Imported Intermediate Inputs and Firms' Productivity Growth: Evidence from the Food Industry*

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Abstract: New imported goods play a central role in determining the gains from trade. Using detailed trade and firm level data for Italy and France, we investigate the relationship between trade integration, imported intermediate inputs and firm performance in the food industry. The main findings show that an increase in import competition spurs firm-level productivity growth. Yet, the productivity growth effect attributable to imported intermediate inputs is significantly stronger than the effect due to imported final products. In addition, we find that *new* imported inputs are of particular importance especially for Italian food firms, but less so for the French ones. Finally, the productivity growth effect of trade integration tends to be asymmetric, namely more productive firms gain more from trade integration. All these stylized facts may have interesting policy implications.

JEL: F14, F15, F61, L66, Q17

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1. Introduction

Does trade liberalization in upstream sectors improve firm-level productivity in the food industry? Answering this question is crucial for the European Union (EU), as it is also related to trade liberalization in the (upstream) agricultural sector. Hence, whether an increase in imported intermediate inputs brings more benefits than costs for the agri-food sector would obviously have strong policy implications. Despite the growing importance of trade in intermediate inputs, very few papers to date have investigated the relationship between imported inputs and food firms' productivity growth.

The literature on endogenous growth provides theoretical insights on to the role played by imported inputs on efficiency gains at the aggregate level (Rivera-Batiz and Romer 1991; Backus et al., 1992). At the micro level, gains could be due to productivity growth realized through input complementarities, lower input costs, and access to new and higher quality inputs (Grossman and Helpman, 1991; Aghion and Howitt 1998). [1] Empirically, studies based on firm-level data strongly confirmed that more imported inputs lead to an increase in firm productivity growth (Amiti and Konings 2007; Kasahara and Rodrigue 2008; Topalova and Khandelwal 2011; Altomonte, Barattieri and Rungi 2014), in the number of new domestic products (Goldberg et al. 2010; Colantone and Crinò, 2014) and in the probability of firms' entry in the export market (Bas and Strauss-Kahn, 2011; Chevassus-Lozza et al. 2014).

With the notable exception of Chevassus-Lozza et al. (2014), who showed that lower input tariffs in agriculture may increase the export sales of high-productivity manufacturing French food firms (but at the expense of low-productivity firms), no studies to date has explicitly

[1] A growing literature focuses on the impact of import competition coming from developing countries, like China, on employment and inequality. Early studies conclude that there exists a low, or moderate, role of outsourcing in explaining jobs lost and wages decrease (see Feenstra and Hanson 1996; Biscourp and Kramarz 2007). However, more recent studies on the US labor market, by disentangling the trade exposure at local level, are fairly more pessimistic about the effect on jobs lost and wages inequality (see Autor et al. 2013; Acemoglu et al. 2014).

tested this relationship in the EU food industry.[2] One difficulty in testing this relationship comes from the fact that information on the intermediate consumption structure at the firm-level is normally missing from the majority of micro-data set. Moreover, the lack of EU input-output (I-O) tables with a sufficient degree of industry disaggregation represents a further problem in this kind of study. As a consequence, researchers are often forced to adopt *ad hoc* solutions. For example, Chevassus-Lozza et al. (2014) combine trade and firm level data to identify the imported products processed by a firm belonging to each 4-digit industry.[3]

In this paper, to identify the effect of imported intermediate inputs on firm level productivity growth we propose an alternative strategy. In particular, we rely on studies that used an industry measure taken from one country, the United States, to approximate the industry characteristics in other countries (see Nunn and Trefler, 2013 for a discussion).[4] More specifically, we make use of the US input-output tables, notoriously more detailed than the EU ones, to measure a consistent index of upstream import penetration. To the extent to which technology is comparable between the US and the EU food processing industry, and this should be indeed the case, then this strategy offers a relatively simple and more consistent solution to the lack of firm-level information on the intermediate consumption structure.

In addition, in our specific context the proposed approach allows us to solve a subtle identification problems, stemming from the use of firm level trade data. Indeed, many food

[2] However, there exists a small but growing literature investigating the relationship between trade and productivity in the food industry, within the framework of firm heterogeneity trade models (see Ruan and Gopinath, 2008; Gullstrand, 2011; Curzi and Olper, 2012; Chevassus-Lozza, Latouche, 2012; Olper, Pacca and Curzi, 2014; Curzi et al. 2014).

[3] Chevassus-Lozza et al. (2014) in order to determine the set of products processed by a 4-digit industry, made use of the French Customs Register, which provides information on imports of all French firms by product at the 8-digit level of the combined nomenclature. After knowing the main firm activity, namely its NACE 4-digit sector, they identify all products imported by a given 4-digit industry. This approach, despite having the advantage of being also based on firm-level imports information, has also some drawbacks. Firstly, information on the intermediate consumption structure for each firm is missing, and secondly it assumes that all French firms' imports, in a given NACE 4-digit, are truly intermediate inputs used in the same industry, a quite strong assumption.

[4] For example, Levchenko (2007) and Nunn (2007) investigated the effect of institutions on cross-country differences in comparative advantage, while Acemoglu et al. (2009) studied the role of financial developments on vertical integration. These and other studies used an industry measure based on the US I-O tables, as a proxy for other countries. A discussion about this approach can be find in Nunn and Trefler (2013) and Ciccone and Papaioannou (2010). Section 2.3 summarized this issue in the context of the present study.

firms are small and thus they access imported intermediate inputs only *indirectly*, through (importing) intermediaries. Thus, a firm that according to the custom data has not imported intermediate inputs, has probably bought (and used) foreign inputs imported by another domestic intermediary, raising a complex selection bias problem. In this paper, by using data of imported inputs at product and sector level, instead of detailed firm level custom data, we do not encounter this kind of identification problem (see Goldberg et al. 2010).

In this paper, we empirically study the productivity growth effect of import competition at both industry and upstream sectors level, by exploiting a large micro-dataset of more than 20,000 French and Italian food firms, observed over the 2004-2012 period. Following Acemoglu et al. (2014) and Altomonte, Barattieri, and Rungi (2014), we measure an index of vertical input penetration at a very detailed level, by combining the BEC classification, which distinguishes between intermediates goods and products for final consumption, with the input-output table taken from the US Bureau of Economic Analysis (BEA). Furthermore, to shed light on the underlying mechanism through which imported intermediate inputs may affect firm-level productivity growth, the impact of upstream import penetration is split in its intensive and extensive trade margins, which account, respectively, for the growth in existing input varieties and the growth in new imported input varieties.

Our specific focus on both Italian and French food firms presents some interesting advantages. First, the two countries share a worldwide recognized quality reputation of their food products, based on a strong food tradition and culture. Second, their food sectors, taken together, represent a large fraction of the EU food industry revenue. However, at the same time, the two countries have a fundamental difference in their agricultural sectors, which lies in the industry that produces a large fraction of the intermediate inputs used in the food industry. Indeed, while France is a net exporter of agricultural products, Italy is a net importer. These similarities and differences add interesting insights to the analysis of the effect of imported intermediate inputs on firms' productivity growth.

Our main findings can be summarized as follows. Firstly, an increase in import competition spurs firm-level productivity growth. However, the productivity growth effect attributable to an increase in imported intermediate inputs is significantly stronger than the effect due to imported final products, a result consistent with the most recent literature (see De Loecker and Goldberg, 2014). In addition, we find that *new* imported inputs are of particular importance especially for Italian food firms, but less so for the French ones, where the effect of imported inputs seems to work mainly through a growth of the intensive trade margin. Finally, the productivity growth effect of trade integration tends to be asymmetric, namely large and more productive firms gain more from trade integration. All these stylized facts may have interesting policy implications.

