How much do technological gap, firm size, and regional characteristics matter for spillovers?

Abstract

The 'absorptive capacity' represents the ability of a country to efficiently absorb and internalise knowledge from other countries. It is mainly determined by domestic firms' ability to increase their technological knowledge stock through the adaptation and application of outside knowledge sources. The cross-border interactions among firms arising from increasing inward FDI may powerfully contribute to a country's absorptive capacity since local firms may exploit foreign firms' knowledge to the degree that it has 'spilled out'. However, the quantity and the quality of FDI spillovers and the channels through which they occur depend upon a plenty of factors such as MNEs-related aspects, host country's characteristics, and domestic firms' internal capabilities. In particular (i) technological gap – i.e. the extent to which MNEs affiliates in an industry are technologically advanced compared to the domestic firms in the same industry – (ii) firm size, and (iii) regional characteristics of the national productive system may powerfully determine the magnitude of spillovers effect. The present paper aims at contributing at the debate about the role of FDI on domestic economy by taking into account these three aspects in the Italian case.

Kewywords: technology gap, absorptive capacity, MNE, FDI, spillovers, firm size, regionality.

JEL Classification: F21 F23 F29

1. Introduction

The presents paper aims at testing the absorptive capacity of Italian firms by focusing, on the one hand, on the role of technological gap for inward FDI-related technological spillovers, and on the other, on different dimensions of the Italian productive system, such as the domestic firm size, and the regional characteristics of Italian economy. The main contribution of our analysis is twofold. First, we present a further evidence of the Italian inward FDI-related spillovers effects, by investigating spillovers at intra-industry and inter industry level, the latter through the empirical analysis of both backward linkages between MNEs and Italian suppliers, and forward linkages between MNEs and Italian customers. Second, we present evidence on the effects on FDI spillovers of the (i) technology gap, (ii) firm size, and (iii) geography between FDI and domestic firms whereas empirical evidence for the Italian case remains still limited.

The reminder of the paper is as follows. Section 2 analyses the role of FDI in the framework of 'absorptive capacity' notion; section 3 depicts the determinants of inward-FDI related spillovers; section 4 discusses the estimation strategy; section 5 depicts the data used;; section 6 describes the results obtained; finally, section 7 concludes.

2. Countries' absorptive capacity and FDI

Generally speaking, the 'absorptive capacity' represents the ability of a country to efficiently absorb and internalise knowledge from other countries. From an empirical point of view it is commonly investigated at the firm level, where technological change takes place, and where available data allow for exploring the role of absorptive capacity in the firm's innovation performance (Criscuolo and Narula, 2008). Therefore, the absorptive capacity is often analysed in terms of the amount of knowledge in the public domain that *firms* are able to assimilate and exploit. In this sense, the absorptive capacity represents the link between the firms' capabilities in implementing new products and the external stock of technological opportunities: it determines a firm's ability to increase its technological knowledge stock through the adaptation and application of outside knowledge sources.

On this basis, starting from the seminal work of Cohen and Levinthal (1989, 1990), a large strand of literature has tried to measure the ability of a firm to integrate and exploit external knowledge. In particular, since both developing and industrialised countries are increasingly relying on inward FDI from MNEs as an explicit mean to improve their technological competitiveness, the cross-border interactions among firms arising from FDI may powerfully contribute to a country's absorptive capacity: when inward FDI-related spillovers happen, local firms can in fact exploit foreign firms' knowledge to the degree that it has 'spilled out'.

But the question is: how can inward FDI-related technology spillovers occur? Literature recognizes at least five *channels* through which spillovers can take place. The first is the so called competition effect: the increased competition brought by FDI entry may stimulate domestic firms to increase their productivity by updating manufacturing technologies and adopting advanced management practices to meet this competitive challenge[1]. Moreover, the presence of MNEs in domestic market can provide domestic firms an opportunity of 'learning by watching' that indirectly contributes to rising intensity of domestic R&D. Secondly, spillovers can occur through imitation and demonstration of any activity of foreign technologies (Blomström and Kokko, 1998). Through exposure to foreign firms' activities, domestic firms can observe these firms' technologies and management practices, and imitate them in their own operations, thus increasing their productivity. The third channel is building domestic linkages both at a backward level – i.e. subcontracting activities between MNEs and local suppliers - and at a forward level – i.e. between MNEs and domestic buyers. When MNEs build such backward and forward linkages with domestic suppliers and distributors, knowledge from foreign firms is transmitted to the suppliers and distributors and ultimately to domestic firms using the same suppliers and distributors (Spencer, 2008). The fourth channel is workers' mobility and training that arise from skills of workers, managers, engineers, etc., acquired from foreign firms and then transferred to local plants. Finally, the fifth channel is the collaboration activity between foreign and domestic firms, since

[1] It is worth noting that the competition effect may also reduce the productivity of domestic firms, for example since the entry of MNEs may increase the costs of inputs such as labour and raw materials, thus creating a typical crowding out effect.

the involvement of local firms and local universities or research institutes in any MNEs' R&D activities may lead to the diffusion of knowledge.

