FDI, intermediate inputs and firm performance: Theory and Evidence from Italy

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Abstract

This paper studies theoretically and empirically – using data from Italian manufacturing firms – how the foreign presence in intermediate good sector (i.e. input FDI) affects firm efficiency and aggregate productivity within final good sector. We show that an important role is played by the absorptive capacity. More specifically, if all firms are able to use intermediate inputs from foreign-owned suppliers, then all of them will enjoy productivity gains from input FDI, without any reallocation effect. Conversely, if only the most productive firms can use intermediate inputs from foreign-owned suppliers, while these firms can enhance further their efficiency, the other firms might suffer productivity losses from input FDI, causing some reallocation effects within final good sector.

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1. Introduction

Over the last past decades, there has been a drastic increase in foreign direct investments (FDI) over the World, as many firms have started to establish affiliates abroad to serve the international market rather than by exporting (Horizontal FDI), or to relocate some stages of production (Vertical FDI). One of the main concerns for policy-makers is to understand whether the host country mainly benefits or suffers from the presence of foreign-owned firms. There is a huge literature on this issue, which attempts to disentangle different channels. The majority of works focus on spillover channels, i.e. how multinationals (MNEs) affect the productivity of local firms.

It is widely argued that multinationals firms can positively influence the productivity of domestic firms within the same sector, as the latter can learn more advanced technologies from the former, or are simply pushed to reduce their inefficiencies following a tougher competition arising from FDI (horizontal spillover). Moreover, multinationals can also generate positive productivity effects in vertically-related sectors, as they can directly transfer more advanced knowledge to domestic firms in upstream sectors, in order to have better intermediates produced by local suppliers (backward vertical spillover), as well as supply more or better intermediate inputs to local producers in downstream sectors (forward vertical spillover). While there is a large amount of empirical evidences which leads to mixed results with different explanations[1], there are very few theoretical models that focus on productivity spillover from FDI (such as Ethier and Markusen, 1996; Rodriguez-Clare, 1996; and Markusen and Venables, 1999).

[1] See the survey in Gorg and Greenaway (2004).

This paper studies theoretically and empirically how input market integration via FDI (i.e. input FDI) affects industry aggregate productivity, through technical efficiency changes within firms (intra-firm channel) as well as market shares reallocation across firms (inter-firm channel), shedding light on the role played by the absorptive capacity. The first channel is well known in the empirical literature as 'forward spillover from FDI', and is (almost) neglected by the theoretical literature. The second channel, that we accordingly name 'forward reallocation from FDI', can be considered as a new source of industry productivity gain from FDI, since to our knowledge, it has never been explored before.

In doing this, we first develop a theoretical framework where two sectors are vertically interrelated and produce differentiated varieties within a monopolistic competition market. We assume that firms in the upstream sector (i.e. intermediate good sector) are symmetric and use only labour as factor of production, similarly to Krugman (1980). Whereas firms in the downstream sector (i.e. final good sector) turn out to be heterogeneous in productivity, following Melitz (2003), and produce their output through combining intermediate inputs manufactured by the upstream sector, as in Ethier (1982). For the purpose of our analysis, we also assume that firms can serve the international market only via FDI, neglecting the trade channel in order to prevent any kind of interactions with firm's decision to trade and trade policy reforms. In our benchmark case, FDI is allowed only within the final good sector, which is associated with a fixed cost larger than that of domestic production – despite multi-plant economies are accounted for as in Markusen (1984) – due to some persistent restrictions to foreign firms. Consequently, only the most productive final good producers are able to serve the international market through establishing affiliates abroad, which can use intermediate inputs produced by local suppliers.

Next, we examine how full openness of intermediate good sector to FDI affects the whole economy by distinguishing two alternative cases. In the first case, all final good producers can use intermediates from foreign-owned suppliers located within country, because of a low required absorptive capacity (*LRAC*). Therefore, all firms uniformly enjoy productivity gains from input FDI (positive forward spillovers), so that both downstream sector's aggregate productivity and consumers' welfare increase without any entry-exit of firms (no reallocation effects). In the second case, only the most productive final good firms – which correspond to firms engaged with a multinational network in our set-up – are able to use these intermediate inputs of foreign origin, as a high absorptive capacity is required (*HRAC*). As a result, while the best performers benefit productivity gains from input FDI (positive forward spillovers), the low-efficiency firms suffer productivity losses (negative forward spillovers). These heterogeneous spillover effects would push the least efficient firms to leave the market, and more other firms to establish affiliates abroad, implying business reallocation effects towards the most productive firms within the final good sector. Consequently, the input FDI impact on downstream sector's aggregate productivity and consumers' welfare remains ambiguous.

By using a sample of Italian manufacturing firms over the period 2005-2012, we find that aggregate productivity gains within industry from input FDI occurs mostly through a reallocation mechanism, rather than through forward spillover within firms, especially in sectors with a higher required absorptive capacity (empirically proxied by a lower R&D intensity of inputs used). This confirms our hypothesis that in the latter sectors, it is more likely that the most productive firms gain in efficiency, and the least productive firms lose and consequently exit the market, implying business reallocation towards more productive firms. This result is consistent with the subsequent firm-level empirical analysis showing that firms enjoy positive forward spillovers from FDI only in sectors where the required absorptive capacity is relatively low (i.e. R&D intensity of inputs used is relatively high), otherwise they can even suffer on average negative forward spillovers.

Our paper contributes to the existing literature on the linkage between FDI and productivity in several ways. First, it complements some recent theoretical studies based on heterogeneous firms, which give emphasis to inter-firm reallocation mechanism, in addition to intra-firm spillover channel (Alfaro and Chen, 2013; Carluccio and Fally, 2012; and Imbruno, 2015). In their paper, Alfaro and Chen (2013) focus on a final good sector and horizontal spillovers from FDI, neglecting the intermediate good sector and the potential FDI impact via vertical linkages. In particular, they show that FDI openness leads to aggregate productivity gains due to both positive knowledge spillover and reallocation effects, as well as ambiguous effects on welfare. Carluccio and Fally (2012) consider the vertical spillover effect from FDI, but only via backward linkages, ignoring the possibility of any FDI impact via forward linkages, i.e. the role of input FDI. Assuming that final good producers use only intermediate inputs produced by local suppliers, they show that following a decrease in fixed cost of output FDI (or fixed cost of technology upgrading), more foreign firms enter the final good market and more firms within both final good and intermediate good sectors will upgrade their technology. As result, the low-productive firms lose in performance (due to inputs losses) and high-productive firms gain (due to input gains), implying ambiguous effects on welfare. Finally, Imbruno (2015) pays more attention on productivity effects from FDI via forward linkages, but he exclusively focuses on intra-firm channel, ignoring the FDI within downstream sector and the related reallocation effects. He shows that non-importers obtain gains from input FDI and losses from input trade, whereas importers might have opposite effects.

This paper also gives a relevant contribution at the empirical level. The majority of works focus on inward FDI effect on firm-level productivity, disentangling different spillover channels, and providing mixed results. A recent meta-analysis of these empirical evidences concludes that backward spillovers are more evident than forward spillovers, while horizontal spillovers have been found statistically insignificant (Havranek and Irsova, 2011). Some studies have already attempted to investigate the role played by the firm-level absorptive capacity, through considering that it is inversely related to the productivity gap between each firm and the most efficient firm within sector. However, the related findings lead to different conclusions. Cantwell (1989), for instance, claims that positive spillovers from FDI occur if productivity gap is relatively low in line with hypothesis that these benefits concern only firms capable enough to absorb the positive externalities from foreign firms. Girma (2005) documents that firms with the largest productivity gap can even suffer negative spillovers from FDI. Conversely, Findlay (1978) argues that firms benefit efficiency gains from FDI if productivity gap is relatively high, as there is more room for improvements. At some extent, our work provides some explanation why low-productivity firms can either gain or lose from (input) FDI openness, which is linked to the potential access to additional intermediate inputs: i.e. the least efficient firms enjoy productivity gains from input FDI in sectors where the required capacity to absorb inputs (RAC) is relatively low, and suffer productivity losses in sectors where RAC is relatively high.

More recently, using firm-level data from Italy over the period 2002-2007, Imbriani et al. (2014) document that forward spillovers from FDI were more evident – compared to both backward and horizontal spillovers – but different across three groups of domestic firms, categorized according to their technological gap respect to foreign firms. Namely, they were negative for firms with the largest gap, and positive for the remaining firms. The empirical section of our work goes further through discriminating the forward spillover effect from

FDI across sectors with different required capacity to use additional inputs as well as between multinational firms and other firms, considering that the former are more likely to be able to use inputs of foreign origin than the latter. Moreover, we also analyze the effect of FDI on aggregate productivity, discerning between intra-firm channel (spillover) and inter-firm channel (reallocation), which is almost neglected by the current empirical literature. Exceptions are represented by Harrison et al. (2013) and Alfaro and Chen (2013)'s evidences, which investigate this issue by using firm-level data from India and 60 countries, respectively. Unlike our paper, both studies focus mainly on the impact of foreign presence or FDI reforms within the same sector (i.e. horizontal spillover and reallocation effect from output FDI), rather than the effect on downstream sector of foreign presence in upstream sector (i.e. vertical spillover via forward linkage and reallocation effect from input FDI), and do not account for the role played by the absorptive capacity.

Our work also relates to the literature studying how the international access to intermediate inputs affects firms' productivity and their decision to serve the foreign market. The majority of studies focus on trade channel, i.e. how importing intermediates generates productivity effects within firms[2] and determines their decision to export[3]. Conversely, our analysis pays more attention on FDI channel, i.e. how using intermediates from foreign-owned suppliers located within country affects productivity within firms, as well as their decision to establish foreign affiliates to serve the international market. To the best of our knowledge, our paper is the first that highlights theoretically the vertical relationship between inward FDI (within intermediate good sector) and outward FDI (in the final good sector) – similarly to the vertical linkage between imports of intermediate goods and exports of final goods, already

[2] See Ethier (1982), Markusen (1989) Grossman and Helpman (1991), Kasahara and Rodrigue, (2008); Halpern, Koren and Szeidl (2011); Schor (2004); Goldberg, Khandelwal, Pavcnik and Topalova (2010); Khandelwal and Topolova (2011) and Amiti and Konings (2007).

