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 find that import penetration has a positive effect on productivity, but the effects are larger for import penetration in up-stream industries. The exact magnitude of these effects however varies when considering the impact of trade openness with respect to different countries or group of countries trading with Italy. Moreover, not every firm benefits equally from these effects, since different firms' characteristics matter in influencing the firms' productivity response to the trade shock.

JEL classification:
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1 Introduction

When analyzing the performance of European economies in the last decade, most studies (e.g. Sapir, 2003) seem nowadays to agree in identifying the decline of European productivity vs. the US one as a major contributing factor. Consistently, in a very detailed study Daveri and Lasinio (2006) 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.

As a result, the need for productivity gains sit nowadays high in the agenda of European policymakers. Strangely enough, however, the relationship between productivity and trade openness is, more often than not, 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, 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-inefficiencies or even lead the less productive firms to leave the market (Melitz, 2003 and Melitz and Ottaviano, 2005). 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, 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[1]. 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 the 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), Pavcnick (2002), Fernandes (2003), Topalova (2004) or Bernard, Jensen and Schott (2006) are just some examples of studies finding a positive effects of trade on firm-level productivity.

All the previously quoted studies, however, 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 explored effects deals essentially with

[1]These studies have been criticised by Rodrik (2000) and Rodriguez and Rodrik (2001), on the grounds that once institutional quality and geographic variables are taken into account the positive effect of trade on productivity disappears. In a recent study, however, Alcalà and Ciccone (2004) find a positive impact of real openness on productivity for 138 countries, even after controlling for institutional quality and geographic variables, when real openness is employed.

productivity gains led by competition effect. On the other hand, it might be interesting to explore 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).

As a result, a growing literature has started to explore this second class of channels, which might yield a richer set of predictions on the relationship between trade flows and productivity gains. 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 strand of literature, since it aims at understanding whether import penetration matters for the productivity of local firms, and 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. The choice of Italy is driven by the peculiar behavior of the country: according to the OECD Factbook 2006, in fact, 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.

Anticipating our main result, 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, a 10% increase in the import penetration ratio of the same industry would result in a productivity increase of limited magnitude (around 0.05%), while an increase of 10% of the import penetration ratio in the up-stream industries would instead increase the productivity of the average firm by some 1.3%. 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.

The paper thus contributes to the literature in a number of ways. To the best of our knowledge, this is the first paper 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 (2005). Second, we employ import penetration ratios rather than MNF tariffs to calculate import penetration. Although tariffs are a direct policy tool, while import penetration ratios are just equilibrium outcomes of import, export and production choices, 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. As proved by Karacaovali (2006), in fact, tariffs are likely to be endogenous to productivity; moreover, MFN tariffs are imperfect indicators of the effective protection because they are rarely the true tariffs applied. Third, we build the import penetration in-

dexes 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. Fourth, we differentiate the impact allowing the trade openness to vary across different countries of source and destination of trade.

The structure of the paper is as follows. Section two is devoted to introduce our semi-parametric econometric estimation of total factor productivity, while Section three discusses the data used in the analysis. Section four contains the main results and the relative robustness checks. Section five concludes.

2 Econometric model

Let us start from a standard Cobb-Douglas production function

$$Y_{it} = AK_{it}^{\beta_k} L_{it}^{\beta_l} \tag{1}$$

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.

2.1 Productivity estimates

The traditional technique adopted to estimate the production coefficients and hence compute TFP starting from a (log-linearized) production function, as in eq(1), 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. 1 in logs one has:

$$y_{it} = \beta_k k_{it} + \beta_l l_{it} + \eta_{it} \tag{2}$$

In order to have a consistent OLS estimator, we need η_{it} (the residual) to be uncorrelated with both k_{it} and l_{it} (the regressors). However, as pointed out by Griliches and Mareisse (1995), profit-maximizing firms immediately adjust their inputs every 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 η can be decomposed into two terms,

so that eq(2) becomes:

$$y_{it} = \beta_k k_{it} + \beta_l l_{it} + \varpi_{it} + \varepsilon_{it} \tag{3}$$

where ϖ_{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 ϖ_{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[2]. In the OP case, investment is the proxy employed. In particular, investment is supposed to be function of capital and productivity:

$$i_{it} = i_t \left(\varpi_{it}, k_{it} \right) \tag{4}$$

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

$$\varpi_{it} = h_t \left(i_{it}, k_{it} \right) \tag{5}$$

where $h_t = i_t^{-1}$. Using eq(5), eq(3) can now be written as

$$y_{it} = \beta_k k_{it} + \beta_l l_{it} + h_t \left(i_{it}, k_{it} \right) + \varepsilon_{it} \tag{6}$$

If we now define a new (unknown) function

$$\phi \left(i_{it}, k_{it} \right) = \beta_k k_{it} + h_t \left(i_{it}, k_{it} \right) \tag{7}$$

that can be proxied by a 3^{rd} or 4^{th} order polynomial in capital and investment, Olley and Pakes (1996) show that it is now possible to estimate consistently β_l and ϕ through OLS from the following equation:

$$y_{it} = \beta_l l_{it} + \phi \left(I_{it}, k_{it} \right) + \varepsilon_{it} \tag{8}$$

Then, in order to recover an estimate for β_k, one can define a function $V_{it} = y_{it} - \hat{\beta}_l l_{it}$ which, by using eq(8), eq(7) and eq(5), can be written as:

$$V_{it} = \beta_k k_{it} + h_t \left(i_{it}, k_{it} \right) + \varepsilon_{it} = \beta_k k_{it} + \varpi_{it} + \varepsilon_{it} \tag{9}$$

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

[2]Both LP and OLS estimates will be presented as robustness checks.

i.e. that $\varpi_{it} = g(\varpi_{it-1}) + \xi_{it}$, eq(9) becomes

$$V_{it} = \beta_k k_{it} + g(\varpi_{it-1}) + \xi_{it} + \varepsilon_{it} \tag{10}$$

which using again eq(5) and (7) can be written as

$$V_{it} = \beta_k k_{it} + g(\phi_{t-1} - \beta_k k_{it-1}) + \mu_{it} \tag{11}$$

Eq(11), where g is an unknown function that can be proxied by a 3^{rd} or 4^{th} order polynomial and $\mu_{it} = \xi_{it} + \varepsilon_{it}$, allows estimating a consistent β_k through a non linear least square procedure.