The remainder of the paper is organized as follows. In section 2, we present how we measure productivity, horizontal and vertical import penetration, our identification strategy and the main expectations. In section 3 we report the econometric results and some robustness checks. Section 4 is devoted to investigate the mechanisms through which imported intermediates inputs affect productivity growth. Finally, section 5 concludes.

2. Data, measures and empirical strategy

In order to apply our empirical strategy, we combine several different datasets. Firstly, we used the micro-data from Amadeus (Bureau van Dijk) to measure firm-level total factor productivity. Secondly, detailed trade flows and production data from Eurostat, supplemented by information from the FAO for the (agricultural) row material inputs, have been combined with the US input-output information from the US Bureau of Economic Analysis (BEA) to measure vertical import penetration. In what follows we describe in detail the different procedures.

2.1 Firm level total factor productivity

In order to estimate total factor productivity (TFP) at the firm level, we start by considering a standard Cobb-Douglas production function $Y_{it} = A_{it} L_{it}^{\beta_l} K_{it}^{\beta_k} M_{it}^{\beta_m}$, where Y_{it} is revenue-based output of firm *i* in the year *t*; L_{it}, K_{it} and M_{it} are, respectively, labour, capital and materials inputs, and β_l, β_k and β_m are the input coefficients to be estimated; finally A_{it} represents the total factor productivity.

A log-linearization of the production function yields $y_{it} = \beta_0 + \beta_l l_{it} + \beta_k k_{it} + \beta_m m_{it} + \eta_{it}$, with $lnA_{it} = \beta_0 + \eta_{it}$, where β_0 represents a measure of the mean efficiency level across firms and over time, and η_{it} is the time-firm-specific deviation from that mean. TFP is extracted from the above equation as a residual and, thus, the parameter of interest is the error term η_{it}.

To get a consistent estimator from the production function, η_{it} must be uncorrelated with the input variables. As it is well known, the use of OLS to estimate the production function would lead η_{it} to be correlated with the input variables, generating simultaneity biases (see Griliches and Mairesse 1995). For this reason, to measure consistent firm-level TFP we used the Levinsohn and Petrin (2003) approach.[5]

The method proposed by Levinsohn and Petrin (2003) (hereafter LP, for brevity), allows to obtain an unbiased estimation of the residual from a Cobb-Douglas production function, based on a semi-parametric estimation. According to this approach, the error term, η_{it}, is decomposed into two parts, $\eta_{it} = \varpi_{it} + \varepsilon_{it}$, with ϖ_{it} representing the transmitted productivity component and ε_{it} an error term that is uncorrelated with input choices. The key difference between the two components is that ϖ_{it} is a state variable that impacts the productivity shocks and is observed by the firm but not by the econometrician.

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[5] Another valuable method that allows overcoming this problem has been proposed by Olley and Pakes (1996). Although such method is conceptually similar to the one by Levinsohn and Petrin (2003), our choice fell to the latter, due to data limitation. Indeed, the Olley and Pakes (1996) method requires the use of investments as proxy for the productivity shocks, an information only partially covered in our firm-level data.

In order to overcome this limitation, LP propose an estimation approach that uses intermediate inputs as proxies for these unobservable shocks, relying on the consideration that intermediates may respond more smoothly to productivity shocks.[6] LP assume that the intermediate inputs demand function depends on the two firm's state variables, k_{it} and ϖ_{it}, $m_{it} = m_{it}(k_{it}, \omega_{it})$. Next, they show that by making mild assumptions on the firm's production technology, the demand function is monotonically increasing in ω_{it}. Thus, the intermediate inputs demand function can be inverted, so that ω_{it} results to be a function of m_{it} and k_{it}, namely $\omega_{it} = \omega_{it}(k_{it}, m_{it})$.

Accordingly, the term accounting for the unobservable productivity, ω_{it}, will be now expressed in terms of observed inputs, $\varpi_{it} = y_{it} - \hat{\beta}_k k_{it} - \hat{\beta}_l l_{it} - \hat{\beta}_m m_{it}$, where ϖ_{it} is the (log of) TFP. Productivity in levels can be obtained as the exponential of ϖ_{it}, i.e. $\Omega_{it} = \exp(\hat{\varpi}_{it})$.

In this paper we estimated firm-level TFP by using balance sheet data coming from the Bureau van Dijk Amadeus database. In particular, we collected data for food firms of two different countries that share similar characteristics in the food sector, Italy and France. The database contains balance sheet data for more than 36,000 food firms over the 2004-2012 period, classified at the NACE 4-digit industry level. In order to estimate a revenue-TFP with the LP method, we used the following variables: operating revenue (turnover) as output variable, labor cost, fixed assets and materials costs as input variables.[7] Before implementing the LP method separately for each of the two considered countries, we carried out an extensive data cleaning procedure. At this purpose, we firstly considered only those firms for which we have data for at least three consecutive years. Secondly, we drop firms reporting

[6] Among the different variables which could account for the use of intermediate inputs by the firms, LP suggest the use of materials or electricity costs.

[7] All the variables used in the TFP estimation have been deflated using national 2-digit industry deflators. Firms operating revenues have been deflated using the GDP price index from EUROSTAT, while for labor costs use was made of a labor cost deflator taken from the European Central Bank. For the intermediate inputs we used the intermediate input deflators from OECD and, finally, firms' capital stock has been deflated using the gross fixed capital formation deflator from EUROSTAT.

negative values for any of the considered variables in the TFP estimation. Finally, considering the same variables, in order to get rid of outliers, we drop firms with values falling below the 1st percentile and above the 99th percentile. With the same purpose, we computed the growth rates of each variable and dropped all firms reporting growth rates smaller than the 1st or greater than the 99th percentile of the relevant distribution. After these cleaning procedures, the final database contains balance sheet data for 25,315 firms (6,692 Italians and 18,623 French).

Table 1 reports some descriptive statistics of the variables used in the Cobb-Douglas production function and the estimated TFP with the LP procedure. Firm-level TFP has been estimated separately for the sample of Italian and French Food firms, and for each of the 10 NACE rev. 2 3-digit industries. As it emerges from summary statistics in Table 1, Italian food firms show, on average, higher TFP level with respect to the French ones. This result stems from the relatively higher representativeness of small firms (in terms of number of employees) in the French sample. As a results, since it is well known that small firms are characterized by lower TFP than the bigger ones, the average value of the French firms' TFP results to be lower than the Italian one.[8]

Moreover, Italian food firms display a positive TFP growth during the 2004-2012 period, equal to 0.5% per annum, an interesting result considering the concomitance of the global crisis and the trade collapse of 2008-2009. In addition, also as a reaction of the declining domestic food demand, the share of firms' revenue exported abroad and the number of exporting food firms increased in Italy (see ISTAT, 2014). By contrast in the French food industry we estimated a significantly reduction in the average totally factor productivity in the observed period (-3.1% per annum), that has been followed by an increasing rate of firms' bankrupt, starting in 2007-2008 and exacerbate in 2010. Moreover, French food firms

[8] This interpretation is corroborate by the pattern of the other variables presented in Table 1, where indeed the Italian food firms display an average higher value for all the variables considered (i.e. output, capital and material costs) with the exception of the labor cost, which is higher in the French sample.

experienced also an overall deterioration of the export performance (see Aleksanyany and Huibanz, 2014).

2.2 Estimating horizontal and vertical imports penetration

We construct the horizontal and vertical import penetration for the period 2003-2011 for each of the 33 food products reported in the manufacturing sector, using the NACE Rev.2 classification at the 4-digit level of disaggregation. Trade data are collected from Comext (Eurostat) according to the Combined Nomenclature (CN) 8-digit classification and distinguishing among five different groups of origin/destination countries.[9] The production data come from the Prodcom database made by Eurostat, following the Prodcom 8-digit classification, and from the FAO data for all the agricultural products not included into the Prodcom database, but strongly relevant for the analysis of food industry sectors.[10] Trade data and production data are both converted and aggregated at NACE 4-digit industry level using the correspondence tables.

