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Effets pro-concurrentiels du commerce international sur les prix, la productivité et les marges : cas de la zone euro

Résumé

Le commerce mondial a récemment ralenti après avoir atteint un pic dans les années 1990 et au début des années 2000. D'après la littérature existante, la mondialisation a des effets pro-concurrentiels sur les prix, la productivité et les marges des entreprises. L'objectif de ce papier est de mesurer si ces effets pro-concurrentiels sont encore observés dans le secteur manufacturier de cinq pays de la zone euro (Autriche, Allemagne, Espagne, France et Italie). Notre analyse repose sur le cadre théorique de Melitz et Ottaviano (2008) et son application empirique par Chen et al. (2004, 2009). Notre contribution est double. Premièrement, nous utilisons à la fois des indicateurs du commerce traditionnels (importations et exportations brutes et en valeur ajoutée) mais aussi des indicateurs novateurs prenant en compte l'essor des chaînes de valeur mondiale. Deuxièmement, nous analysons les effets du commerce au niveau sectoriel. Nous trouvons que les effets pro-concurrentiels sont plus fortement mis en évidence lorsque la pénétration des importations est mesurée en valeur ajoutée et ces effets sont particulièrement marqués dans les secteurs où la concentration des entreprises est faible. Ce dernier résultat semble indiquer que la concurrence induite par le commerce est atténuée dans les secteur à forte concentration. Toutefois, notre modèle ne prend en compte que la concurrence par les prix et des recherches supplémentaires sur l'amélioration de la qualité pourraient compléter nos résultats.

Mots-clés : inflation, marges des entreprises, productivité, concurrence, mondialisation

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Pro-competitive effects of globalisation on prices, productivity and markups: Evidence in the Euro Area

Abstract

Global trade has recently slowed down after a peak in the 1990s and early 2000s. Existing literature shows evidence of pro-competitive effects of trade liberalisation during this booming period on prices, productivity and markups. The goal of this paper is to assess whether such pro-competitive effects are still carried on in the manufacturing industry of five Euro Area countries (Austria, Germany, Spain, France and Italy). Our analysis is based on Melitz and Ottaviano's (2008) theoretical framework and its empirical setup by Chen et al. (2004, 2009). Our contribution is twofold. First, we use traditional trade indicators (gross and value added exports and imports) but also novel indicators that account for the development of global value chains. Second, from the findings of Chen et al. (2004, 2009), we go further by investigating the effect of trade at sector level with respect to quality upgrading and firm concentration. We find that pro-competitive effects are more significant when using import penetration in value-added terms and such effects are particularly strong in sectors with low concentration. Indeed, higher concentration seems to mitigate the trade-induced competition. However, our model focuses on price competition and further research on the quality upgrading would be complementary to our results.

Keywords: inflation, markups, productivity, competition, globalisation

Classification JEL : E31, F12, F14, L11, L16

Contents

1 Introduction

Global trade has recently slowed down after a peak in the 1990s and early 2000s. Existing literature shows evidence of pro-competitive effects of trade liberalisation during this booming period on prices, productivity and markups. As mentioned in Bernard *et al.* (2012), it is generally admitted that trade liberalisation can induce welfare gain with a broader range of product varieties ("taster for variety"), reallocation of resources with the exit of low-productivity firms and direct pro-competitive effects on markups lowering the price level and so forth.

The goal of this paper is to assess whether such pro-competitive effects of trade are still carried on in manufacturing sectors of five countries of the Euro Area (Austria, France, Germany, Italy and Spain), while focusing on sector heterogeneity. Our analysis builds on Melitz and Ottaviano (2008) theoretical model of heterogeneous firms' response to international trade and its empirical setup by Chen *et al.* (2004, 2009). Chen *et al.* (2004, 2009) estimate the model of Melitz and Ottaviano (2008) at the sector-level and present the short- and long-run dynamics of production price level, markups (price-cost margins) and labour productivity over the period 1989-1999 and for seven European countries. In a similar way, through sector-level data on prices, markups, productivity, the number of domestically producing firms and the market size, we assess the pro-competitive effects of trade openness, as measured by import penetration in domestic markets. Our data cover eight manufacturing industries in our selected Euro Area countries over the period 1995-2014, which allows us to control for the Great Recession.

Our main findings are that the trade-induced pro-competitive effect is variable across sectors. When significant, in most cases, trade liberalisation, measured by import penetration, is negatively correlated with price and markups and positively correlated with labour productivity, in line with the theoretical predictions of the Melitz and Ottaviano (2008) model.

The novelty of our paper is threefold. First, we carry out a sector-by-sector analysis to shed light on sectors in which trade induces tougher competition in the context of globalisation. Higher competition would crowd out firms that are not productive enough and thus would increase average productivity while lowering prices and markups. Second, unlike the existing papers on the same subject, we consider developments of the global value chains (GVC), by measuring trade in value added terms and GVC participation. Since gross trade flows are recorded each time they cross borders, they include re-exported imports and re-imported exports and can hence overstate the size of the degree of openness (here, measured by the import penetration). In addition, the measures of global value chain has enabled a thorough analysis of the international trade since traditional measures of trade are unable to take into account the full interdependence of markets and economies.

The remainder of this paper is as follows. Section 2 provides a review of the related literature. Section 3 presents the theoretical framework leading to the empirical model in section 4. Section 5 introduces preliminary investigation with descriptive analysis, while section 6 provides the empirical results comparing estimations using gross import penetration ratio to the estimation using value added import penetration ratio. After a brief robustnes check, section 7 concludes.

2 Review of literature

Traditional international trade theories such as Ricardo or Hecksher-Ohlin models mainly focus on inter-industry trade based on heterogeneous characteristics across countries and homogeneous productivity across firms. With the idea of the "taste for variety" and monopolistic competition *à la* Dixit and Stiglitz (1977), Krugman (1980) introduced the new trade theory based on intra-industry trade. Instead of considering national comparative advantage, industries become the determining actors of trade. In a seminal paper, Melitz (2003) builds the so-called "new-new trade theory" according to which, micro-based firm heterogeneity influences and determines the aggregate outcome. Melitz and Ottaviano (2008) further develop this approach with firm-level productivity heterogeneity. The model provides evidence for a minority of highly productive firms (and not industries) exporting to the foreign markets, less productive firms supplying to the domestic market and crowding-out of the least productive firms.

Chen *et al.* (2004, 2009) propose an estimable version of a reduced form of the Melitz and Ottaviano (2008) model at the country level. The 2004 version uses a simultaneous equations system to assess the pro-competitive effects of increased import penetration (as a measure of trade openness) and the 2009 version an error correction model to distinguish between short run dynamics and long run equilibrium. Increased trade openness implies more varieties and larger market size. The increase in the number of firms induces a tougher competition which has two effects. First, markups decrease since the model gets closer to the perfect competition situation. Second, higher competition leads to the leaving of the least productive firms and increases average productivity. Both effects would contribute to a decline of the prices.

However, Chen *et al.* (2004, 2009) overlook the effect of product quality. Higher competition can encourage firms to invest in research and development in order to improve the product quality, as a "defensive innovation" strategy (Acemoglu, 2003). Indeed, on French manufacturing firm-level data, Bellone *et al.* (2014) provide evidence that markups are higher for exporters and quality-enhancing effect can be more relevant than price-lowering effect within the globalisation. Also, Aghion *et al.* (2005) and Aghion *et al.* (2006) highlight that firms can adopt two strategies when facing a higher competition: the "escape-competition" strategy for products close to the frontier, based on the quality-upgrading in order to compete with potential new entrants, and the "appropriability" strategy for products that became so common that firms are discouraged to invest in quality and prefer to compete on prices.

Concerning the effect of globalisation on productivity, Mcmillan *et al.* (2014) show that globalisation improves the way resources are used: labour can move from low-productivity sectors to high-productivity ones and enhance allocation efficiency. Furthermore, as GVC developed over the last decades, firms can also choose to specialise in specific tasks and participate to a specific stage of the production process. For instance, they can move upstream to provide intermediate products or downstream to assemble intermediate products. They can also choose to import intermediate products to assemble and produce domestically, or import final products to address domestic demand. Kasahara and Lapham (2013) and Kasahara and Rodrigue (2008) highlight the effect on productivity of intermediate imports specialisation. Since a country can specialise in the most productive stage of the production process, it can then enhance productivity.

3 Theoretical framework

Our theoretical framework stems from Melitz and Ottaviano (2008) who develop a monopolistically competitive model of trade which link prices, productivity and markups to market size and trade. Their model also distinguishes short-run from long-run dynamics. Before introducing our empirical framework, we present here the key features of the Melitz and Ottaviano (2008) theoretical model to lay ground for the steps leading to our empirical setup. More specifically we present here how prices are directly related to markups and productivity and how these three variables are linked to the number of firms supplying the market and to trade costs. The model presents two economies (domestic and foreign). Foreign variables are marked with an asterisk (*).

3.1 Consumer behaviour

Consumer preferences are assumed to be identical across all countries. For a representative consumer, indexed by i, the utility from consumption is derived from a quasi-linear preferences over a numeraire good and a continuum of varieties indexed by ω and given by:

$$U^i(q_0^i, (q_\omega^i)_{\omega\in\Omega}) = q_0^i + \alpha \int_{\omega\in\Omega} q_\omega^i d\omega - \frac{1}{2}\gamma \int_{\omega\in\Omega} (q_\omega^i)^2 d\omega - \frac{1}{2}\eta \left(\int_{\omega\in\Omega} q_\omega^i d\omega \right)^2 \tag{1}$$

where q_0^i and q_ω^i represent the agent's consumption level of the numeraire good and of each variety ω respectively. The demand parameters α, η and γ are all positive. The parameter γ measures the degree of product differentiation between the varieties ω. For $\gamma = 0$, varieties are perfect substitutes and consumers only care about their consumption level $Q^i = \int_{\omega\in\Omega} q_\omega^i d\omega$.