3 See Bas and Strauss-Kahn (2011), Bas (2012), Chevassus-Lozza et al. (2013), Kasahara and Lapham (2013), Feng et al (2012) and Imbruno (2014),

documented in the literature – providing new insights to be further explored. Finally, our work also complements several studies on international sourcing via vertical (outward) FDI from downstream sector – i.e. when firms establish affiliates abroad in order to produce intermediate goods necessary for the final stage of production at home, giving rise to the so-called intra-firm trade[4] – since it focuses on international outsourcing via horizontal (inward) FDI from upstream sector. A recent empirical study on FDI from US by Ramondo et al. (2012) supports relatively more our story. They document that the majority of FDI occurring in different sectors compared to the parent firm's sector are not vertical, as usually assumed in the empirical studies, but they are horizontal as most of foreign affiliates in vertically-related sectors sell mostly to unaffiliated parties in the host countries and do not trade within parent firm's multinational network at all.

The rest of paper is organized as follows. Section 2 develops the theoretical framework to highlight some predictions, which are tested empirically in the section 3 by using firm-level data from the Italian manufacturing sector. Section 4 provides conclusion remarks.

2. Theoretical framework

This section develops a multi-country model to analyze the impact of FDI integration of input market on firm efficiency, firm's decision to establish an affiliate abroad to serve the international market (Horizontal FDI) and the related effects on the whole economy, in terms of aggregate productivity and consumers' welfare.

[4] See Helpman (1984), Antras (2003), Antras and Helpman (2004), Yeaple (2003), and Keller and Yeaple (2009).

2.1. Set-up of the model (benchmark case)

There are *n+1* countries which are symmetric in consumers' preferences, factor endowments and production systems. Each country has two sectors vertically interrelated to each other, where all firms are assumed to produce their differentiated varieties under monopolistic competition and increasing returns to scale. More specifically, in the downstream sector, i.e. final good sector (*y*), all firms are assumed to be heterogeneous in productivity (as Melitz, 2003) and to use both intermediate inputs and labour for their production process (as Ethier, 1982). Conversely, in the upstream sector, i.e. intermediate good sector (*m*), all firms turn out to be symmetric in productivity and to use labour only as factor of production (as Krugman, 1980). In the benchmark model we assume that while final good firms can decide to serve the international market by establishing affiliates abroad (i.e. *output FDI*) – by incurring an additional fixed cost higher than the fixed cost of domestic production – input suppliers can serve the domestic market only. In other words, both domestic-owned and foreign-owned final good producers established within a country can use only intermediates produced by domestic-owned suppliers located within the same country, as FDI in intermediated good sector (i.e. *input FDI*) is not allowed. We also assume that international trade is not permitted in both sectors at all, in order to prevent any kind of interaction with trade policy and firm's decision to trade. This model can be considered as a modified version of Helpman, Melitz and Yeaple (2004)'s framework, where the trade channel has been eliminated and an intermediate good sector has been added. Final good producers therefore use intermediate inputs in addition to labour, and can serve the foreign market only by FDI channel, rather than through the alternative trade channel as well.

2.1.1. Consumers preferences

Each country has a given number of labour units L, inelastically supplied at common wage rate w by a representative consumer. The latter exhibits CES preferences such that the utility function is $U = \left[\int_{y \in \Omega_y} q_y(y)^{\frac{\sigma-1}{\sigma}} dy \right]^{\frac{\sigma}{\sigma-1}}$, where $q_y(y)$ is the consumption quantity for each variety $y \in \Omega_y$, and $\sigma = \frac{1}{1-\rho} > 1$ stands for the elasticity of substitution between any two varieties within the set of final goods available Ω_y. Consequently, the demand for each final variety y is given by $q_y(y) = \left[\frac{p_y(y)}{P_y} \right]^{-\sigma} \frac{R_y}{P_y}$, where $R_y = wL$ is the total spending in final goods which equals the aggregate revenue within the final good sector in each country, $p_y(y)$ is the price of the variety y, and $P_y = \left[\int_{y \in \Omega_y} p_y(y)^{1-\sigma} dy \right]^{\frac{1}{1-\sigma}}$ is the aggregate price index of all final differentiated varieties available. As usual in the heterogeneous firms literature, we use the wage rate as *numeraire*, so that it equals one everywhere ($w=1$).

2.1.2. Final good sector

Firms in the final good sector are assumed to be heterogeneous in *ex-ante* productivity φ_y and to supply a variety y under monopolistic competition and increasing returns to scale, as Melitz (2003). However, unlike Melitz (2003), each firm's output is produced by combining all available intermediate inputs m, stemming from the intermediate good sector, through a CES production function *à la Ethier (1982)*:

(2.1) $$q_y = \varphi_y X_m = \varphi_y \left[\int_{m \in \Omega_m} x_m(m)^{\frac{\sigma-1}{\sigma}} dm \right]^{\frac{\sigma}{\sigma-1}}$$

where q_y denotes the firm-level output, X_m stands for the firm-level aggregate consumption in intermediate inputs, x_m represents the quantity consumed of each input variety $m \in \Omega_m$, and $\sigma = \frac{1}{1-\rho} > 1$ is the elasticity of substitution between any two inputs available within the set of intermediate goods Ω_m [5]. Thus, the firm-level demand for an intermediate variety *m* is $x_m(m) = \left[\frac{p_m(m)}{P_m} \right]^{-\sigma} \frac{q_y}{\varphi_y}$, where $p_m(m)$ is the price of the input variety *m* and P_m is the aggregate price index of all available differentiated inputs:

(2.2) $$P_m = \left[\int_{m \in \Omega_m} p_m(m)^{1-\sigma} dm \right]^{\frac{1}{1-\sigma}}$$

The production of each variety *y* also requires a fixed cost f_y^D in terms of labour, therefore the final good producer's total cost to supply the entire domestic market is $c_y = f_y^D + \frac{P_m}{\varphi_y} q_y$. By bearing in mind its residual demand, each firm sets its profit-maximizing price $p_y(\varphi_y) = \frac{P_m}{\rho \varphi_y}$, making the following profit from the domestic market

(2.3) $$\pi_y^D(\varphi_y) = \frac{R_y}{\sigma} \left(\frac{P_y \rho \varphi_y}{P_m} \right)^{\sigma-1} - f_y^D$$

[5] To save further notation and make the model as simple as possible, the elasticity of input substitution is assumed to be the same as the elasticity of output substitution.

As Helpman et al. (2004), a final good firm can also serve the international market through establishing an affiliate abroad (i.e. FDI channel), by incurring an additional fixed cost per each host foreign country, which is assumed to be relatively higher than the domestic fixed of production $f_y^F > f_y^D$. In other words, even if the final good sector is open to FDI, it is not completely liberalized for foreign-owned firms, as they are still subject to some FDI restrictions. Unlike Helpman et al. (2004) and following Markusen (1984), we assume that firms opening a foreign affiliate can further benefit from some multi-plant economies. There are firm-specific activities which exhibit "jointness" characteristics compared with plant-specific activities. For example, R&D activity is usually concentrated within the parent plant. However, once an innovation is developed, it can be incorporated into related affiliates, i.e. other plants within the same firm, without losing the marginal product of that innovation. Thus, the efficiency advantage of multi-plant firm is connected to its ability to avoid duplication in R&D, which is necessarily involved the single-plant firm. We model this, assuming that the second plant is associated with a lower fixed cost compared to the first plant, i.e. a firm will face the following fixed cost to establish an affiliate abroad: βf_y^F, where $0 < \beta < 1$. Nevertheless, this additional fixed cost of foreign production is still assumed to be larger than the fixed cost of domestic production due to relevant restrictions to FDI within final good sector, i.e. $\beta f_y^F > f_y^D$. Therefore, the additional profit from each foreign country is

(2.4) $$\pi_y^F(\varphi_y) = \frac{R_y}{\sigma}\left(\frac{P_y \rho \varphi_y}{P_m}\right)^{\sigma-1} - \beta f_y^F$$

2.1.3. Intermediate good sector

It is worth noting that the firm-level demand for a given input variety $x_m(m)$ can be written as a function of firm-level spending in all intermediate inputs $\frac{P_m}{\varphi_y} q_y$. Then, by aggregating $x_m(m)$ across all final good firms and considering that some of them are able to serve additional *n* foreign markets through FDI channel, we can highlight the aggregate demand for a specific input variety $q_m(m) = \left[\frac{p_m(m)}{P_m}\right]^{-\sigma} \frac{R_m}{P_m}$, where R_m is the aggregate spending in all intermediate inputs across all final good firms which is equivalent to the aggregate revenue within intermediate good sector in each country.

The intermediate good firms are assumed to be symmetric in productivity φ_m and to produce a differentiated variety m under monopolistic competition and increasing returns to scale by using only labour, as Krugman (1980). Thus, the intermediate good firm's total cost to serve the home market is $c_m = f_m^D + \frac{q_m}{\varphi_m}$. By facing its residual demand curve, each intermediate good firm charges the profit-maximizing price $p_m(\varphi_m) = \frac{1}{\rho \varphi_m}$, yielding the following profit

$$\pi_m = \frac{1}{(\sigma - 1)\varphi_m} q_m - f_m^D \tag{2.5}$$

2.1.4. Equilibrium

Final good firms enter the market by paying a sunk fixed cost of entry f_e to draw their *ex-ante* productivity φ_y from the Pareto cumulative distribution $G(\varphi_y) = 1 - (\varphi_y)^{-k}$, where

$k > 1$. Then, they immediately decide whether to exit the market or to produce. A firm will stay in the home final good market as long as its profit is positive, i.e. if its productivity is higher than the survival-cutoff φ_y^D arising from the *Domestic Zero Profit Condition* ($\pi_y^D(\varphi_y^D) = 0$). Similarly, a final good producer will serve the foreign market via FDI channel only if the foreign profit is positive, i.e. if its productivity exceeds the FDI-cutoff φ_y^F coming from the *FDI Zero Profit Condition* ($\pi_y^F(\varphi_y^F) = 0$). Finally, by considering that in each period there is an exogenous probability of exit δ, a final good producer will enter the market if the expected value of profits is higher than the sunk fixed cost of entry f_e. Consequently, the free entry cutoff $\varphi_y{}^D$ comes from the following *Free Entry Condition*:

$$[1 - G(\varphi_y^D)]\frac{\tilde{\pi}_y}{\delta} = f_e \tag{2.6}$$

where $1 - G(\varphi_y^D)$ is the probability of survival and $\tilde{\pi}_y$ is per-period expected profit of surviving firms:

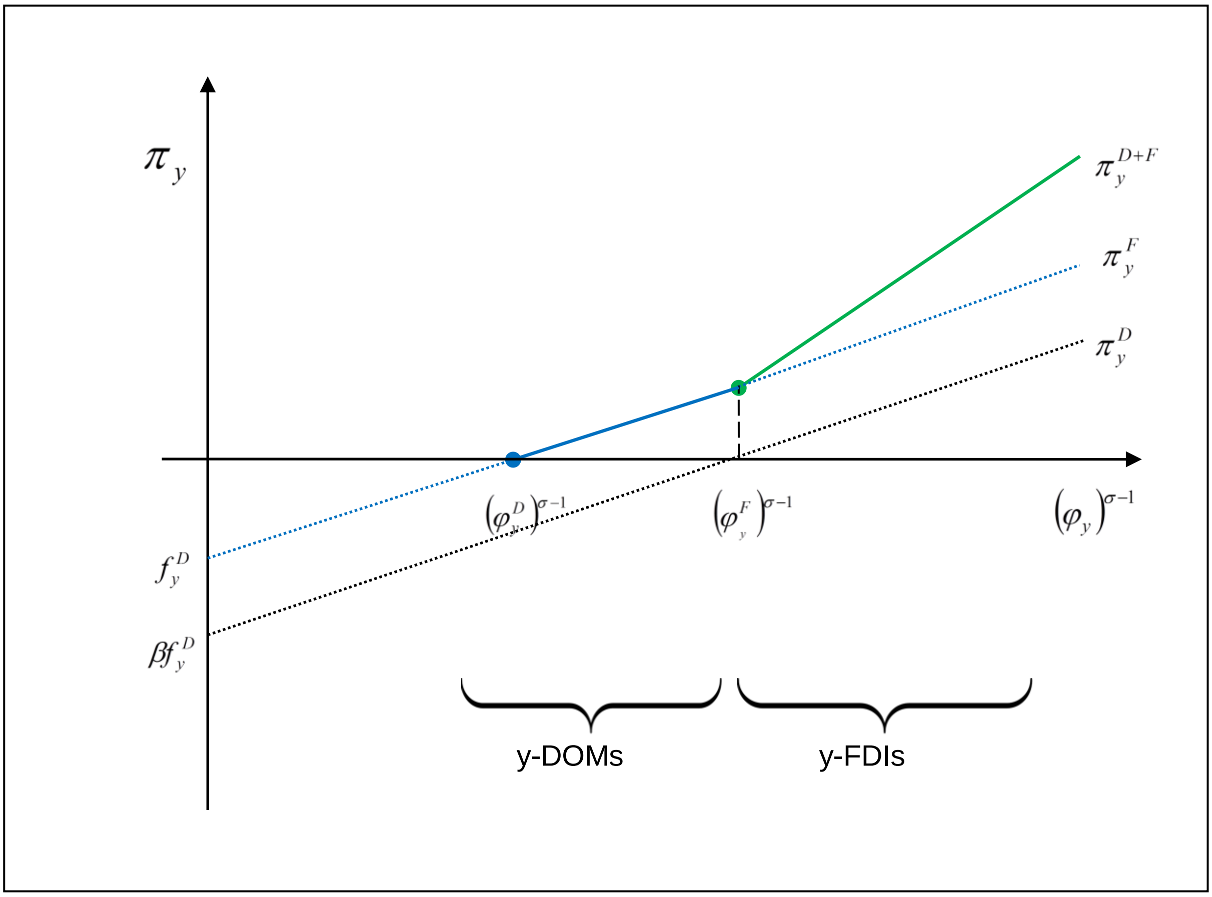
$$\tilde{\pi}_y = \int_{\varphi_y^D}^{\varphi_y^F} \pi_y^D(\varphi_y)\frac{g(\varphi_y)}{1 - G(\varphi_y^D)}d\varphi + n\int_{\varphi_y^F}^{\infty} \pi_y^F(\varphi_y)\frac{g(\varphi_y)}{1 - G(\varphi_y^D)}d\varphi$$

which in turn can simply be written as $\tilde{\pi}_y = \left(\frac{\sigma - 1}{1 + k - \sigma}\right)\Delta_y$, where $\Delta_y = f_y^D + n\psi_y^F \beta f_y^F$ is the average fixed cost paid by all domestic-owned final good firms through considering that some of them are engaged in outward FDI,[6] since $\psi_y^F = \frac{1 - G(\varphi_y^F)}{1 - G(\varphi_y^D)}$ denotes the probability of investing abroad (or portion of FDI-makers) within final good sector. By considering the all

[6] Because of symmetry, it also corresponds to the average fixed cost paid by all firms located within country – both domestic-owned and foreign-owned – to serve the home market.

three conditions, we can find the uniqueness of equilibrium $\left(\varphi_y{}^D, \varphi_y{}^F, \tilde{\pi}_y\right)$ and highlight the relationship between the two productivity cutoffs: $\varphi_y^F = \left(\frac{\beta f_y^F}{f_y^D}\right)^{\frac{1}{\sigma-1}} \varphi_y^D$.

Figure 1 - Final good sector (or Downstream sector)



Notice that $\varphi_y^F > \varphi_y^D$ as long as $\beta f_y^F > f_y^D$, i.e. the fixed cost related to FDI is sufficiently higher than the fixed cost of domestic production. From **Figure 1**, we can see that while less productive final good firms will produce only for the home market (i.e. all firms whose productivity φ_y ranges between φ_y^D and φ_y^F), more productive ones will also serve the whole foreign market by FDI channel (i.e. all firms whose productivity φ_y is higher than φ_y^F).

Now, it is worth pointing out that all final good producers can only access all intermediate inputs produced domestically by domestic-owned suppliers, since no trade and FDI within intermediate good sector is permitted. Thus, in each country, symmetric intermediate good firms will enter the market as long as domestic profit is positive: i.e. in equilibrium, the profit equation (2.5) will equal zero, implying that the output for a representative input supplier is $q_m = (\sigma - 1)\varphi_m f_m^D$.

As in Melitz (2003), we focus on the steady state equilibrium so that $R_y = L$ and $R_m = \rho R_y = \rho L$. Thus, the mass of input suppliers (i.e. the number of available input varieties) and the related price index of intermediate inputs are respectively

(2.7) $$M = \frac{R_m}{r_m} = \frac{\rho L}{\sigma f_m^D}$$

(2.8) $$P_m = \frac{M^{\frac{1}{1-\sigma}}}{\rho \varphi_m} = \left(\frac{\rho L}{\sigma f_m^D} \right)^{\frac{1}{1-\sigma}} \frac{1}{\rho \varphi_m}$$

The mass of domestic-owned final good firms located within each country is

(2.9) $$N = \frac{R_y}{\tilde{r}_y} = \frac{L}{\sigma \left(f_y^D + n \psi_y^F \beta f_y^F \right) \left(\frac{k}{1+k-\sigma} \right)}$$

while the mass of final good producers engaged with outward FDI within each country is $N_F = \psi_y^F N$. Consequently, the mass of all final good firms competing within each country, i.e. the number of available final good varieties, is $N_T = N + nN_F = (1 + n\psi_y^F)N$. Using the Domestic Zero Profit condition within final good sector, the related price index can be written simply as function of survival cutoff φ_y^D:

$$(2.10) \qquad P_y = \left(\frac{R_y}{\sigma f_y^D}\right)^{\frac{1}{1-\sigma}} \frac{P_m}{\rho \varphi_y^D} = \left(\frac{\rho L^2}{\sigma^2 f_m^D f_y^D}\right)^{\frac{1}{1-\sigma}} \frac{1}{\rho^2 \varphi_m \varphi_y^D}$$

It is worth to pointing out that while firm-level efficiency (firm-level marginal cost) within final good sector turns out to be increasing (decreasing) in both number and average productivity of symmetric input suppliers, the firm-level productivity measured as Ethier (1982) is positively related to the number of input suppliers (or input varieties) only:

$$(2.11) \qquad \varphi_y^{Ethier} = \varphi_y \left[\int_0^M x_m^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}} \left[\int_0^M x_m\right]^{-1} = \varphi_y [M]^{\frac{1}{\sigma-1}}$$

Moreover, the weighted average productivity *à la Ethier (1982)* within final good sector[7] is represented by

$$(2.12) \qquad \tilde{\varphi}_y^{Ethier} = [M]^{\frac{1}{\sigma-1}} \left[\left(\frac{k}{1+k-\sigma}\right) \frac{f_y^D + \psi_y^F n \beta f_y^F}{f_y^D}\right]^{\frac{1}{\sigma-1}} \varphi_y^D$$

and the welfare per worker (final consumer) is given by

$$(2.13) \qquad \frac{U}{L} = P_y^{-1} = [M]^{\frac{1}{\sigma-1}} \left(\frac{L}{\sigma f_y^D}\right)^{\frac{1}{\sigma-1}} \rho^2 \varphi_m \varphi_y^D$$

Thus, in addition to being positively related to both the number and the average productivity of final good firms as in Melitz (2003), economy's welfare is also increasing in both the number and the average productivity of input suppliers.

[7] Because of the symmetry, equation (2.12) measures either the weighted average efficiency (productivity) of domestic-owned firms located within country, by considering that some of them also serve the international market by FDI, or the weighted average efficiency (productivity) of all firms competing within country, i.e. both domestic-owned firms and foreign-owned affiliates located within country. The first definition refers to the national aggregate efficiency (productivity), being based on the ownership status, like GNP, whereas the second definition refers to the domestic aggregate efficiency (productivity), as it is based on the location status, like GDP.

2.2. FDI integration of intermediate input market

This section studies the impact of FDI integration of intermediate input market on firm-level performance, aggregate productivity and consumers' welfare, by considering two different cases. In the first case (section 2.2.1), all final good firms are be able to use the additional inputs from foreign-owned suppliers located within the home country, as the required absorptive capacity (RAC^m) is relatively low. In the second case (section 2.2.2), only the most productive final good producers in each country can integrate the new inputs from foreign-owned suppliers, being required a relatively high absorptive capacity. In our set-up the most productive firms correspond to all final good producers engaged in multinational network, i.e. both domestic-owned FDI makers (outward multinationals) and foreign-owned affiliates (inward multinationals) in each country. In other words, we assume that the minimum extent of firm-level fixed cost required to "absorb" inputs from abroad equals the fixed cost of domestic production f_y^D in the first case, and the fixed cost of multinational production $f_y^D + \beta f_y^F$ in the second case.[8]

[8] In the empirical literature on productivity spillover from FDI and the role of absorptive capacity, the latter is usually proxied at the firm-level in different ways, such as by productivity gap between any single firm and the best performer within sector, the R&D status or the export status of firms, assuming that the absorptive capacity is higher for firms with smaller productivity gap, firms engaged in innovation activity or firms involved in international trade. Therefore, we could include either the export channel or the R&D channel in our model in order to figure out which firms are more likely to be able to adopt the foreign inputs. However, we have decided to assume that only firms engaged in FDI are able to use foreign inputs (in the second case) for several reasons: firstly, to make the model as simple as possible – by focussing on FDI only, rather than in further alternative modes of internationalization or technology upgrading – and secondly to be more coherent with the data available – since our dataset unfortunately does have no information about whether firms are involved in export or imperfect information about R&D activity, but it provides information on foreign ownership of firms (inward FDI) and whether firms have foreign affiliates (outward FDI).