Having obtained consistent estimates for β_l and β_k, it is then possible to calculate an unbiased measure of the firm level TFP as

$$tfp_{it} = y_{it} - \hat{\beta}_k k_{it} - \hat{\beta}_l l_{it} \tag{12}$$

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

2.2 Import penetration, intermediate inputs and productivity

Once having obtained reliable TFP estimates, we have tested the impact of import penetration on productivity according to the following econometric models:

$$tfp_{ijt} = \alpha_0 + \alpha_1 H\_imp_{zjt} + \alpha_2 V\_imp_{-zjt} + \gamma_i + \delta_t + \epsilon_{ijt} \tag{13}$$

where tfp_{ijt} is the log-productivity of firm i operating in industry j at time t while γ_i and δ_t are respectively firm and time fixed effects. H_imp_{zjt} is a measure of the horizontal import penetration from country z in industry j at time t. It is computed as:

$$H\_imp_{zjt} = \frac{IMP_{zjt}}{IMP_{zjt} + PROD_{jt} - EXP_{zjt}} \tag{14}$$

where IMP_{zjt} and EXP_{zjt} are the imports and exports of Italy from/to country z in industry j in year t, while $PROD_{jt}$ is the national output of industry j in year t.

The measure of the vertical import penetration, V_imp_{zjt}, is somewhat more complicated, since it reflects the linkages present in the up-stream industries. Following Smarzynska (2004), who has used a similar indicator in order to measure "vertical" FDI presence, the index is computed as the weighted average of the up-stream industries' horizontal import penetration ratios using as weights the time-varying input-output coefficients retrieved from the Italian Input-Output matrix:

$$V\_imp_{zjt} = \sum_{k \ if \ k \neq j} a_{kjt} \cdot H\_imp_{zkt} \tag{15}$$

where a_{kjt} is the weight of industry k as input of industry j at time t.

3 Data description

3.1 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 the 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 has 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. Table 1 reports the geographical distribution of the firms in our sample. The number for each region ranges from 55 (Valle d'Aosta) to more than 10,000 (Lombardia). The correlation between the sample distribution and official Census data of 2001 is 0.96 and significant at 1 per cent level.

[Table 1 about here]

As for the distribution across industries, Table 2 shows how the number of firms for each NACE2-digits sector ranges from 119 in the case of sector 23 ("Manufacture of coke, refined petroleum products and nuclear fuel") to more than 5,000 firms in sector 29 ("Machinery and equipment"). Again, the correlation with Census data is pretty good (0.71) and significant.

[Table 2 about here]

As far as the firms' size is concerned, Table 3 shows the distribution across the size classes adopted by the Italian National Institute of Statistics. Firm size is measured by employment. Looking at the firms for which employment data in 2001 are 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 it is almost impossible to obtain data on the myriads of micro firms that build up the Italian manufacturing sector, we have to cope with this (albeit moderate) "size bias" of the sample.

[Table 3 about here]

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[3].

Table 4 shows some descriptive statistics of the sample. Panel A shows the descriptive statistics for the values of the different variables whereas panel B reports the information on growth rates.

[Table 4 about here]

3.2 Tfp estimates

We have estimated separate production functions for each NACE2-digits sector. All our variables are deflated using 2-digits price deflators. The deflator for capital, following Smarzynska (2004), is the simple average of five industries capital deflators[4]. 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 or the LP estimates. As for the capital coefficients, OP coefficients are usually higher than OLS ones, while LP capital coefficients seem to be systematically lower[5].

[Table 5 about here]

Using OP estimates as our baseline model, we report in Graph 1 the evolution of an aggregate TFP index[6] that shows a declining trend for our sample firms, particularly from 2000 to 2003, consistently with the results of the studies previously cited. Graph 2 disentangles

[3]Note that we are dealing with the ownership data of the last available year, which prevents us from capturing any possible change of status in the period considered (as for example due to M&A operations). Although foreign ownership is not the main object of our analysis, this caveat should be taken in mind when discussing our results.

[4]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".

[5]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.

[6]The index has been computed as the ratio between the yearly unweighted average of the firm level TFP and its initial (1996) value.

the evolution of the TFP index according to its geographical and industrial dimensions

[Graph 1 and 2 about here]

As for the geographical heterogeneity of the TFP evolution, in Graph 3 we report the break-down by region.While most of southern regions display a declining path, the majority of northern regions is characterised by an almost flat path, with a little decrease in productivity from 2000 to 2003 and some signs of recovery in 2004[7].

[Graph 3 about here]

3.3 Import penetration ratios

In order to compute import penetration indexes according to eq(14) we have used information on trade flows and production provided by EUROSTAT. Values of imports and exports are 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 are then reclassified at the 3-digit NACE rev. 1.1 level, using the relevant correspondence tables provided by EUROSTAT. The product-based data, coupled with a geographic breakdown, thus allow us to discern import penetration by partner. Data on production are instead collected using the PRODCOM database, always at the 8-digit classification, and are then converted in NACE detailed level as done for trade flows. Table 6 reports some descriptive statistics on the calculated import penetration ratios at the 2-digit level of aggregation[8].