3. The determinants of inward FDI spillovers

The magnitude of inward FDI-related spillovers may be affected by several factors that, consequently, influence firms' technology adoption. In particular, the empirical literature on absorptive capacity recognizes (i) MNEs-related aspects, (ii) host country's characteristics, and (iii) domestic firms' internal capabilities as the main determinants of firms' technology adoption from FDI. It is worth noting that the first two groups (MNEs-related aspects and host country's characteristics) affect mainly the domestic firms' *opportunity* to learn from MNEs, whereas the third group (firms' internal capabilities) influences predominantly the domestic firms' *capacity* to learn from MNEs (Zhang et al., 2010).

On the side of MNEs' characteristics, the diversity of FDI country origins can increase domestic firms' opportunity to learn through exposure to different systems of technologies, management practices and cultural values brought by MNEs. This is because countries differ along important dimensions including geography, culture, administrative and institutional context, domestic market, and business system. Exposure to an environment with diverse technologies and management practices can facilitate domestic firms' openness and promote their learning from foreign firms.

On the side of host country's features, the characteristics of domestic productive system (mainly in terms of regional development, sectoral innovation system, etc.) represent crucial determinants of technological spillovers since they may act as constraints on the possibility of MNEs to transfer technologies.

Finally, on the side of domestic firms' internal capabilities, the firm size and the level of technology used in domestic firms - that is the *technology gap* between MNEs and local firms - represent two powerful and, at the same time, strongly *interrelated* factors influencing technology adoption. The firms' size may influence inward FDI-related spillovers insofar as large firms should have a stronger capacity than small ones to recognize, understand, and learn technologies and management practices brought by

MNEs, to spread the fixed costs of R&D over a larger sales base, and to exploit economies of scale and scope in R&D activities. Moreover, they posses a larger stock of internal resources and knowledge that can be used as complementary assets to the transferred technology from MNEs. In other words, large domestic firms have more internal complementary assets that can be used to exploit FDI spillovers (Zhang et al., 2010). Finally, the degree of the technology gap between local and foreign firms – i.e. the extent to which foreign firms in an industry are technologically advanced compared to the domestic firms in the same industry – represents an important spillovers determinant. Technological gap is relevant to the spillover effect both at horizontal and vertical level. At horizontal level, the extent of spillovers between MNEs and domestic firms is likely to depend on the technological sophistication of local firms; similarly, at vertical level, the extent of backward (forward) linkages between MNEs and local suppliers (buyers) of intermediate goods is likely to depend upon the stock of technological capabilities of domestic firms in supplying (buying) sectors. It is worth stressing that from both a theoretical and an empirical point of view, it is not obvious what the relation between the level of technology gap – whether small or large - and spillovers should be, since the absorptive capacity literature suggests two opposing arguments. The first argument - proposed originally by Findlay (1978) and confirmed by several works, such as those of Wang and Blomstrom (1992), Blomstrom and Wolff (1994), and very recently, by Jordaan (2008), and Jabbour and Mucchielli (2007) - argues that the potential for positive spillovers is higher when the technology gap between domestic firms and MNEs is large. This assumption is based on the idea that firms with lower stocks of technology have a greater scope for technological accumulation in that they have a larger backlog of established knowledge to assimilate. The second argument is that when technology gap is too large, the diversity of MNEs may have a weak impact on the productivity of the domestic firms since MNEs affiliates may be too advanced to leave any mark on local host country's firms. Cantwell (1989), for example, states that a firm's ability to follow and adapt the technological developments of other firms largely depends on its existing technological capability since when technology gap is large, the domestic firms do not have internal knowledge resources to recognize the value and contents of a variety of knowledge elements brought by MNEs, thus making spillovers not probable to occur. From an empirical point of view, this second argument was initially supported by Kokko (1994), and very recently by Takii (2005), Dimelis (2005), and Hamida and Gugler (2009).

4. Estimation strategy

Estimating the direct effects of FDI is not an easy task as we lack data on the past ownership of firms to test for the additional effect of foreign entry into the domestic market. Moreover, foreign firms usually target larger and more productive firms, thus a selection bias arises when one just compares the performance of foreign *versus* domestic firms. Therefore, in this paper, we focus on the indirect effects only.

The traditional approach to analyse productivity consists in estimating a production function and then in using the residuals not explained by the input factors (capital, labor) as a proxy for total factor productivity (Solow residuals). However, as Levinsohn and Petrin (2003) point out, when estimating the production function, one must account for the correlation between input levels and productivity, as profit-maximizing firms respond to increasing productivity by increased use of factor inputs. Thus, methods that ignore this endogeneity problem - such as OLS or the fixed-effects estimator - inevitably lead to estimate inconsistently the parameters of the production function. For this reason, in line with the recent literature, we employ a semi-parametric approach suggested by Olley and Pakes (1996) and then modified by Levinsohn and Petrin (2003). This method allows for firm-specific productivity differences that exhibit idiosyncratic changes over time. In principle, the method estimates a traditional Cobb-Douglas production function, taking into account that the error term has two components, of which one is correlated with the choice of inputs by the firm, but is not observable by the econometrician. The authors develop an estimator that uses a free variable such as intermediate inputs (material costs or fuel or electricity) as a proxy for this unobservable productivity shock. Following this technique, we firstly estimate a logarithmic transformation of a Cobb-Douglas production function:

$$\ln VA_{it} = \alpha + \beta_1 \ln L_{it} + \beta_2 \ln K_{it} + \beta_3 \ln M_{it} + \varepsilon_{it} \qquad [1]$$

