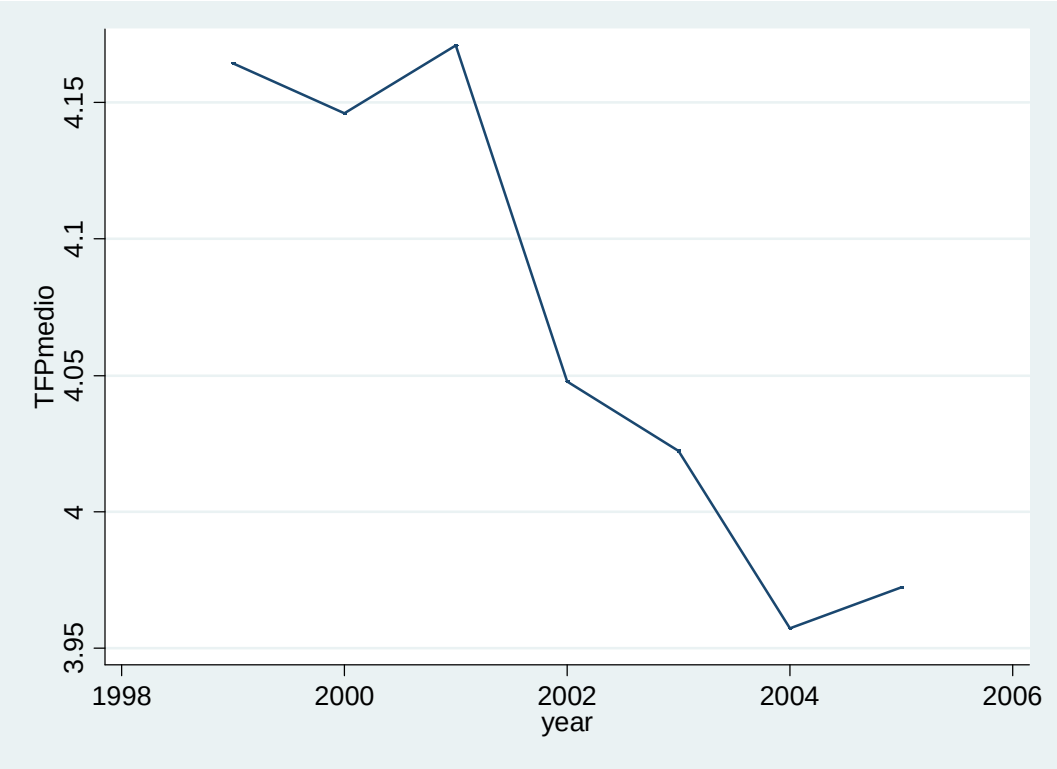

Table 3: Impact of MNEs on overall sample

	(1)	(2)	(3)	(4)	(5)	(6)
$\alpha MNE_{total\ (t-1)}$	0.106***					
	(0.021)					
$\alpha MNE_{energy(t-1)}$		0.022***				0.018***
		(0.006)				(0.007)
$\alpha MNE_{ICT(t-1)}$			0.524***			0.177*
			(0.083)			(0.103)
$\alpha MNE_{logistics(t-1)}$				0.042***		-0.021
				(0.015)		(0.016)
$\alpha MNE_{consultancy(t-1)}$					0.329***	0.290***
					(0.039)	(0.048)
$Markup_{(s,t-1)}$	0.005*	0.004*	0.004	0.004*	0.004*	0.004*
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Constant	3.369***	2.260***	3.373***	3.370***	3.363***	2.278***
	(0.004)	(0.006)	(0.004)	(0.004)	(0.005)	(0.007)
Time Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Number of Obs.	467784	467784	467784	467784	467784	467784
R-squared	0.11	0.11	0.11	0.11	0.11	0.11

Notes: Panel estimates with firm fixed effects. Standardized "beta" coefficients are reported, with robust standard errors in parentheses. * significant at 1%; ** significant at 5%; *** significant at 1%