Inverted demand is determined by solving the consumer's problem, which is given by:

$$\max_{q_0^i, \{q_\omega^i\}_{\omega\in\Omega}} \quad U^i(q_0^i, (q_\omega^i)_{\omega\in\Omega}) \text{ subject to}$$

$$q_0^i + \int_{\omega\in\Omega} p_\omega q_\omega^i d\omega \leq R^i$$

where R^i is the total revenue and p_ω is the price of variety ω.

Solving the consumer's problem leads to: $\gamma q_\omega^i = \alpha - p_\omega - \eta Q^i$. In the limit case where $\gamma = 0$, the aggregate quantity of varieties supplied to the market only depend on the price. By defining the aggregate price index, $\overline{p} = \frac{1}{N} \int_{\omega\in\Omega} p_\omega d\omega$, aggregate consumption for a consumer i can be defined: $Q^i = \frac{\alpha - \overline{p}N}{\gamma + \eta N}$ where N is the number of firms supplying to the domestic market. Demand for variety ω remains positive as long as $p_\omega \leq \frac{1}{\gamma+\eta N}(\alpha\gamma + \eta N \overline{p}) = p_{\max}$, where $p_{\max}$ represents the price at which there is no demand for variety ω.

Summing over all consumers, whose size is given by L, gives total demand in the home country for variety ω as:

$$Q_\omega = Lq_\omega^i = \frac{\alpha L}{\gamma + \eta N} - \frac{L}{\gamma} p_\omega + \frac{1}{\gamma} \frac{\eta N L}{\gamma + \eta N} \overline{p} = \frac{L}{\gamma}(p_{\max} - p_\omega) \tag{2}$$

Demand for each variety is linear in prices but unlike the traditional monopolistically competitive setup *à la* Dixit and Stiglitz (1977), the price elasticity of demand increasingly depends on the number of firms, so of varieties, in the sector (N), which is a feature introduced in Ottaviano *et al.* (2002).

3.2 Firm behaviour

Labour is the only factor of production with a unit cost c (linear production technology) and is perfectly mobile domestically between firms, but not across countries. International wage differences are therefore possible[1]. As a result, the variation in unit production costs across firms in a sector solely stems from technological reasons, *i.e.* differences in labour productivity across firms. In contrast, unit production costs vary across countries due to differences in both

[1] Our estimation is carried out on at the sector level. In this regard, wages are differentiated at the sector level.

wages and technology. Each firm produces at marginal cost c (equal to the firm's unit labour cost).

Domestic firms can sell to the domestic market or export with *ad-valorem* cost $\tau^* > 1$ (also called "iceberg costs"), reflecting transportation costs or tariffs determined in the foreign economy. As a result, production for exports has unit cost $\tau^* c$. Transportation costs for foreign goods entering the domestic economy are symmetrically denoted by τ. Firms' entry decisions entail a fixed cost f_E, which firms have to pay to establish production in whichever economy.

Since our sample includes only Euro Area countries that mainly trade with each other and are submitted to the same trade regulations, we assume trade costs are symmetric, *i.e.* $\tau = \tau^*$.Assuming domestic and foreign markets are segmented and firms use a linear production technology, they separately maximise its profits across countries (domestic profit $\Pi_D(c)$ and foreign profit $\Pi_X(c)$) which are given by:

$$\Pi_D(c) = (p_D(c) - c)q_D(c) \tag{3}$$
$$\Pi_X(c) = (p_X(c) - \tau c)q_X(c) \tag{4}$$

Profit maximisation problems are given by:

$$\max_{p_D(c),\, q_D(c)} \Pi_D(c) = (p_D(c) - c)q_D(c) \text{ subject to } q_D(c) = \frac{L}{\gamma}(p_{\max} - p_D(c)) \tag{5}$$
$$\max_{p_X(c),\, q_X(c)} \Pi_X(c) = (p_X(c) - \tau c)q_X(c) \text{ subject to } q_X(c) = \frac{L^*}{\gamma}(p^*_{\max} - p_X(c^*)) \tag{6}$$

Firms maximise profits based on the demand for the variety derived in the previous section (equation 2). This yields:

$$q_D(c) = \frac{L}{2\gamma}[p_D(c) - c] \quad \text{and} \quad p_D(c) = \frac{1}{2}(p_{\max} + c)$$
$$q_X(c) = \frac{L^*}{2\gamma}[p_X(c) - \tau c] \text{ and } p_X(c) = \frac{1}{2}(p^*_{\max} + \tau c)$$

From these equations, there exists a cut-off cost c_D which expresses the threshold such that domestic firms with $0 \le c < c_D$ produce to supply to the domestic market whereas domestic firms with $c > c_D$ stop producing and leave the domestic market. At the optimum, $c_D = p_{\max}$ and $p_D(c_D) = c_D$. Likewise the cut-off cost for domestic firms exporting in the foreign economy is $c_X = \frac{c^*_D}{\tau} = \frac{p^*_{\max}}{\tau}$. Trade barriers make it more difficult for exporters to break even relative to domestic producers and to verify zero-profit conditions compared to domestic producers. Due to trade costs, firms have to choose how much to produce for domestic markets and how much for export.

To obtain closed form expressions for the key variables, the inverse of costs, $1/c$, in domestic (resp. foreign) economy is assumed to follow a Pareto distribution with cumulative distribution function $G(c) = \left(\frac{c}{c_M}\right)^k$ (resp. $G^*(c) = \left(\frac{c}{c^*_M}\right)^k$), with k a parameter measuring the dispersion of cost draws and $c \in [0, c_M]$ (resp. $c \in [0, c^*_M]$). In this setup, $1/c_M$ represents the lower bound of productivity in the domestic economy. To allow for cross-country productivity differences, we extend the model so that the upper bound for costs differs across countries, *i.e.* $c_M \neq c^*_M$. By comparing c_M and c^*_M, the domestic economy displays either relatively low cost (high productivity) or high cost (low productivity), compared to the foreign economy.

Assuming N_E (resp. N_E^*) firms located, in the sense of producing, in the domestic (resp. foreign) economy, the Pareto assumption simplifies the expressions for the average cost $\bar{c}$ for all firms producing in the domestic economy and the resulting aggregate price index $\bar{p}$, given by:

$$\bar{c} = \frac{1}{N_E G(c_D) + N_E^* G^*(\frac{c_D}{\tau})} \left(N_E \int_0^{c_D} c dG(c) + N_E^* \int_0^{\frac{c_D}{\tau}} c dG^*(c) \right) = \frac{k}{k+1} c_D \tag{7}$$

$$\bar{p} = \frac{1}{N_E G(c_D) + N_E^* G^*(\frac{c_D}{\tau})} \left(N_E \int_0^{c_D} p(c) dG(c) + N_E^* \int_0^{\frac{c_D}{\tau}} p(c) dG^*(c) \right) = \frac{2k+1}{2(k+1)} c_D \tag{8}$$

Moreover, unit costs only depend on wages and on labour productivity and average labour productivity is thus given by:

$$\bar{z} = \frac{w}{\bar{c}} = \frac{k+1}{k} \frac{w}{c_D} \tag{9}$$

where w denotes the nominal wage[2] in the domestic economy. With markups for domestic sales equal to $\mu_\omega = p_\omega - c_\omega$, average markups in the domestic economy are:

$$\bar{\mu} = \bar{p} - \bar{c} = \frac{1}{2(k+1)} c_D \tag{10}$$

From equations (8), (9) and (10), price, markup and labour productivity are related to the marginal cost c_D:

$$\begin{cases} \bar{p} = \frac{2k+1}{2(k+1)} c_D \\ \bar{z} = \frac{k+1}{k} \frac{w}{c_D} \\ \bar{\mu} = \frac{1}{2(k+1)} c_D \end{cases}$$

From the consumer behaviour, $p_{\max} = \frac{1}{\gamma + \eta N} (\alpha\gamma + \eta N \bar{p})$ and using the equation $p_{\max} = c_D$, we obtain :

$$N = \frac{2\gamma(k+1)}{\eta} \left(\frac{\alpha}{c_D} - 1 \right) \tag{11}$$

The previous equation shows a decreasing relationship between N and c_D. An increase in c_D implies an increase in $p_{\max}$, which is related to lower aggregated demand Q^i and lower number of varieties. This characterises the demand side of the economy.

We now introduce Melitz and Ottaviano (2008) approach to distinguish short-term effects from long-term ones and thus explain dynamic effects of trade liberalisation.

3.3 Short run implications

In the short run, firm location is assumed to be fixed and the number of firms located in each economy is also constant, with $\overline{N}_{SR}$ (resp. $\overline{N}^*_{SR}$) firms in the domestic (resp. foreign) economy. More precisely, $\overline{N}_{SR}$ and $\overline{N}^*_{SR}$ denote the total number of firms that can potentially produce or not within the economy. The decision is whether to produce or not and which markets to supply based on the zero-profit condition. The number of firms supplying to the domestic market is then given by :

[2] Our estimation is done at the sector level and we take the nominal sectoral wage, assuming that wages are equal within the same sector.

$$N = \underbrace{\overline{N}_{SR} G(c_D)}_{\text{Domestic firms supplying to the domestic market}} + \underbrace{\overline{N}^*_{SR} G^*\left(\frac{c_D}{\tau}\right)}_{\text{Foreign firms supplying to the domestic market}}$$

Using Pareto distribution, the previous equation gives :

$$N = \left(\frac{\overline{N}_{SR}}{c_M^k} + \frac{1}{\tau^k} \frac{\overline{N}^*_{SR}}{(c_M^*)^k} \right) c_D^k \tag{12}$$

The previous equation, derived from the firm's decision, shows an increasing relationship between N and c_D. The larger the level of cut-off costs c_D, the larger the number of firms supplying to the domestic economy.