where subscripts i and t refer, respectively, to firm and time; α is an intercept; $\ln VA_{it}$ is the natural logarithm of a firm's value added; $\ln L_{it}$ is the natural logarithm of a firm's labor input; $\ln K_{it}$ is the natural logarithm of a firm's fixed asset; $\ln M_{it}$ is the natural logarithm of a firm's material input; and ε_{it} ~ IID (0, σ^2) is the error term accounting for possible stochastic shocks at a firm level which may affect the dependent variable. The estimation is done for each manufacturing sector j (at the 2-digit NACE level) separately, using a sample of domestic firms only. Value added enters the equation as real value added, computed as real turnover minus real material costs. Monetary data were deflated by the producer price index for the corresponding 2-digit NACE sector. Labor input refers to the number of employees. Within the technique applied, material costs were used as a proxy for the unobservable productivity shock. A measure of the natural logarithm of total factor productivity TFP_{it} is obtained as the difference between the natural logarithm of the value added and the natural logarithm of capital and the natural logarithm of labor, multiplied by their estimated coefficients.

In the second step, we relate the total factor productivity to the foreign presence variables (specifically: horizontal, backward and forward spillovers) and other control variables (specifically: the level of competition within the sector, the economies of scale, and firm fixed effects), thus estimating the following unbalanced panel model of local firms via the fixed-effects estimator:

$$TFP_{it} = \begin{array}{l} \sigma + \theta_1 HERFI_{jt} + \theta_2 MES_{jt} + \theta_3 ES_{jt} + \theta_4 HSPILL_{jt} + \\ + \theta_5 BACKSPILL_{jt} + \theta_6 FORSPILL_{jt} + \theta_7 D_t + \chi_{it} \end{array} \qquad [2]$$

where:

- subscripts i, j and t refer, respectively, to firm, sector, and time;
- σ is an intercept;
- $HERFI_{jt}$ ((the Herfindahl index of turnover) is a proxy for the level of concentration and thus competition within the sector and year;
- MES_{jt} (minimum efficient scale) is a proxy for economies of scale;
- ES_{jt} represents the size of the sector (i.e., external spillovers) (see Castellani and Zanfei, 2007);

- $HSPILL_{jt}$ is a proxy accounting for the foreign presence in the same sector and is defined as the share of foreign firms' output in total sector output:

$$HSPILL_{jt} = \frac{\sum_{i \in j, i = MNEs} OUTPUT_{ijt}}{\sum_{i \in j} OUTPUT_{ijt}} \quad [3]$$

- $BACKSPILL_{jt}$ and $FORSPILL_{jt}$ are proxies for the potential vertical spillovers. In particular, the variable $BACKSPILL_{jt}$ stands for the foreign presence in linked downstream sectors (to which a local company supplies its inputs). Ideally, one would need the share of the firm's output sold to foreign firms. As this information is not available, we use input-output tables to trace inter-industry supply linkages and proxy the share of the firm's output sold to foreign companies by the share of the sector's output for intermediate consumption within the domestic economy sold to foreign companies in downstream sectors. The input-output tables reveal information about the amount supplied by the sector *j* to its sourcing sector *k*. In addition, we employ information about the foreign presence in sector *k* (the variable $HSPILL_{jt}$). Thus, the variable $BACKSPILL_{jt}$ is defined as:

$$BACKSPILL_{jt} = \sum_{k, k \neq j} \gamma_{jkt} HORIZ_{kt} \quad [4]$$

where γ_{jkt} is the proportion of the or *j*'s output supplied to sourcing sectors *k* and is calculated using the input-output table for domestic intermediate consumption (*i.e.* excluding imports). In addition, intra-industry supplies are not accounted for, as this effect is captured by the variable $HSPILL_{jt}$. Similarly, $FORSPILL_{jt}$ captures the potential for forward vertical spillovers to local firms that buy inputs from foreign firms, and is defined as:

$$FORSPILL_{jt} = \sum_{l, l \neq j} \delta_{ljt} HORIZ_{lt} \quad [5]$$

where δ_{ljt} is the proportion of sector *j*'s inputs purchased from upstream sectors *l*. Intra-industry supplies are not accounted for in this case either, as this effect is captured by the variable $HSPILL_{jt}$. Note that for both the cases, the weights γ_{jkt} and

δ_{ljt} are calculated using the proportion in total output for intermediate consumption (or total input used), not only the output (input) supplied to (bought from) the manufacturing sectors (thus, the sum of γ_{jkt} or δ_{ljt} , respectively, is not equal to 1);

- D_t is a dummy time variable employed to control for possible unobserved factors;
- χ_{it} ~ IID (0, σ^2) is the error term accounting for possible stochastic shocks at a firm level which may affect the dependent variable.

As easily observable, variables capturing both horizontal and vertical spillovers are sector specific but time-varying.

