Import Penetration, Intermediate Inputs and Productivity:

Evidence from Italian Firms

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Abstract

We test the impact of import penetration on the productivity of a sample of roughly 35,000 Italian manufacturing firms operating in the period 1996-2003, considering the impact on productivity of both import penetration in the same industry and import penetration in the up-stream industries. We also distinguish the source country of imports.

We find that: 1) import penetration has a positive effect on productivity. 2) The effects are much larger for import penetration in up-stream industries than for import penetration in the same industry. 3) Imports from the other European countries and the BRICS have more significant impact on the productivity of Italian firms than imports from the U.S.

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1. Introduction

Today productivity gains are a key target for European policymakers. In a very detailed study, Daveri and Lasinio (2005) find that the current stagnation of the Italian economy is mainly a labour productivity problem, mostly driven by a decline in total factor productivity (TFP), especially in manufacturing sectors. Better understanding the drivers of productivity, is thus a very important task for economists and policymakers.

The relationship between productivity and trade openness is sometimes perceived as a negative one, periodically leading to protectionist calls throughout the EU member States. And yet, a vast body of theoretical and empirical literature points to a positive relationship between trade openness and productivity, in particular for developing countries.

From a theoretical point of view, several channels might explain a positive effect of trade and trade liberalization on productivity. An increased product market competition, for instance, may stimulate firms to reduce their x-inefficiences or even lead the less productive firms to leave the market (Melitz, 2003 and Melitz and Ottaviano, 2008). Other important channels might be the increased availability of foreign (possibly better) intermediate inputs that can also stimulate technological innovation (see for example Grossman and Helpman, 1991) and possible scale effects due to the greater market size (Krugman and Helpman, 1985).

As for the empirical contributions, most studies explore the "horizontal" channels through which the trade shock affects productivity, i.e. all those channels captured by within-industry measures of integration (such as import penetration in the same industry or output tariff reductions). As a result, the economic nature of the effects explored deals essentially with productivity gains led by competition effect and selection.[2] Few studies have instead tried to asses also "vertical" channels, i.e. all those channels captured by across-industry measures of integration such as imported input, input tariffs or import penetration in the up-stream industries, especially in light of the recent trends showing that international trade in components is growing faster than trade in final goods (Hummels et al., 2001).

In particular, Amiti and Konings (2007) consider the impact of both output and input tariffs on productivity for a sample of Indonesian firms, concluding that a 10% reduction in output tariffs would increase productivity by 1%, while a 10% reduction in input tariffs would increase TFP by 3% on average, and by 11% in input-importing firms.

The present paper is related to this last (and growing) strand of literature, since it aims at understanding not only whether import penetration matters for the productivity of local firms, but also whether the impact is different when considering trade measures within or across (up-stream) industries and across different countries of origin of the imports.

In particular, the exercise is carried out on a sample of roughly 35,000 Italian manufacturing firms operating in the period 1996-2003.[3] We find that import penetration is positively related to productivity,

[2] The cross-country studies of Ades and Glaeser (1999), Frankel and Romer (1999), and Alesina, Spolaore, and Wacziarg (2000) all found significant effects of trade on growth and productivity. The finding is also confirmed in industry studies such as Trefler (2004), who finds an increase by 14% in labour productivity in those Canadian and US industries with highest output tariff cuts. In a developing country context, Shor (2004) analyzes tariffs for a sample of Brazilian industries, showing that input tariffs have a negative effect on productivity. At the firm-level, Tybout and Westbrook (1995), Krishna and Mitra (1998), Pavcnik (2002), Fernandes (2007) and Topalova and Khandelwal (2011), all find positive effects of trade on firm-level productivity.

[3] Italy is the only country among those surveyed which has displayed a negative average growth rate of its multi-factor productivity in the period 1996-2003 (-0.3 per cent), while at the same time experiencing an increasing trade openness.

with an effect which is however differentiated if considering within vs. across-industries (vertical) indicators. In particular, our baseline result is that a 1% increase in the import penetration ratio of the same industry is associated with a productivity increase of limited magnitude (around 0.06%), while an increase of 1% of the import penetration ratio in the up-stream industries is associated with an increase in the productivity of the average firm by around 13%. These results however vary a great deal when considering the impact of trade openness with respect to different countries or group of countries trading with Italy. In particular, we find strong productivity effects from vertical import penetration coming from other EU countries, the U.S. and the BRICs (Brazil, Russia, India and China), while no productivity effects are found when considering imports from Japan. This might in fact reflect different technological content of imports coming from different countries. We also find much stronger productivity effects from imports in the same industry coming from the other EU countries and the BRICS than from imports coming from the U.S. or Japan. This might be due to the fact that the products imported from the BRICS and the other EU countries are more directly in competition with the domestic products than those imported from Japan or the U.S.