2.2.1. Case A: Low Required Absorptive Capacity (*Low RAC^m*)

In this subsection, we see how the openness of intermediate good sector to FDI influences firm-level productivity and the whole economy, by assuming that all final good producers can use inputs produced by foreign-owned suppliers. Thus, any heterogeneous firm within final good sector exhibits the following CES production function

$$q_y = \varphi_y \left[\int_{m \in \Omega_m^D} x_m(m)^{\frac{\sigma-1}{\sigma}} dm + n \int_{m \in \Omega_m^F} x_m(m)^{\frac{\sigma-1}{\sigma}} dm \right]^{\frac{\sigma}{\sigma-1}} \tag{2.14}$$

and faces a new price index of intermediates which now refers to all inputs produced by both domestic-owned and foreign-owned suppliers located within the home country, i.e. by all World producers of intermediates:

$$P_m^T = \left[\int_{m \in \Omega_m^D} p_m(m)^{1-\sigma} dm + n \int_{m \in \Omega_m^F} p_m(m)^{1-\sigma} dm \right]^{\frac{1}{1-\sigma}} \tag{2.15}$$

Consequently, any input supplier will serve the whole market in each foreign country in addition to the domestic one. Indeed, the aggregate demand for each specific input variety is $q_m(m) = (p_m)^{-\sigma} R_m (n+1)(P_m^T)^{\sigma-1}$, which can be written alternatively as $q_m(m) = (p_m)^{-\sigma} R_m (P_m^D)^{\sigma-1}$, where P_m^D is the price index of intermediate inputs produced by domestic-owned suppliers located within the country. Indeed, the two price indexes are related to each other as follows: $P_m^T = (1+n)^{\frac{1}{1-\sigma}} P_m^D$.

Like in the final good sector, we assume that intermediate firms have to face additional fixed investments per each foreign market supplied, and they also benefit from multi-plant economies. As consequence, the additional fixed cost per each foreign country is βf_m^F, where $0 < \beta < 1$. Unlike the final good sector, where firms are still subject to some FDI restrictions (given that $\beta f_y^F > f_y^D$), we assume that *full* FDI liberalization takes place within the intermediates sector such that $f_m^F = f_m^D$. Thus, a representative input supplier faces the cost $c_m(A) = f_m^D(1+\beta n) + \frac{q_m^T}{\varphi_m}$ to serve all final good producers in the World, producing a larger amount of output $q_m^T(A) = (\sigma - 1)\varphi_m f_m^D(1+\beta n)$.

While the mass of domestic-owned input suppliers located in each country is lower than that in the benchmark case

$$M^D(A) = \frac{R_m}{r_m} = \frac{\rho L}{\sigma f_m^D(1+\beta n)} < M \qquad (2.16)$$

the mass of both domestic-owned and foreign-owned suppliers competing in each country, which corresponds to the number of all available input varieties in each country, is relatively higher

$$M^T(A) = (1+n)M^D = \left(\frac{1+n}{1+\beta n}\right)\frac{\rho L}{\sigma f_m^D} > M \qquad (2.17)$$

Therefore, the price index of all available intermediates is lower $P_m^T(A) < P_m$.

These results imply that all final good firms enjoy uniformly efficiency gains from input FDI ($\varphi_y^{Ethier}(A) = \varphi_y\left[M^T(A)\right]^{\frac{1}{\sigma-1}} > \varphi_y^{Ethier}$), such that both weighted average productivity within final good sector ($\tilde{\varphi}_y^{Ethier}(A) > \tilde{\varphi}_y^{Ethier}$) and consumer's welfare ($\frac{U}{L}(A) > \frac{U}{L}$) improve without any business reallocation effect across final good firms. Indeed, aggregate productivity *à la Ethier (1982)* of final good firms and consumer's welfare are now given by

$$\tilde{\varphi}_y^{Ethier}(A) = \left[M^T(A)\right]^{\frac{1}{\sigma-1}}\left[\left(\frac{k}{1+k-\sigma}\right)\frac{f_y^D + \psi_y^F n\beta f_y^F}{f_y^D}\right]^{\frac{1}{\sigma-1}}\varphi_y^D$$

$$\frac{U}{L}(A) = \left[M^T(A)\right]^{\frac{1}{\sigma-1}} \left(\frac{L}{\sigma f_y^D}\right)^{\frac{1}{\sigma-1}} \rho^2 \varphi_m \varphi_y^D$$

Testable prediction 1. *If all firms can use additional foreign intermediates, full FDI integration of input market implies a uniform increase in efficiency for all firms, without any entry-exit dynamics within industry. Consequently, each country enjoys aggregate productivity (welfare) gains from input FDI, arising from efficiency changes within firms only, i.e. without any business reallocation effect across firms.*

2.2.2. Case B: High Required Absorptive Capacity (*High RAC^m^*)

In this subsection, we study how the openness of intermediate good sector to FDI influences firm-level productivity and the whole economy, by assuming that only the most productive final good firms within each country – i.e. both outward multinationals and inward multinationals in our model (all MNEs) – are able to use inputs produced by foreign-owned suppliers, while the remaining firms are unable to use these new additional inputs because of their insufficient absorptive capacity. Thus, while the former firms exhibit a production function and face the price index of intermediate inputs similar to those in the case A (i.e. the equations (2.14) and (2.15)), the latter firms keep a production function and the price index of inputs similar to those in the benchmark case (i.e. the equations (2.1) and (2.2)).

Consequently, the aggregate demand for each specific input variety is $q_m(m) = (p_m)^{-\sigma} R_m \left(P_m^D\right)^{\sigma-1}$. In other words, any input supplier will serve not only both domestic-owned and foreign-owned final good producers located within home country, but also all firms involved in a multinational network in each foreign country[9]. As result, the input supplier's market share in each foreign country is given by $s_y^F = \frac{\psi_y^F + n\psi_y^F}{1+n\psi_y^F} < 1$.

Similarly to the case A, we assume that an input supplier incurs an additional fixed cost of FDI in each foreign country. Following Arkolakis (2010) and Akerman and Forslid (2009), this additional cost is proportional to the share of foreign market supplied ($s_y^F \beta f_m^D$), as the marketing costs of establishing a new brand is relatively lower in markets with a lower share of potential buyers[10]. Thus, a representative intermediate input supplier faces the cost $c_m(B) = f_m^D\left(1+n\beta s_y^F\right) + \frac{q_m^T}{\varphi_m}$ to serve all final good firms in the World, producing a certain amount of output, which turns out to be smaller than the case A, but still larger than the benchmark case: $q_m^T(B) = (\sigma-1)\varphi_m f_m^D\left(1+n\beta s_y^F\right)$.

The mass of domestic-owned input suppliers located in each country, which equals the number of available input varieties for the least productive final good producers in each country is lower than that of the benchmark case

$$M^D(B) = \frac{R_m}{r_m} = \frac{\rho L}{\sigma f_m^D\left(1+n\beta s_y^F\right)} < M \tag{2.18}$$

and the related price index is accordingly higher $P_m^D(B) > P_m$. Whereas the mass of both domestic-owned and foreign-owned suppliers competing in each country, which

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[9] Notice that when we calculate the demand for each intermediate variety by FDI-makers, we consider the total demand of inputs by domestic-owned FDI-makers to serve both domestic and foreign markets, which corresponds to the total demand of inputs by both domestic-owned FDI-makers and foreign-owned affiliates to serve the home market (because of symmetry).

[10] Notice that if all final good firms were able to use foreign inputs ($\psi_y^F = 1$), then the fixed cost of FDI within intermediate good sector would exactly be as that in the case A (βf_m^D).

corresponds to the number of all available input varieties for the most productive final good producers, is higher than that in the former cases

$$M^F(B) = (n+1)M^D = \left(\frac{1+n}{1+n\beta s_y^F}\right)\frac{\rho L}{\sigma f_m^D} > M^T > M \tag{2.19}$$

As a consequence, the related price index is accordingly lower $P_m^F(B) < P_m^T < P_m$.

These results indicate that the most productive final good firms enjoy efficiency gains from input FDI ($\varphi_y^{Ethier\_F}(B) = \varphi_y\left[M^F(B)\right]^{\frac{1}{\sigma-1}} > \varphi_y^{Ethier}$), whereas the least productive firms suffer efficiency losses from input FDI ($\varphi_y^{Ethier\_D}(B) = \varphi_y\left[M^D(B)\right]^{\frac{1}{\sigma-1}} < \varphi_y^{Ethier}$). Indeed, the survival cutoff increases ($\varphi_y^D(B) > \varphi_y^D$) and the FDI cutoff decreases ($\varphi_y^F(B) < \varphi_y^F$) within final good sector, implying that the least productive firms exit the market and more firms decide to establish affiliates abroad. Moreover, while the probability of survival decreases ($\psi_y^{in}(B) < \psi_y^{in}$), the probability of making FDI – which equals the probability of benefiting from FDI spillovers through forward linkages in the current case – increases ($\psi_y^F(B) > \psi_y^F$) within final good sector. These effects entail some business reallocation towards more productive firms similarly to Melitz (2003)'s model. However, by accounting for these positive and negative effects altogether, the changes in both aggregate productivity and welfare remain ambiguous. Indeed, final good sector's aggregate productivity à la Ethier (1982) and consumer's welfare in case B are represented respectively by

$$\tilde{\varphi}_y^{Ethier}(B) = \left[M^D(B)\right]^{\frac{1}{\sigma-1}}\left[\left(\frac{k}{1+k-\sigma}\right)\frac{f_y^D + \psi_y^F(B)n\beta f_y^F}{f_y^D}\right]^{\frac{1}{\sigma-1}}\varphi_y^D(B)$$

$$\frac{U}{L}(B) = \left[M^D(B)\right]^{\frac{1}{\sigma-1}}\left(\frac{L}{\sigma f_y^D}\right)^{\frac{1}{\sigma-1}}\rho^2\varphi_m\varphi_y^D(B)$$

We can clearly see that the weighted average productivity increases ($\tilde{\varphi}_y^{Ethier}(B) > \tilde{\varphi}_y^{Ethier}$) only if the benefits from reallocation – associated with the exit of the least productive firms ($\varphi_y^D(B) > \varphi_y^D$) and a higher proportion of firms able to make FDI, i.e. able to use foreign inputs ($\psi_y^F(B) > \psi_y^F$) – overcome the losses from domestic input varieties ($M^D(B) < M$); otherwise it declines ($\tilde{\varphi}_y^{Ethier}(B) < \tilde{\varphi}_y^{Ethier}$). Similarly, consumers' welfare improves ($\frac{U}{L}(B) > \frac{U}{L}$) only if the benefits from reallocation – linked to the exit of the least productive firms ($\varphi_y^D(B) > \varphi_y^D$) – are larger than the losses from domestic input varieties ($M^D(B) < M$); otherwise it worsens ($\frac{U}{L}(B) < \frac{U}{L}$).