The horizontal import penetration for each industry *z* in year *t* has been calculated as follows:

(1) $$h\_imp_{zt}^{g} = \frac{imp_{zt}^{g}}{prod_{zt} + imp_{zt}^{g} - exp_{zt}^{g}}$$

where imp_{zt}^{g} (exp_{zt}^{g}) are the imports (exports) from (to) the country group g (World or a specific country group) in industry *z* at time *t*, and $prod_{zt}$ is the production value of industry *z* in year *t*.

The vertical import penetration is a measure of the foreign presence in the industry *z* that is being supplied by sector *j*. Its calculation requires a more elaborated procedure and, following Acemoglu et al. (2014) and Altomonte et al. (2014), the *Backward* - or vertical - import

[9] The country groups are defined as follows: EU15 refers to the 14 European countries, with Belgium and Luxembourg reported as a single country; "Emerging" considers 21 emerging countries following the MSCI classification; NMS includes the 12 new Member States of the EU; OECD, considers 13 OECD countries not included in previous groups; "Other Countries" includes the remaining countries, mainly developing ones.
[10] Specifically, we include ten agricultural sectors, from NACE code 0111 to 0311.

penetration of industry z is defined as the weighted average of the import penetration of its inputs, according to the formula:

(2) $$v\_imp_{zt}^{g} = \sum_{j \in z} d_{jz} h\_imp_{jt}^{g*}$$

where d_{jz} is the weight of inputs used by industry z from industry j ($d_{jz}= use_{jz} / \sum_{j\in z} use_{jz}$) on the total inputs utilized by industry z, while $h\_imp_{jt}^{g*}$ is the import penetration of all inputs coming from industry j whose goods are used as inputs in the production processes of industry z. Thus, as in Altomonte, Barattieri and Rungi (2014), to calculate import penetration of intermediate inputs, starting from the databases previously described, we measure production and trade considering only those products that, at CN 8-digit and Prodcom 8-digit level, are classified as "intermediate" goods according to the Broad Economic – SNA Categories (BEC) classification.[11]

Finally, to construct the input-output weight (d_{jz}), namely the share of input from industry j in the production of industry z, we use the 2007 US Input-Output tables provided by the Bureau of Economic Analysis.[12] These Input-Output tables show how industries interact with each other at a highly disaggregated level, namely six-digit I-O industry codes, and provide detailed information on the flows of goods and services that comprise the production process of industries. To construct the (d_{jz}) weight, we employ the "Use table", which reports the value of inputs of commodity j used in the production of industry z.[13] Converted into the NACE classification, the final number of intermediate inputs involved in the 33 food NACE

[11] The BEC categories set out the distinctions of primary and processed goods, of capital, intermediate and consumption goods, and of durable, semidurable and non-durable consumer goods. The SNA (System of National Account) categories distinguish between intermediate, consumption and capital goods.

[12] The Bureau of Economic Analysis reports I-O tables with 389 BEA industry codes, of which 237 are in manufacturing and 13 in agriculture. Detailed data used to estimates the Industry Economic Accounts of the BEA come from 2007 Economic Census and are consequently available only for year 2007. BEA codes are connected with the North American Industry Classification System (NAICS) code structure, that is then converted to NACE codes.

[13] The "Use Table" shows the use of commodities by intermediate and final users. For example, for the bakery products industry, the table shows the amount (in dollars) of flour, eggs, yeast, and other inputs that are necessary to produce baked goods and the secondary products of the industry, such as flour mixes and frozen food. (data are available at the website http://www.bea.gov/industry/io_annual.htm).

4-digit industries, is equal to 94. Most of the inputs come from agricultural and food sectors, representing on average 70% of the inputs used in the food industry, with an almost equal partition between them, but with strong differences among industries.

Table 2 and Table 3 present simple descriptive statistics of horizontal and vertical import penetration, obtained distinguishing among trade partner groups and 3-digit industry aggregations, respectively.[14] During the observed period, the average measure of vertical import penetration was around 0.5 for both Italy and France. However, for Italian food firms the vertical dependency from abroad, other than increasing over time, is significantly higher than the horizontal import penetration. By contrast, for France the vertical index is decreasing across the observed period, and only slightly higher than the horizontal one. As discussed in the introduction, these patterns in vertical import penetration between Italy and France are especially due to differences in agricultural comparative advantage.

Among commercial partners, European Union countries represent the most important source of food industry inputs, generally followed by Emerging and OECD countries, although the largest positive changes in the vertical penetration ratio are always observed for the new Member States of the European Union. By contrast, the two import penetration indices, when measured with respect to the developing countries, are on average decreasing over time.

To have a snapshot of the variation in competition across industries and over time, Table 3 reports horizontal and vertical inputs penetration indices for each 3-digit food industries. As can be seen, there is a considerable variation across both industries and countries. It is worth noting that four out of eleven 3-digit sectors register, in both Italian and French markets, an horizontal import penetration above the mean (fish, fruit and vegetable, oils and tobacco), and that some sectors show a relevant increase in import competition, in particular oils, dairy, mill and bakery products. Moving to the vertical import penetration, changes are less pronounced,

[14] To save space, we do not display 4-digit industries information. However, this information is disposable from the authors upon request.

but the average value of the index is generally higher than the horizontal one. In Italy, where only fish and tobacco sectors have a vertical index that is lower than the horizontal one, the measure ranges from a maximum of 1 (meat), to a minimum of 0.1 (tobacco) and increases in many of the analyzed sectors and, in particular, in the manufacture of beverage, bakery, grains mill and starch products, and in meat products. Quite different is the French situation, where almost all sectors registered a decrease in the vertical import penetration that is particularly strong for dairy, fruit and vegetables and bakery products. The only exceptions are meat, fish and animal feed products, which show a weak increase in the observed period.

2.3. Identification strategy

To identify the firm-level productivity gains from importing intermediate inputs we use a reduced form approach, in the spirit of Amiti and Konings (2007), Altomonte et al. (2014) and many others.[15] We regress firm-level estimates of TFP on our indices of import penetration at industry and upstream sectors level, respectively. As recently argued by Bloom et al. (2014), this reduced form approach tends to be fully consistent with theory. Hence, we use the following empirical specification to relate horizontal and vertical import penetration to productivity (Altomonte, Barattieri and Rungi 2014):

$$y_{it} = \beta_0 + \beta_1 \log h\_imp_{zt-1}^{g} + \beta_2 \log v\_imp_{zt-1}^{g} + \alpha_i + \theta_t + \varepsilon_{izt}, \quad (3)$$

where y_{it} is the log of TFP of the firm *i* in year *t* and is regressed on the NACE 4-digit sectors lagged logs of horizontal and vertical import penetration, related to the geographic origins g. Moreover, α_i and θ_t are firm and time fixed effects, respectively, and ε_{izt} is an iid error term. By including firm (and time) fixed effects, equation (3) identifies the impact of import penetration variables on TFP by exploiting the within firm variation in productivity, hence

[15] The alternative is to follow a more structural approach, where the imported intermediate inputs are embedded directly in the estimation of the firm-level production function (see, e.g., Halpern et al. 2011). However, this approach needs direct information on the firm-level share of imported inputs, information that is missing in our dataset. Moreover, as recently discussed in Bloom et al. (2014), this apparently more structural approach is not exempt from problems.

controlling for time invariant observed and unobserved firm' level heterogeneity. Moreover, note that the import penetration variables enter the equation lagged one year, because we are assuming that a firm needs some time to adapt to the new situation, and to reduce the potential bias induced by a spurious correlation due to shocks simultaneously affecting imports and productivity.