The paper contributes to the literature in a number of ways. First, and to the best of our knowledge, this is one of the few papers to consider in a core European country (Italy) both the horizontal and vertical channels through which economic integration might affect productivity, in the spirit of Amiti and Konings (2007), testing at the same time whether these effects differ across source-countries. Altomonte and Barattieri (2008) in a preliminary exploration of the data used in this paper, found the differential impact of horizontal versus vertical import penetration on productivity, but they did not differentiate by source country nor checked the robustness of their results. Bas and Strauss-Kahn (2010) report results coming from French custom data. They focus on vertical channels, but do not consider horizontal ones. [4] Halpern et al. (2009) analyze the impact of imported intermediate inputs on a sample of Hungarian manufacturing sector. Kasahara and Rodrigue (2008) use Chilean plants data instead. They all find, as we do, positive and significant effects of imported intermediate inputs on productivity. Castellani, Serti and Tomasi (2010), explore the link between imports and productivity for Italian firms and find evidence of self-selection effects into importing activity (the most productive firms are the ones engaging in export activities). Finally, Conti, Lo Turco, and Maggioni (2012) analyze the import productivity nexus for Italian manufacturing firms using propensity scores matching techniques, also finding a differential impact of imports on productivity depending on the trading partners.

To test our trade channels, we employ import penetration ratios rather than MNF tariffs to calculate import penetration. It might be preferable to use trade-related indicators instead of tariff-related ones when interested in a positive analysis of the impact of economic integration on productivity. MFN tariffs, in fact, are imperfect indicators of the effective protection because they are rarely the true tariffs applied. We also build the import penetration indexes for the up-stream industries using time-varying technology coefficients retrieved from Input-Output tables, thus directly observing the linkages across sectors in every considered year.

The structure of the paper is as follows. Section two provides description and discussion of data used in the analysis, providing a picture of Italian imports through several measures of trade openness. Section three is devoted to introduce first our semi-parametric econometric estimation of total factor productivity, then to report estimates on linkages between productivity and the several measures of openness we use. Section four discusses the main results obtained and the relative robustness checks. Section five concludes.

[4] Bas and Strauss-Kahn (2010) also differentiate between developed and developing source countries.

2. Data description

2.1 The sample of italian manufacturing firms

A commercial dataset called AIDA, collected by the Bureau van Dijk, was used in order to retrieve balance sheet data relative to sales, value added, net tangible fixed assets, number of employees and ownership structure of the Italian manufacturing firms. The total sample was made up by 61,335 firms. Taking 2001 as the reference year and comparing sample data with the official Industrial Census of that year, these firms accounted for the 73% of total manufacturing value added and 54% of manufacturing employment. However, due to the quality of data, extensive data cleaning had been necessary. We adopted a two-stage data cleaning procedure. First, we dropped all those firms reporting negative values of any of the considered variables. Second, in order to get rid of outliers, we computed the growth rates of each variable and dropped all firms reporting growth rates smaller than the 1st or greater than the 99th percentiles of the relevant distribution. The resulting sample is constituted of 34,385 firms, representing the 40.7% of total manufacturing value added and 31.7% of manufacturing employment in 2001. To validate our sample, we compared it with official data along three dimensions: geographical location, industrial activity and firms' size. The correlation between the distribution of our sample and the distribution of the 2001 Census is 0.96 and significant at the 1 per cent level. As for the distribution across industries, the correlation with the Census data is pretty good (0.71) and significant. As far as firms' size is concerned, Table 1 shows the distribution across the size classes adopted by the Italian National Institute of Statistics. Firm size is measured by employment. Looking at firms for which employment data in 2001 is available, there is a fair representation of micro firms (11.2%). Clearly, the third column shows how this sample under-represents micro-firms, which in Italy account for more than 80% of total firms. This (relative) over-representation of large firms is clearly a drawback that must be taken in mind along all the analysis. However, since micro firms are not obliged to report balance sheet data, it is almost impossible to obtain otherwise these latter on a regular basis and we have to cope with an (albeit moderate) "size bias" of the sample. The last relevant feature retrieved from our data is the firm ownership structure, which for each firm we were able to identify in 2004. Hence, we classified as foreign (FORMNE) those firms with a direct foreign participation greater than 10%, while we considered as domestic MNEs (DOMMNE) all those firms with participation abroad greater than 10% in 2004. We have got a total of 453 foreign firms and 1,365 domestic multinationals in our sample.

2.2 An analysis of Italian imports

Information on trade flows and production by industry has been provided by EUROSTAT. Values of imports and exports of the manufacturing sector were collected at a detailed product level according to the CN 8-digit classification used for custom purposes, for the period 1996-2004 and for different countries of origin/destination. The data were then reclassified at the 4-digit NACE rev. 1.1 level, using the relative correspondence tables provided by EUROSTAT. The product-based data, coupled with a geographical breakdown, thus allowed us to draw a detailed picture of the changing pattern of Italian imports in a relevant period. Data on production were collected using EUROSTAT with its PRODCOM database at a 8-digit product classification, whose codes were once again converted at NACE industry detailed levels as done for trade flows. A preliminary evidence provided by these data shows that overall openness on the import side has rapidly increased in the considered period, in Italy as in other European countries.[5]

In order to distinguish between the different channels through which import penetration can affect productivity, we have constructed a measure of both horizontal and vertical import penetration.
The horizontal penetration index measures the relative importance of the imports originated from the same *j* industry of affiliation for each firm of our dataset, and it is calculated as:

$$H\_IMP_{zjt} = \frac{IMP_{zjt}}{IMP_{zjt} + PROD_{jt} - EXP_{zjt}} \qquad (1)$$

where IMP_{zjt} are the total Italian imports from country *z* in industry *j* at time *t*, EXP_{zjt} are the exports of Italy to country *z* in industry *j* in year *t*, while $PROD_{jt}$ is the national Italian output of industry *j* in year *t*. The denominator of the above ratio thus allows to weigh imports with the level of apparent consumption.