6. Data used

The empirical analysis included in this paper has been conducted by using firm-level data from the AIDA database (Analisi Informatizzata Delle Aziende) provided by the Bureau Van Dijk. The AIDA database collects annual accounts of Italian corporate enterprises and contains information on a wide set of economic and financial variables, such as sales, costs and number of employees, value added, fixed tangible assets, R&D, start-up year, as well as the sector of activity and ownership status. In order to study the spillover effects of foreign firms on domestic firms, we have identified all Italian firms whose Global Ultimate owner is foreign.[2] By omitting all observations for which the necessary data are incomplete, we obtained an unbalanced panel of 560,000 observations, over the period 2002-2007. Each variable included in the database was deflationed through the price index provided by ISTAT (Italian Institute of Statistics). The advantage of using such a dataset is twofold. Firstly, it is highly representative of the entire universe of corporate companies (e.g., in 2007, our sample covers about 87 percent of total employees declared by the Italian National Institute of Statistics – ISTAT, ASIA, 2008). Secondly, our dataset reflects quite well the actual size distribution of firms in the Italian economy characterized, as it is well known, by a large

[2]Although the AIDA database offers a flexible definition of ultimate ownership (over 25% or over 50%), in our analysis we consider only a share of 25%. Moreover, as the data were collected year by year, the ownership status variable is time-variant.

weight of small and medium-sized enterprise (SME).[3] Finally, the Input-Output matrix adopted to determine the possible vertical spillover was provided by ISTAT.

Table A1 (in Appendix) contains the mean of the variables for the whole sample distinguished by ownership type as well as tests of comparison of means for the two groups of firms (domestic *versus* foreign firms). All figures presented in the table are averages over the sample period. Focusing our attention on some firm and industry level variables, we observe that multinationals are on average larger, more productive, and more profitable compared to the domestic firms. They also tend to operate in industries more concentrated and with an higher minimum efficient scale.

5. Results

As we have seen above, foreign firms outperform local firms in productivity levels, thus we expect to detect some productivity spillovers in our analysis. Moreover, there might also be some potential for spillovers due to possible complementarities between the technologies of domestic and foreign firms. Table A3 (in Appendix) presents the results of the estimation of equation [2]. Main results can be summarized as follows. First, the horizontal spillovers seem to be positive but insignificant positive. Secondly, we find that backward spillovers tend to be positive but not significant while the forward ones are positive and significant. In line with the theoretical reasoning underlying the spillover channels, our findings suggest that being a customer of foreign companies has a beneficial effect on a firms' productivity. Moreover, concentration as measured by the Herfindahl index in our results is negative and significant, suggesting that less concentrated sectors (i.e. sectors with more competition) benefit more in terms of productivity increases; the economies of scale as measured by the minimum efficient scale are positive but not significant; and finally the size of sector is positive and significant.

Table A4 (in Appendix) presents the estimation results for equation [2] when non-linear spillovers effects are added ($HSPILL^2_{jt}$, $BACKSPILL^2_{jt}$, and $FORSPILL^2_{jt}$). The

[3] Approximately 95 percent of firms present in our database have less than fifty employees, compared to the official statistics of 98,5 percent in 2006 (ISTAT, ASIA, 2008)

findings can be summarized as follows: first, if spillovers exist, they tend to be highly non-linear. Interestingly, the effect of $HSPILL_{jt}$ is positive up to a certain level of foreign ownership, but turns negative after the foreign presence exceeds a certain threshold. Second, for the backward spillovers, we find opposite effects: they are negative up to a certain threshold of foreign presence in the downstream sector, after which the effect turns positive. Third, the forward spillovers are also non-linear: they are first positive and then turn negative with an increasing foreign presence in the upstream sectors.

In the Tables A5–A13 (in Appendix), we split the sample by a certain characteristic in order to detect differences in the pattern of spillovers across different groups of firms (so-called conditional spillovers). In particular, we employ breakdowns by (i) absorptive capability, (ii) firm size, and (iii) geographical area in order to take into account the peculiar dimensions of the Italian productive system characterized by a large presence of SME and by a typical economic duality between the more advanced regions in the North and the less advanced regions in the South of the Peninsula. At this regard, Table A2 (in Appendix) compares the distribution of Italian firms by ownership status, regional location and size (small, medium and large firms), this latter measured by the number of employees[4]. According to the figures, domestic firms represent the largest percentage of Italian firms (99.3 %), and are mainly of smaller size, while the share of foreign firms is very small (0.7%).[5] It also appears that foreign firms are mainly of large size and are mostly concentrated in the North-west region (58.4 % of the total).

We define absorptive capability in terms of the relative productivity performance of domestic companies *vis-à-vis* foreign companies in the same sector. Thus, the absorptive capability AC_{ij} for a firm i is defined in terms of TFP gap, i.e. as the difference between the productivity of the average foreign firm in the sector and each firm in the sector (see, for example, Jabbour and Mucchielli, 2007; Flores, 2007). It is worth noting that, following the main literature, we use the terms 'productivity gap' and

[4] Where small firms have 1-49 employees, medium firms 50- 249, large firms more than 250 employees.
[5] Our figure is close to that provided by ISTAT according to which in 2007 about 0,3% of Italian firms is foreign owned (ISTAT, 2009). The discrepancy is because our sample is restricted to corporate companies.