A critical issue of our identification strategy is the endogeneity concerns due to both measurement errors, induced by the use of the US I-O tables to measure vertical import penetration, and by possible simultaneity bias between import penetration and TFP. Starting from the measurement error problem, as discussed in Ciccone and Papaioannou (2010), the properties of OLS estimations when the industry measure from one country is an imperfect proxy for the other countries, have two main sources of bias. One is a standard attenuation bias, according to which if there exists a random measurement error associated with the industry measure, then the estimated coefficient will be biased downward. A second bias can arise when the measure used is systematically a better proxy for certain countries, than others. They refer to this as an amplification bias. However, note that in our specific context this amplification bias should be nearly irrelevant, because the Italian and French food industries technologies tend to be very close with each other. For this reason the attenuation bias overwhelms the measurement errors problem, making our estimation of the vertical import penetration effect, if anything, biased downward.

Concerning the issue of the simultaneity bias, it is worth noting that when estimating equation (3) we regress firm-level TFP on industry (or upstream) import penetration, a situation that, at least partially, attenuates the endogeneity concerns. However, to account more formally for the potential endogeneity bias, as a robustness check we also estimate equation (3) in a dynamic fashion, by using the Arellano and Bond (1991) first difference GMM estimator, and by treating import penetration indices as endogenous.

2.4 Expectations

Our expectation from the estimation of equation (3) is that $\beta_1 > 0$ and $\beta_2 > 0$, meaning that an increase in both horizontal and vertical import penetrations, should translate into an increase in firm-level TFP, *ceteris paribus*. Moreover, we also should expect that $\beta_2 > \beta_1$, and thus that the magnitude of the effect of vertical import penetration on firms' TFP growth should be higher than the one of horizontal import penetration. The last expectation is in line with previous empirical evidence (e.g. Amiti and Konings 2007), and stems from the following theoretical considerations (see De Loecker, 2011; De Loecker and Goldberg 2014). Firstly, standard TFP measures include both information on firms "physical productivity" and "profitability".[16] In particular, the latter is strictly related to firms' prices and markup, as well as costs. Secondly, horizontal and vertical import penetrations have a different impact on both firms' marginal costs and markup.

To see this, consider a market characterized by monopolistic competition and linear demand as in De Loecker and Goldberg (2014), and note that horizontal import penetration involves product for the final consumption (*output*), while vertical import penetration involves intermediate goods (*input*). Panel A of Figure 1 presents the case of an *output* tariffs liberalization. The equilibrium in the domestic market is defined by the interaction of the marginal revenue curve mr_0 and the marginal cost mc_0, which leads firms to produce the quantity q_0 at the price p_0, and to get the markup η_0. After the output tariff liberalization, an increase in horizontal import penetration leads domestic firms to face a tougher competition. This leads the marginal revenue curve to move inward (mr_1). Assuming that the marginal cost remains constant, at the new equilibrium firms produce a lower quantity q_1 at a lower price p_1, which translates into a lower markup ($\eta_1 < \eta_0$).

[16] Indeed, when we allow for both output and input price variation across firms, as in standard monopolistic competition models, then the lack of firm-level (inputs/outputs) deflators makes the estimation of (physical) TFP very difficult. See De Loecker (2011) for an in-depth discussion.

Panel B of Figure 1 presents the case of *input* tariffs liberalization. In this case, an increase in imported intermediate inputs does not affect the competitive environment faced by domestic firms, and at the same time it leads to a reduction of input costs. As a consequence, the marginal cost curve shifts downwards (from mc_0 to mc_1). Thus, in the new situation firms produce a higher quantity (q_1) at a lower price (p_1), that however allows firms to have a higher markup ($\eta_1 > \eta_0$).

Since the TFP measure also captures some aspects related to the firm's profitability, the discussion above explains the reason why we expect that the estimated TFP elasticity to vertical import penetration should be, *ceteris paribus*, higher in magnitude that the TFP elasticity of horizontal import penetration.

Finally, and this is important, as shown by Goldberg et al. (2010), both theoretically and empirically, the reduction of input costs induced by input tariffs liberalization could be the result of two main mechanisms.[17] Firstly, a reduction of the average input price as an effect of tariffs liberalization. Secondly, the use of *new* imported inputs due to an expansion of imported varieties (increase of the extensive trade margin).[18] In the final section of this paper, to shed light on the importance of the two mechanisms, we propose a decomposition of the vertical import penetration effect in its intensive and extensive trade margin components.

3. Results

This section starts by discussing the main empirical results concerning the estimation of the relationship between outputs and inputs trade integration and firm-level TFP growth. Then it proposes some robustness check to test whether the endogeneity concern of trade integration indices affects our main results. Finally, in the subsequent Section 4 we propose a

[17] See Goldberg et al. (2010) for an in-depth discussion on this point, as well as subsequent Section 4.
[18] Note that, in the first case (input price reduction) we have only "static gain" from trade. By contrast, in the second case (expansion of imported varieties) there should be also "dynamic gain" for trade due to the expansion of new domestic products.

decomposition of the effect of imported intermediate inputs on TFP growth to study the main mechanisms at work.

3.1 Baseline Results

Table 4 reports the baseline results of the analysis performed by regressing the log of firm-level total factors productivity on our two indicators of horizontal and vertical import penetration, plus a full set of firm and time fixed effects.[19] In these regressions, we pooled together both French and Italian food firms, thus assuming that they are similarly affected by import penetration indices. Later, we will relax this assumption.

In column 1 the import penetration ratios refer to the World. The one year lagged horizontal import penetration positively affects productivity. However, although the coefficient is estimated with high precision (*p-value* < 0.01), the magnitude of the economic effect is quite small. Indeed, quantitatively, a 10% increase in import penetration will induce a TFP growth of only 0.07%, all other things being equal.[20]

Moving to the effect of vertical import penetration, its estimated coefficient also displays a statistically significant positive sign (*p-value* < 0.01). Thus, consistent with the expectations and previous evidence, an increase in imports in the upstream intermediate inputs contributes to firm level productivity growth. However, and interestingly, the economic effect of vertical import penetration is of one order of magnitude higher than the one of horizontal import penetration. A 10% increase in upstream integration would result in a 2.1% increase in productivity, *ceteris paribus*. This represents a large economic effect and its order of magnitude is similar to previous findings (see, e.g., Amiti and Konings, 2007). Thus, the results show that the productivity gains from increasing integration in upstream sectors are

[19] The Hausman test systematically identified fixed effect estimator as preferable to the alternative random effects estimator.

[20] Interestingly, running a specification that include only horizontal import penetration, the estimated coefficient doubles in magnitude, suggesting that omitting vertical import penetration from the model induces an omitted variable bias.

much higher than those from increasing integration in output, a finding that is consistent with the mechanism highlighted by De Loecker and Goldberg (2014) and summarized in Section 2.4, according to which an increase in vertical inputs penetration tends to translate to an increase of firms' markup.

The subsequent columns of Table 4 display the results obtained by considering import penetration indices measured for different trading partners. Firstly, considering import penetration coming from the EU15 countries (Column 2), once again more integration in both output and upstream sectors induced by the single market positively contributed to productivity gains. Here the main differences with respect to previous results are that the estimated effect of horizontal import penetration coming from the EU15 countries, as expected, is higher in magnitude, while the one of vertical import penetration is lower, but still about five times greater than the previous one. Very similar results are obtained when considering import penetration indices from Emerging countries (see column 3), but not from OECD (column 4). In the last case, horizontal import penetration significantly contributes to productivity growth, while the effect of vertical import penetration is negative, although the magnitude of the estimated coefficient, equal to −0.007, is very low.