[Table 6 about here]

As it is possible to see, there are structural differences in the exposure to international trade flows, ranging from 58% of average import penetration ratio registered by NACE industry 24 (chemicals) to the 5% of sector 22 (publishing and printing). As for the evolution over time of the import penetration ratios, Graph 4 reports the dynamics in different industries. Also in this case there is a lot of trend heterogeneity, with an upward trend in some industries (e.g. textiles - 17 or wearing apparel - 18), almost flat in others (wood -20; motor vehicles - 34), or decreasing (pulp and paper - 21; basic metals - 27). Obviously, the heterogeneity further increases if one looks at the 3-digits industries, which are not reported here.

[Graph 4 about here]

[7]The path displayed by the Aosta Valley region might be due to the small number of observations

[8]Horizontal import penetration ratios are used at a 3-digit level because this seems to be an optimal level of disaggregation once taking into account the number of sample observations by sector. Vertical penetration ratios can be calculated only at 2-digit level because this is the only available disaggregation for Imput-Output technology as provided by ISTAT

As for the import penetration indexes in the up-stream industries, we have built the variable according to the methodology previously described. To this extent, ISTAT provides annual Input-Output matrixes for the period 1996-2003. This allows us obtaining time-varying input-output coefficients a_{kjt}. In order to check whether the latter display a 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. We can thus exclude a major reshaping of the overall I/O structure of the Italian economy in the considered years. However, in a number of industries some technological change has actually taken places, with changes 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).

Table 7 reports the relevant descriptive statistics on vertical import-penetration indexes, revealing again a significant heterogeneity. The industry with the highest up-stream ratio is NACE industry 25 (rubber and plastic products) while the one with the lowest value is NACE 20 (wood).

[Table 7 about here]

The extent of heterogeneity among industries is depicted in Graph 5 showing the evolution of vertical penetration ratios among industries, often different from the corresponding horizontal figures plotted in Graph 4.

[Graph 5 about here]

Both the horizontal and the vertical penetration indexes are then calculated distinguishing a number of Italian trade partners. As before, 3-digit NACE indexes are used for horizontal ratios and 2-digit figures for vertical ones. We have sorted out a total of 6 representative partners: the World (thus accounting for the total Italian trade flows), the European countries before the enlargement (EU-15), USA, the new member states of the European Union (NMS), the so-called BRICs (Brazil, Russia, India and China as new emerging markets) and China alone. As clearly summarized by Table 8 and Graph 6, average vertical import penetration ratios have rapidly grown on average for the period of concern if we look at emerging economies (BRICs or China alone) and found a renewed upward trend after 2000 in the case of the New Member States.

[Table 8 about here]

[Graph 6 about here]

4 Results

4.1 Main Results

Table 9 contains the main results of the analysis, obtained from the estimation of eq(13), with the horizontal and vertical penetration measures taken in logs (to recover elasticities) and lagged one year in order to control for the potential endogeneity of the trade measure. The Breusch-Pagan test rejected the Pooled OLS as a possible estimator, while the Hausman test identified fixed effects estimator preferable in this case to the alternative random effects estimator. Also, since we perform a regression on micro units using mainly aggregate variables as covariates (at the industry level), we control for the potential downward bias in the estimated errors by clustering the standard errors for all firm-level observations.

Column 1 presents the results of the model using import penetration indexes from the entire world. As it can be seen, the horizontal import penetration ratio displays a positive and significant coefficient, revealing however a quite small effect in absolute value. An increase in horizontal import penetration of 10% would results, *ceteris paribus*, in an increase of productivity of around 0.06%[9]. 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 of 10% in the "vertical" import penetration would result, *ceteris paribus*, in an increase of productivity by 1.3%.

Columns 2 to 6 report the results obtained running the same specification over different groups of countries. 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 twice as large as the one obtained 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 significantly associated with a decrease in productivity of Italian firms, while vertical import penetration displays positive effects on TFP, but of a much lower magnitude. Moving to the impact of Italian trade with the New Member States (Column 4), the results are in line with the ones obtained at the world level, and the same is true when considering trade with the BRICs (Column 5). Concentrating on the impact of Chinese competition (Column 6), we can also see that trade with China, if anything, has either a neutral (horizontal) or positive (vertical) effect on the productivity of the Italian firms, a finding not surprising for economists, but not so straightforward for policy-makers.

[Table 9 about here]

In Table 10 we analyse in more details our findings, interacting the trade measures with

[9]Given that all the variables are taken in logs, the coefficients can be interpreted as elasticities.

some characteristics of firms, in particular a dummy signalling 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)[10]. 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 premia 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), a clear indication that FDI in Italy tend to follow a market-seeking attitude, substituting trade with local presence. A similar finding is obtained for the Italian firms with a participation abroad (Column 3), a finding consistent with the fact that multinational groups in general tend to exploit different trade channels than the average domestic firm. Interestingly enough, however, when interacting the FOR or DOM dummies with the trade penetration within the EU-15 countries (Column 4 and 5), we have found 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. The latter finding is again consistent with the idea that the advantages of market integration in Europe tend to be accrued relatively more by larger, international firms.

[Table 10 about here]

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 11 report the results obtained when using alternatively the TFP obtained with OLS estimates of the production function coefficients and with labour productivity measured as value added per employee. The results are qualitatively the same, with only a slight different in the point estimates with respect to Column 1 of Table 8, our benchmark specification.

[Table 11 and 12 about here]

Columns 3 to 5 in Table 11 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[11]. Even through such a more demanding specification,

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

[11] If firm-specific fixed effects are spuriously correlated with other covariates, the latter might lead to

the results are virtually unchanged, with only the effect of horizontal import penetration slightly less significant.

Another concern is related to the time-varying nature of the I-O coefficients used to build the vertical import penetration ratio variable, since the latter might be endogenous to trade shocks and productivity[12]. To this extent, Column 1 of Table 12 reports the results that are obtained using the I-O coefficients of 1996 (i.e. the starting period of our sample). The results obtained are almost identical, with only slight changes in the point estimates.