‘technology gap’ interchangeably, although the concepts are not exactly the same. Indeed, technology gap can be defined as the difference in the *technique* available for production, whereas productivity gap represents the difference in *productivity* when the same technology is used (Kathuria, 2010). Since determining the technology gap is often tricky, most of the empirical work (including ours) has proxied the ‘technology gap’ through measures of ‘productivity gap’: the general idea is that a more productive foreign firm is a reflection of the technological gap between the foreign and the domestic firm. We check for the sensitivity of the model to alternative ranges of gap (‘sub-samples strategy’). In other words, we split the sample into three groups according to the absorptive capability. By employing an exogenous grouping model we select an some hoc values from the observations to divide the sample into three sub-samples (low, medium, and high gap). In particular, the group with low *AC* consists of firms with *AC* below the 25th percentile of the *AC* distribution across all domestic firms; the medium *AC* group contains firms with *AC* between the 25th and 75th percentiles, while the high *AC* group includes firms with *AC* above the 75th percentile. Tables A5, A6 and A7 (in Appendix) present the results. According to part of literature we find some positive spillovers in the group of firms with a low-medium absorptive capacity, as these most probably have a productivity gap to fill and, at the same time, particularly medium gap firms have some basic level of technology that enables them to adapt to better technologies.

Tables A8-A10 present the results by firm size. We differentiate between small firms (up to 50 employees), medium-sized firms (between 50 and 250 employees) and large firms (more than 250 employees). Results show that medium-sized companies are able to benefit most from spillovers. This hypothesis is supported for horizontal spillovers while forward spillovers are found to be positive for small sized firms.

Finally, tables A11-A14 (in Appendix) report the estimates for productivity spillovers in the Italian manufacturing sector at sub-national level[6]. In particular, table A10 is

[6] The north-western region comprehends Lombardia, Piemonte, Liguria and Val d’Aosta; the north-eastern region is composed by Friuli, Trentino, Veneto and Emilia; the central region are composed by Toscana, Marche Lazio, Umbria, and finally the southern area comprehends Abruzzo, Molise, Campania, Calabria, Basilicata, Puglia, Sicilia and Sardegna.

referred to the north-western region, table A11 concerns the north-eastern area, equation A12 regards the central regions and equation A13 the southern area. Looking at the table, we may note that horizontal spillovers are present only in the north-western area. Indeed, the *HSPILL* variable carries a positive coefficient both for the north-western and the north-eastern region and a negative sign for both the central and southern areas. However, the coefficient is statistically significant at the 5 per cent level only in table A13. On the other hand, Table A10 shows that the presence of a negative spillovers from FDI in the central region of Italy.

6. Conclusions

This paper aimed to verify the presence of FDI-related spillovers from MNEs in the Italian manufacturing sector both at an intra-industry and at an inter-industry level, by taking into account different dimensions of the Italian productive system. In particular it analyzed the absorptive capacity of Italian firms on the basis of (i) the technological gap between domestic an foreign firms, (ii) the domestic firm size, and (iii) the regional classification of Italian economy. Results suggest al least five interesting conclusions. Firstly, local firms seem to not benefit from the presence of foreign companies in their sector since the horizontal spillovers seem to be positive but insignificant positive. At the same time, we find that backward spillovers tend to be positive but not significant while the forward ones are positive and significant: in line with the theoretical reasoning underlying the spillover channels, our findings suggest that being a customer of foreign companies has a beneficial effect on a firm’s productivity. Secondly, when spillovers exist, they tend to be highly non-linear: in particular, the effect of both horizontal and forward spillovers is positive up to a certain level of foreign ownership, but turns negative after the foreign presence exceeds a certain threshold; on the opposite, the backward spillovers are negative up to a certain threshold of foreign presence in the downstream sector, after which the effect turns positive. Thirdly, we find some positive spillovers in the group of firms with a low-medium absorptive capacity, as these most probably have a productivity gap to fill. Fourthly, medium-sized companies are able to benefit most from spillovers. This hypothesis is supported for horizontal spillovers while forward spillovers are found to be positive for small sized firms. Fifthly, positive horizontal spillovers are present only in the North-Western area, being significant but negative in the Centre of Italy, positive but not significant in the North-Eastern regions, and negative but not significant in the South.

References

Blalock, G. and P. J. Gertler (2009) 'How firm capabilities affect who benefits from foreign technology'. Journal of Development Economics, 90, 192–199

Blomstrom, M. and A. Kokko (1995) '*Multinational corporations and spillovers: A review of the evidence*'. Mimeo.

Blomstrom, M. and A. Kokko (1998) 'Multinational Corporations and Spillovers'. *Journal of Economic Surveys* 112: 247-77.

Blomstrom, M. and E. N. Wolff (1994) 'Multinational corporations and productivity convergence in Mexico'. In: Baumol, W.J., Nelson, R.R., Wolff, E.N. (Eds.) '*Convergence of Productivity: Cross-National Studies and Historical Evidence*'. Oxford University Press, Oxford, pp. 263–284.

Borensztein, E., De Gregorio, J., and J. W. Lee, (1998) 'How Does FDI Affect Economic Growth'. *Journal of International Economics*, 45, pp. 115–135.

Bougheas, S., Greenaway, D., Jangkamolkulchai. K. and R. Kneller (2008) 'Technology Gap, Foreign Direct Investment, and Market Structure'. University of Nottingham Research Paper Series, Globalisation, Productivity and Technology No. 2008/06

Cantwell, J. (1989) '*Technological Innovation and Multinational Corporations*'. Oxford: Basil Blackwell

Castellani, D. and A. Zanfei (2007) 'Multinational companies and productivity spillovers: is there a specification error?' *Applied Economics Letters*, 14, 1047-1051.

Cohen, W. M. and D. A. Levinthal (1989) 'Innovation and Learning: The Two Faces of R&D'. *The Economic Journal*, 99, 569–596.