Equations (12) and (11) show that in the short run, the number of firms supplying to the domestic economy N and the cut-off cost c_D depend on the trade costs τ, the productivity upper bounds c_M and c_M^* and the number of firms located in both countries N_{SR} and N_{SR}^*. More precisely, a decrease in trade costs τ affects firms' production decisions by reducing the cut-off cost c_D and thus increasing the number of firms exporting in domestic economy. It results in lower average price $\overline{p}$, mark-up $\overline{\mu}$ and higher productivity $\overline{z}$, implying pro-competitive effects of globalisation.

3.4 Long run implications

In the long run, firms can decide to relocate elsewhere, and incur the fixed costs f_E or f_E^*. The number of firms located in each economy is determined by free entry and the zero profit condition:

$$\int_0^{c_D} \Pi_D(c) dG(c) + \int_0^{c_X} \Pi_X(c) dG(c) = f_E$$

$$\int_0^{c_D^*} \Pi_D^*(c) dG^*(c) + \int_0^{c_X^*} \Pi_X^*(c) dG^*(c) = f_E^*$$

avec $c_X = \frac{c_D^*}{\tau}$ et $c_X^* = \frac{c_D}{\tau}$.

Combining with $\Pi_D(c) = \frac{L}{4\gamma}(c_D - c)^2$ (resp. $\Pi_D^*(c) = \frac{L^*}{4\gamma}(c_D^* - c)^2$) and $\Pi_X(c) = \frac{L^*}{4\gamma}(c_D^* - \tau c)^2$ (resp. $\Pi_X^*(c) = \frac{L}{4\gamma}(c_D - \tau c)^2$), it is possible to solve the system of equations to obtain c_D as an expression of τ, c_M, c_M^*, f_E and L :

$$c_D^{k+2} = \frac{\phi}{L} \left[\frac{1 - (\tau\lambda)^{-k}}{1 - \tau^{-2k}} \right] \tag{13}$$

$$(c_D^*)^{k+2} = \frac{\phi^*}{L^*} \left[\frac{1 - (\tau\lambda^*)^{-k}}{1 - \tau^{-2k}} \right] \tag{14}$$

where $\phi = 2(k+1)(k+2)c_M^k f_E$ (resp. $\phi^* = 2(k+1)(k+2)c_M^k f_E^*$) and $\lambda = c_M/c_M^*$ (resp. $\lambda^* = c_M^*/c_M$). On the long run, c_D (resp. c_D^*) does not depend on N but on structural characteristics of domestic and foreign economies, that is the distribution of costs c_M (resp. c_M^*), the level of fixed costs

f_E , the market size L and trade costs τ.

Equation (11) derived from the consumer side is still valid to characterise the demand side of the economy:

$$N = \frac{2\gamma(k+1)}{\eta}\left(\frac{\alpha}{c_D} - 1\right) \tag{15}$$

$$N^* = \frac{2\gamma(k+1)}{\eta}\left(\frac{\alpha}{c_D^*} - 1\right) \tag{16}$$

Note that from equations (13), (14), (15) and (16), the number of firms producing in each economy in the long run is only determined by the characteristics of domestic and foreign economy, namely the market sizes (L and L^*) and trade costs (τ).

Given that f_E and f_E^* do not depend on trade costs and that trade costs are the same between regions ($\tau = \tau^*$), a fall in trade costs means that, for a firm located in the foreign economy (resp. domestic), it is less costly to export in the domestic (resp. foreign) economy. In the long run, it leads to an downward shift in cut-off costs c_D and c_D^*, and to a increase in N and N^*. It implies lower prices, lower markups and higher productivity, as in the short run.

Note that the endogenous long run equilibrium number of firms located in each country (N_{LR} and N_{LR}^*) can be determined by the following relations :

$$N = N_{LR}G(c_D) + N_{LR}^* G^*\left(\frac{c_D}{\tau}\right)$$

$$N^* = N_{LR}^* G^*(c_D^*) + N_{LR} G\left(\frac{c_D^*}{\tau}\right)$$

Using Pareto distribution, the previous equation gives N_{LR} and N_{LR}^* depending on N, N^*, c_D and c_D^*, that is on structural characteristics of both countries.

4 Empirical framework

In this section, we adapt the theoretical framework to more estimable models based on Chen *et al.* (2009). We first introduce and discuss assumptions used to make the theoretical model estimable.

4.1 Empirical setup

As highlighted in Chen *et al.* (2009), trade costs τ are key variables characterising the trade liberalisation. However, since reliable estimates of trade costs are difficult to obtain at the country or sectoral level, like in Chen *et al.* (2009), we use the import penetration ratio as a measure of openness since, in our theoretical framework, import penetration can simply be expressed in terms of trade costs. Import penetration is defined as the weight of imports in total domestic demand :

$$\theta = \frac{\int_0^{c_X^*} p_X^*(c) q_X^*(c) dG^*(c)}{\int_0^{c_D} p_D(c) q_D(c) dG(c) + \int_0^{c_X^*} p_X^*(c) q_X^*(c) dG^*(c)}$$

Since $p_D(c)q_D(c) = \frac{L}{4\gamma}(c_D^2 - c^2)$, $p_X^*(c)q_X^*(c) = \frac{L}{4\gamma}(c_D^2 - \tau^2 c^2)$ and $c_X^* = \frac{c_D}{\tau}$, under the Pareto distribution, it implies:

$$\tau^k = \frac{1-\theta}{\theta}\left(\frac{c_M}{c_M^*}\right)^k \tag{17}$$

This expression highlights that trade costs can be approximated by the import penetration, assuming $\frac{c_M}{c_M^*}$ does not change over time. Import penetration increases with the fall in trade costs applied to imports and with relative domestic costs.

4.2 Empirical model

Following the theoretical framework and following Chen *et al.* (2009), we estimate equations of production prices, labour productivity and markups as an error correction model separately, which enables to distinguish between short run and long run pro-competitive effects of trade liberalisation. The estimation is implemented at the industry level of the manufacturing sector and on a panel of five Euro area countries (Austria, France, Germany, Italy and Spain. We test unit root of our individual series and using Fisher test, we find that main key variables such as relative prices, productivity, markups and openness contain unit root. The non-stationarity supports the use of the error correction model.

First, all nominal variables are deflated by the overall inflation in order to clean the effect of pure monetary inflation. Chen *et al.* (2009) used the monetary base to clean the pure monetary inflation trend but as our scope of countries cover a few Eurozone countries, monetary base data per country was not available. In this regard, for the price measure, we use the relative price defined as industry-level price divided by overall manufacturing price. By doing so, we do analyse the deviation from the overall trend.

Second, long run relations are derived from a log-differentiation form of equations (11), from the long run relation between c_D and the structural characteristics of the economy and from the previous relation between trade costs and domestic openness. Long run relations thus include domestic market size (measured by domestic gross domestic product), domestic openness and, as for the productivity equation is concerned, real wages. Moreover, since $\frac{c_M}{c_M^*}$ represents relative upper bounds for unit production costs between countries, its evolution may capture technological progress from domestic country relatively to the other: since our geographic sample is focused on large economies of the Euro area, $\frac{c_M}{c_M^*}$ can be assumed constant. This assumes that the dynamics of technological progress is rather homogeneous across countries[3].

Third, short run relations are also derived from a log-differentiation form of equations (11), given the short run equilibrium between c_D and N. They namely include the number of firms in the domestic industry and the domestic openness.

The effect of trade on our three variables of interest is thus assessed through the following equations, for the country i, the industry j and the year t:

[3]The CompNet data enable to plot the evolution for the last decile of the productivity and indeed, the dynamics is rather stable over time

$$\Delta \ln p_{ijt} = \alpha_0^p + \alpha_1^p \Delta \ln \theta_{ijt} + \alpha_2^p \Delta \ln D_{ijt} + \beta \left[\ln p_{ijt-1} + \gamma_0^p + \gamma_1^p \ln \theta_{ijt-1} + \gamma_3 \ln L_{it-1} \right] + \varepsilon_{ijt}^p$$
$$\Delta \ln z_{ijt} = \alpha_0^z + \alpha_1^z \Delta \ln \theta_{ijt} + \alpha_2^z \Delta \ln D_{ijt} + \beta^z \left[\ln z_{ijt-1} + \gamma_0^z + \gamma_1^z \ln \theta_{ijt-1} + \gamma_3^z \ln L_{it-1} + \gamma_4^z \ln w_{ijt-1} \right] + \epsilon_{ijt}^z$$
$$\Delta \ln \mu_{ijt} = \alpha_0^\mu + \alpha_1^\mu \Delta \ln \theta_{ijt} + \alpha_2^\mu \Delta \ln D_{ijt} + \beta^\mu \left[\ln \mu_{ijt-1} + \gamma_0^\mu + \gamma_1^\mu \ln \theta_{ijt-1} + \gamma_3^\mu \ln L_{it-1} \right] + \epsilon_{ijt}^\mu$$

where α_0^p, α_0^z and α_0^μ are the intercept, θ_{ijt} the import penetration in industry j of country i in year t, D_{ijt} the number of domestic firms, L_{it} is the gross domestic product of country i and w_{ijt} is the real remuneration level.