The index of vertical import penetration, V_IMP_{zjt}, is a more elaborated notion of penetration that proxies the relative importance of backward linkages for imports that are used as intermediate inputs in the production processes of firms affiliated to an industry *j*. Here we follow the strategy by Smarzynska (2004), who has used a similar indicator in order to measure 'vertical' FDI presence, adapting it to the trade case.
Departing from gross trade flows and production data, we first distinguish between intermediates and final goods according to BEC-SNA categories following the correspondence tables provided by EUROSTAT. [6]
Since we are interested only in imports, exports and domestic production that are used as inputs in production processes, we then consider only intermediate goods and we aggregate them at the NACE 2-digit level obtaining $IMP^{*}{}_{zkt}$, $EXP^{*}{}_{zkt}$, and $PROD^{*}{}_{kt}$, which represent respectively the imports, the exports and the domestic production at time *t* for industry *k*, from partner *z* in the case of trade flows.
As done before for the measure of horizontal penetration, we then obtain a ratio that further weights imports for national demand, now with all components net of final goods:

$$H_{IMP}{}^{*}{}_{zkt} = \frac{IMP^{*}{}_{zkt}}{IMP^{*}{}_{zkt} + PROD^{*}{}_{kt} - EXP^{*}{}_{zkt}} \qquad (2)$$

From Italian Input-Output matrices we derive time-varying usage coefficients for imported inputs as follows:[7]

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[6] BEC (Broad Economic Categories) is an end-use classification that is easily reclassified following the System of National Accounts (SNA) that categorizes goods as intermediates (primary, semifinished and parts and components) or final goods (capital goods and consumption goods).

[7] Italian Input-Output matrices differentiate between use of domestic production and use of imports, We rely on this latter table in order to derive our usage coefficients. In order to check whether the latter display a clear time-trend, we have checked the correlation between the 1996 and the 2003 input-output coefficients, which turned out to be very high and significant. However, a process of technological change is in some cases quite relevant,

$$\alpha_{kjt} = \frac{input_{kjt}}{total_{jt}} \quad (3)$$

where at the numerator we have the usage of industry *k*'s imports as an input of industry *j* at time *t*, while at the denominator we have the total usage of imported inputs by industry *j* at time *t.*

The assumption here is that an Input-Output matrix allows us to derive coefficients of a common production function for imported materials of a representative firm belonging to industry *j*. Therefore, we use the above coefficients to weigh the penetration ratio calculated in eq. (2) according to the formula:

$$V\_IMP_{zjt} = \sum_{k \text{ if } k \neq j} \alpha_{kjt} H\_IMP^{*}_{zkt} \quad (4)$$

The latter is a measure of vertical import penetration which should be able to proxy the backward linkages that an Italian firm can exploit beyond national borders. [8]

Table 2 provides simple descriptive statistics of horizontal import penetration ratios, taking whole world as a partner. [9] Heterogeneity is significant among industries. From a 1.06 of average import penetration ratio registered by NACE industry 30 (office machinery and computers) to the 0.05 of NACE industry 22 (publishing and printing). As for the evolution over time of the import penetration ratios, also here there is a lot of trend heterogeneity, with an upward trend in some industries (e.g. textiles – 17 or wearing apparel - 18), almost at in others (wood -20; motor vehicles - 34), or decreasing (pulp and paper - 21; basic metals - 27). Obviously, here as in the case of trade margins, heterogeneity through time further increases if one looks at 4-digit industries, which are not reported.

Table 3 reports instead descriptive statistics on vertical import-penetration indexes at 2-digit level of aggregation, revealing again a significant heterogeneity. The industry with the highest up-stream ratio is NACE industry 30 (office machinery and computers) while the one with the lowest value is NACE 20 (wood products). Also in this case, trends look pretty different.

In general, we find an overall correlation between the indicators of horizontal and vertical import penetration of about 0.15.

Table 4 report the average horizontal and vertical import penetration ratios disaggregated by commercial partners. Penetration ratios have rapidly grown for the period of interest if we look at emerging economies (BRICs or China alone), and found a renewed upward trend after 2000 in the case

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with differences in coefficients ranging from -15\% (the weight of sector 23 - petroleum products - as input of itself) to +12\% (the weight of sector 34 - motor vehicles - as input of itself)

[8] Ideally we would like to be able to use data for the vertical import penetration at a more disaggregated level than 2-digits industries. However, the data constraint is represented by the I-O coefficients, which are available only at 2-digits levels of aggregation.