Cohen, W. M. and D. A. Levinthal (1990) 'Absorptive Capacity: A New Perspective on Learning and Innovation'. *Administrative Science Quarterly*, 35, 128–152.

Criscuolo, P. and R. Narula (2008) 'A novel approach to national technological accumulation and absorptive capacity: aggregating Cohen and Levinthal'. *The European Journal of Development Research*, vol. 20(1), pages 56-73.

Dimelis, S. (2005) 'Spillovers from Foreign Direct Investment and Firm Growth: Technological, Financial and Market Structure Effects'. *International Journal of the Economics of Business*, Vol. 12, No. 1, pp. 85–104.

Findlay, R. (1978) 'Relative backwardness, direct foreign investment and the transfer of technology: a simple dynamic mode'. *Quarterly Journal of Economics*, 92, pp. 1-16.

Fletcher, M. (2009) 'Learning processes in the development of absorptive capacity of internationalizing SMEs'. In Jones, M. V., Dimitratos, P., Fletcher, M., and S. Young (editors) '*Internationalization, Entrepreneurship and the Smaller Firm. Evidence from Around the World*'. Edward Elgar, Cheltenham, UK, Northampton, MA, USA

Flores R. G. JR., Fontoura, M. P. and G. S. SANTOS (2007) 'Foreign Direct Investment Spillovers in Portugal: Additional Lessons from a Country Study'. *The European Journal of Development Research*, Vol.19, No.3, pp. 372–390.

Girma, S. and Görg, H. (2007) 'The Role of the Efficiency Gap for Spillovers from FDI: Evidence from the UK Electronics and Engineering Sectors'. *Open Econ Rev* 18: pp. 215–232

Glass A. J. and K. Saggi (1998) ‘International technology transfer and the technology gap’. Journal of Development Economics Vol. 55, pp. 369–398.

Hamida, L.B. and P. Gugler (2009) “Are there demonstration-related spillovers from FDI? Evidence from Switzerland” International Business Review 18: pp. 494–508.

Hansen, E. B. (1999) ‘Threshold Effect in Non-dynamic Panels: Estimation, Testing, and Inference’. *Journal of Econometrics*, 93, 345–368.

Jabbour, L. and J. L. Mucchielli (2007) ‘Technology transfer through vertical linkages: the case of the Spanish manufacturing industry’. *Journal of Applied Economics*, Vol X, No. 1, 115-136.

Jordaan, J. A. (2008) ‘Intra- and Inter-industry Externalities from Foreign Direct Investment in the Mexican Manufacturing Sector: New Evidence from Mexican Regions’. *World Development* Vol. 36, No. 12, pp. 2838–2854.

Kathuria, Vinish (2010) ‘Does the Technology Gap Influence Spillovers? A Post-liberalization Analysis of Indian Manufacturing Industries’. *Oxford Development Studies*, 38: 2, 145 – 170.

Kim, L. (1998) ‘Crisis construction and organizational learning: capability building in catching-up at Hyundai Motor’, *Organization Science*, 9 (4), pp. 506–21.

Kokko, A. (1994) ‘Technology, market characteristics, and spillovers’. *Journal of Development Economics* 43 (2), pp. 279– 293.

Kohpaiboon, A. (2006) ‘Foreign Direct Investment and Technology Spillover: A Cross-Industry Analysis of Thai Manufacturing’. *World Development* Vol. 34, No. 3, pp. 541–556.

Lai, M., Wang, H. and S. Zhu (2009) ‘Double-edged effects of the technology gap and technology spillovers: Evidence from the Chinese industrial sector’. *China Economic Review* 20: pp. 414–424.

Levinsohn, J. and Petrin, A. (2003). “Estimating Production Functions using Inputs to Control for Unobservables”, Review of Economic Studies 70, pp.317-341

Massoud, N. (2008) ‘Assessing the Employment Effect of FDI Inflows to Egypt: Does the Mode of Entry Matter?’. Paper presented at International Conference on ‘The Unemployment Crisis in the Arab Countries’, 17-18 March 2008, Cairo, Egypt.

Olley, G. S. and A. Pakes (1996) ‘The dynamics of productivity in the telecommunications equipment industry’. *Econometrica* 64: 1263–97.

Romer, P. (1994) ‘New goods, old theory and the welfare cost of trade restrictions’. *Journal of Development Economics*, vol. 43 (1), pp. 5–38.

Sjöholm, F. (1999) ‘Technology gap, competition and spillovers from direct foreign investment: evidence from establishment data’. *Journal of Development Studies* 36: 53-73.

Spencer J. W. (2008) ‘The impact of multinational enterprise strategy on indigenous enterprises: horizontal spillovers and crowding out in developing countries’. *Academy of Management Review* **33**: 341-361.

Takii, S. (2005) ‘Productivity spillovers and characteristics of foreign multinational plants in Indonesian manufacturing 1990–1995’. *Journal of Development Economics* 76, 521– 542.

Xu, B. (2000) ‘Multinational Enterprises, Technology Diffusion, and Host Country Productivity Growth’. *Journal of Development Economics*, 62, pp. 477–493.

Wang, Y. and M. Blomstrom (1992) ‘Foreign Investment and Technology Transfer: A Simple Model’. *European Economic Review*, 36: 137-55. 1992.