In Column 5 the import penetration indices are evaluated considering the EU new member states as partners. Both horizontal and vertical import penetrations display a significant negative productivity growth effect. These results, especially considering vertical import penetration, are somewhat unexpected because one can argue that, for both French and Italian food firms, sourcing intermediate inputs from NMS could represent a way for reducing production costs.[21] We will come back later to the interpretation of this result. Finally, considering import penetration from the residual "Other Countries" group, mainly represented

[21] However, note that, if we consider the theory of effective protection (see Corden 1971), the integration of NMS in 2004 due to a reduction of inputs tariffs, *ceteris paribus*, increased the EU effective protection, and, thus by reducing import competition could led to lower productivity.

by developing countries, both indices have their expected positive effect on productivity growth (see column 6).

In Table 5, the effect of horizontal and vertical import penetrations is analyzed considering separated coefficients for French and Italian firms, in order to study in detail whether the patterns discussed above change for the two countries. Generally speaking, the overall pattern is quite similar, namely both indices tend to positively affect productivity, and import penetration in upstream sectors systematically exerts a stronger effect on both Italian and French food firms. However, some interesting differences emerge which are worth noting.

First, considering horizontal import penetration, the overall productivity growth effect is significantly positive for French firms, but only barely significant for Italian firms (10% level). The productivity growth of French firms results to be largely driven by horizontal competition coming from the EU15 and, especially, OECD countries. By contrast, Italian firms are affected especially by competition coming from emerging and NMS countries.

Second, moving to vertical import penetration, the productivity growth for French firms is, once again, largely and positively driven by intermediates inputs coming from the EU15 and emerging countries, but it is negatively affected by the growth of imported inputs coming from both the OECD and NMS countries. Considering Italian firms, they are considerably affected, besides the imports coming from EU15, by imports in intermediate inputs coming from emerging and NMS countries.

While with the data in hand it is difficult to understand the reasons at the root of these findings, factors related to differences in agricultural comparative advantage between the two countries could be at work here. Consider, for example, the opposite pattern of import competition coming from NMS countries. NMS vertical import penetration is significantly positive for Italian food firms, but significantly negative for French firms. How can we interpret these differences? One possibility is to look at the patterns of vertical integration indices reported in Table 2. For Italy, NMS vertical import penetration displays an average value of 19% and a growth rate in the 2003-2011 period of about 11% per year. By contrast, the same numbers for France are 11.5% and 3.5%. Thus, the Italian firms bought about twice as much material inputs from NMS as French firms, on average, and displayed a growth rate in the observed period that is three times higher. These are big differences that can be at the root of the contrasting evidence related to the impact of vertical integration from NMS.[22]

Finally, in Table 6 we ask to the data an important question: is the impact of horizontal and vertical import penetration conditional to the (initial) level of firms' productivity? Indeed, standard firm heterogeneity trade models predict that an increase in horizontal import competition should induce a market share reallocation from low- to high-productivity firms (see Melitz, 2003; Melitz and Ottaviano, 2008). A similar prediction, although based on a different mechanism, has been recently highlighted by Chevassus-Lozza et al. (2014) for trade liberalization in upstream sectors. These authors indeed showed that the output price elasticity of downstream firms, with respect to a change in input tariffs, increases with firms' productivity.

To test these predictions we run our baseline regression by interacting both horizontal and vertical integration indices with four dummies that identify the different quartiles of the TFP distribution, using the TFP sample distribution of the initial year to attenuate possible endogeneity bias.[23] The results are interesting and, for both import penetration indices, the magnitude of the TFP growth tends to be significantly higher for firms with higher initial level of productivity, *ceteris paribus* (see Table 6).[24] When considering horizontal import

[22] Note also that these differences are largely attributable to what happens in the processing/preserving meat (NACE 10.3) and manufacture of dairy (NACE 10.5) industries. Indeed, in these two important food sectors, vertical import penetration for Italy is, respectively, 100% and 73%, and for French is only 16.8% and 15.9% (see table 2).

[23] Because our panel is unbalanced, by using the initial year to identify the quartiles of the TFP distribution we lost about 25% of the observations.

[24] We conducted a battery of *F*-tests for assessing whether the estimated coefficients of horizontal and vertical import penetration reported in Table 6 are significantly different across the quartiles. These *F*-test reject the

penetration, the estimated effect for the lower quartile is negative, although insignificant, and it progressively increases as we move to the higher quartiles of TFP distribution. This pattern proves to be consistent with the prediction of Melitz-type firm heterogeneity models. The only unexpected result is the one related to the upper quartile, where the estimated TFP growth effect induced by horizontal import competition is not significantly different from the previous third quartile. Different reasons can justify this finding. For example, one can argue that more efficient firms, being often multinationals in nature, use a different strategy and, thus, they can be less affected by the increasing competitive environment (see Colantone et al. 2014).

Interestingly, the effect is even starker for vertical import penetration, where the estimated coefficients tend to grow progressively as we move from the lower to the upper quartiles of the TFP distribution. Here, the most efficient firms show a TFP growth effect induced by an increase in imported intermediate inputs that is 2.5 times stronger than the least efficient firms. However, it is important to stress that also less productive firms significantly benefit from trade liberalization in intermediate inputs. Taken together, these findings result to be interesting for different reasons. Firstly because they confirm that importer firms, which are concentrated in the upper tail of the distribution (see Bernard et al. 2012), gain proportionally more from trade liberalization in upstream sectors, a result fully consistent with the predictions of Chevassus-Lozza et al. (2014). Secondly, and perhaps more interestingly, these effects are also sizeable for the less efficient firms of the sample, suggesting that the benefits of having more competitive upstream sectors are spread also to firms that do not import directly.

equality of the coefficients in all cases but the one between the third and upper quartiles of horizontal import penetration. The outcomes of the tests are available upon request.

3.2 Robustness Check: Dynamic panel model

As discussed in the identification section, one potential shortcoming of the results discussed above is the possible simultaneity bias between TFP and import penetration indices. To investigate this issue, we now move to dynamic panel model using the Arellano and Bond (1991) first difference generalized method of moment (GMM) estimator.

The results from dynamic panel models are reported in Table 7. For comparative purpose, column (1) displays the regression (1) of Table 4. Column 2 reports the results from a dynamic fixed effects model, while in columns (3) and (4) are shown the results from a first difference GMM estimator. The only difference between the two GMM estimators is the lag structure used for the import penetration instruments: AB2 in column 3 starts from the second lag, while AB3 in column 4 from the third lag.

All the results from the dynamic panel models strongly confirm our previous findings, showing that simultaneity bias between import penetration and TFP does not seem to be a major problem of our static fixed effects results. Indeed, all the standards GMM endogeneity tests reported at the bottom of the table (AR2 and Hansen) are insignificant, suggesting that the GMM specifications do not suffer from serious correlation problems between the residual and the import penetration indices. Furthermore, when vertical import penetration is considered, we find a remarkable consistency across estimators of the magnitude of the estimated effect. For example, the long-run TFP elasticity of the LSDV, AB2 and AB3 estimators, equal respectively to 0.183, 0.264 and 0.199, are all rather close to the elasticity of the static model, which is equal to 0.213.[25] However, some differences in the GMM model lie in the magnitude of the estimated elasticity of horizontal import penetration, which is now significantly higher in comparison with the static model, suggesting that in this specific case

[25] Note that in the dynamic specifications reported in Table 7, the estimated import penetration coefficients are lower in magnitude, because they are measuring short-term elasticities. To obtain long-run elasticities comparable with the static specification reported in column 1, it is necessary to divide the estimated coefficient of import penetration for one minus the coefficient of the lagged depend variables.

endogeneity bias could be at work in the static model. Yet, the elasticity of the imported intermediate inputs is still about three times higher than the one of horizontal import penetration, thus giving a broad confirmation of our *a*-priory expectations.