[9] Variables in Table 2 are summarized at the 2-digit level of aggregation, whereas the actual horizontal import penetration ratios used in the dataset are at a 4-digit level of disaggregation. Vertical penetration ratios can be instead calculated only at 2-digit level because this is the only available disaggregation for Input-Output technology as provided by ISTAT.

of the new Member States (MS) of the European Union. The United States count more for horizontal trade than for vertical trade and horizontal ratios are on average decreasing, at the contrary of new MS, BRICs and China, among which increasing shares of Italian imports are apportioned. Import penetrations for Japan are attested at moderate levels.

3. Econometric model

Let us start from a standard Cobb-Douglas production function:

$$Y_{it} = AK_{it}^{\beta_k}L_{it}^{\beta_l} \quad (5)$$

where Y_{it} is a measure of production (in our case value added), K and L are the capital and labour inputs and β_k and β_l the inputs coefficients. A is total factor productivity (TFP). Since our aim is to verify in which way TFP is affected by import penetration, the first step of the analysis is to obtain an unbiased estimate of total factor productivity.

3.1 Productivity estimation

The traditional technique adopted to estimate the production coefficients and hence compute TFP starting from a log-linearized production function as in eq (3) is ordinary least squares. However, this technique is affected by several problems, among which the most serious is the so-called simultaneity bias. Taking eq. 3 in logs one has:

$$y_{it} = \beta_k k_{it} + \beta_l l_{it} + \mu_{it} \quad (6)$$

In order to have a consistent OLS estimator, we need μ_{it} (the residual) to be uncorrelated with both the regressors. However, as pointed out by Griliches and Mairesse (1995), profit-maximizing firms immediately adjust their inputs each time they observe a productivity shock, which makes input levels correlated with the same shocks. Since productivity shocks are unobserved to the econometrician, they enter in the error term of the regression. Hence, inputs turn out to be correlated with the error term of the regression, and thus OLS estimates of production functions are problematic. Olley and Pakes (OP, 1996) and Levinsohn and Petrin (LP, 2003) have developed two similar semi-parametric estimation procedures to overcome this problem. Both techniques suppose that the productivity term μ_{it} can be decomposed into two terms, so that eq(4) becomes:

$$y_{it} = \beta_k k_{it} + \beta_l l_{it} + \omega_{it} + \varepsilon_{it} \quad (7)$$

where ω_{it} is a productivity shock observed by the firm (but not by the econometrician) that is able to change the input choices while ε_{it} is a white noise uncorrelated to inputs. The key point in both the OP and the LP estimators is to "turn unobservables into observables", namely to find an observable proxy for the productivity term ω_{it}. In particular, the OP methodology uses investment as proxy while the LP methodology uses material costs. Since the OP estimator will be our baseline model, we go into the detail of this methodology. In the OP case, investment is the proxy employed. In particular, investment is supposed to be function of capital and productivity:

$$i_{it} = i_t(\omega_{it}, k_{it}) \quad (8)$$

Where i_{it} is the investment of firm *i* at time *t*. By inverting this function, it is possible to define ω_{it} as:

$$\omega_{it} = h_t(k_{it}, i_{it}) \quad (9)$$

where $h_t = i_t^{-1}$. Using eq(7), eq(5) can now be written as:

$$y_{it} = \beta_k k_{it} + \beta_l l_{it} + h_t(k_{it}, i_{it}) + \varepsilon_{it} \quad (10)$$

If we now define a new (unknown) function

$$\varphi(k_{it}, i_{it}) = \beta_k k_{it} + h_t(k_{it}, i_{it}) \quad (11)$$

that can be proxied by a third order polynomial in capital and investment, Olley and Pakes (1996) show that it is now possible to estimate consistently β_l and $\varphi(k_{it}, i_{it})$ through OLS from the following equation:

$$y_{it} = \beta_l l_{it} + \varphi(k_{it}, i_{it}) + \varepsilon_{it} \quad (12)$$

Then, in order to recover an estimate for β_k , one can define a function

$$V_{it} = y_{it} - \widehat{\beta_l} l_{it} = \beta_k k_{it} + h_t(k_{it}, i_{it}) + \varepsilon_{it} = \beta_k k_{it} + \omega_{it} + \varepsilon_{it} \quad (13)$$

Moreover, if we assume that our productivity term follows a first-order Markov process, i.e. that

$$\omega_{it} = g(\omega_{it-1}) + \vartheta_{it}$$

Eq(11) becomes:

$$V_{it} = \beta_k k_{it} + g(\omega_{it-1}) + \vartheta_{it} + \varepsilon_{it} \quad (14)$$

which can be written as

$$V_{it} = \beta_k k_{it} + g(\varphi_{t-1} - \beta_k k_{it-1}) + \delta_{it} \quad (15)$$

where *g* is an unknown function that can be proxied by a third or fourth order polynomial and $\delta_{it} = \vartheta_{it} + \varepsilon_{it}$. Eq (13) allows estimating a consistent $\widehat{\beta_k}$ through a non-linear least square procedure.

Having obtained consistent estimates for $\widehat{\beta_l}$ and $\widehat{\beta_k}$, it is then possible to calculate an unbiased measure of the firm level TFP as

$$tfp_{it} = y_{it} - \widehat{\beta_k} k_{it} - \widehat{\beta_l} l_{it} \qquad (16)$$

which can then be used as a dependent variable in the following model design.