In Column 2 of Table 12 we have tested whether the results change using a different aggregation for our horizontal trade measure (at NACE2 rather than NACE3), since the lack of observation at this finer industry level might induce a systematic bias in our estimates. In Column 3 we report the results recalculating instead the trade penetration index excluding exports, i.e. bounding the index between 0 and 1, to test for the sensitivity of our coefficients. The results are qualitatively the same, with some slight differences in the point estimates. However, our main result of a large difference in the impact of the two import penetration indexes on productivity in favor of the vertical one is not altered.

5 Conclusions

We have tested the impact of import penetration 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 impact on productivity 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) semiparametric estimation, we have regressed Total Factor Productivity on the two import penetration ratios, controlling for fixed characteristics.

Three main results emerged from this analysis. First, 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, a 10% increase in the import penetration ratio of the same industry would result in a productivity increase that ranges from 0.06% to 0.08% according to the TFP measure and the econometric specification. An increase of 10% of the import penetration ratio in the up-stream industries would instead increase average productivity by 0.9% to 1.5%. Second, both foreign firms and domestic firms participating in international networks are on average more productive than the other firms. The productivity premium of foreign firms ranges from 14% to 48% while the one of international domestic firms ranges from 10.1% to 41% according to the TFP

potentially inconsistent estimates.

[12]It could be the case that a trade shock which increases productivity in an upstream industry leads over time to a more intensive use of inputs from the same industry.

measure and the econometric specification. We also find, however, that import penetration alone does not explain much of the individual variance in TFP levels, which is clearly (and not surprisingly) linked also to other relevant factors.

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Table 1: Geographical distribution of firms

Regione	Freq.	Percent
Abruzzo	602	1.75
Basilicata	121	0.35
Calabria	177	0.51
Campania	1,350	3.93
Emilia-Romagna	4,299	12.5
Friuli	1,048	3.05
Lazio	1,255	3.65
Liguria	409	1.19
Lombardia	10,415	30.29
Marche	1,258	3.66
Molise	65	0.19
Piemonte	2,956	8.6
Puglia	881	2.56
Sardegna	208	0.6
Sicilia	590	1.72
Toscana	2,729	7.94
Trentino-Alto Adige	486	1.41
Umbria	430	1.25
Valle d'Aosta	55	0.16
Veneto	5,051	14.69
Total	**34,385**	**100**

Table 2: Activity distribution of firms

CODE	NACE_DESCRIPTION	Freq.	Percent
15	Manufacture of food products and beverages	3,251	9.45
17	Manufacture of textiles	2,047	5.95
18	Manufacture of wearing apparel; dressing and dyeing of fur	1,437	4.18
19	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear	1,470	4.28
20	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and..	1,086	3.16
21	Manufacture of pulp, paper and paper products	845	2.46
22	Publishing, printing and reproduction of recorded media	1,533	4.46
23	Manufacture of coke, refined petroleum products and nuclear fuel	119	0.35
24	Manufacture of chemicals and chemical products	1,511	4.39
25	Manufacture of rubber and plastic products	2,219	6.45
26	Manufacture of other non-metallic mineral products	2,278	6.62
27	Manufacture of basic metals	1,030	3
28	Manufacture of fabricated metal products, except machinery and equipment	3,530	10.27
29	Manufacture of machinery and equipment n.e.c.	5,171	15.04
30	Manufacture of office machinery and computers	234	0.68
31	Manufacture of electrical machinery and apparatus n.e.c.	1,599	4.65
32	Manufacture of radio, television and communication equipment and apparatus	490	1.43
33	Manufacture of medical, precision and optical instruments, watches and clocks	749	2.18
34	Manufacture of motor vehicles, trailers and semi-trailers	558	1.62
35	Manufacture of other transport equipment	447	1.3
36	Manufacture of furniture; manufacturing n.e.c.	2,781	8.09
	Total	**34,385**	**100**

Table 3: Size distribution of firms

	Sample 2001		Census 2001		
size	Freq.	Percent	Freq.	Percent	Firm 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 4: Descriptive statistics

(A)					
Variable	Obs	Mean	Std. Dev	Min	Max
PROD_DEFL	182149	1.29E+07	7.31E+07	204.2953	5.40E+09
Y_DEFL	182149	1.25E+07	7.16E+07	198.023	5.35E+09
VA_DEFL	182149	3154958	1.59E+07	10.49453	1.11E+09
M_DEFL	151898	7022836	4.95E+07	1.87991	4.98E+09
K_DEFL	182149	2669536	1.91E+07	4.735422	1.85E+09
L	178420	62.57517	357.8281	1	103761
(B)					
Variable	Obs	Mean	Std. Dev	Min	Max
DPROD	141526	0.063077	0.194417	-0.44328	1.980081
DY	141526	0.064328	0.203545	-0.47451	1.993963
DVA	141526	0.070475	0.248729	-0.62854	1.997875
DM	141526	0.0742	0.274415	-0.62274	1.999147
DK	141526	0.075576	0.341839	-0.67925	1.999518
DL	141526	0.069498	0.263197	-0.81667	1.982955