4. Mechanism

In the previous sections we documented a strong positive effect of vertical import penetration on firms' TFP growth. Hence, a natural question arises, namely which kind of mechanisms are driving this result? As discussed in section 2.4, an increase of imported intermediate inputs due to trade integration reduces the firm-level marginal costs. However, this effect on one hand can be driven by a simple substitution effect between domestic and foreign inputs that are now cheaper. On the other hand, the effect could be the results of *new* imported inputs that increase the ability of firms to *upgrade* the existing products, or to produce completely new products. Which of the two effects prevails is of relevant importance because, in the first case it would lead mainly to "static gain" from trade, whereas in the second case also "dynamic gains" from trade would be at work (see Goldberg et al. 2010).

We try to shed light on the relevance of the two mechanisms in our analysis through a decomposition of the vertical import penetration index. Indeed, because the growth of imports reflects the action of two margins – namely the intensive and the extensive margins – we decomposed the vertical import penetration in these components. Considering the horizontal import penetration of each input, the first component includes only the CN 8-digit inputs imported both in the first and in all the other subsequent years. After aggregation through equation (2), we call this component *existing imported inputs* or *vertical intensive margin*. By contrast, the second component or *vertical extensive margin* is based on the aggregation through equation (2) of all the other imported input codes, mostly driven by *new imported inputs*, because very few products ceased to be imported over the analyzed period.

Table 8 reports summary statistics of the decomposition of vertical import penetration. As it is evident from the data, the two considered countries display a very different pattern. In Italy, the (level) average of trade integration in imported inputs (vertical input penetration), equals to 0.538, is due for the 60% to the extensive margin (0.32) and for the 40% to the intensive margin (0.22). In addition, considering the growth rate, the trade integration due to new input varieties (6.4% per annum) largely dominates the growth rate due to existing input varieties (2.2% per annum). Hence for Italy, the contribution of *new* imported inputs largely dominated the process of trade integration in the considered period.

In France the situation is in stark contrast. Indeed, first of all, we observe an overall *reduction* of trade integration due to imported intermediate inputs. Secondly, considering the period average, the contribution to vertical integration due to *existing* imported inputs largely dominates the one of *new* imported inputs, although the latter displays a better growth performance than the former.[26]

How do these overall patterns translate into estimated TFP growth elasticities? Being a "simple" decomposition of vertical import penetration, the econometric results considering the World as the partner, should follow quite closely the summary statistics discussed above. In fact, as emerge from the econometric results reported in Table 9, in the case of France the positive TFP growth effect of vertical import penetration is largely dominated by the contribution of existing imported inputs, although the new imported inputs display a positive and significant elasticity. In this regard, note that the overall (positive) TFP growth effect of new imported inputs for French firms, is driven by the positive correlation between a strong *reduction* in new imported inputs from the "Other countries" group (see footnote 25) and the *negative* TFP growth rate. In fact, and quite surprisingly, the relationship between TFP

[26] Indeed, note that in France the negative growth rate in the extensive margin of vertical import penetration is totally driven by an extraordinary drop of imported input lines coming from the "Other countries" group (-34%), hence from least developing countries. By contrast, the growth of new input varieties is systematically positive when considering the other sources, such as NMS (18.4%), OECD (4.2%), Emerging (0.21%) or the EU15 (1.47%).

growth and the increase of new imported inputs from the other origins (EU15, Emerging, OECDs and NMSs) is systematically negative and significant.

By contrast, in the case of Italy the econometric results show that, overall, what matters is the effect of new imported inputs, while the existing imported inputs display an insignificant negative effect on TFP growth. Note moreover that, the magnitude of the new imported inputs elasticity for Italian food firms is 2.5 times higher than the one for French firms, and that it is mainly driven by new imported inputs coming from the NMSs and the EU15.

What does all this mean? One way of interpreting these findings is that the adaptation of the food firms in the two countries to the new market conditions has been quite different. Contrary to French food firms, the Italian ones exploited the new opportunities offered by the trade integration especially with the EU new member states, by expanding their domestic product scope and product upgrading, exploiting the introduction of new imported varieties.

It is beyond the scope of the present study to understand the different behavior of Italian vs. France food firms. However, it could be interesting to note that the aforementioned differences in agricultural comparative advantage between France and Italy, exacerbated by the food price shocks and the trade collapse induced by the global crisis (Curzi et al. 2013), could be at work here.

5. Discussion and conclusions

Our results strongly support the idea that an increase in a firms' exposure to international trade leads to a growth of firms' productivity. This view emerged from the recent theoretical models of international trade allowing for firm heterogeneity (e.g. Melitz, 2003; Bernard et al., 2003), and has been supported by a number of empirical studies, which have found that trade liberalization in intermediate inputs significantly contributes to firm productivity growth, particularly in developing countries (Amiti and Konings 2007; Halpern, Koren and

Szeidl, 2011; Kasahara and Rodrigue 2008; Topalova and Khandelwal 2011; Goldberg et al. 2010).

This paper, by exploiting the US I-O table to measure a consistent index of vertical import penetration for the French and Italian food sectors, contributes to the existing literature by showing that the productivity growth effect of upstream trade liberalization holds true for the food industry, and significantly overcomes a similar effect induced by horizontal import competition. In particular, we find that trade liberalization in intermediate inputs induces a productivity growth effect that is from three to five times stronger (depending on the specification) than import competition coming from the same industry. In addition, we find that *new* imported inputs are of particular importance especially for Italian food firms, but less so for the French ones, where the effect of imported inputs seems to work mainly through the growth of the intensive trade margin. Furthermore, and consistently with theory, we also showed that the magnitude of the TFP growth effect is increasing with the initial level of firms' productivity.

These findings have important implications for the EU trade policy. In fact, if the objective of European institutions is to spur productivity growth in the food industry, further trade liberalization, in particular in the upstream sectors, would be a potential valuable strategy. In addition, our analysis shows that not all imports affect all firms to the same extent. This provides useful elements for tailoring public policies to the real needs of heterogeneous firms, in such a way that the adjustment to globalization can be accommodated efficiently.

Yet, in evaluating these policy implications some caveats are in order. This is because this article focused exclusively on the positive side effects of trade liberalization (TFP growth), disregarding the adjustment costs related to the possible (un-)employment effects. Indeed, the findings of asymmetric growth effects of trade liberalization on firms of different size and productivity calls for a careful investigation of the employment effects. This could be done, for example, along the line of the recent literature that focused on the US labor markets (see Autor, Dorn and Hanson, 2013; Acemoglu et al. 2014).

Finally, our approach, in addition to the US I-O relations, is based on detailed trade and production information. Because similar data are normally available for many countries, a similar approach can be applied in order to carefully study the effects of trade integration and imported inputs on other (developed) countries. Moreover, although our approach presents some advantages in comparison to the use of firm-level inputs trade data, the use in addition of firm-level information may shed new light in the comprehension of the mechanisms at work, an issue only partially addressed in the present paper. For example, by matching firm-level data with custom information on imported inputs and exported outputs, both by sources and destinations, our understanding of food firms' behavior in the international markets could significantly increase.