Country and industry fixed effects are also included given the panel aspect of our data. Finally, a dummy for the crisis period is added to account for the Great Recession[4].

4.3 Instrumenting openness

As underlined in Chen *et al.* (2004, 2009), approximating trade costs with openness in our empirical model also introduce endogeneity bias, since openness θ also depends on domestic factors. For instance, foreign countries can base their decision to export on domestic prices of their trade partners. If the latter experience increasing inflation, consumers can be more attracted to imported products. Likewise the relation between productivity and openness can also be ambiguous. Openness can increase productivity, while the most productive firms can choose to trade with foreign partners.

To address the endogeneity issue, we follow Chen *et al.* (2004, 2009) and chose a number of instruments to reflect trade liberalisation. We however focus on variables related to trade costs (*i.e.* transport an transaction costs), since we took openness as proxy of trade costs. To instrument openness, we use traditional tariff and non-tariff barrier variables as well as some competitiveness variables.

For tariff barriers, a bulkiness variable and apparent tariff rate are used. Bulkiness relates to the weight of imported goods, the underlying assumption being that the heavier they are, the more expensive their transport costs are (Hummels, 2001). Heavier goods would thus reduce incentives to import. Bulkiness is defined as the ratio of exports in value to exports in volume (weight in kg) for each sector. In order to wipe out potential endogeneity, we take the exports to US which are computed as the sum of the exports to US from the five countries in our sample minus those from the country of interest i. The formal expression is given as follows:

$$\text{Bulkiness}_{ijt} = \frac{valX_{\text{US},jt} - valX_{\text{US},ijt}}{volX_{\text{US},jt} - volX_{\text{US},ijt}}$$

where i indexes country, j sector, t time period and $valX_{\text{US}}$ and $volX_{\text{US}}$ designate respectively the exports in value and in weight (kg).

Since our database contains Euro area countries, same tariff rates apply for all the imports. In order to assess the impact of trade liberalisation, Ahn *et al.* (2016) have built an effective tariff rate. In a similar way, import-weighted tariff rates are computed at the sector level using the following formula, for country i, industry j and time t:

$$\tilde{T}_{ijt} = \frac{T_{EU,jt} m_{ijt}}{m_{it}}$$

[4] The period chosen to account for the crisis is 2008 - 2009 and it may seem arbitrary. However, this choice is robust to one or two extra years around this period.

where $T_{EU,jt}$ designates the European Union tariff rate and m_{ijt} import from non EU partners of country i in industry j in current value at time t.

The effective tariff rate can be seen as a proxy for the degree of protection of the domestic suppliers. It is thus expected to be negatively correlated to import penetration in final demand.

For non-tariff barrier, gravity variables are used. The gravity model of international trade provides an explanation for the empirically observed regularity of the trade flows. From the seminal contribution of Krugman (1980) to the theoretical and empirical explanation given by Chaney (2013), trade flows between two countries are proportional to the economic size (measured as gross value added) and inversely proportional to the distance separating these two countries. For a country i and an industry j, the following gravity variable is computed at time t:

$$G_{ijt} = \sum_{k \neq i} \frac{Y_{kjt}/Y_{kt}}{d_{ik}}$$

where d_{ik} is the distance between country i and country k, Y_{kjt} is the gross value added of industry j in country k and Y_{kt} is the total gross value added of country k.

Finally we add competitiveness variables since increased competitiveness can also increase import penetration. The real effective exchange rate (REER) is defined as a weighted average of bilateral exchange rates. Hence it reflects the value of a currency, as well as the trade structure of the country. It covers 67 countries (Darvas, 2012).

Following Martin and Mejean (2014), we include the Balassa index which measures revealed comparative advantage of a country i for a given industry j, by comparing the country i's export share for this industry to a reference area's export share for the same industry (the Euro area is chosen as reference area):

$$\text{Balassa}_{ij} = \frac{x_{ij}/X_i}{x_{aj}/X_a}$$

where x_{ij} (resp. x_{aj}) are the export in goods j from country i (resp. reference area a) and X_i (resp. X_a) are total exports from country i (resp. reference area a, *i.e.* Euro area).

In the IV estimation, the power and relevance of the instruments have to be tested. Stock and Yogo test the null hypothesis of the existence of weak instruments and Sargan test the null hypothesis that instruments are not correlated with the error terms. Our pooled estimation passes those two tests. At the sector level, our estimation passes the Sargan test in general but the results are mitigated for the Stock and Yogo test, implying that there might be some weak instruments. When regressing endogenous variables on the instruments, the latter explain 70% of variance and only some instruments are associated with insignificant coefficient. Given this, for the stability issue, we keep using the same instruments for the sector-level estimation as the pooled-sample estimation.

5 A preliminary investigation: descriptive analysis

5.1 Data processing

Our sample covers five Euro Area countries (Austria, France, Germany, Italy and Spain) and nine manufacturing sectors[5] over the period 1995-2014. Our country and sector selection is

[5]See Table 9 in Appendix A.1

based on data availability [6]. Those five selected countries represent 61% of the GDP of European Union and around 85% of the GDP of the Euro area. We combine data from Eurostat, OECD, World Input-Output Database (WIOD) and from the Bank for the Accounts of Companies Harmonized (BACH) databases (see Table 8 in Appendix A.1 for further details on our dataset.

Domestic data at sectoral level. For our price data, we use annual average of producer price index in manufacturing industry for domestic market. It measures the average price development of all goods and related services resulting from that activity and sold on the domestic market. Labour productivity is measured as the ratio of value added in volume to total employment (employees and self-employed), as provided by Eurostat national accounts. For the number of active domestic firms we use data provided by Eurostat Structural Business Survey (SBS) .

To compute markups, we use the Bank for the Accounts of Companies Harmonized (BACH) database which gathers harmonized economic and financial information of non-financial enterprises by size class and business sector[7]. The main drawback of BACH concerns national representativeness. The selected companies in the BACH database represent neither a complete survey nor a statistically representative sample. Some countries have administrative databases that cover the entire population of non-financial corporations. Nonetheless for most countries, subsets of the total population are available and large companies are generally over represented[8].

Markups are usually measured with Lerner index, defined as the difference between price and marginal costs divided by price. But since marginal costs are hard to observe, based on the BACH database and Chen *et al.* (2009) approach, we define markups using information on total variable costs only (*i.e.* cost of goods sold, materials and consumables plus staff costs):

$$\mu_{ijt} = \left[\frac{\text{unit price}}{\text{unit variable costs}}\right]_{ijt} = \left[\frac{\text{turnover}}{\text{total variable costs}}\right]_{ijt}$$

for country i, industry j and time t. $turnover$ and total variable costs are both weighted average of the firm-level data.

Trade data We use two indicators for openness: gross and value added import penetration in domestic final demand For gross import penetration, we use data from Eurostat and OECD STAN Bilateral Trade Database in goods. Gross import penetration is defined as the ratio of total imports relative to the total production dedicated to the domestic market, *i.e.* the sum of imports and sector output net of exports.

For the value added import penetration, we use WIOD Input-Output Tables 2016 edition and 2013 editions for pre-2000 data. Value added import penetration is computed as the content of foreign value added in the domestic final demand, based on Stehrer (2012) method

[6] At the country-level, the main constraint is the country coverage of BACH database. At the sector-level, the main constraint is the availability of producer prices for disaggregated manufacturing sectors. Sector data are in NACE Rev.2 (See A.2 for further details on converting sector data defined in other classificaiton into NACE Rev.2)

[7] It covers eleven European countries : Austria, Belgium, Czech Republic, France, Germany, Italy, the Netherlands, Poland, Portugal, Slovak Republic and Spain. Denmark, Luxembourg, Romania and Turkey are expected to join the BACH database in the coming years.

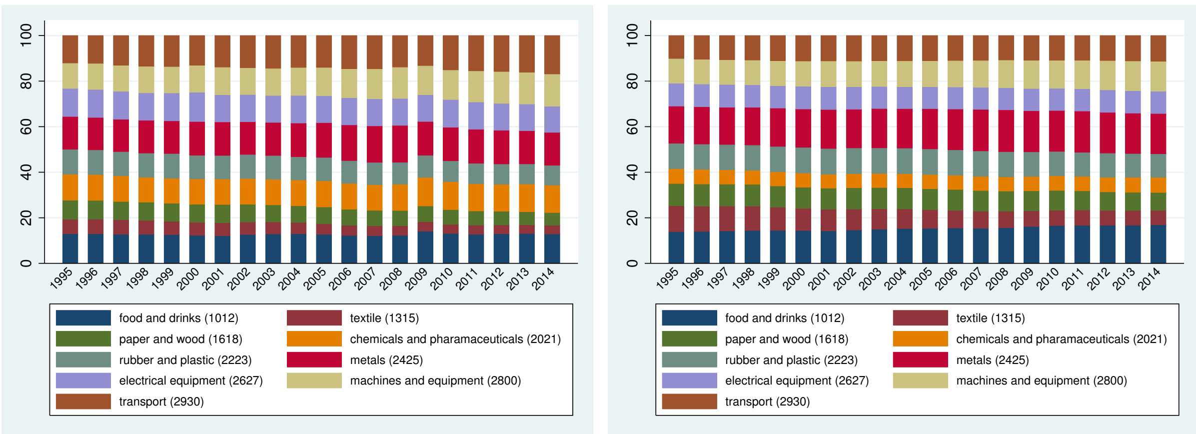
[8] In the case of Italy, the entire population of non-financial corporations is well covered in the manufacturing sector.