Testable prediction 2. *If only the most efficient producers are able to use additional foreign intermediate inputs, full FDI integration of input market implies efficiency gains only for these firms, while the remaining firms suffer efficiency losses: the least productive firms are forced to exit the market and more firms start to serve the international market through (output) FDI, implying some business reallocation across firms. Consequently, each country enjoys aggregate productivity (welfare) gains from input FDI, only if productivity gains from reallocation across firms in addition to efficiency gains within high-productivity firms (multinationals) are larger than efficiency losses within low-productivity firms (non-non-multinationals). Otherwise, country's aggregate productivity (welfare) falls.*

3. Empirical Evidence

Using firm-level data, this section empirically explores how FDI integration of intermediate input market (i.e. input FDI) affects aggregate productivity within the Italian manufacturing sector over the period 2005-2012. The section is organized as follows. The first subsection (3.1) describes the data used and provides some descriptive statistics on the main variables of interest. The second subsection (0) investigates the impact of input FDI on industry-level aggregate productivity, disentangling the intra-firm effect and the inter-firm effect as in Harrison et al. (2013). In doing this, we also distinguish industries according to the degree of effort to absorb additional intermediate inputs. Finally, the last subsection (3.3) focuses more deeply on input FDI effect on firm-level productivity, by discriminating firms that are more likely to have the absorptive capacity required to integrate the additional foreign inputs in their production system respect to other firms.

3.1. Data and variables

3.1.1. Data sources and the sample

The data used for this analysis are yearly drawn from AIDA (Analisi Informatizzata Delle Aziende) database, a commercial dataset provided by Bureau Van Dijk containing information on Italian companies which has recently been used in an increasing number of empirical studies (see for example, Imbriani et al., 2011; Ferragina et al., 2012; Cainelli et al., 2013; Imbriani et al., 2014).[11] AIDA provides information on a wide set of economic

[11] Usually, users of AIDA microdata extract information on firm status only for the year of the data acquisition. However, in our paper, in order to capture the demography of firms, we extract firm level observations year-by-year.

and financial variables, such as sales, costs and number of employees, value added, start-up year, sector of activity at five-digit ATECO 2002, as well as legal and ownership status.

Since AIDA offers almost complete coverage of capital-owned firms in Italy, we focus our analysis only on this group of firms. In particular, our sample refers to the three following types of firms: public limited companies (Società per azioni, S.p.a.), private limited companies (Società a responsabilità limitata, S.r.l.), and partnerships limited by shares (Società in accomandita per azioni, S.a.p.a).

We start with an AIDA sample of about 530 thousand observations (about 66 thousand per year) over the years 2005-2012. We then impose a number of restrictions on the data. First, we identify all companies active on December 31st 2004 with positive values of turnover and value added over the period 2005-2012. Second, we exclude all firms with an added value-turnover ratio <0 and >1. Third, we exclude all firms with incomplete or inconsistent data in terms of value added, total labour cost, fixed capital and value of production, and firms where start-up year, number of employees, and sector of activity were not available over the period 2005-2012. The resulting dataset is an unbalanced panel of 357,846 observations.

The information on ownership status enclosed in the database allows us to split our sample into three categories of firms: outward multinationals (OMNEs), inward multinationals (IMNEs), and non-multinationals (NMNEs). Specifically, we classify a firm as IMNE if its ultimate owner is not Italian. AIDA defines ultimate owner as the shareholder with more than 24.9% of cash flow rights not controlled by anyone else.[12] In our specific case, we consider a share of ownership greater/equal to 50 percent. Likewise, we identify as OMNE

[12] This, therefore, usually involves tracking down multiple chains and repetitive identification of major shareholders up to identify an independent owner (i.e., not controlled by anyone else).

firm a non-foreign-owned firm with a share of direct ownership greater/equal to 50 percent in firms located in countries other than Italy.[13]

In order to know if firms are active in each year, we use the 'legal status' variable in the AIDA database indicating whether a firm is active or inactive. Firms are classified as inactive when they are in liquidation, dissolved or in receivership. As it is well known, however, the status of inactivity could mask a takeover or merger, or even a change of the firm's location mid-way through the study period.[14]

Table 1: Distribution of Italian firms by size and ownership status (percentages, sample average)**

	IMNEs	OMNEs	NMNEs
Small firms	0.60	0.41	98.99
Medium firms	3.85	6.10	90.06
Large firms	14.34	22.00	63.65
Total	**1.12**	**1.31**	**97.57**

Note: **Small firms (1-49 employees); medium firms (50-249 employees); large firms (more than 250 employees).
Source: authors' elaborations on AIDA database.

The advantage of using this dataset is twofold. Firstly, it is highly representative of the entire universe of Italian capital-owned firms where private limited companies represent about 84% of total capital-owned firms (e.g., as against 95% declared by the Italian National Institute of Statistics – ISTAT 2011). Secondly, it reflects quite well the size distribution of firms in the Italian economy, which is characterized by a high weight of small and medium-sized enterprises. **Table 1** compares the distribution of Italian firms by ownership status

[13] As indicated at the beginning of section 3.1.1., Aida provides firm ownership status for the last year rather than annually. Fortunately, as the data were yearly collected, the ownership status is time-variant.

[14] In order to reduce mis-measurement problems, we complement the 'legal status' variable from AIDA with information from the Italian Business Register (ASIA) on the timing of the "real" legal cessation of the firm's activity.

(IMNEs, OMNEs, NMNEs) and firm size (small, medium and large firms), the latter measured by the number of employees. According to the figures, non-multinational firms represented the vast majority (97.57 %) of Italian firms and were mainly of smaller sizes (i.e. those with fewer than 50 employees accounted for around 99.0 % of total domestic firms). The number of both Domestic and Foreign MNEs was rather low.

3.1.2. Productivity

To empirically measure firm-level productivity, we account for labour *L* and capital *K* in addition to the CES consumption of intermediate inputs *X* for the production of the output *q*, by extending the equation (2.1) to the standard Cobb-Douglas function

(3.1) $$q_{ijt} = \varphi_{ijt} X_{ijt}^{\alpha_j^m} L_{ijt}^{\alpha_j^l} K_{ijt}^{\alpha_j^k}$$

where α_j^m, α_j^l and α_j^k are the related factor shares of production, φ is the Hicksian-neutral productivity, while *i*, *j* and *t* denote firm, sector and time, respectively. Notice that this production function can be also written alternatively in the following way

(3.2) $$q_{it} = \Phi_{ijt}(\varphi_{ijt}, M_{it}) Z_{ijt}^{\alpha_j^m} L_{ijt}^{\alpha_j^l} K_{ijt}^{\alpha_j^k}$$

Where *Z* stands for the linear consumption of intermediate inputs and Φ is the Ethier productivity, which turns out to be increasing in both Hicksian productivity φ and number of intermediate inputs used M. Now, for each 2-digit Ateco sector we first estimate the coefficients of production ($\hat{\alpha}_j^m, \hat{\alpha}_j^l$ and $\hat{\alpha}_j^k$) using Olley-Pakes (1996)'s methodology and then we measure our firm-level productivity as:

$$\Phi_{ijt} = \frac{q_{ijt}}{Z_{ijt}^{\hat{\alpha}_j^m} L_{ijt}^{\hat{\alpha}_j^l} K_{ijt}^{\hat{\alpha}_j^k}}$$

where q is measured as value-added, Z corresponds to the value of intermediate inputs,[15] L is the number of employees and K is the capital proxied by the net value of fixed assets. It is worth noting that all variables are deflated by their corresponding price indices at the two-digit industry level, except for capital deflated by a fixed assets investment index.

Once the firm-level productivity is measured, we calculate the aggregate productivity at 2-digit-industry level $\Phi_{jt}^{AGGREGATE}$ as the weighted average of firm-level productivities Φ_{ijt} by using firm-level market share $s_{ijt} = \frac{sales_{ijt}}{sales_{jt}}$ as weights

(3.4) $$\Phi_{jt}^{AGGREGATE} = \sum_{i \in j} \Phi_{ijt} s_{ijt}$$

Then, following Olley-Pakes (1996) and Harrison et al. (2013), we split the aggregate productivity into intra-firm productivity $\Phi_{jt}^{INTRAFIRM}$ and inter-firm productivity $\Phi_{jt}^{INTERFIRM}$:

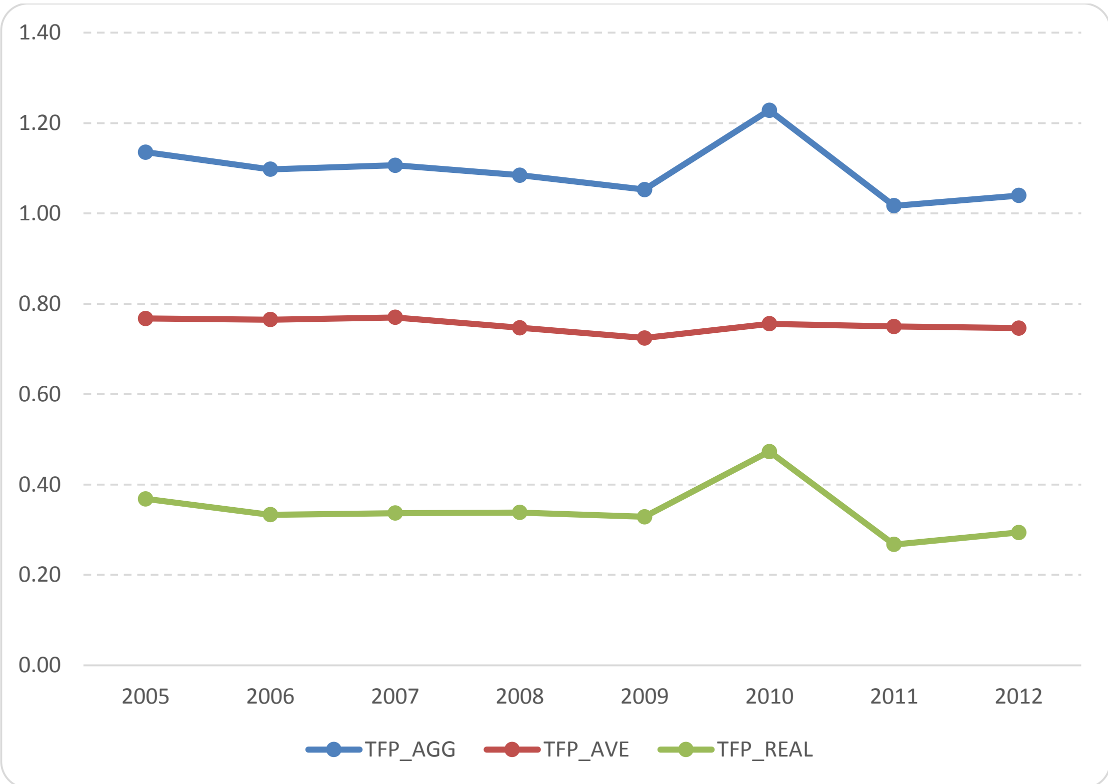
(3.5) $$\Phi_{jt}^{AGGREGATE} = \sum_{i \in \Omega_{jt}} s_{ijt} \Phi_{ijt} = \overline{\Phi}_{jt} + \sum_{i \in \Omega_{jt}} \Delta s_{ijt} \Delta \Phi_{ijt} = \Phi_{jt}^{INTRAFIRM} + \Phi_{jt}^{INTERFIRM}$$

where $\Delta\Phi_{ijt} = \Phi_{ijt} - \overline{\Phi}_{jt}$; $\Delta s_{ijt} = s_{ijt} - \bar{s}_{jt}$, and where $\bar{s}_{jt}$ represents the unweighted mean market share. The first component ($\Phi_{jt}^{INTRAFIRM}$) is the unweighted average productivity and measures the average firm efficiency, while the second component ($\Phi_{jt}^{INTERFIRM}$) is the covariance between firm productivity and market share and captures how much aggregate productivity is due to market share allocation across firms heterogeneous in efficiency. For instance, if both components increase over time means that the aggregate productivity

[15] Measured by the difference between production value and value added.

increases thanks to both efficiency improvements within firms and market share reallocation towards more productive firms. From **Figure 2**, we can see that in 2005, about 2/3 of estimated aggregate productivity is linked to intra-firm channel and the remaining share is associated with inter-firm channel. Second, we notice a slight decrease in aggregate productivity until 2009, and then a drastic increase in 2010, followed by a new fall in 2011. It is worth noting that while the declining trend until 2009 is basically due to within-firm changes in productivity, the fluctuating trend after 2009 is mainly due to reallocation mechanism. It seems that following the financial crisis in 2007, all firms uniformly suffer productivity losses, which lead the exit of least productive firms, and therefore the market share reallocation towards the high-productivity firms in 2010. Moreover, in 2011 we can see that while the average firm productivity remains constant, the aggregate productivity dramatically decreased due to some market share reallocation towards low-efficiency firms.

Figure 2: Aggregate productivity and related components over time



Source: authors' elaborations on AIDA database

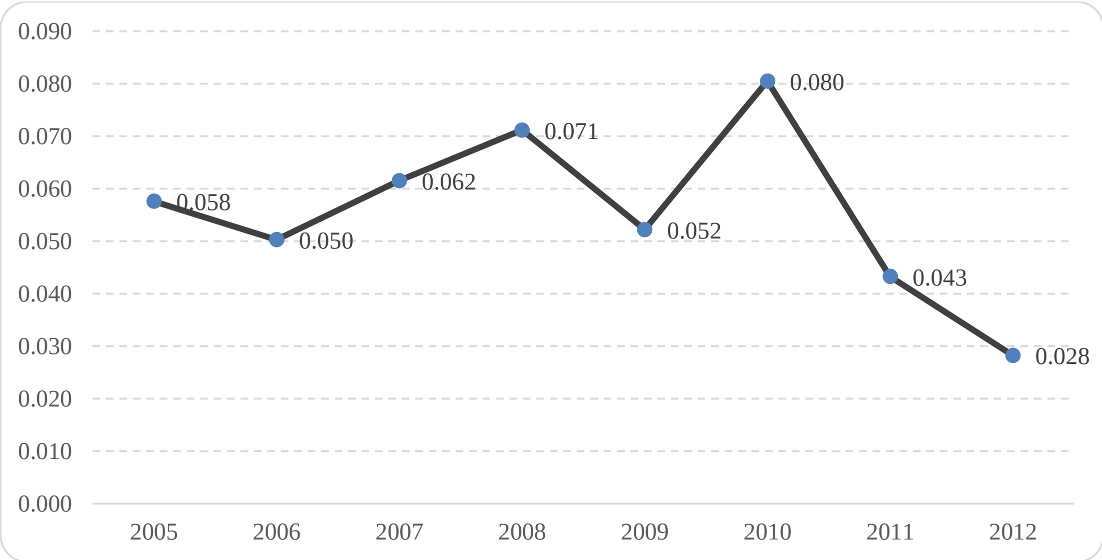
3.1.3. Input FDI integration

To capture FDI integration of intermediate input market, we use the 2-digit sector level weighted average of foreign affiliates' sales in total sales in upstream sectors, which is also known in the literature as vertical spillover from FDI via forward linkages:

$$FDI_{jt}^{m} = \sum_{k,k\neq j} w_{kj}^{2005} * \left(\frac{FOR\_sales_{kt}}{ALL\_sales_{kt}}\right) \tag{3.6}$$

where weights w_{kj}^{2005} are the input shares arising from the Italian input-output table for the year 2005. In other words, FDI_{jt}^{m} proxies the extent of intermediate inputs sourced by Italian firms stemming from foreign-owned suppliers located in Italy.

Figure 3: Input FDI over time



Source: authors' elaborations on AIDA database

Figure 3 displays that the presence of foreign input suppliers located in Italy increased unsteadily until 2010 – with some falls in 2006 and 2009 – and then dramatically fell, reaching the lowest peak in 2012. This trend looks similar to that of aggregate productivity over the period 2008-2011, highlighting a positive correlation between input FDI and economic growth over time. However, these two trends appear completely different before 2008 and after 2011. Thus, more investigation is necessary to see whether there is any relationship between aggregate productivity (and related components) and input market integration, which has been left for the next econometric sections (0 and 3.3).

3.1.4. Absorptive capacity

The absorptive capacity represents the ability of enterprises to efficiently absorb and internalise knowledge from outside sources through the adaptation and application of external knowledge sources (Cohen and Levinthal 1989, 1990). Therefore, it represents the link between the firms' capabilities to implement new products and the external stock of technological opportunities. Starting from the seminal works of Cohen and Levinthal (1989, 1990), several studies have stressed the key role of the absorptive capacity of domestically-owned enterprises in benefitting from FDI spillovers, i.e. their ability to internalize and adapt the knowledge from foreign-owned companies into their own businesses.[16]

In the empirical literature, the absorptive capacity is generally proxied through the degree of the technology gap between foreign-owned and domestic-owned firms, i.e. the extent to which foreign-owned enterprises in an industry are technologically advanced compared to domestic-owned enterprises in the same industry. More specifically, at horizontal level, the extent of spillovers is likely to depend on the technological sophistication of domestically-owned companies; similarly, at vertical level, the extent of backward (forward) linkages between MNEs and domestic suppliers (buyers) of intermediate goods is likely to depend

[16] Such as Kokko, 1994, Kokko et al., 1996; Kinoshita, 2001; Narula and Marin, 2003; Kolasa, 2008; Blalock and Gertler, 2009.

upon the stock of technological capabilities of domestically-owned enterprises in supplying (buying) sectors. In other words, small technological gaps may represent high levels of absorptive capacity and, consequently, they should favour positive externalities from FDI: the internal knowledge resources of domestically-owned firms allow them to recognize the value and content of a variety of knowledge elements brought by MNEs, thus making positive spillovers very likely to occur at both horizontal and vertical level (Cantwell, 1989; Kokko, 1994; Hamida and Gugler, 2009).[17]

However, to the extent that the domestic-owned companies are technologically sophisticated, their willingness to invest in absorbing the new knowledge can be dramatically lowered. This means that small technological gaps can also reflect a limitation of the scope for potential externalities, which can prevent positive spillovers from occurring (Jordaan, 2005). Furthermore, when the technological differences between foreign and domestically-owned enterprises are limited, their direct competition increases: this can also result in some local firms ceasing production or losing some market share, and may, consequently, result in negative spillovers. Alternatively, this means that when the technological gap is large there is space for positive externalities spilled-out from MNEs towards domestically-owned enterprises. In this case, the local companies with a lower stock of technology have a greater scope for technological accumulation in that they have a larger backlog of established knowledge to assimilate (Findlay, 1978; Wang and Blomström, 1992; Blomström and Wolff, 1994; Jabbour and Mucchielli, 2007). At the same time, negative externalities from direct competition are less likely to occur (Joordan, 2005; 2008).[18] Finally, some authors (for

[17] The empirical evidence supporting such a hypothesis includes the works of Borensztein et al. (1998), Girma et al. (2001), Barrios et al. (2002), Cheung and Lin (2004), Karpaty and Lundber (2004), Dimelis (2005), Sohinger (2005), and Takii (2005).
[18] Such hypothesis is supported by a number of empirical works, such as those of Blomström and Wolff (1994), Zukowski-Gagelman (2000), Haskel et al. (2007), Castellani and Zanfei (2003), Blalock and Gertler (2009), and Sawada (2010).

instance Kokko et al., 1996; and Zhang et al., 2010) have stressed the possible existence of 'threshold effects' meaning that FDI spillovers may occur only when the technology gap is medium, i.e. neither 'too small nor 'too large'.[19]