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Table 1. Descriptive Statistics Relative to TFP

	All			Italy			France		
	Obs	Mean	Std. Dev.	Obs	Mean	Std. Dev.	Obs	Mean	Std. Dev.
(ln) TFP	129,454	3.26	0.91	36,050	4.23	0.89	93,404	2.88	0.58
Avg TFP growth	129,454	-2.2%	0.3	36,050	0.5%	0.38	93,404	-3.2%	0.26
(ln) Output	129,454	6.73	1.41	36,050	7.58	1.19	93,404	6.4	1.35
(ln) L	129,454	5.34	1.14	36,050	5.26	1.06	93,404	5.38	1.17
(ln) K	129,454	5.32	1.51	36,050	6.12	1.43	93,404	5.02	1.43
(ln) Materials	129,454	5.81	1.69	36,050	6.99	1.37	93,404	5.35	1.57

Notes: Avg TFP growth refers to the average annual TFP growth in the covered period. TFP has been estimated separately for the Italian and French sample using the Levinsohn and Petrin (2003) method. The estimated coefficients of the Cobb-Douglas production function for the Italian sample are: 0.353 for Labor, 0.062 for Capital and 0.523 for Material costs (return to scale 0.94). The estimated coefficients for the French sample are: 0.389 for Labor, 0.069 for Capital and 0.549 for Material costs (return to scale 1). All the coefficients in the two samples are precisely estimated and significant at the 1% level.
Source: figures based on data described in the text.

Table 2. Horizontal and Vertical Import Penetration by Trade Partners

	Horizontal Import Penetration					
	Italy			France		
Country groups	Mean	Standard Dev.	Avg Annual Growth	Mean	Standard Dev.	Avg Annual Growth
World	0.324	0.278	0.30%	0.427	0.326	0.84%
EU 15	0.271	0.278	-0.47%	0.349	0.294	0.05%
Emerging	0.085	0.295	4.62%	0.042	0.113	5.18%
OECD	0.032	0.181	-4.59%	0.024	0.049	3.61%
NMS	0.026	0.143	18.83%	0.009	0.026	22.28%
Other Countries	0.026	0.143	-1.03%	0.009	0.026	-2.41%

	Vertical Import Penetration					
	Italy			France		
Country groups	Mean	Standard Dev.	Avg Annual Growth	Mean	Standard Dev.	Avg Annual Growth
World	0.538	0.246	4.65%	0.478	0.231	-2.20%
EU 15	0.422	0.238	2.94%	0.357	0.161	0.49%
Emerging	0.245	0.214	6.36%	0.151	0.133	-0.45%
OECD	0.178	0.171	-2.39%	0.310	0.310	-0.68%
NMS	0.188	0.179	4.33%	0.121	0.213	19.07%
Other Countries	0.088	0.172	-14.65%	0.044	0.094	-28.73%

Source: figures based on data described in the text. The mean and average growth rates of import penetration indices are measured over the period 2003-2011

Table 3. Horizontal and Vertical Import Penetration by NACE 3-digit Sectors

Horizontal Import Penetration		Italy			France		
NACE	Description	Mean	Standard Dev.	Avg Annual Growth	Mean	Standard Dev.	Avg Annual Growth
10.1	Processing and preserving of meat and production of meat products	0.168	0.171	1.37%	0.238	0.152	-1.22%
10.2	Processing and preserving of fish, crustaceans and molluscs	0.837	0.078	-2.50%	0.727	0.060	-1.84%
10.3	Processing and preserving of fruit and vegetables	0.409	0.142	-3.68%	0.857	0.359	0.87%
10.4	Manufacture of vegetable and animal oils and fats	0.499	0.210	3.16%	0.769	0.214	1.37%
10.5	Manufacture of dairy products	0.166	0.080	4.44%	0.184	0.051	2.63%
10.6	Manufacture of grain mill products, starches and starch products	0.257	0.169	8.92%	0.393	0.062	3.84%
10.7	Manufacture of bakery and farinaceous products	0.055	0.046	5.99%	0.224	0.141	5.94%
10.8	Manufacture of other food products	0.266	0.185	5.71%	0.421	0.282	-2.63%
10.9	Manufacture of prepared animal feeds	0.187	0.220	-3.50%	0.087	0.089	3.54%
11.0	Manufacture of beverages	0.305	0.354	-2.41%	0.290	0.241	1.96%
12.0	Manufacture of tobacco products	0.960	0.006	0.53%	0.988	0.156	4.61%

Vertical Import Penetration		Italy			France		
NACE	Description	Mean	Standard Dev.	Avg Annual Growth	Mean	Standard Dev.	Avg Annual Growth
10.1	Processing and preserving of meat and production of meat products	1.017	0.209	2.27%	0.168	0.061	0.65%
10.2	Processing and preserving of fish, crustaceans and molluscs	0.191	0.012	-1.00%	0.055	0.002	1.56%
10.3	Processing and preserving of fruit and vegetables	0.448	0.135	-0.18%	0.623	0.188	-2.22%
10.4	Manufacture of vegetable and animal oils and fats	0.911	0.026	0.65%	0.337	0.024	-1.14%
10.5	Manufacture of dairy products	0.735	0.013	-0.87%	0.159	0.014	-9.25%
10.6	Manufacture of grain mill products, starches and starch products	0.487	0.049	2.79%	0.566	0.064	-0.47%
10.7	Manufacture of bakery and farinaceous products	0.463	0.071	2.80%	0.638	0.104	-2.43%
10.8	Manufacture of other food products	0.447	0.169	2.76%	0.450	0.144	-1.40%
10.9	Manufacture of prepared animal feeds	0.666	0.147	0.45%	0.551	0.131	0.41%
11.0	Manufacture of beverages	0.364	0.136	4.06%	0.645	0.162	-0.34%
12.0	Manufacture of tobacco products	0.101	0.010	-1.79%	0.804	0.127	-0.68%

Source: figures based on data described in the text. The mean and average growth rates of import penetration indices are measured over the period 2003-2011

Table 4. Import Penetration and Productivity: Baseline Regression Results

Dependent variable: log of TFP	(1) World	(2) EU 15	(3) Emerging Countries	(4) OECD	(5) NMS	(6) Other Countries
Log Horizontal IP (t-1)	0.0073***	0.0233***	0.0142***	0.0238***	-0.0075***	0.0131***
	(0.0027)	(0.0028)	(0.0026)	(0.0030)	(0.0015)	(0.0011)
Log Vertical IP (t-1)	0.213***	0.104***	0.112***	-0.0073**	-0.0096***	0.0165***
	(0.0088)	(0.0068)	(0.0091)	(0.0034)	(0.0016)	(0.0015)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	129454	131025	131011	131014	131021	131000
R-square	0.922	0.921	0.921	0.921	0.921	0.921

Notes: Robust standard errors clustered at firm level under the coefficients; * p<0.1, ** p<0.05, *** p<0.01.

Source: figures based on data described in the text.

Table 5. Import Penetration and Productivity: Results Split by French and Italian Firms

Dependent variable: log of TFP	(1) World	(2) EU 15	(3) Emerging Countries	(4) OECD	(5) NMS	(6) Other Countries
Log Horizontal IP (t-1) FR	0.0068***	0.0265***	0.0010	0.0532***	-0.0149***	0.0113***
	(0.0025)	(0.0029)	(0.0028)	(0.0034)	(0.0016)	(0.0013)
Log Horizontal IP (t-1) IT	0.0285*	0.0221	0.0272***	-0.0079	0.0190***	0.0136***
	(0.0150)	(0.0158)	(0.0050)	(0.0054)	(0.0031)	(0.0020)
Log Vertical IP (t-1) FR	0.330***	0.153***	0.1270***	-0.0615***	-0.139***	0.0459***
	(0.0133)	(0.0099)	(0.0134)	(0.0067)	(0.0095)	(0.0020)
Log Vertical IP (t-1) IT	0.0622***	0.0413*	0.2990***	-0.0191***	0.0301***	0.0034
	(0.0177)	(0.0221)	(0.0235)	(0.0069)	(0.0073)	(0.0095)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	129454	131025	131011	131014	131021	131000
R-squared	0.923	0.921	0.921	0.921	0.921	0.921

Notes: Robust standard errors clustered at firm level under the coefficients; * p<0.1, ** p<0.05, *** p<0.01.