Table 4: Impact of MNEs at provincial level

	(1)	(2)	(3)	(4)	(5)	(6)
$\alpha MNE_{total\ (p,t-1)}$	0.141***					
	(0.029)					
$\alpha MNE_{energy(p,t-1)}$		-0.064				-0.065***
		(0.007)				(0.007)
$\alpha MNE_{ICT(p,t-1)}$			0.120***			0.025
			(0.026)			(0.035)
$\alpha MNE_{logistics(p,t-1)}$				0.066***		-0.041*
				(0.018)		(0.022)
$\alpha MNE_{consultancy(p,t-1)}$					0.264***	0.270***
					(0.048)	(0.063)
$Markup_{(p,t-1)}$	0.004*	0.004	0.004	0.004*	0.004*	0.004
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Constant	3.370***	2.357***	3.371***	3.371***	3.368***	2.360***
	(0.004)	(0.005)	(0.004)	(0.004)	(0.004)	(0.005)
Time Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Number of Obs.	467784	467784	467784	467784	467784	467784
R-squared	0.11	0.11	0.11	0.11	0.11	0.11

Notes: Panel estimates with firm fixed effects. Standardized "beta" coefficients are reported, with robust standard errors in parentheses. * significant at 1%; ** significant at 5%; *** significant at 1%

Appendix

Variables Definition

Value added (Y): turnover minus costs for materials, labour and services, deflated with the corresponding two-digit producer price index.

Labour (L): labour costs from balance sheet deflated with GDP deflator.

Fixed Capital (K): book value of total fixed material immobilizations deflated with the corresponding two-digit producer price index.

Intermediate good (M): cost for materials, deflated with the corresponding price index.

Manufacturing industries included in the analysis

Food products and beverages (15); Tobacco products (16); Textiles (17); Wearing apparel; dressing and dyeing of fur (18); Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear (19); Wood and products of wood and cork, except furniture; articles of straw and plaiting materials (20); Pulp, paper and paper products (21); Publishing, printing and reproduction of recorded media (22); Coke, refined petroleum products and nuclear fuel (23); Chemicals and chemical products (24); Rubber and plastic products (25); Other non-metallic mineral products (26); Basic metals (27); Fabricated metal products, except machinery and equipment (28); Machinery and equipment n.e.c. (29); Office machinery and computers (30); Electrical machinery and apparatus n.e.c. (31); Radio, television and communication equipment and apparatus (32); Medical, precision and optical instruments, watches and clocks (33); Motor vehicles, trailers and semi-trailers (34); Other transportation (35); Manufacture of furniture; manufacturing n.e.c. (36); Recycling (37).

Table A.1: Classification of Manufacturing Industries according to Technological Level (NACE codes in parentheses)

High-Technology Industries	Low-Technology industry
Aircrafts and Spacecrafts (353)	Building and repair of ships and boats (351)
Office, accounting and computing machinery (30)	Rubber and plastic products (25)
Radio, TV and communications equipment (32)	Coke, refined petroleum products and nuclear fuel(23)
Medical, precision and optical instruments (33)	Other non-metallic mineral products (26)
Electrical machinery and apparatus n.e.c. (31)	Basic metals and fabricated metal products (27-28)
Motor Vehicles, trailers and semi-trailers (34)	Manufacturing n.e.c., recycling (36-37)
Chemicals (excluding pharmaceuticals) (24)	Wood, pulp, paper prod., printing and publishing (20-22)
Railroad and transport equipment (352, 353, 354)	Food products, beverages and tobacco (15-16)
Machinery and equipments n.e.c. (29)	Textiles, textile products, leather and footwear (17-19)

Table A.2: Summary Statistics

		(1)	(2)	(3)	(4)	(5)	(6)	(7)
Mean		2.766	97.45	2.076	16.058	49.933	29.388	0.305
Standard dev.		2.071	101.978	2.477	25.848	64.733	33.608	0.093
Min		-7.096	6.973	0.026	0.649	1.966	2.528	-1.077
Max		13.038	593.877	37.788	188.619	496.992	174.816	0.520
Nunber of Obs.		545748	467784	467784	467784	467784	467784	467784
TFP_t	*(1)*	1						
$\alpha IMN_{totale(t-1)}$	*(2)*	0.037*	1					
$\alpha IMN_{energy(t-1)}$	*(3)*	0.094*	0.247*	1				
$\alpha IMN_{ICT(t-1)}$	*(4)*	0.038*	0.709*	0.147*	1			
$\alpha IMN_{logistics(t-1)}$	*(5)*	-0.004*	0.881*	0.237*	0.385*	1		
$\alpha IMN_{consultancy(t-1)}$	*(6)*	0.085*	0.772*	0.110*	0.640*	0.438*	1	
$Markup_{(s,t-1)}$	*(7)*	0.042*	0.099*	-0.060*	0.160*	-0.082*	0.343*	1