3.2 Tfp estimates

We have estimated separate production functions for each NACE2-digits sector. All our variables are deflated using 2-digit price deflators. The deflator for capital, following Smarzynska (2004), is the simple average of five industries capital deflators.[10] Table 5 shows the results obtained for the coefficients using the different techniques previously described. In particular, it is worth noting the expected up-ward bias of the OLS labour coefficients with respect to the OP estimates. As for the capital coefficients, OP coefficients are usually higher than OLS ones. [11]

Using OP estimates as our baseline model, we report in Graph 1 the evolution of an aggregate TFP index that shows a declining trend for our sample of firms, particularly from 2000 to 2003, consistently with the results of the studies previously cited.

3.3 Italian imports and productivity

In order to test the impact of import penetration on productivity, we use the following econometric model:

$$tfp_{it} = \alpha_0 + \alpha_1 H\_imp_{zjt-1} + \alpha_2 V\_imp_{zjt-1} + \sigma_i + \tau_t + \epsilon_{ijt} \qquad (17)$$

where the log-productivity is tested against the measure of lagged logs of horizontal import penetration and vertical import penetration, with firms and time fixed effects. We insert import penetration variables lagged one period to acknowledge that time might be needed for the channels described in the introduction to operate, as well as to avoid some spurious correlation between the dependent and independent variables induced by some common shock affecting both imports and productivity.

4. Results

4.1 Main Results

Table 6 contains the main results of the analysis. The Breusch-Pagan test rejected the Pooled OLS as a possible estimator, while the Hausman test identified fixed effect estimator preferable in this case to the alternative random effect estimator.

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[10] NACE sectors 29 "Manufacture of machinery and equipment n.e.c."; 30, "Manufacture of office machinery and computers"; 31,"Manufacture of electrical machinery and apparatus " ; 34, "Manufacture of motor vehicles, trailers and semi-trailers"; 35, "Manufacture of other transport equipment"

[11] The negative OP capital coefficients for industry 22 "Publishing, printing and reproduction of recorded media" and 23 "Manufacture of coke, refined petroleum products and nuclear fuel" might be due to the small number of observations in these industries.

Column 1 of Table 6 presents the results of the model using import penetration indexes from the entire world. The lagged logs of both horizontal and vertical ratios take into account production and exports, weighing detailed import flows by domestic demand. As it can be seen from estimates, horizontal import penetration ratios display a positive and significant coefficient, revealing however a quite small effect in absolute value. An increase in horizontal import penetration of 1%, *ceteris paribus,* would result in an increase of productivity of around 0.06% at the margin. Also the coefficient attached to the import penetration in the up-stream industries is positive and statistically significant. However, most notably, its absolute value is sensibly higher: an increase in the "vertical" import penetration of 1% would result, *ceteris paribus*, in an increase of productivity by 13% at the margin.

Columns 2 to 6 report the results obtained running the same specification over different trading partners. In Column 2 we explicitly test for the effects of the EU single market, limiting the calculation of import penetration indexes to the EU-15 countries. As it can be seen, both trade measures are positively and significantly associated to productivity gains, with the coefficient of horizontal import penetration once again smaller as when world trade is considered. In Column 3 we repeat the same exercise considering the Italian trade with the United States. Surprisingly, the latter analysis reveals that an increase in horizontal import penetration from the US is not significantly associated with an increase in productivity of Italian firms. Having conducted the same specification on a more aggregate level of import penetration (3-digit level) we found even a negative impact. Even US vertical import penetration does not seem to influence TFP. In the case of Japan if the horizontal measure of import penetration does not show significance against firm performance, the vertical one seems to have a negative but minor effect. Moving to the impact of Italian trade with the new EU Member States[12] (Column 4), the results are in line with the ones obtained at the world level, and the same is true when considering trade with BRICs (Column 5). Concentrating on the impact of Chinese competition (Column 6), we can also see that trade with China eventually has a positive effect on the productivity of the Italian firms both if we consider the industry to which a firm belongs and if we consider the advantages coming from trade in intermediates. Even if this finding is not surprising for economists, it is often not so straightforward for policy-makers.[13]

In Table 7 we analyse in more details our findings, interacting the trade measures with some characteristics of firms, in particular a dummy signaling whether the Italian firm is controlled by a multinational group (FOR_MNE), or whether the same domestic firm is a parent company with a participation abroad (DOM_MNE).[14] All these firm-level characteristics seem to be positively correlated with productivity. In particular, Column 1 shows how foreign affiliates display a productivity which is around 23% higher than the average firm, while Italian firms with participations abroad seem, on average, to be 19% more productive than the other firms, in line with the results of a vast literature on the productivity premium attributable to international firms.

When we interact these firm characteristics with our trade penetration measures, we find that foreign affiliates seem to take relatively less advantage than the average domestic firms from an increase in world trade penetration (Column 2). This might reflect a tendency for FDI in Italy to be market-seeking in nature, by substituting trade with local presence. A similar finding is obtained for the Italian firms with a participation abroad (Column 3). This might suggest that multinational groups tend to exploit different trade channels than the average domestic firm. Interestingly enough, however, when interacting the

[12] Bulgaria, Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania Slovakia, and Slovenia.