Table 5: Estimated coefficients of productivity

NACE2	B_OLS_k	B_OP_k	B_LP_k	B_OLS_l	B_OP_l	B_LP_l
15	0.199286	0.1849	0.0908	0.807484	0.7669	0.7302
17	0.156383	0.2947	0.0911	0.767666	0.7646	0.6793
18	0.14598	0.1008	0.0817	0.785492	0.7606	0.6884
19	0.156995	0.2617	0.0607	0.772181	0.7706	0.6835
20	0.151688	0.2615	0.084	0.758334	0.7279	0.6773
21	0.163492	0.0124	0.059	0.829653	0.8149	0.7079
22	0.100989	-0.1478	0.0879	0.875345	0.8492	0.791
23	0.237177	-0.2347	0.1991	0.82989	0.6974	0.6793
24	0.125747	0.039	0.0475	0.880446	0.8631	0.7011
25	0.164333	0.1867	0.0977	0.807254	0.7641	0.7019
26	0.19005	0.2926	0.0837	0.795313	0.7589	0.7078
27	0.179544	0.2456	0.0982	0.809779	0.7515	0.7328
28	0.150927	0.1866	0.0687	0.805118	0.7702	0.7393
29	0.146798	0.1816	0.1125	0.82128	0.7957	0.7085
30	0.142311	0.1768	0.1554	0.806228	0.789	0.7742
31	0.146407	0.1709	0.0987	0.79652	0.7665	0.6984
32	0.129786	0.0636	0.0968	0.858254	0.8232	0.7427
33	0.131017	0.0884	0.0619	0.815538	0.7442	0.6917
34	0.126878	0.2201	0.0592	0.875367	0.8229	0.7351
35	0.17106	0.1074	0.0929	0.813883	0.816	0.7493
36	0.127275	0.1333	0.0693	0.806038	0.8168	0.6938

Table 6: Import penetration ratios

CODE	NACE_DESCRIPTION	mean	standard deviation	1996	2004
15	Manufacture of food products and beverages	18.01%	1.68	21.87%	18.26%
17	Manufacture of textiles	17.64%	5.87	10.87%	22.67%
18	Manufacture of wearing apparel; dressing and dyeing of fur	23.71%	8.98	14.29%	34.13%
19	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear	28.04%	4.93	21.11%	32.41%
20	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and..	22.37%	3.01	27.00%	21.74%
21	Manufacture of pulp, paper and paper products	24.43%	2.47	27.76%	23.32%
22	Publishing, printing and reproduction of recorded media	4.60%	1.21	6.29%	5.08%
24	Manufacture of chemicals and chemical products	57.79%	3.63	58.26%	62.09%
25	Manufacture of rubber and plastic products	17.77%	2.98	21.00%	18.02%
26	Manufacture of other non-metallic mineral products	9.19%	0.43	9.40%	8.78%
27	Manufacture of basic metals	33.05%	3.36	35.09%	35.47%
28	Manufacture of fabricated metal products, except machinery and equipment	10.75%	1.14	12.69%	10.02%
29	Manufacture of machinery and equipment n.e.c.	19.34%	0.98	19.46%	19.89%
31	Manufacture of electrical machinery and apparatus n.e.c.	24.77%	3.64	27.92%	27.28%
32	Manufacture of radio, television and communication equipment and apparatus	53.78%	4.15	50.07%	63.51%
33	Manufacture of medical, precision and optical instruments, watches and clocks	47.70%	2.33	46.00%	47.09%
34	Manufacture of motor vehicles, trailers and semi-trailers	49.49%	6.38	58.19%	51.34%
35	Manufacture of other transport equipment	29.77%	3.56	25.58%	30.80%
36	Manufacture of furniture; manufacturing n.e.c.	11.32%	2.44	14.51%	13.01%

Table 7: Vertical import penetration ratios

CODE	NACE_DESCRIPTION	mean	standard deviation	1996	2003
15	Manufacture of food products and beverages	10.19%	1.19	10.32%	11.45%
17	Manufacture of textiles	18.00%	3.25	16.77%	20.98%
18	Manufacture of wearing apparel; dressing and dyeing of fur	25.82%	9.02	17.99%	33.05%
19	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear	12.44%	1.39	14.10%	13.18%
20	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and..	8.87%	1.09	9.89%	9.40%
21	Manufacture of pulp, paper and paper products	21.08%	2.51	22.46%	22.78%
22	Publishing, printing and reproduction of recorded media	26.82%	2.93	29.60%	27.49%
24	Manufacture of chemicals and chemical products	9.77%	0.93	11.28%	8.97%
25	Manufacture of rubber and plastic products	54.10%	5.53	55.68%	57.74%
26	Manufacture of other non-metallic mineral products	21.87%	2.23	24.76%	20.67%
27	Manufacture of basic metals	16.25%	1.92	17.79%	17.58%
28	Manufacture of fabricated metal products, except machinery and equipment	29.02%	3.39	33.48%	26.49%
29	Manufacture of machinery and equipment n.e.c.	23.70%	3.55	29.35%	22.45%
31	Manufacture of electrical machinery and apparatus n.e.c.	29.29%	2.89	33.57%	27.87%
32	Manufacture of radio, television and communication equipment and apparatus	24.44%	2.31	28.82%	23.33%
33	Manufacture of medical, precision and optical instruments, watches and clocks	30.14%	3.19	34.54%	30.58%
34	Manufacture of motor vehicles, trailers and semi-trailers	23.61%	3.22	28.59%	21.07%
35	Manufacture of other transport equipment	26.87%	3.86	33.46%	26.52%
36	Manufacture of furniture; manufacturing n.e.c.	28.86%	3.02	34.03%	27.96%

Table 8: Average vertical and horizontal import penetration by partner

All sectors (average)	Horiz.	Vertical	Horiz.	Vertical	Horiz.	Vertical
	mean		1996		2004	2003
World	28.35%	24.46%	29.27%	25.96%	29.61%	26.97%
UE-15	20.81%	15.72%	22.54%	16.87%	20.98%	16.83%
USA	3.23%	1.57%	4.07%	1.72%	2.75%	1.55%
NMS	2.97%	4.49%	2.75%	4.32%	3.59%	4.92%
BRICs	3.96%	1.22%	3.32%	1.02%	4.82%	1.77%
China	3.03%	0.69%	2.80%	0.48%	4.66%	1.13%