Winters, A. (2004) ‘Trade liberalisation and economic performance: an overview’. *The Economic Journal*, 114 (February), F4–F21.

Zhang, Y, Li, H., Li, Y, and L.A. Zhou (2010) **‘**FDI spillovers in an emerging market: the role of foreign firms' country origin diversity and domestic firms' absorptive capacity’. Strategic Management Journal Early View, Volume 31 Issue 9, pp. 969 – 989.

APPENDIX

Table A1: Mean statistics by ownership status and t-test of comparison of means for the distributions (domestic *versus* foreign firms)

	Mean			
	Domestic Firms	Foreign Firms	Diff	t
	(1)	(3)		
SIZE	27.5	216.1	-188	-40.5***
TFP	9.5	10.4	-0.9	-72.9***
WAGE	24925	35056	-10130	-0.2
TECH	0.0123	0.0024	0.0098	0.1
Net Profit	152991	1732627	164529	-6.3***
MES	0.006	0.015	-0.008	-20.9***
HERF	269	456	-186	-20.3***

(Source: Authors' elaborations based on the AIDA database)

Table A2: Distribution of Italian firms by size, ownership status and regional location (percentages, sample average)

	Foreign Firms	Domestic Firms	TOTAL
SIZE_1_49	0.3	99.7	89.9
SIZE _50_249	3.3	96.7	8.8
SIZE _>250	11.5	88.5	1.3
TOTAL	**0.7**	**99.3**	**100.0**
NORTH-WEST	1.2	98.8	34.4
NORTH-EAST	0.6	99.4	28.7
CENTRE	0.4	99.6	19.6
SOUTH	0.2	99.8	17.3
TOTAL	**0.7**	**99.3**	**100.0**

(Source: Authors' elaborations based on the AIDA database)

Table A3 – Estimation equation [3]

Dependent variable: TFP		
Regressors	*Coefficient*	*Robust Stand Err.*
HERFI	-.000011*	1.93e-06
ES	1.33e-13*	2.08e-14
HSPILL	.0943845	.0697576
MES	.2621101	.224394
Backspill	.2422064	.3897247
Forspill	.007371**	.0033556
Time dummies	Yes	
Cons	9.457418*	.0043069
Adjusted R^2	0.6360	
n OBS	562745	

Note:
Areg estimation was performed to fit a linear regression absorbing one categorical factor.
** = statistically significant at 0.01 per cent level.*
*** = statistically significant at 0.05 per cent level.*
**** = statistically significant at 0.10 per cent level.*

Table A4 – Non linearity

Dependent variable: TFP		
Regressors	*Coefficient*	*Robust Stand Err.*
HERFI	-.0000109*	1.94e-06
ES	1.25e-13*	2.09e-14
HSPILL	.5029815*	.114138
MES	.2888463	.2253876
Backspill	-1.808409*	.6203801
Forspill	.0157925***	.0094169
Hspill2	-.7570114*	.1660574
Fspill2	-.0003107	.0002394
Bspill2	19.92066*	5.456433
Time dummies	Yes	
Cons	9.455976*	.004392
Adjusted R^2	0.6360	
n OBS	562745	

Note:
Areg estimation was performed to fit a linear regression absorbing one categorical factor.
** = statistically significant at 0.01 per cent level.*
*** = statistically significant at 0.05 per cent level.*
**** = statistically significant at 0.10 per cent level.*

Table A5 – High gap

Dependent variable: TFP		
Regressors	*Coefficient*	*Robust Stand Err.*
HERFI	-.0000244*	2.83e-06
ES	2.51e-13*	2.86e-14
HSPILL	.7128739*	.1272567
MES	.0765054	.6069011
Backspill	-1.21915***	.7314502
Forspill	.0144156**	.0065613
Time dummies	Yes	
Cons	10.00821*	.005823
Adjusted R^2	0.7515	
n OBS	130818	

Note:
Areg estimation was performed to fit a linear regression absorbing one categorical factor.
** = statistically significant at 0.01 per cent level.*
*** = statistically significant at 0.05 per cent level.*
**** = statistically significant at 0.10 per cent level.*

Table A6 – Medium gap

Dependent variable: TFP		
Regressors	*Coefficient*	*Robust Stand Err.*
HERFI	-.0000174*	9.50e-07
ES	9.76e-14*	1.29e-14
HSPILL	.6082534*	.0632358
MES	-1.569377*	.264689
Backspill	-1.633449*	.3343887
Forspill	.0938388*	.0076064
Time dummies	Yes	
Cons	9.528358*	.0027886
Adjusted R^2	0.7228	
n OBS	262073	

Note:
Areg estimation was performed to fit a linear regression absorbing one categorical factor.
** = statistically significant at 0.01 per cent level.*
*** = statistically significant at 0.05 per cent level.*
**** = statistically significant at 0.10 per cent level.*

Table A7 – Low gap

	Dependent variable: TFP	
Regressors	*Coefficient*	*Robust Stand Err.*
HERFI	-.0000748*	.000016
ES	8.17e-13*	1.74e-13
HSPILL	.0145181	.1638045
MES	.6398304**	.3165415
Backspill	.6130624	.9135287
Forspill	-.005781	.016312
Time dummies	Yes	
Cons	8.795227*	.027323
Adjusted R^2	0.6221	
n OBS	169854	