[13] We also tried several specifications including in the regressions more than one country (or group of country). The results do not change substantially.

[14] In this case, we introduce in the specification industry fixed effects, since firm effects are now captured by the FOR and DOM dummies.

FOR or DOM dummies with the trade penetration within the EU-15 countries (Column 4 and 5), we find that both domestic and foreign multinational firms operating in Italy do seem to benefit relatively more from horizontal penetration from other EU countries with respect to the average firm. This suggests that the advantages of market integration in Europe tend to be accrued relatively more by larger, international firms.

4.2 Robustness checks

In order to verify the accurateness of these results we performed some robustness checks. First, we employed different measures of productivity. Columns 1 and 2 of Table 8 report the results obtained when using alternatively the TFP obtained using, respectively, OLS estimates of the production function coefficients and labour productivity, measured as value added per employee. The results are qualitatively the same, with only a slight difference in the point estimates with respect to Column 1 of Table 6, our benchmark specification. Columns 3 to 5 in Table 8 report a second set of robustness checks, running the specification in first differences for all the previously discussed productivity measures, thus wiping out unobserved firm heterogeneity.[15] Even in this more demanding specification results are virtually unchanged, with the effect of horizontal import penetration only being slightly less significant. In Column 1 of Table 9 we have tested whether the results change using a different aggregation for our horizontal trade measure (at NACE2 rather than NACE4), since the lack of observation at this finer industry level might induce a systematic bias in our estimates. In Column 2 we report the results obtained using a different measure of import penetration, namely the ratio between imports and production, without correcting for imports and exports.[16] The results are qualitatively the same, with some slight differences in the point estimates. In particular, the difference between the impact of horizontal and vertical import penetration when using the same aggregation level appears lower than in our baseline case. On the other hand, the difference appears to be magnified when using the alternative measure of import penetration. The difference, however, remain sizeable and statistically significant in both cases.
Finally, as for trade orientation, we have controlled for a potential bias induced by technology gap among trade partners weighing import penetrations (both horizontal and vertical ones) by a country index based on yearly GERD (Gross Expenditure on Reasearch and Development) taking US as benchmark. These indexes, interacted with import penetrations, should allow us to catch the distance to technology frontier. Point estimates of horizontal penetrations in Table 10 are similar to those in Table 6, whereas coefficients for vertical penetrations are slightly lower but maintain significance and order of magnitude, from EU15 to China.

5. Conclusions

We have tested the impact of import penetration and trade margins on productivity using a sample of roughly 35,000 Italian manufacturing firms operating in the period 1996-2003. In line with the approach of the most recent literature, we have considered the effect of both import penetration in the same industry (competition-led productivity gain) and of import penetration in the up-stream industries (to gauge the productivity gain led by better input availability). After having obtained unbiased productivity measures through the Olley and Pakes (1996) semi parametric estimation, we have regressed Total Factor Productivity on the two import penetration ratios, controlling for fixed characteristics.

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[15] If firm-specific fixed effects are spuriously correlated with other covariates, the latter might lead to potentially inconsistent estimates.
[16] We thank an anonymous referee for this suggestion.

We find that import penetration positively matters for productivity, with an effect which is however differentiated if considering within vs. across-industries (vertical) indicators. In particular, we find that a 1% increase in the import penetration ratio of the same industry would result in a productivity increase that ranges from 0.5% to 4% according to the TFP measure and the econometric specification.
Second, a 1% increase of the import penetration ratio in the up-stream industries would instead increase average productivity by 9% to 13%.
Third, we find that import penetration coming from different trading partners has differential impact on productivity, with the EU and BRICS trade being more productivity inducing than the trade with the U.S. and Japan.

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Table 1: Size distribution of firms

	Sample 2001		Census 2001		
size	Freq.	Percent	Freq.	Percent	Coverage
1-9	3,844	11.2%	447,859	82.5%	0.9%
10-19	4,881	14.2%	55,553	10.2%	8.8%
20-49	6,646	19.3%	27,075	5.0%	24.5%
50-249	4,641	13.5%	10,872	2.0%	42.7%
249-	809	2.4%	1,517	0.3%	53.3%
N/A	13,564	39.4%			2.5%
TOTAL	**34,385**	**100.0%**	**542,876**	**100.0%**	**6.3%**