A major aim of our paper is to check whether the impact of the presence of foreign suppliers on Italian firms' productivity is likely to depend upon the level of the required absorptive capacity (RAC^m) of the latter firms. More specifically, we want to empirically explore whether the input FDI effects are different between sectors where all firms can use additional intermediate inputs (*low-* RAC^m sectors) and sectors where only some firms are actually able to use them (*high-* RAC^m sectors), as highlighted in the theory section. By considering that inputs with smaller R&D content can require larger firm-level efforts and investments to be improved and used for further processing, our measure that allows us to discriminate sectors according to the level of required capacity to absorb additional inputs (RAC^m) is given by the weighted average of R&D intensity in upstream sectors

$$RD_j^m = \sum_{k,k\neq j} w_{kj}^{2005} * \left(\frac{RD\_expenditure}{Sales}\right)_k^{2005} \qquad (3.7)$$

Similarly to input FDI, the weights are from the Italian input-output table. Therefore, if RD_j^m is close to zero (one) means that firms in sector *j* mainly use relatively low (high) R&D-intensive inputs, which require high (low) firm-level efforts of absorptivity. This implies that only the most productive firms (all firms) are able to use additional intermediate inputs. In the initial year of our sample (2005), manufacturing sector's RD_j^m is on average around 0.070, which however hides a certain heterogeneity across the 2-digit sectors within a range

[19] Empirical evidence supporting the existence of a threshold effect includes the works of Flores et al. (2002), Proenca et al. (2002) and Girma (2005).

of 0.012 – 0.157. For instance, *chemical*, *machinery* and *office machinery* sectors exhibit the highest RD^m (i.e. the lowest RAC^m) such that the within-firm effect is expected to dominate. Conversely, *wearing apparel, leather* and *wood* sectors display the lowest RD^m (i.e. the highest RAC^m) for which reallocation effect is expected to be prevalent.

Table 2: Mean differences among firms by ownership status

	Mean			Diff_1-2	t	Diff_1-3	t	Diff_2-3	t
	IMNEs	**OMNEs**	**NMNEs**						
	(1)	**(2)**	**(3)**						
AGE	23.63	28.00	18.94	-4.37	-13.60	4.69	21.01	9.05	43.90
SIZE	187.52	271.35	28.31	-83.83	-5.71	159.21	97.23	243.04	127.09
TFP	1.032	0.936	0.748	0.10	4.69	0.284	28.18	0.19	20.48

Source: authors' elaborations on AIDA database

Finally, we also need to identify firms that are able to use additional intermediates within each sector. This is extremely relevant within high-RAC sectors according to our model. The empirical literature highlights different ways to detect firms that are more likely to have the absorptive capacity necessary to benefit from FDI spillovers: firms with low productivity gap, firms involved with R&D activities and firms engaged with export activities. In our analysis, we identify firms able to use inputs from foreign-owned suppliers with those involved in a multinational network, i.e. both inward MNEs and outward MNEs. Our choice is due to several reasons: first, to be more closely related with our theoretical framework; second, the information used by other studies is unavailable (export status) or imperfect (firm-level R&D expenditure) in our dataset; and third, the existing empirical literature on the linkage between firm-level productivity gap and FDI spillovers is ambiguous, as reviewed above.

Table 2 contains the means of the variables for the whole sample distinguished by the FDI status, as well as tests for the comparison of means of the three groups of firms. All figures presented in the table are averages over the sample period. Focusing our attention on some firm level variables, such as age, size, and TFP, we observe that both OMNEs and IMNEs are on average larger, more productive, and older than NMNEs, and therefore more likely to use additional inputs from foreign-owned suppliers.

3.2. Industry-level analysis

To study the impact of input FDI on aggregate productivity at industry level, we consider the following baseline equation, which is similar to Harrison et al. (2013)'s specification:

$$\ln Y_{jt} = \beta_1 FDI_{jt}^{m} + \beta_2 FDI_{jt}^{m} * RD_{j}^{m} + \beta_3 X_{jt} + \phi_j + \phi_t + \varepsilon_{jt} \tag{3.8}$$

where Y_{jt} is the estimated aggregate productivity of industry j at time t $\Phi_{jt}^{AGGREGATE}$ (or each productivity component alternatively as measured in section 3.1.2, i.e. either $\Phi_{jt}^{INTRAFIRM}$ or $\Phi_{jt}^{INTERFIRM}$); FDI_{jt}^{m} is the industry-level input FDI at time *t*, which is also known in the literature as vertical spillover via forward linkages; RD_{j}^{m} measures the R&D intensity of inputs used in each sector in the initial year – whose the inverse ratio proxies the degree of sector-level absorptive capacity required to use foreign inputs – X_{jt} is a set of industry-level time-varying controls; ϕ_j and ϕ_t denote industry and time dummies respectively, and ε_{jt} is the error term. A detailed description of the control variables (X_{jt}) is provided in **Table 3**.

Table 3: Description of industry- and firm-specific control variables

FP	Share of foreign firms' sales in total sector sales. It accounts for the foreign presence in the same sector: $$FP_{jt} = \frac{FOR\_sales_{jt}}{ALL\_sales_{jt}}$$
BACK	Foreign presence in linked downstream sectors (to which a DOF supplies its inputs): $$BACK_{jt} = \sum_{k,k\neq j} \gamma_{jkt} \left(\frac{FOR\_sales_{kt}}{ALL\_sales_{kt}} \right)$$ where γ_{jkt} is the proportion of the or *j*'s output supplied to sourcing sectors *k* obtained from the input-output table for domestic intermediate consumption (*i.e.* excluding imports).
HERF	Herfindahl index of turnover (in log), used as a proxy for the level of concentration and thus competition within the sector and year. It is constructed as: $$\sum_{i=1}^{N} \left[\frac{sales_{ijt}}{sales_{jt}} \right]^2$$ It can be readily deduced that *HERFI* is bound between 0 and 1 and that higher *HERF* values indicate greater market concentration, i.e. less competition.
VPI	Following Altomonte et al. (2008), VPI is a measure of vertical import penetration (in log) and reflects the linkages present in the up-stream industries. VPI has been calculated as the weighted average of the up-stream industries' horizontal import penetration ratios using as weights the 2005 input-output coefficients retrieved from the Italian Input-Output matrix. $$VIP_j = \sum_{k,k\neq j} w_{kj}^{2005} * (HP)_k^{2005}$$ $$HP_{jt} = \frac{IMP_{jt}}{IMP_{tj} + PROD_{jt} - EXP_{jt}}$$ where EXPjt (IMPjt) are the exports (imports) of Italy to (from) the Rest of the World in industry j in year t, while PRODjt is the national output of industry j in year t.
AGE	Firm age (in log), defined as the difference between year of observation t and the official year of incorporation of the firm.
SIZE	Firms are classified into three groups: Small firms (1-49 employees); medium firms (50-249 employees); large firms (more than 250 employees).

From our theoretical predictions, we expect $\beta_1 < 0$, $\beta_2 > 0$ for intra-firm productivity and $\beta_1 > 0$, $\beta_2 < 0$ for inter-firm productivity, as all firms tend to gain uniformly from input FDI when RD_j^m is relatively high (i.e. RAC^m is relatively low), whereas some firms might lose when RD_j^m is relatively low (i.e. RAC^m is relatively high).

In **Table 4**, we report results from the Fixed Effect (FE) estimates with clustered standard errors at the industry-level, in order to account for unobserved time-invariant industry characteristics and potential serial correlation within industry. The first three columns (1-3) show just the linkage between input FDI and aggregate productivity and the related components. *Column 1* indicates that an increase in access to foreign intermediate inputs via inward FDI channel exerts a positive effect on aggregate productivity within sector: more specifically, an increase in input FDI by 10 percentage points leads to an increase in aggregate productivity by about 9.5%. This result is consistent with the findings of other studies on Italy which argue that it is more likely that productivity gains from FDI will take place through vertical linkages, i.e. backward and/or forward spillovers, rather than by horizontal ones (Imbriani and Reganati, 2002 and 2004; Castellani and Zanfei, 2003; Reganati and Sica, 2007; Imbriani et.al. 2014). In particular, Imbriani et. al. (2014) found that Italian firms improved their performance once they were offered products and services from MNEs in upstream sectors. *Columns 2* and *3* show results for intra-firm component and inter-firm component of productivity, respectively. It is worth noting that aggregate productivity gains from input FDI are mainly due to the reallocation channel rather than forward spillover channel (4/5 versus 1/5). This result suggests that aggregate productivity gains arising from input FDI mostly occur through market shares' shift towards more productive firms, rather than through within-firm mechanisms.

Table 4: Industry-level linkage between input FDI and productivity

	$\Phi_{jt}^{AGGREGATE}$	$\Phi_{jt}^{INTRAFIRM}$	$\Phi_{jt}^{INTERFIRM}$	$\Phi_{jt}^{AGGREGATE}$	$\Phi_{jt}^{INTRAFIRM}$	$\Phi_{jt}^{INTERFIRM}$	$\Phi_{jt}^{AGGREGATE}$	$\Phi_{jt}^{INTRAFIRM}$	$\Phi_{jt}^{INTERFIRM}$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
FDI^m	0.946***	0.184***	0.762***	1.341***	0.198***	1.143***	1.558***	0.245	1.312***
	(0.229)	(0.036)	(0.215)	(0.155)	(0.069)	(0.095)	(0.454)	(0.335)	(0.237)
$FDI^m{*}RD^m$				-7.273***	-0.265	-7.008***	7.609**	-0.333	7.276***
				(1.783)	(0.86)	(1.063)	(2.987)	(1.993)	(1.534)
FP							-0.136	-0.021	-0.115
							(0.329)	(0.250)	(0.166)
BACK							-0.055	-0.038	-0.016
							(1.129)	(0.774)	(0.505)
HERF							0.044	0.008	0.037
							(0.059)	(0.024)	(0.041)
VPI							-0.007	0.026	-0.033
							(0.040)	((0.018)	(0.041)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of Observations	168	168	168	168	168	168	168	168	168
Number of Industries	21	21	21	21	21	21	21	21	21
R-squared	0.286	0.246	0.28	0.316	0.246	0.335	0.324	0.255	0.351

***, **,* indicate statistical significance at the 1, 5 and 10 percent levels.
Standard errors (in parentheses) have been corrected for clustering at the industry level.