Note:
Areg estimation was performed to fit a linear regression absorbing one categorical factor.
** = statistically significant at 0.01 per cent level.*
*** = statistically significant at 0.05 per cent level.*
**** = statistically significant at 0.10 per cent level.*

Table A8 – Small firms

	Dependent variable: TFP	
Regressors	*Coefficient*	*Robust Stand Err.*
HERFI	-.0000102*	2.16e-06
ES	1.79e-13*	2.31e-14
HSPILL	.0215377	.0761313
MES	.3179075	.2446083
Backspill	.4976595	.4243664
Forspill	.0088794**	.0036358
Time dummies	Yes	
Cons	9.39158*	.0047609
Adjusted R^2	0.6114	
n OBS	505293	

Note:
Areg estimation was performed to fit a linear regression absorbing one categorical factor.
** = statistically significant at 0.01 per cent level.*
*** = statistically significant at 0.05 per cent level.*
**** = statistically significant at 0.10 per cent level.*

Table A9 – Medium firms

	Dependent variable: TFP	
Regressors	*Coefficient*	*Robust Stand Err.*
HERFI	-.0000166*	2.80e-06
ES	5.73e-14	4.00e-14
HSPILL	.3410495**	.1346623
MES	.6512995*	.2515717
Backspill	-.7657724	.7766334
Forspill	.0035613	.0030119
Time dummies	Yes	
Cons	9.980589*	.0072906
Adjusted R^2	0.7250	
n OBS	50688	

Note:
Areg estimation was performed to fit a linear regression absorbing one categorical factor.
** = statistically significant at 0.01 per cent level.*
*** = statistically significant at 0.05 per cent level.*
**** = statistically significant at 0.10 per cent level.*

Table A10 – Large firms

Dependent variable: $\ln Y_{it}$		
Regressors	*Coefficient*	*Robust Stand Err.*
HERFI	-.0000107	8.08e-06
ES	-2.55e-13**	1.30e-13
HSPILL	.6017962	.4252512
MES	-.3757997	.5008337
Backspill	-1.164538	2.311613
Forspill	.0099157	.0544955
Time dummies	Yes	
Cons	10.57099*	.021442
Adjusted R^2	0.8016	
n OBS	6764	

Note:
Areg estimation was performed to fit a linear regression absorbing one categorical factor.
** = statistically significant at 0.01 per cent level.*
*** = statistically significant at 0.05 per cent level.*
**** = statistically significant at 0.10 per cent level.*

Table A11 – Centre

Dependent variable: TFP		
Regressors	*Coefficient*	*Robust Stand Err.*
HERFI	-.0000194*	5.45e-06
ES	1.25e-14	5.53e-14
HSPILL	-.193717**	.0810281
MES	.1995353	.4137799
Backspill	1.547117*	.4704356
Forspill	.0124554	.0098771
Time dummies	Yes	
Cons	9.471244*	.0102383
Adjusted R^2	0,6036	
n OBS	109105	

Note:
Areg estimation was performed to fit a linear regression absorbing one categorical factor.
** = statistically significant at 0.01 per cent level.*
*** = statistically significant at 0.05 per cent level.*
**** = statistically significant at 0.10 per cent level.*

Table A12– South

Dependent variable: TFP		
Regressors	*Coefficient*	*Robust Stand Err.*
HERFI	-4.42e-06	7.47e-06
ES	2.42e-13*	7.67e-14
HSPILL	-.0887323	.1517594
MES	-.1018954	.5301077
Backspill	.6278998	.8353995
Forspill	.0004002	.0033817
Time dummies	Yes	
Cons	9.210084*	.0147398
Adjusted R^2	0,5557	
n OBS	94851	

Note:
Areg estimation was performed to fit a linear regression absorbing one categorical factor.
** = statistically significant at 0.01 per cent level.*
*** = statistically significant at 0.05 per cent level.*
**** = statistically significant at 0.10 per cent level.*

Table A13 – North East

Dependent variable: TFP		
Regressors	*Coefficient*	*Robust Stand Err.*
HERFI	-9.27e-06*	3.31e-06
ES	1.96e-13*	3.44e-14
HSPILL	.0254971	.073973
MES	.3918378	.3792944
Backspill	.0252692	.3185491
Forspill	.016954	. 0178985
Time dummies	Yes	
Cons	9.510479*	.0072733
Adjusted R^2	0,6517	
n OBS	164255	

Note:
Areg estimation was performed to fit a linear regression absorbing one categorical factor.
** = statistically significant at 0.01 per cent level.*
*** = statistically significant at 0.05 per cent level.*
**** = statistically significant at 0.10 per cent level.*

Table A14 – North West

Dependent variable: TFP		
Regressors	*Coefficient*	*Robust Stand Err.*
HERFI	-9.41e-06*	2.74e-06
ES	7.98e-14*	2.96e-14
HSPILL	.1270997**	.0516451
MES	.5702902	.3274291
Backspill	-.3037768	.3048155
Forspill	-.001014	.0036905
Time dummies		
Cons	9.5416*	.0063247
Adjusted R^2	0,6543	
n OBS	194534	

Note:
Areg estimation was performed to fit a linear regression absorbing one categorical factor.
** = statistically significant at 0.01 per cent level.*
*** = statistically significant at 0.05 per cent level.*
**** = statistically significant at 0.10 per cent level.*