[8] BACH provides sector data at the 2-digit level. For our nine aggregated sectors, $turnover$ and total variable costs are computed as simple sums of the sector data at the 2-digit level.

(see Appendix C for a more detailed presentation). Measurements in value added terms avoid double-counting intermediates in gross trade flows and overstating the size of trade openness, especially when the production process is fragmented in international supply chains. Hence, using a value added import penetration indicator is more consistent with pro-competitive effects of trade openness as identified in our theoretical framework. Moreover, value added trade flows account for the inter-dependencies between the production in one country and its consumption in another country. They retrace where income is generated and where it is spent Flaig *et al.* (2018) and then more accurately account import penetration.

5.2 Sectoral dynamics

Before addressing the estimation, some stylised facts are presented to point out the sectoral heterogeneity of the nine manufacturing industries considered, in terms of value added and employment dynamics and in terms of variables of interest.



(a) VA (b) Employment

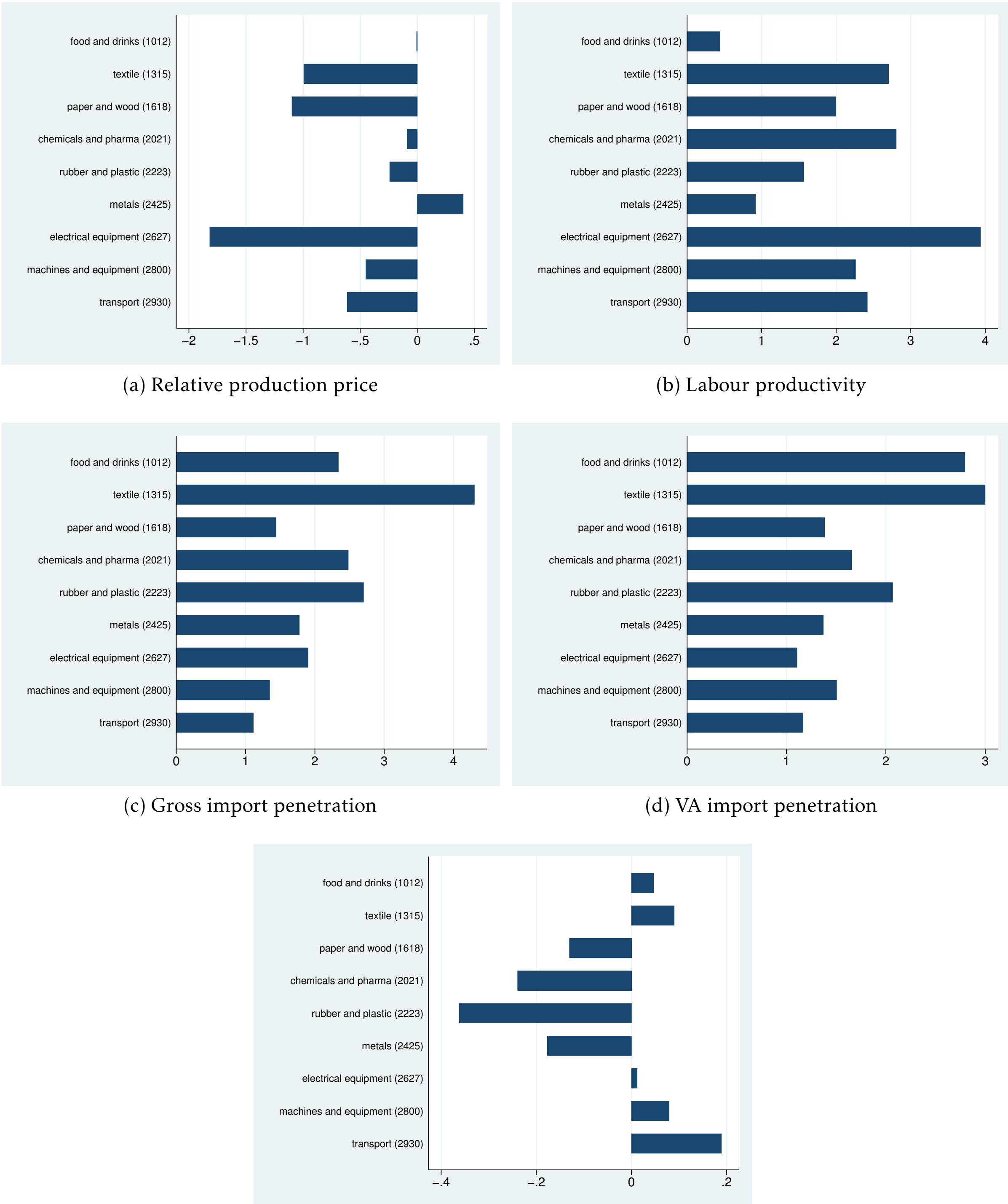
Figure 1: Dynamics of sectoral shares per industry over time

Figure 1 displays the shares of manufacturing sectors from 1995 to 2014 in terms of value added and employment[9]. In general, the sectoral shares remain rather stable over time. Nevertheless, the share of the sectors of textile (1315), wood and paper (1618) and rubber and plastic (2223) have decreased over the period 1995-2014 whereas the shares of the sectors of chemicals and pharmaceuticals (2021) and vehicles and transport (2930) have most increased.

Information on the relative shares of sectors can be interesting when studying the competitive effect. Indeed, a declining sector may be related to trade openness differently. For instance, some sectors can be regarded as strategic sectors and be subsidised by the state, which may cancel out or mitigate productivity gains or crowding out of less productive firms. Bacila (2010) highlights that state aid can be used to intervene in industries in crisis so as to mitigate the adjustment process that may be too fast. Although Eastern European countries are not included in our sample, Hashi *et al.* (2005) find that microeconomic policies to subsidise firms can have major impacts on the sectoral dynamics.

[9]The shares are computed after summing up the variable (in current value) over the set of countries.

5.3 Trends analysis



(a) Relative production price

(b) Labour productivity

(c) Gross import penetration

(d) VA import penetration

(e) Markups

Figure 2: Time trends (controlled for country fixed effects)
Note: The variable of interest is regressed over time trend and the coefficient is reported.

As far as the long-term dynamics of our key variables is concerned, Figure 2 displays the coefficient obtained by regressing key variables on a time trend for the period 1995-2014, while controlling for country fixed effects. The result can be interpreted as a long term time trend and, by using all the information available during the sample period, is more robust to the start and end date.

Relative production price has most decreased in the sectors of textile (1315), wood and paper (1618), electrical equipment (2627) and vehicles and transport (2930) while it has increased in the sector of metals (2425). Labour productivity has significantly increased in all sectors. The growth has been the highest in the sectors of electrical equipment (2627), textile (1315), chemicals and pharmaceuticals (2021), vehicles and transport (2930) and has been much more moderate in the sectors of food and drinks and metals.

Gross import penetrations has increased over time. The dynamics is similar in terms of VA import penetration, with some differences across industries: reflecting a more and more fragmented production process, increase in openness is higher for the sector of foods and drinks (1012) measured in terms of value added, whereas it is slightly lower for the sectors of metals (2425) and electrical equipment (2627).

Finally, markups are characterised by globally but differentiated decreasing dynamics. The decrease is the strongest in the sector of rubber and plastic (2223) followed by chemicals and pharmaceuticals (2021), metals (2425) and wood and paper. Conversely, markups have been increasing in the sectors of food and drinks (1012), textile (1315), electrical equipment (2627) and vehicles and transport (2930). In textile (1315) and vehicles and transport (2930), the decrease in markups joined to the increase in prices may result from a composition effect, surviving firms being characterised by higher markups due to their comparative advantages.

6 Estimation

In this section, we first carry out estimation on the pooled sample (with country-sector-year dimensions) to assess short and long run effects of trade openness, in line with Melitz and Ottaviano (2008) theoretical framework. However, as highlighted in the previous section, sectoral heterogeneity is high so we opt for a sector-by-sector approach. Then, we try to go further than Melitz and Ottaviano (2008) and Chen *et al.* (2009) by putting in perspective additional drivers such as sector concentration and product quality to explain small or the lack of competitive effects of globalisation in some sectors. Finally we include robustness checks to alternate measures of trade openness and labour productivity.

6.1 Baseline results

6.1.1 Pooled sample

In the first place, the estimation is carried out with the pooled sample, as in Chen *et al.* (2009). Estimation with gross import penetration (OLS and IV) yields results globally similar to those of Chen *et al.* (2009) with expected short run effects on productivity and markups, *i.e.* positive for the productivity and negative for the markups (Table 1). When using the VA import penetration in the pooled sample regression, the results are improved in the short run.

As expected and found in Chen *et al.* (2009), trade is negatively and significantly correlated with prices. The effects on productivity and markups are preserved. Instrumentation does not seem to change significantly the results even though the magnitude of coefficients is higher. With both indicators, no matter OLS or IV, the effect of trade openness in the long run is unclear. While it is never significant for productivity, it is significant in the instrumented specification of trade for markups and in the instrumented specification of gross trade for price. These long-run effects are nevertheless small in comparison to the short-run effects. We then pursue our investigation by focusing on the sectoral heterogeneity.