Table 2: Horizontal import penetration ratios

nace2	Description	mean	standard deviation	1996	2003
15	Manufacture of food products and beverages	0.21	0.02	0.26	0.21
17	Manufacture of textiles	0.30	0.15	0.15	0.42
18	Manufacture of wearing apparel; dressing and dyeing of fur	0.44	0.23	0.23	0.69
19	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear	0.90	0.19	0.75	1.04
20	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and..	0.25	0.04	0.31	0.25
21	Manufacture of pulp, paper and paper products	0.30	0.04	0.35	0.29
22	Publishing, printing and reproduction of recorded media	0.05	0.02	0.07	0.05
24	Manufacture of chemicals and chemical products	0.93	0.10	0.92	1.03
25	Manufacture of rubber and plastic products	0.27	0.07	0.35	0.27
26	Manufacture of other non-metallic mineral products	0.13	0.01	0.14	0.12
27	Manufacture of basic metals	0.45	0.06	0.51	0.40
28	Manufacture of fabricated metal products, except machinery and equipment	0.16	0.03	0.21	0.14
29	Manufacture of machinery and equipment n.e.c.	0.42	0.07	0.53	0.42
30	Manufacture of office machinery and computers	1.06	0.07	1.22	1.03
31	Manufacture of electrical machinery and apparatus n.e.c.	0.36	0.07	0.46	0.39
32	Manufacture of radio, television and communication equipment and apparatus	0.78	0.04	0.76	0.77

33	Manufacture of medical, precision and optical instruments, watches and clocks	0.77	0.04	0.78	0.72
34	Manufacture of motor vehicles, trailers and semi-trailers	0.82	0.25	1.31	0.77
35	Manufacture of other transport equipment	0.54	0.09	0.55	0.63
36	Manufacture of furniture; manufacturing n.e.c.	0.25	0.14	0.56	0.21

Table 3: Vertical import penetration ratios

NACE rev. 1	Description	mean	standard deviation	1996	2003
15	Manufacture of food products and beverages	0.24	0.01	0.22	0.26
17	Manufacture of textiles	0.36	0.03	0.31	0.39
18	Manufacture of wearing apparel; dressing and dyeing of fur	0.26	0.03	0.21	0.29
19	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear	0.22	0.01	0.19	0.23
20	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and..	0.24	0.01	0.21	0.26
21	Manufacture of pulp, paper and paper products	0.29	0.02	0.25	0.32
22	Publishing, printing and reproduction of recorded media	0.31	0.02	0.28	0.33
24	Manufacture of chemicals and chemical products	0.26	0.01	0.24	0.28
25	Manufacture of rubber and plastic products	0.40	0.03	0.35	0.43
26	Manufacture of other non-metallic mineral products	0.33	0.02	0.30	0.35
27	Manufacture of basic metals	0.24	0.01	0.21	0.26
28	Manufacture of fabricated metal products, except machinery and equipment	0.44	0.02	0.41	0.47
29	Manufacture of machinery and equipment n.e.c.	0.25	0.01	0.24	0.27
30	Manufacture of office machinery and computers	0.39	0.04	0.39	0.39
31	Manufacture of electrical machinery and apparatus n.e.c.	0.34	0.02	0.32	0.37
32	Manufacture of radio, television and communication equipment and apparatus	0.30	0.02	0.27	0.33
33	Manufacture of medical, precision and optical instruments, watches and clocks	0.30	0.02	0.27	0.32
34	Manufacture of motor vehicles, trailers and semi-trailers	0.25	0.01	0.23	0.27
35	Manufacture of other transport equipment	0.32	0.02	0.29	0.34
36	Manufacture of furniture; manufacturing n.e.c.	0.28	0.01	0.26	0.30

Table 4: Average vertical and horizontal import penetration by partner

All sectors	Horiz.	Vertical	Horiz.	Vertical	Horiz.	Vertical
(average)	mean		1996		2004	2003
World	0.284	0.239	0.293	0.265	0.296	0.242
UE-15	0.208	0.153	0.225	0.172	0.210	0.149
USA	0.032	0.013	0.041	0.015	0.028	0.012
Japan	0.008	0.089	0.012	0.026	0.007	0.055
NMS	0.030	0.045	0.028	0.050	0.036	0.050
BRICs	0.040	0.013	0.033	0.011	0.048	0.016
China	0.030	0.006	0.028	0.004	0.047	0.009

Table 5: Estimated coefficients of productivity

NACE2	B_OLS_k	B_OP_k	B_OLS_l	B_OP_l
15	0.20	0.18	0.81	0.77
17	0.16	0.29	0.77	0.76
18	0.15	0.10	0.79	0.76
19	0.16	0.26	0.77	0.77
20	0.15	0.26	0.76	0.73
21	0.16	0.01	0.83	0.81
22	0.10	-0.15	0.88	0.85
23	0.24	-0.23	0.83	0.70
24	0.13	0.04	0.88	0.86
25	0.16	0.19	0.81	0.76
26	0.19	0.29	0.80	0.76
27	0.18	0.25	0.81	0.75
28	0.15	0.19	0.81	0.77
29	0.15	0.18	0.82	0.80
30	0.14	0.18	0.81	0.79
31	0.15	0.17	0.80	0.77
32	0.13	0.06	0.86	0.82
33	0.13	0.09	0.82	0.74
34	0.13	0.22	0.88	0.82
35	0.17	0.11	0.81	0.82
36	0.13	0.13	0.81	0.82