Table 9: Import penetration, trade orientation and productivity

Dep var: ln(TFP) OP	World	EU-15	USA	NMS	BRICs	China
Horizontal_imp_pen	.006**	.011***	-.004**	.008***	.006***	.003*
	(.003)	(.003)	(.002)	(.002)	(.002)	(.002)
Vertical_imp_pen	.129***	.121***	.067***	.097***	.116***	.097***
	(.010)	(.011)	(.011)	(.008)	(.009)	(.010)
Constant	9.43***	9.43***	9.44***	9.47***	9.74***	9.61***
	(.017)	(.021)	(.050)	(.027)	(.043)	(.049)
Firms fixed effects	yes	yes	yes	yes	yes	yes
Time fixed effects	yes	yes	yes	yes	yes	yes
Observations	158,983	159,276	160,935	160,835	161,343	161,262

***,**,* Statistically significant at 1%, 5%, 10% respectively.
FE (within) estimator. Standard errors clustered at firm level.
Trade penetration measures taken in logs and lagged one year.

Table 10: Import penetration, firm characteristics and productivity

Dep var: ln(TFP) OP	World	World	World	EU-15	EU-15
Horizontal_imp_pen	.019***	.019***	.019***	.024***	.024***
	(.004)	(.004)	(.004)	(.004)	(.004)
Vertical_imp_pen	.082***	.084***	.084***	.072***	.073***
	(.011)	(.012)	(.012)	(.012)	(.012)
FOR_MNE	.233***	.174***		.190***	
	(.008)	(.029)		(.037)	
DOM_MNE	.188***		.169***		.171***
	(.005)		(.017)		(.021)
Horizontal*FOR_MNE		-.001		.016**	
		(.008)		(.008)	
Vertical*FOR_MNE		-.052***		-.045***	
		(.016)		(.016)	
Horizontal*DOM_MNE			-.008		.012***
			(.004)		(.005)
Vertical*DOM_MNE			-.013		-.025***
			(.009)		(.009)
Constant	9.33***	9.34***	9.34***	9.39***	9.38***
	(.016)	(.016)	(.015)	(.023)	(.023)
Industry fixed effects	yes	yes	yes	yes	yes
Time fixed effects	yes	yes	yes	yes	yes
Observations	158,983	158,983	158,983	159,276	159,276

***,**,* Statistically significant at 1%, 5%, 10% respectively
FE (within) estimator.
Trade penetration measures taken in logs and lagged one year.

Table 11: Alternative productivity estimates – World Import Penetration

Dep var:	ln(TFP) OLS	ln(lab_prod)	Δln(TFP) OP	Δln(TFP) OLS	Δln(lab_prod)
Horizontal_imp_pen	.008***	.008***			
	(.002)	(.003)			
Vertical_imp_pen	.122***	.153***			
	(.011)	(.012)			
Δ Horizontal_imp_pen			.003	.004*	.004
			(.002)	(.002)	(.003)
Δ Vertical_imp_pen			.093***	.095***	.114***
			(.013)	(.013)	(.014)
Constant	9.52***	11.01***	.031***	.030***	.032***
	(.018)	(.020)	(.003)	(.004)	(.004)
Firms fixed effects	yes	yes	yes	yes	yes
Time fixed effects	yes	yes	yes	yes	yes
Observations	158,983	158,983	114,231	114,231	114,231

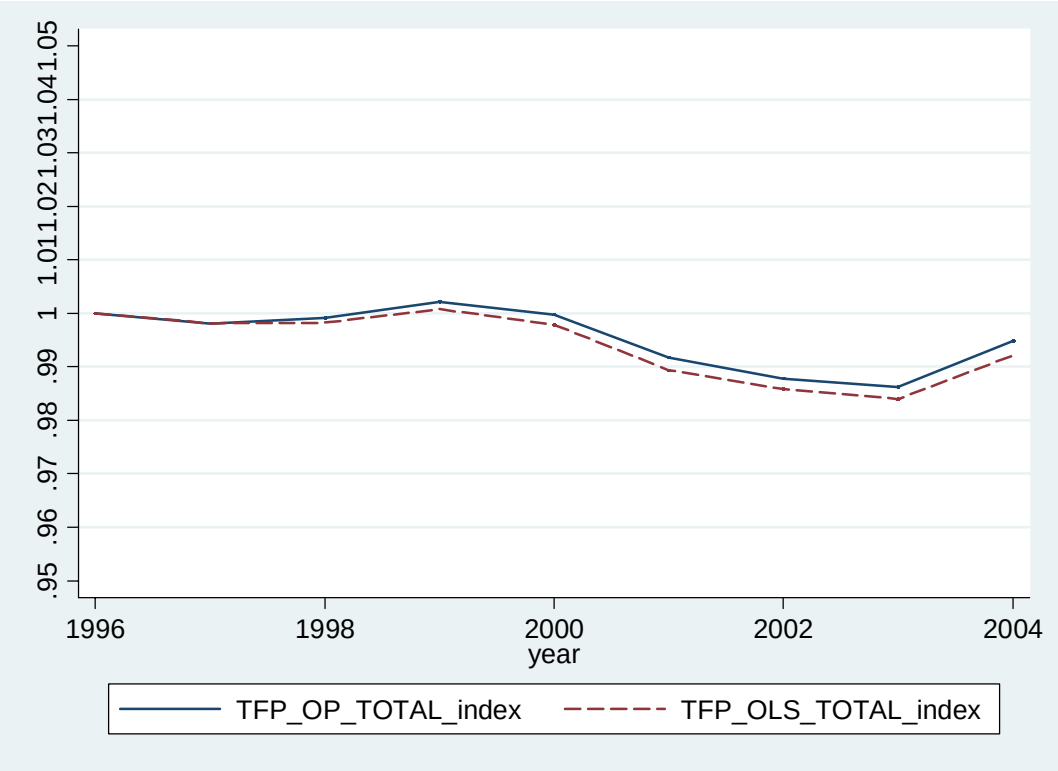
***,**,* Statistically significant at 1%, 5%, 10% respectively
FE (within) estimator. Standard errors clustered at firm level.
Trade penetration measures taken in logs and lagged one year.