Source: figures based on data described in the text.

Table 6. Import Penetration and Productivity: Results Split by Initial Level of TFP

Dependent variable: Log of TFP	Horizontal	Vertical
Log IP (t-1) first quartile of TFP	-0.0012	0.128***
	(0.0030)	(0.0142)
Log IP (t-1) second quartile of TFP	0.0133***	0.163***
	(0.0043)	(0.0127)
Log IP (t-1) third quartile of TFP	0.0196***	0.227***
	(0.0062)	(0.0128)
Log IP (t-1) fourth quartile of TFP	0.0209**	0.325***
	(0.0097)	(0.0190)
Firm FE	Yes	
Time FE	Yes	
Observations	98221	
R-squared	0.918	

Notes: Robust standard errors clustered at firm level under the coefficients; * $p<0.1$, ** $p<0.05$, *** $p<0.01$.

Source: figures based on data described in the text.

Table 7. Robustness Checks: Dynamic Panel Model

	(1)	(2)	(3)	(4)
	Static	Dynamic panel model		
	Fixed effects	LSDV	AB2	AB3
Log Horizontal IP (t-1)	0.0073***	0.009***	0.040***	0.042***
	(0.00266)	(0.0022)	(0.00696)	(0.00763)
Log Vertical IP (t-1)	0.213***	0.102***	0.152***	0.122***
	(0.00878)	(0.0075)	(0.0220)	(0.0349)
Log TFP (t-1)		0.444***	0.424***	0.387***
		(0.0059)	(0.0362)	(0.0374)
AR1 (p-value)			0.084	0.086
AR2 (p-value)			0.372	0.394
Hansen Test (p-value)			0.179	0.191
Observations	129454	129454	104802	104802

Notes: Column 1 reproduces the results reported in Column (1) of Table 4; Column 2 reports results based on a last square with dummy (LSDV) variables dynamic panel model; Columns 3-4 report dynamic panel First difference GMM two-step estimator implemented in STATA, using the xtabond2 routine; lagged dependent variable instrumented with its $t-2$ and longer lags levels; import penetration indices instrumented with their $t-2$ ($t-3$) and longer lags levels in the AB2 (AB3) columns, respectively; Year fixed effects are included in each regression; Windmeijer-corrected cluster-robust standard errors in parentheses; *, ** and *** indicate statistical significance at 10, 5 and 1 percent level, respectively.

Source: figures based on data described in the text.

Table 8. Decomposition of Vertical IP in its extensive and intensive trade margins

	Italy			*France*		
	Mean	Standard Dev.	Annual Growth	Mean	Standard Dev.	Annual Growth
Vertical Import Penetration	0.538	0.246	4.65%	0.478	0.231	-2.20%
due to:						
New imported inputs	0.320	0.192	6.44%	0.166	0.125	-1.73%
Existing imported inputs	0.224	0.115	2.33%	0.337	0.172	-3.94%

Notes: The table reports a decomposition of vertical import penetration in its extensive (new imported inputs) and intensive (existing imported inputs) trade margins. The intensive margin is defined as the volume of imported inputs due to tariff lines always present in the considered period. The remaining trade volume is considered as the extensive margin, and thus it represents the net contribution of new and cessed imported varieties. By definition, the sum of the contribution of the intensive and the extensive margins equals total trade. In our specific case, however, we lose the mathematical identity due to aggregation problems when computing the import penetration using equation (2).

Source: figures based on data described in the text.

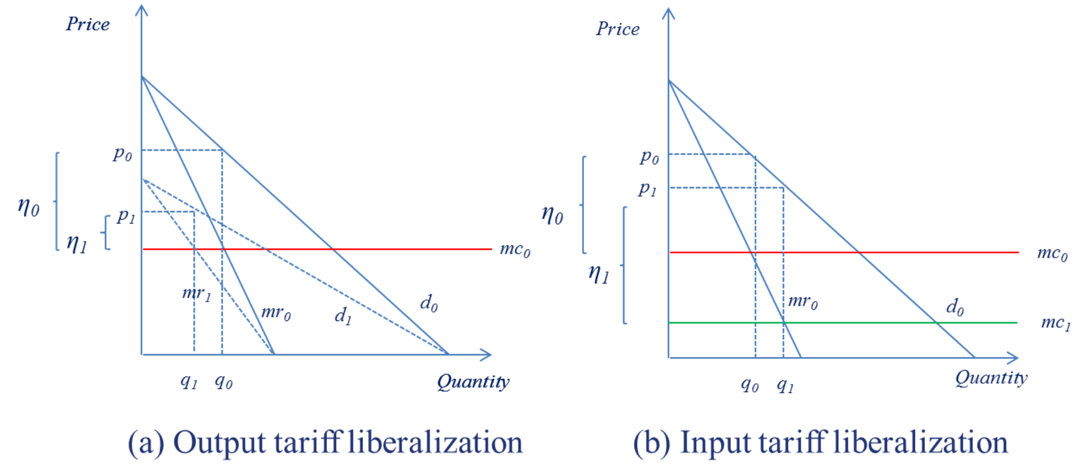
Table 9. Decomposition of Vertical Import Penetration (IP) effects on firm level TFP growth

Dependent variable: log of TFP	(1) World	(2) EU 15	(3) Emerging Countries	(4) OECD	(5) NMS	(6) Other Countries
Log Horizontal IP (t-1) FR	0.0199***	0.0292***	0.0072**	0.0678***	-0.0164***	0.0118***
	(0.0034)	(0.0029)	(0.0033)	(0.0038)	(0.0016)	(0.0014)
Log Horizontal IP (t-1) IT	0.0246*	0.0219	0.0240***	0.0005	0.0199***	0.0145***
	(0.0147)	(0.0159)	(0.0050)	(0.0055)	(0.0031)	(0.0021)
Log Vertical IP (t-1) FR due to:						
Existing imported inputs	0.287***	0.162***	0.0703***	0.0528***	-0.0595***	0.0058***
	(0.0143)	(0.0142)	(0.0095)	(0.0044)	(0.0073)	(0.0021)
New imported inputs	0.0260**	-0.0383***	-0.0078	-0.0726***	-0.0978***	0.0375***
	(0.0126)	(0.0111)	(0.0086)	(0.0036)	(0.0087)	(0.0024)
Log Vertical IP (t-1) IT due to:						
Existing imported inputs	-0.0289	0.0134	0.265***	0.0698***	-0.103***	-0.0009
	(0.0224)	(0.0177)	(0.0187)	(0.0064)	(0.0088)	(0.0109)
New imported inputs	0.0665***	0.0304*	0.0088	-0.0724***	0.0883***	0.0124*
	(0.0176)	(0.0171)	(0.0117)	(0.0089)	(0.0073)	(0.0072)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	129454	131025	131011	131014	131021	131000
R-squared	0.923	0.921	0.921	0.921	0.921	0.921

Notes: The table reports the TFP growth effects of vertical import penetration split in its extensive (new imported inputs) and intensive (existing imported inputs) trade margins. The intensive margin is defined as the volume of imported inputs due to tariff lines always present in the considered period. The remaining trade volume is considered as the extensive margin, and thus it represents the net contribution of new and cessed imported varieties. Robust standard errors clustered at firm level under the coefficients; * p<0.1, ** p<0.05, *** p<0.01.

Source: figures based on data described in the text.

Figure 1. Effect of output and input tariffs liberalization on firms' markup



Source: adapted from De Loecker and Goldberg (2014)