Table 6: Import penetration, trade orientation and productivity

Dependent variable: log of TFP OP	**World**	**EU-15**	**USA**	**Japan**	**NMS**	**BRICS**	**China**
H_imp$_{zjt-1}$	**.006*** **	**.012*** **	**-.004** **	**.001**	**.008*** **	**.006*** **	**.003** **
	(.002)	**(.003)**	**(.002)**	**(.001)**	**(.002)**	**(.002)**	**(.001)**
V_imp$_{zjt-1}$	**.130*** **	**.122*** **	**.068*** **	**-.019*** **	**.098*** **	**.116*** **	**.097*** **

	(.007)	**(.008)**	**(.008)**	**(.002)**	**(.005)**	**(.006)**	**(.007)**
Constant	**9.382*** **	**9.439*** **	**9.443*** **	**9.112*** **	**9.529*** **	**9.743*** **	**9.734*** **
	(.010)	**(.014)**	**(.036)**	**(.012)**	**(.018)**	**(.030)**	**(.041)**
Firm FE	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Time FE	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Observations	**159,276**	**159,276**	**159,276**	**159,276**	**159,276**	**159,276**	**159,276**
R-squared	**0.05**	**0.05**	**0.05**	**0.06**	**0.05**	**0.05**	**0.05**

***,**,* Statistically significant at 1%, 5%, 10% respectively. FE (within) estimator. Standard errors clustered at firm level

Table 7: Import penetration, firm characteristics and productivity

Dependent variable: log of TFP OP	World	World	World	EU-15	EU-15
H_imp_{zjt-1}	.017***	.019***	.018***	.018***	.016***
	(.001)	(.001)	(.001)	(.001)	(.001)
V_imp_{zjt-1}	.088***	.087***	.089***	.081***	.083***
	(0.011)	(.011)	(.011)	(.012)	(.012)
foreign MNE	.241***	.151***		.158***	
	(.008)	(.029)		(.038)	
domestic MNE	.191***		.168***		.171***
	(.005)		(.017)		(.022)
foreign MNE* H_imp_{zjt-1}		.006		.020*	
		(.008)		(.009)	
foreign MNE* V_imp_{zjt-1}		-.076***		-.069***	
		(.016)		(.016)	
domestic MNE* H_imp_{zjt-1}			-.004		.015***
			(.005)		(.005)
domestic MNE* V_imp_{zjt-1}			-.018*		-.030***
			(.009)		(.010)
constant	9.186***	9.195***	9.192***	9.220***	9.215***
	(.024)	(.024)	(.024)	(.031)	(.031)
Industry FE	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes
Observations	158,983	158,983	158,983	158,983	158,983
R-squared	0.89	0.89	0.89	0.89	0.89

***,**,* Statistically significant at 1%, 5%, 10% respectively. FE (within) estimator.

Table 8: Alternative productivity estimates – World Import Penetration

Dependent variable:	log of TFP OLS	log of labor productivity	Δ log of TFP OP	Δ log of TFP OLS	Δ log of labor productivity
H_imp_{zjt-1}	.009***	.008***			
	(.002)	(.002)			
V_imp_{zjt-1}	.122***	.154***			
	(.007)	(.008)			
Δ H_imp_{zjt-1}			.007***	.001***	.010***
			(.002)	(.000)	(.003)
Δ V_imp_{zjt-1}			.095***	.003***	.119***
			(.013)	(.000)	(.014)
Constant	9.467***	10.948***	.005*	-.001***	-.001
	(.010)	(.011)	(.002)	(.000)	(.001)
Firm FE	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes
Observations	158,983	158,983	123,663	123,663	123,663
R-squared	0.05	0.07	0.04	0.45	0.04

***,**,* Statistically significant at 1%, 5%, 10% respectively, FE (within) estimator. Standard errors clustered at firm level

Table 9: Robustness and sensitivity analysis – World Import Penetration

Dep var: ln(tfp) OP	NACE2 Index	IMP/PROD
H_imp_{zjt-1}	.020***	.043***
	(.0033)	(.0060)
V_imp_{zjt-1}	.101***	.211***
	(.0078)	(.0117)
Constant	9.32***	9.71***
	(.011)	(.012)
Firm FE	yes	Yes
Time FE	yes	Yes
Observations	164,678	164,678
R-squared	0.05	0.05

***,**,* Statistically significant at 1%, 5%, 10% respectively
FE (within) estimator. Standard errors clustered at firm level

Table 10: Robustness and sensitivity analysis - Technology gap, trade orientation and productivity

Dependent variable: log of TFP OP	EU-15	Japan	NMS	BRICS	China
GERD_*H*_*imp*$_{zjt-1}$	.012***	.002*	.008***	.006***	.003**
	(.003)	(.001)	(.002)	(.002)	(.001)
GERD_*V*_*imp*$_{zjt-1}$	.122***	.004	.098***	.116***	.097***
	(.008)	(.002)	(.005)	(.006)	(.007)
Constant	9.489***	9.232***	9.661***	9.878***	9.868***
	(.017)	(.012)	(.024)	(.036)	(.051)
Firm FE	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes
Observations	159,276	159,276	159,276	159,276	159,276
R-squared	0.05	0.07	0.05	0.05	0.05

***,**,* Statistically significant at 1%, 5%, 10% respectively, FE (within) estimator. Standard errors clustered at firm level

Graph 1: Average TFP