Table 12: Robustness and sensitivity analysis – World Import Penetration

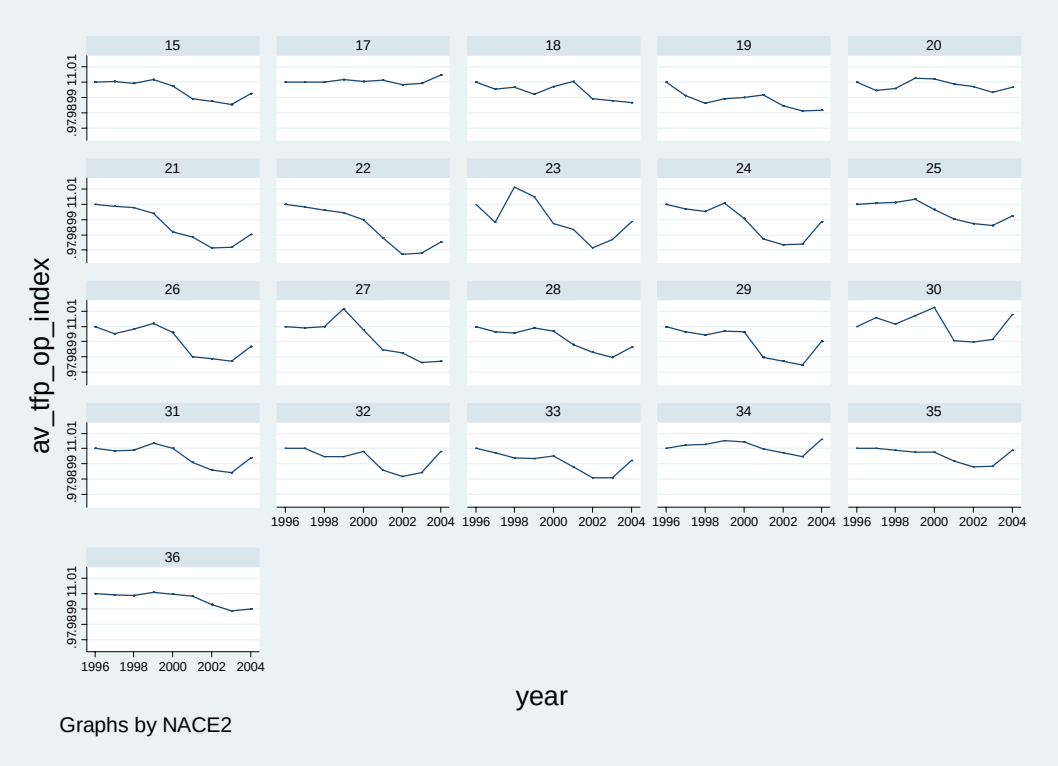
Dep var: ln(tfp) OP	Fixed I/O coeff	NACE2 Index	Bounded Index (0-1)
Horizontal_imp_pen	.007***	.020***	.043***
	(.003)	(.004)	(.008)
Vertical_imp_pen	.133***	.102***	.211***
	(.012)	(.011)	(.018)
Constant	9.44***	9.32***	9.71***
	(.019)	(.015)	(.043)
Firms fixed effects	yes	yes	yes
Time fixed effects	yes	yes	yes
Observations	158,983	164,678	159,441

***,**,* Statistically significant at 1%, 5%, 10% respectively
FE (within) estimator. Standard errors clustered at firm level.
Trade penetration measures taken in logs and lagged one year.