When we account for the interaction with RD^m in the columns 4-6 following our baseline specification, we can notice that aggregate productivity gains from input FDI are decreasing in R&D intensity of inputs used (*column 4*). Therefore, sectors using R&D-intensive inputs (i.e. low-RAC sectors) suffer aggregate productivity losses. These results are robust as control variables are included (*column 7*) and suggest that the reallocation channel would dominate the forward spillover channel. This is confirmed when we split the aggregate productivity into intra-firm component (*column 5*) and inter-firm component (*column 6*). In fact, the reallocation-related coefficients exhibit similar signs and magnitudes in line with our expectations and are robust even when other industry characteristics are accounted for (*column 9*). Conversely, the average productivity seems to be increasing only in input FDI. However, this result is not robust as other control variables are included (*column 8*).

In other words, the input FDI effect on aggregate productivity seems to be almost totally explained by the reallocation mechanism. However, the reason why the intra-firm effect from input FDI is less evident might be that different firms within the same sector obtain opposite effects as highlighted in our theoretical framework: i.e. while the most productive firms would gain in efficiency, the least productive firms can lose and consequently exit the market, causing business reallocation towards the best firms. According to our theoretical model, this should be more visible within high-RAC sectors, which have been empirically identified with sectors using low-R&D-intensive inputs.

3.3. Firm-level analysis

In order to explore more deeply the input FDI effect on firm productivity, in the firm-level analysis, we discriminate between multinationals and the other firms, in addition to distinguish sectors according to their required absorptive capacity. In particular, we focus on the following econometric specification:

$$\ln \Phi_{ijt} = \gamma_1 FDI_{jt}^{m} + \gamma_2 FDI_{jt}^{m} * MNE_{ij} + \gamma_3 FDI_{jt}^{m} * RD_j^m + \gamma_4 FDI_{jt}^{m} * MNE_{ij} * RD_j^m + \\ + \gamma_5 X_{jt} + \gamma_6 Z_{it} + \phi_i + \phi_t + \mu_{ijt} \tag{3.9}$$

where Φ_{ijt} is the estimated productivity of firm i in sector *j* at time t; MNE_{it} is a dummy variable taking value one if a firm is engaged with either inward or outward FDI, and zero otherwise; Z_{ijt} is a vector of firm-level control variables measuring firm-specific characteristics that may affect firm productivity (such as age and size). FDI_{jt}^{m} , RD_{j}^{m} and X_{jt} are respectively the industry-level variables already described in the former section (see **Table 3**). Finally, μ_{ijt} is the stochastic disturbance term.

According to our theoretical predictions highlighted in section 2, we expect $\gamma_1 < 0$ and $\gamma_1 + \gamma_2 > 0$, since non-multinationals should suffer productivity losses and multinationals should enjoy productivity gains from input FDI if the absorptive capacity required RAC_{j}^{m} is relatively high (i.e. if RD_{j}^{m} is close to zero). Moreover, we expect $\gamma_3 > 0$ and $\gamma_4 \approx 0$, as all firms would obtain similar productivity gains from input FDI if the absorptive capacity required RAC_{j}^{m} is relatively low (i.e. if RD_{j}^{m} is relatively high). Our analysis is restricted to the balanced panel of firms that do not change their multinational status over time, to make sure that our results are not driven by either entry-exit of firms in the market or entry-exit of firms into a multinational network.

In **Table 5**, we report the FE estimations by clustering the standard errors at the firm level. To see whether there is any difference between multinationals and non-multinationals into productivity effect from input FDI, *column 1* shows firstly the results from a reduced specification, i.e. without the interactions with RD^{m}. We can see that all firms enjoy similar forward spillover effects from FDI: more specifically, an increase in input FDI by 10 percentage points implies productivity improvement within firm by 1.25%.

From the results of our baseline specification in *column 2*, we can notice that while R&D intensity of inputs does not play any role for non-MNEs, MNEs seem to enjoy gains from input FDI only in sectors where the R&D intensity in intermediate inputs is close to zero.

Whereas, in sectors where R&D intensity in intermediates is relatively high, MNEs suffer negative forward spillovers.

Table 5: Firm-level linkage between input FDI and productivity

	All firms permanent in MNE status		
	$\ln \Phi_{ijt}$	$\ln \Phi_{ijt}$	$\ln \Phi_{ijt}$
	(1)	(2)	(3)
FDI^m	0.125***	0.059	-0.506***
	(0.026)	(0.055)	(0.146)
*FDI^m * MNE*	-0.445	0.562**	0.584**
	(0.368	(0.238)	(0.235)
*RD^m * FDI^m*		0.590	3.212***
		(0.437)	(0.759)
*RD^m * FDI^m *MNE*		-10.605**	-10.666***
		(4.097)	(4.044)
FP			0.366***
			(0.096)
BACK			-0.742***
			(0.2361)
HERF			0.029***
			(0.0051)
VPI			0.007
			(0.0051)
SIZE			0.008
			(0.0082)
AGE			0.085***
			(0.0058)
Firm FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Number of Observations	159440	159440	157402
Number of Firms	19930	19930	19821
R-squared	0.013	0.013	0.0181

***, **,* indicate statistical significance at the 1, 5 and 10 percent levels.

Standard errors (in parentheses) have been corrected for clustering at the firm level.

However, as we control for other industry and firm characteristics, the results appear to be more in line with our theoretical predictions. First, in sectors with low R&D intensity of intermediate inputs (i.e. high-RAC sectors), while MNEs still keep benefitting from positive forward spillovers from FDI, non-MNEs suffer negative forward spillovers. For example, in the extreme case where $RD_j^m = 0$ within sector, we estimate that following an increase in input FDI by 10 percentage points, firm productivity increases by about 0.78% for MNEs and decreases by about 5.06% for non-MNEs. Conversely, in the case with the highest input R&D intensity possible within sector ($RD_j^m = 1$), as input FDI increases by 10 percentage points, non-MNEs improve their efficiency by 27.06 % and MNEs decline theirs by 73.76%. Thus, in low-RAC sectors, while non-MNEs enjoy positive forward spillovers from FDI as they are able to use inputs of foreign origin, MNEs suffer negative positive spillovers maybe because foreign input reallocation from MNEs to non-MNEs.

On average, firm productivity improves when the foreign presence increases within the same sector (positive horizontal spillovers), while reduces as the foreign presence enhances within the downstream sectors (negative backward spillovers). Thus, Italian firms benefit from intra-industry FDI, as they can learn new technologies or marketing strategies from foreign competitors or can be pushed by tougher foreign competition to reduce their inefficiencies (Castellani and Zanfei, 2007). The negative backward spillovers seem to suggest that Italian input suppliers decrease their efficiency, as they might be unable to supply foreign-owned firms. It is possible that foreign multinationals crowd some local competitors out, and at the same time source inputs only from either the local suppliers able to upgrade their technology, or other foreign suppliers that have followed their clients to the new host country. In a such case, domestic owned suppliers can on average decline their performance, as their market shares shrink and consequently they lose potential economies of scales (see Javorcik, 2008 for further discussion).

Since our productivity estimates could capture markups, we have also included in our regression the Herfindahl concentration index at industry level, which proxies the market power within industry. We have found that market concentration has a positive but very small impact on Italian firms' performance: an increase of industry concentration (decrease in the level of competition) by 1% is associated with an increase in firm performance by 0.03 %. While this effect might be simply linked to the change in potential markups included in our productivity measures, the theoretical literature does not present a clear conclusion on the impact of competition on the productivity of firms. In our case, the negative competition effects on productivity (e.g. losses from reducing economies of scales) seem to have overcome the positive ones (e.g. gains from reducing X-inefficiency). In addition, productivity improvements within firm are associated with sectors that exhibit higher import propensity of intermediate inputs. Although this linkage is not statistically significant, it is in line with the theoretical literature on trade in intermediate inputs (Ethier, 1982; Markusen, 1989; and Grossman and Helpman, 1991), which argues that access to more and/or better intermediates from abroad raises the productivity of firms in downstream industries. Older firms show larger increase in productivity than younger firms; this finding supports the liability of newness hypothesis according to which older firms might have more experience and foresight in operating to their business environment. Finally, the firm-level linkage between efficiency and size turns out to be positive, although statistically insignificant.

4. Conclusion

In this paper, we study the impact of input market integration via FDI (i.e. input FDI) on firm-level efficiency and industry aggregate productivity, shedding light on the role played by the absorptive capacity.

We develop a monopolistic-competition model where a final good sector with heterogeneous firms is vertically interrelated with an intermediate good sector with symmetric firms. Assuming that FDI is initially allowed only in the first sector, we examine how the openness of intermediate good sector to FDI affects the aggregate productivity of final good firms, by disentangling between the intra-firm channel (forward spillover) and inter-firm channel (forward reallocation). We show that if all final good producers are able to ‘absorb’ inputs from foreign-owned suppliers, input FDI implies uniform productivity gains within firms (positive forward spillovers), without any entry-exit of firms within final good sector (no forward reallocation). If only the most productive final good firms have the capacity to absorb inputs of foreign origin, input FDI entails efficiency gains exclusively for them. Conversely, the other firms suffer a decline in efficiency (negative forward spillovers) so that the least productive firms are forced to exit the market, implying market shares' reallocation towards the most productive firms (positive forward reallocation).

We evaluate these predictions using data from Italian manufacturing firms in the period 2005-2012. Analysing the impact of input FDI on aggregate productivity at the industry level, we find that an increase in access to foreign intermediate inputs via inward FDI channel exerts a positive effect on aggregate productivity within sector. Moreover, by decomposing aggregate productivity into intra-firm and inter-firm components, we see that aggregate productivity gains from input FDI are mainly due to the reallocation rather than spillover channel. The gains from forward reallocation dominate those via forward spillover even when we account for the R&D intensity of intermediate inputs to discriminate sectors according to their capability to absorb additional inputs. It is worth noting that productivity gains from input FDI are decreasing in R&D intensity of inputs used within sector. These results are consistent with our theoretical predictions and suggest that while the most productive firms gain in efficiency, the least productive firms can lose and consequently exit the market, especially in sectors using low R&D-intensive inputs, which are associated with high-required absorptive capacity.

Finally, our empirical analysis at the firm level provides evidence that non-multinationals obtain productivity losses (gains) from input FDI when the R&D intensity of inputs within sector is relatively low (high). Opposite findings have been found for multinationals. These results are also coherent with our theoretical predictions, since in sectors where the required absorptive capacity is relatively high, non-multinationals suffer negative forward spillovers from FDI, whereas firms involved in a multinational network enjoy positive forward spillovers. Conversely, in sectors where the required absorptive capacity is relatively low, non-multinationals' productivity benefits from input FDI, and multinationals decrease their efficiency (maybe because of input reallocation from MNEs to non-MNEs).

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