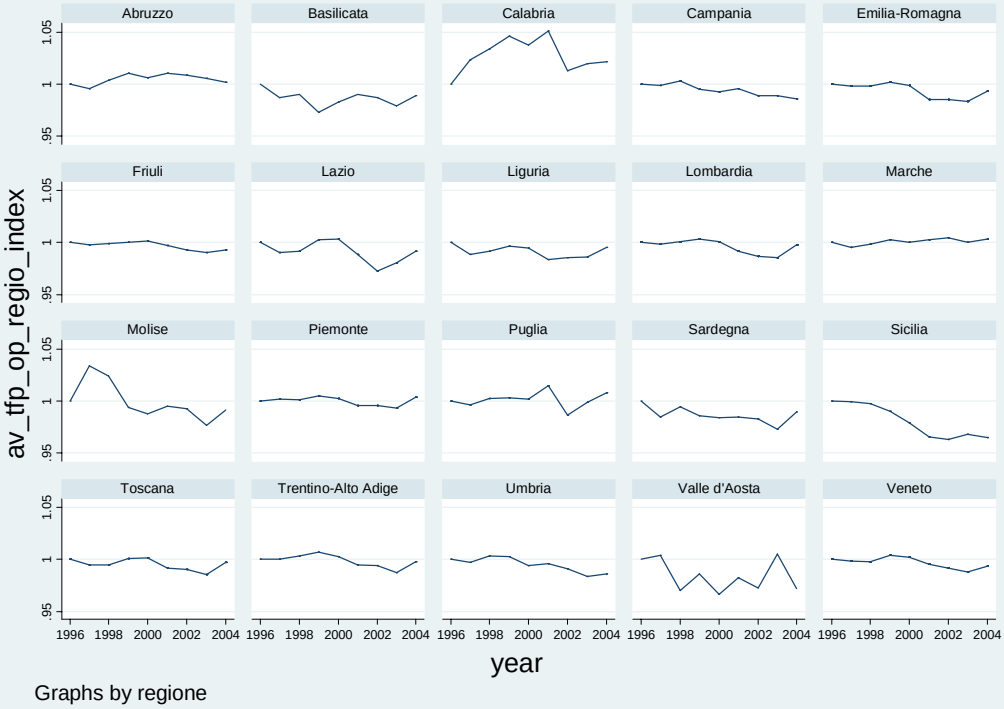
Graph 1: Average TFP



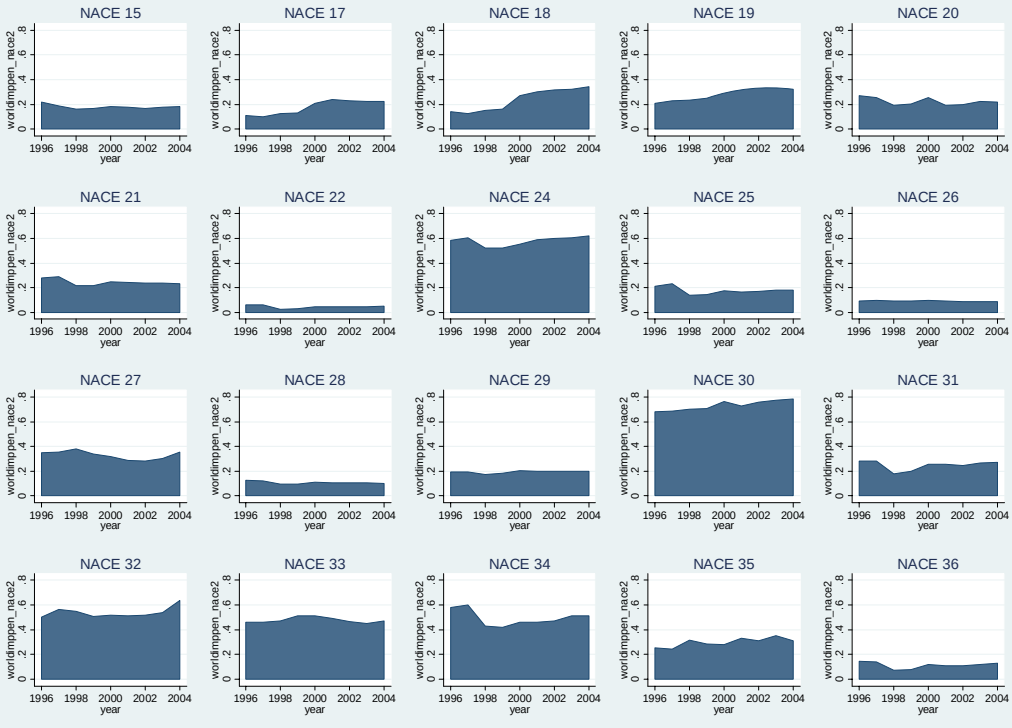
Graph 2: Average TFP by industry



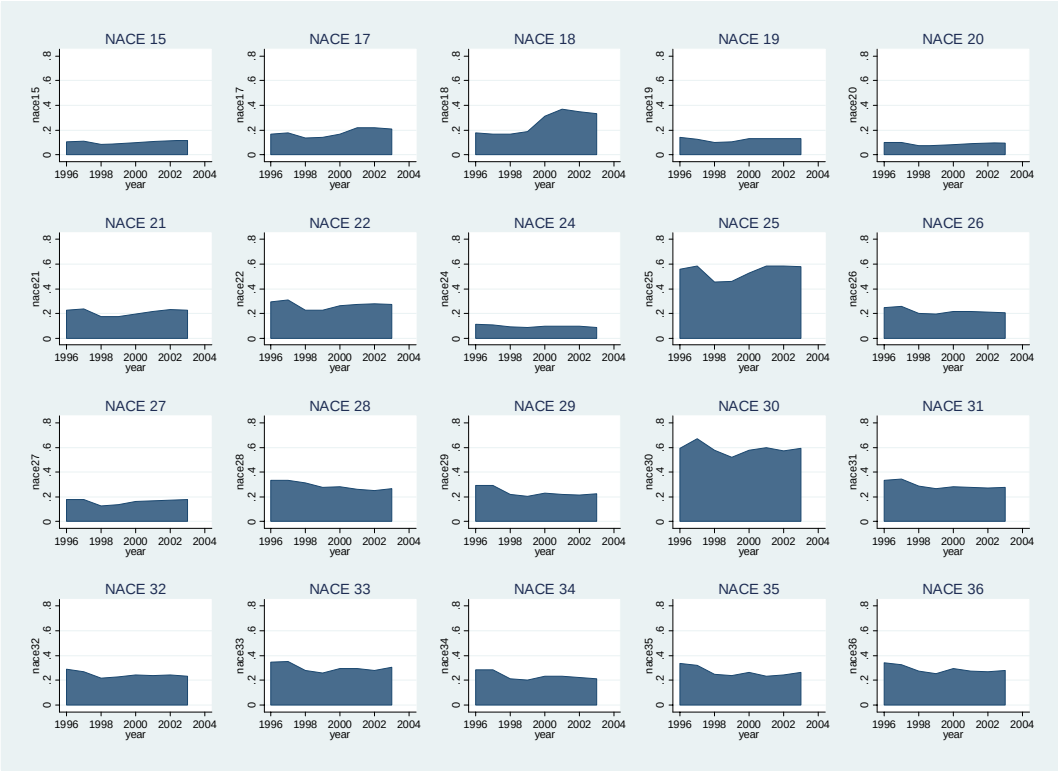
Graph 3: Average TFP by region



Graph 4: Average import penetration ratios



Graph 5: Vertical import penetration ratios



Graph 6: Average vertical import penetration by partner