Table 1: Pooled sample regression

	(1)	(2)	(3)	(4)
Dependent variable: Price $\Delta \ln ppi_{it}$				
$\Delta \ln \theta_{it}$	0.01	-0.11***	-0.05***	-0.13***
	(0.02)	(0.03)	(0.02)	(0.04)
$\Delta \ln D_{it}$	0.01	0.00	0.01	0.00
	(0.01)	(0.01)	(0.01)	(0.01)
$\ln \frac{\text{PPI}_{it-1}}{\text{PPItot}_{t-1}}$	-0.13***	-0.14***	-0.13***	-0.13***
	(0.02)	(0.02)	(0.02)	(0.02)
$\ln \theta_{it-1}$	-0.01	-0.02**	0.00	-0.01
	(0.01)	(0.01)	(0.01)	(0.01)
$\ln L_{it-1}$	-0.04***	-0.04***	-0.05***	-0.05***
	(0.01)	(0.01)	(0.01)	(0.01)
crisis	0.01***	0.01***	0.01***	0.01***
	(0.00)	(0.00)	(0.00)	(0.00)
Observations	769	769	769	769
$Within R^2$	0.11	0.04	0.12	0.10
Dependent variable: Productivity $\Delta \ln z_{it}$				
$\Delta \ln \theta_{it}$	0.09**	0.34***	0.18***	0.46***
	(0.04)	(0.08)	(0.05)	(0.10)
$\Delta \ln D_{it}$	0.02	0.04	0.01	0.02
	(0.03)	(0.03)	(0.03)	(0.03)
$\ln z_{t-1}$	-0.18***	-0.18***	-0.18***	-0.17***
	(0.02)	(0.02)	(0.02)	(0.02)
$\ln \theta_{it-1}$	0.01	0.04	-0.00	0.03
	(0.02)	(0.02)	(0.02)	(0.03)
$\ln L_{it-1}$	0.24***	0.23***	0.25***	0.24***
	(0.04)	(0.04)	(0.04)	(0.04)
$\ln \frac{w_{it-1}}{\text{PPI}_{it-1}}$	-0.05**	-0.04	-0.06***	-0.05**
	(0.02)	(0.02)	(0.02)	(0.02)
crisis	-0.08***	-0.08***	-0.08***	-0.07***
	(0.01)	(0.01)	(0.01)	(0.01)
Observations	769	769	769	769
$Within R^2$	0.28	0.24	0.29	0.26
Dependent variable: Markup $\Delta \ln \mu_{it}$				
$\Delta \ln \theta_{it}$	-0.04***	-0.08***	-0.10***	-0.12***
	(0.01)	(0.03)	(0.02)	(0.03)
$\Delta \ln D_{it}$	-0.01	-0.01	-0.00	-0.01
	(0.01)	(0.01)	(0.01)	(0.01)
$\ln \mu_{it-1}$	-0.28***	-0.29***	-0.28***	-0.28***
	(0.02)	(0.02)	(0.02)	(0.02)
$\ln \theta_{it-1}$	-0.01	-0.01*	-0.02***	-0.02***
	(0.01)	(0.01)	(0.01)	(0.01)
$\ln L_{it-1}$	-0.00	-0.00	0.00	0.01
	(0.01)	(0.01)	(0.01)	(0.01)
crisis	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Observations	810	810	810	810
$Within R^2$	0.16	0.16	0.20	0.19
Import indicator	gross	gross	VA	VA
Specification	OLS	IV	OLS	IV
Country x sect. fixed eff.	yes	yes	yes	yes

Note: Standard errors in parentheses. *, ** and *** denote statistical significance at the 10%, 5% and 1% levels.

6.1.2 Sector-by-sector approach

In this section, the estimation is carried out at the sector level. Using the gross import penetration as a measure of trade openness, its effect on key variables is less clear as regards the mechanism described in theory (Table 2). As for prices, the short run coefficient of openness is negative and significant only in the sectors of food and drinks (1012), textile (1315), rubber (2223) and machinery (2800) while the coefficient is positive and significant for the sector of metals (2425). In the long run, its openness is negatively correlated to prices in the sectors of wood and paper (1618) and electrical equipments (2627).

As for productivity, when significant, openness is positively correlated in the sectors of wood and paper (1618), rubber (2223), metals (2425) and electrical equipment (2627) in the short run. In the long run, it is positively correlated to productivity in the sector of wood and paper (1618).

As for markups, when significant, the coefficients of openness are negative, namely in the sectors of wood and paper (1618) and, only in the short run, in food and drinks (1012) and metals (2425), and in the long run only in machinery (2800). Surprisingly, the effect of the crisis dummy is not observable for the markups.

On the whole, the empirical evidence for the theoretical mechanism is weak when using the gross import penetration ratio. After investigation, the related literature on global value chains seems to provide a part of the answer to this result. Traditional measures of imports and exports can be potentially biased with the double counting issues of re-exported goods since they are recorded each and every time they cross borders. Hence, gross statistics can overstate their importance to the real demand and supply for the goods.

Estimation with VA import penetration has the advantage to better account for the real production process. Recent development in globalisation implies an increase in the interconnections across countries. One country's imports may already contain some value added that is created within the same importing country. This measurement issue can be addressed by measuring value added or in simple terms, the contribution of each country to the production of the good. As a matter of fact, the results of estimation are highly improved when using the import penetration measured in value added.

Table 3 displays a clearer effect of the VA import penetration on key variables. When significant, the sign of the coefficients in most cases corresponds to the expected one. Openness seems to affect productivity positively and prices negatively in most sectors in the short run and, in a smaller extent, in the long run. Its effects on markups are less clear but, when significant, are negative both in the short run and in the long run. Conversely to Chen *et al.* (2009), there is no evidence of a reversal effect of trade liberalisation between the short and the long run. As highlighted in Baghli *et al.* (1998), ”economic long run” can differ from ”econometric long run”: given the short estimation period, the long-run relation derived from the theoretical economic model may not meet the estimated ”econometric long run”. In our framework, the lack of sign reversal between long run and short run coefficients may imply that ”long-run economic” implications of trade liberalisation needs more decades to be observed.

As for the prices, the effect of openness is significant in all sectors except those of wood and paper (1618), chemicals and pharmaceuticals (2021) and electrical equipment (2627). Sectors in which an increase in openness has no effect on the productivity are the sectors of food and drinks (1012), textile (1315), chemicals and pharmaceuticals (2021) and vehicles and transport (2930). Finally, sectors in which the effect on markups is significant and with the expected sign are the sectors of food and drinks (1012), wood and paper (1618), rubber and plastic (2223)

Table 2: Sectoral regression using gross import penetration

	1012 Food	1315 Textile	1618 Wood	2021 Chemicals	2223 Rubber	2425 Metals	2627 ICT	2800 Machinery	2930 Transport
Dependent variable: Price $\Delta \ln ppi_{it}$									
$\Delta \ln \theta_{it}$	-0.30***	-0.22*	-0.10	0.29	-0.12**	0.25***	-0.12	-0.16**	-0.07
	(0.08)	(0.12)	(0.09)	(0.20)	(0.06)	(0.07)	(0.09)	(0.07)	(0.08)
$\Delta \ln D_{it}$	-0.06*	0.00	-0.00	-0.01	0.01	0.08*	0.02	0.01	0.00
	(0.03)	(0.04)	(0.04)	(0.05)	(0.04)	(0.04)	(0.04)	(0.04)	(0.05)
$\ln \frac{\text{PPI}_{it-1}}{\text{PPItot}_{t-1}}$	-0.18**	-0.34***	-0.32***	-0.14*	-0.22***	-0.20**	-0.14***	-0.32***	-0.17**
	(0.08)	(0.09)	(0.10)	(0.08)	(0.06)	(0.08)	(0.05)	(0.08)	(0.07)
$\ln \theta_{it-1}$	0.02	-0.04	-0.13**	0.00	-0.01	0.01	-0.11*	-0.02	-0.02
	(0.02)	(0.03)	(0.06)	(0.03)	(0.02)	(0.03)	(0.07)	(0.03)	(0.05)
$\ln L_{it-1}$	-0.05*	-0.13**	-0.09**	0.02	-0.03	0.03	-0.05	-0.12***	-0.10**
	(0.03)	(0.06)	(0.05)	(0.04)	(0.02)	(0.03)	(0.04)	(0.04)	(0.04)
crisis	0.01*	0.01	-0.00	-0.01	0.02***	0.02	0.00	0.02**	0.03***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Observations	89	88	85	89	89	81	81	78	89
$Within R^2$	0.24	0.14	0.12	-0.52	0.22	0.25	0.16	0.22	0.21
Dependent variable: Productivity $\Delta \ln z_{it}$									
$\Delta \ln \theta_{it}$	0.08	0.23	0.22**	-0.29	0.25*	0.35***	0.30*	0.13	-0.14
	(0.19)	(0.23)	(0.10)	(0.22)	(0.13)	(0.12)	(0.18)	(0.19)	(0.21)
$\Delta \ln D_{it}$	0.08	-0.11	0.03	-0.06	0.02	0.03	-0.02	0.10	0.10
	(0.07)	(0.08)	(0.06)	(0.12)	(0.10)	(0.12)	(0.10)	(0.10)	(0.12)
$\ln z_{t-1}$	-0.38***	-0.55***	-0.22***	-0.18**	-0.21***	-0.30***	-0.21***	-0.28***	-0.24***
	(0.09)	(0.09)	(0.07)	(0.08)	(0.06)	(0.08)	(0.07)	(0.09)	(0.08)
$\ln \theta_{it-1}$	-0.01	-0.01	0.14*	0.01	0.08	0.03	0.14	-0.02	-0.11
	(0.04)	(0.06)	(0.08)	(0.08)	(0.05)	(0.08)	(0.14)	(0.08)	(0.14)
$\ln L_{it-1}$	0.15*	0.40***	0.23***	0.18	0.07	0.24**	0.33***	0.40**	0.49***
	(0.09)	(0.13)	(0.08)	(0.14)	(0.07)	(0.11)	(0.11)	(0.17)	(0.18)
$\ln \frac{w_{it-1}}{\text{PPI}_{it-1}}$	0.23**	-0.33***	-0.09	-0.01	0.01	-0.26***	-0.06	-0.02	0.07
	(0.10)	(0.08)	(0.05)	(0.14)	(0.07)	(0.07)	(0.07)	(0.11)	(0.12)
crisis	-0.05***	-0.07***	-0.04***	-0.05***	-0.08***	-0.10***	-0.05**	-0.11***	-0.15***
	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)	(0.02)	(0.02)	(0.03)
Observations	89	88	85	89	89	81	81	78	89
$Within R^2$	0.36	0.40	0.26	0.13	0.39	0.54	0.27	0.40	0.37
Dependent variable: Markup $\Delta \ln \mu_{it}$									
$\Delta \ln \theta_{it}$	-0.21*	-0.05	-0.08**	0.04	-0.07	-0.14***	-0.01	-0.02	0.07
	(0.11)	(0.08)	(0.04)	(0.08)	(0.05)	(0.04)	(0.05)	(0.06)	(0.07)
$\Delta \ln D_{it}$	-0.03	0.03	-0.01	-0.06	0.01	0.01	-0.03	0.04	-0.02
	(0.04)	(0.02)	(0.02)	(0.04)	(0.03)	(0.04)	(0.03)	(0.03)	(0.04)
$\ln \mu_{it-1}$	-0.21***	-0.63***	-0.78***	-0.45***	-0.38***	-0.29***	-0.30***	-0.35***	-0.42***
	(0.07)	(0.10)	(0.10)	(0.09)	(0.10)	(0.08)	(0.09)	(0.08)	(0.09)
$\ln \theta_{it-1}$	-0.03	-0.01	-0.06***	0.00	-0.02	-0.02	0.03	-0.05**	0.06
	(0.02)	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.02)	(0.04)
$\ln L_{it-1}$	-0.01	0.04	0.01	-0.05*	-0.07***	-0.01	-0.02	0.03	0.04
	(0.04)	(0.04)	(0.02)	(0.03)	(0.02)	(0.03)	(0.03)	(0.02)	(0.03)
crisis	-0.00	0.00	0.00	0.01	0.00	-0.01	0.01	0.02**	-0.01
	(0.01)	(0.01)	(0.00)	(0.01)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)
Observations	90	90	90	90	90	90	90	90	90
$Within R^2$	0.05	0.32	0.45	0.28	0.23	0.22	0.21	0.26	0.22
Import indicator	gross	gross	gross	gross	gross	gross	gross	gross	gross
Specification	IV	IV	IV	IV	IV	IV	IV	IV	IV
Country fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes

Note: Standard errors in parentheses. *, ** and *** denote statistical significance at the 10%, 5% and 1% levels.

Table 3: Sectoral regression using VA import penetration

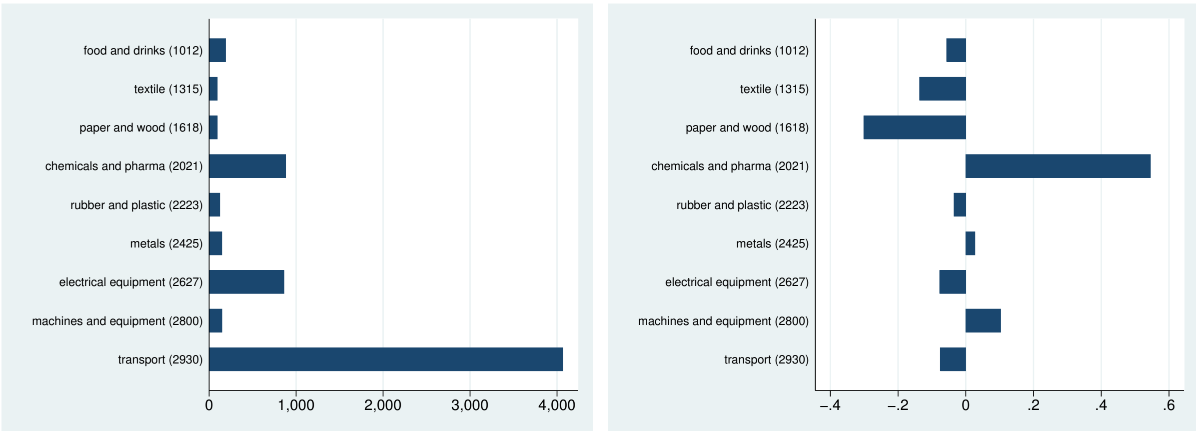
	1012 Food	1315 Textile	1618 Wood	2021 Chemicals	2223 Rubber	2425 Metals	2627 ICT	2800 Machinery	2930 Transport
Dependent variable: Price $\Delta \ln ppi_{it}$									
$\Delta \ln \theta_{it}$	-0.25***	-0.36**	-0.12	-0.02	-0.19***	0.32***	-0.19	-0.20**	-0.35**
	(0.06)	(0.15)	(0.10)	(0.14)	(0.06)	(0.08)	(0.12)	(0.09)	(0.16)
$\Delta \ln D_{it}$	-0.02	-0.01	-0.02	-0.04	0.01	0.06	0.02	0.03	0.00
	(0.03)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
$\ln \frac{\text{PPI}_{it-1}}{\text{PPItot}_{t-1}}$	-0.29***	-0.34***	-0.28***	-0.18***	-0.20***	-0.20***	-0.10***	-0.34***	-0.23***
	(0.07)	(0.09)	(0.08)	(0.07)	(0.05)	(0.07)	(0.04)	(0.07)	(0.07)
$\ln \theta_{it-1}$	0.02	-0.03	-0.11*	-0.02	-0.03	0.05	-0.14*	-0.01	-0.15***
	(0.02)	(0.02)	(0.06)	(0.04)	(0.02)	(0.05)	(0.08)	(0.03)	(0.06)
$\ln L_{it-1}$	-0.05**	-0.18***	-0.08*	0.00	-0.02	0.01	-0.05	-0.12***	-0.07*
	(0.03)	(0.05)	(0.04)	(0.03)	(0.02)	(0.04)	(0.04)	(0.04)	(0.04)
crisis	0.01*	0.01	-0.00	-0.00	0.01*	0.01	0.01	0.02*	0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Observations	89	88	85	89	89	81	81	78	89
$Within R^2$	0.26	0.08	0.12	0.12	0.36	0.30	0.20	0.34	0.22
Dependent variable: Productivity $\Delta \ln z_{it}$									
$\Delta \ln \theta_{it}$	0.22	0.34	0.35***	-0.01	0.46***	0.57***	0.50*	0.42*	-0.03
	(0.14)	(0.22)	(0.12)	(0.32)	(0.16)	(0.17)	(0.26)	(0.24)	(0.37)
$\Delta \ln D_{it}$	0.07	-0.11	0.04	0.00	0.03	0.03	-0.03	0.07	0.09
	(0.06)	(0.08)	(0.06)	(0.11)	(0.10)	(0.11)	(0.10)	(0.10)	(0.12)
$\ln z_{t-1}$	-0.39***	-0.54***	-0.21***	-0.23***	-0.18***	-0.31***	-0.17***	-0.29***	-0.25***
	(0.08)	(0.09)	(0.07)	(0.07)	(0.06)	(0.08)	(0.05)	(0.08)	(0.09)
$\ln \theta_{it-1}$	-0.02	-0.02	0.15*	0.15	0.13	0.28**	0.13	-0.03	-0.11
	(0.04)	(0.04)	(0.09)	(0.10)	(0.08)	(0.12)	(0.19)	(0.08)	(0.15)
$\ln L_{it-1}$	0.21**	0.43***	0.19**	0.17	0.02	0.05	0.33***	0.42***	0.50***
	(0.10)	(0.12)	(0.09)	(0.14)	(0.09)	(0.12)	(0.12)	(0.16)	(0.19)
$\ln \frac{w_{it-1}}{\text{PPI}_{it-1}}$	0.17	-0.32***	-0.08	0.03	0.02	-0.18**	-0.05	-0.01	0.08
	(0.10)	(0.08)	(0.06)	(0.14)	(0.07)	(0.08)	(0.07)	(0.10)	(0.12)
crisis	-0.05***	-0.06***	-0.04***	-0.06***	-0.07***	-0.10***	-0.05**	-0.09***	-0.14***
	(0.02)	(0.02)	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)
Observations	89	88	85	89	89	81	81	78	89
$Within R^2$	0.29	0.45	0.23	0.23	0.38	0.57	0.25	0.45	0.36
Dependent variable: Markup $\Delta \ln \mu_{it}$									
$\Delta \ln \theta_{it}$	-0.24***	0.03	-0.12***	-0.02	-0.17***	-0.22***	-0.08	-0.10	0.04
	(0.08)	(0.08)	(0.04)	(0.12)	(0.06)	(0.05)	(0.08)	(0.08)	(0.12)
$\Delta \ln D_{it}$	-0.02	0.03	-0.01	-0.07*	-0.00	0.01	-0.02	0.05	-0.02
	(0.04)	(0.02)	(0.02)	(0.04)	(0.03)	(0.04)	(0.03)	(0.03)	(0.04)
$\ln \mu_{it-1}$	-0.18***	-0.66***	-0.75***	-0.47***	-0.41***	-0.32***	-0.28***	-0.32***	-0.38***
	(0.07)	(0.12)	(0.10)	(0.09)	(0.09)	(0.08)	(0.08)	(0.08)	(0.09)
$\ln \theta_{it-1}$	-0.04**	-0.01	-0.08***	-0.03	-0.05*	-0.06*	-0.01	-0.03	0.01
	(0.02)	(0.01)	(0.03)	(0.03)	(0.03)	(0.04)	(0.05)	(0.03)	(0.04)
$\ln L_{it-1}$	0.01	0.04	0.02	-0.04	-0.06***	0.01	0.00	0.03	0.06*
	(0.04)	(0.03)	(0.02)	(0.03)	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)
crisis	-0.00	0.00	-0.00	0.01	-0.00	-0.01	0.00	0.01	-0.01
	(0.01)	(0.01)	(0.00)	(0.01)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)
Observations	90	90	90	90	90	90	90	90	90
$Within R^2$	0.15	0.30	0.48	0.32	0.40	0.32	0.22	0.19	0.19
Import indicator	VA	VA	VA	VA	VA	VA	VA	VA	VA
Specification	IV	IV	IV	IV	IV	IV	IV	IV	IV
Country fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes

Note: Standard errors in parentheses. *, ** and *** denote statistical significance at the 10%, 5% and 1% levels.

and metals (2425).

6.2 Effects of firm concentration and product quality

Information on firm concentration is measured by the Herfindahl-Hirschmann Index (HHI) and quality changes. (Figure 3) provides further insight on sectors with few or no significant effect of trade openness, as chemicals and pharmaceuticals (2021) or vehicles and transport (2930). Interestingly, those sectors also display the highest level in firm concentration (HHI). They are also digitally-intensive sectors which are not only bigger but exhibit higher markups (Calligaris *et al.* (2018)). In this paper, we do not pursue investigation on the relationship that may exist between firm concentration and the weak competitive effect of trade. Nevertheless, we observe that sectors with weak trade effects are those characterised by high firm concentration.



(a) Firm concentration (HHI index in level)

(b) Exports quality change (annual growth)

Figure 3: Firm concentration and product quality

Sources: CompNet databases; Eurostat; Henn *et al.* (2013).

Figure 4: Firm concentration and quality change (average 1995-2014)

The sectors of food and drinks (1012) and textile (1315) display also a slightly higher firm concentration level than other sectors such as those of wood and paper (1618), rubber and plastic (2223) and metals (2425) and this may be related to the weak effect of trade openness on productivity and markups. In this regard, a part of the answer to the absence of the effect of trade openness may be attributed to the high firm concentration. As highlighted in Mendoza *et al.* (2013), high concentration can limit the competition between firms. However we only observe the weak effect of the trade openness with high firm-level concentration, without any implication on the causal relationship.

6.3 Effect of low-wage countries

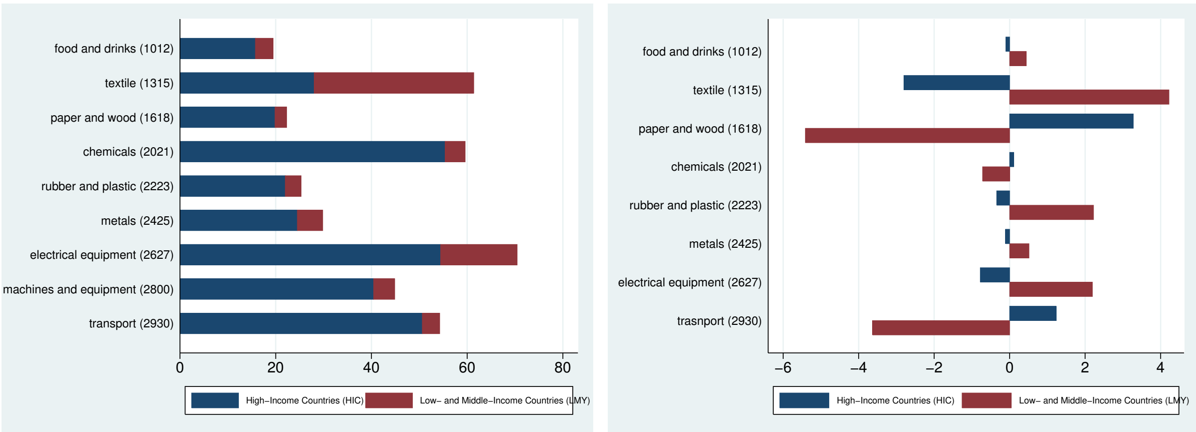
Another driver that should be taken into account is the origin of imports. Our theoretical framework does not entirely address the question of structural differences across countries but, as underlined by Auer *et al.* (2013), competition with low-wage countries entails changes in inflationary pressure in Europe. In reality, the level of development and the overall income level do affect the cost structure and the business environment as well as the products that are exported or imported. Following the classification given by the World Bank[10], we distinguish,

[10] https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups

in sectoral imports of our selected countries, those from high-income countries and those from low- and middle-income countries (as proxy of low-wage countries).

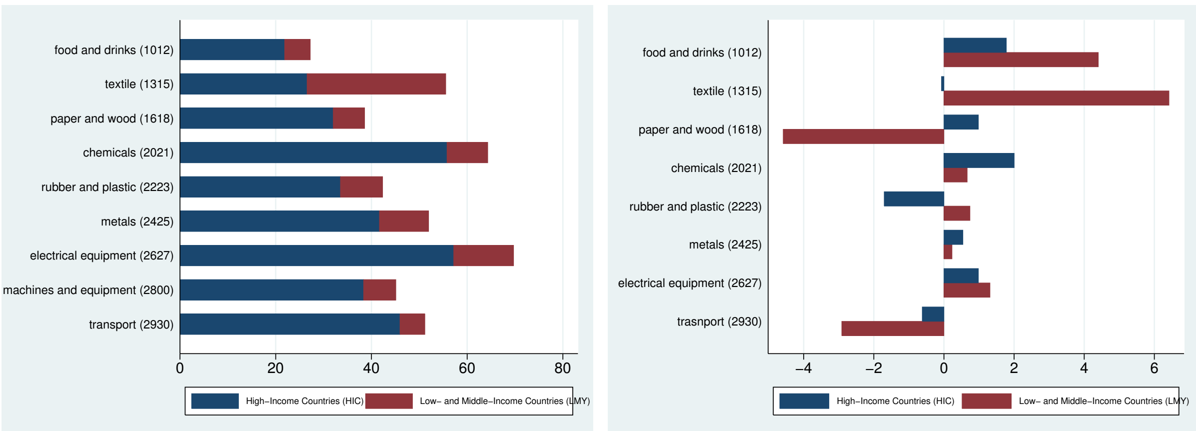
As displayed in figure 5, not only is the level of the import penetration different between sectors, but the composition of the imports is also heterogeneous. Among sectors with high openness such as textile (1315), chemicals and pharmaceuticals (2021), electrical equipment (2627) and vehicles and transport (2930), the share of low- and middle-income countries is high (and increasing over time) in the sectors of textile and electrical equipment while it is very low (and decreasing) in the two others.

Figure 6 shows that in terms of value added, the import penetration of goods from the low and middle-income countries becomes larger in most sectors. Furthermore, the growth rates of the VA import penetration from different type of countries are strongly affected compared to the 5.



(a) Gross import penetration ratio (average over time) (b) Annual average growth of the gross import penetration over 2000-2014

Figure 5: Origins of imports (gross measures) - By level of income



(a) VA import penetration ratio (average over time) (b) Annual average growth of the VA import penetration over 2000-2014

Figure 6: Origins of imports (VA measures) -By level of income

Similarly to the previous section, we run the regression on the pooled sample in the first place and at the sector level in the second place, distinguishing between (gross or VA) import penetration from low- and middle-income countries(LMY) and from high-income countries (HIC).

For the pooled sample, openness as regards low- and middle-income countries is negatively correlated with markup whereas openness as regards high-income countries, when significant, is negatively correlated with prices. When using the gross import penetration ratio, productivity, when significant, increases with the imports from both low- and middle- income and from high income countries.

When significant, openness towards both high-income and low- and middle-income yields similar results. Trade liberalisation tends to increase productivity and decrease markups. More precisely, openness towards high-income countries exerts strong competitive effects on prices in the sectors of food and drinks and electrical equipment while that of low- and middle-income countries have stronger effect in the sectors of textile, rubber and plastic, and transport equipment. In the case of productivity, trade with low- and middle-income countries only has a positive and significant effects. As for the markups, only openness towards low- and middle-income decreases markups.

Table 4: Pooled sample regression by import origin

	(1)	(2)
Dependent variable: Price $\Delta \ln ppi_{it}$		
$\Delta \ln \theta_{it}^{HIC}$	-0.03	-0.23**
	(0.07)	(0.10)
$\Delta \ln \theta_{it}^{LMY}$	-0.04	0.02
	(0.03)	(0.03)
$\Delta \ln D_{it}$	0.00	-0.01
	(0.01)	(0.02)
$\ln \frac{\text{PPI}_{it-1}}{\text{PPItot}_{t-1}}$	-0.16***	-0.12***
	(0.02)	(0.02)
$\ln \theta_{it-1}^{HIC}$	0.01	-0.03
	(0.01)	(0.03)
$\ln \theta_{it-1}^{LMY}$	-0.02***	0.01
	(0.01)	(0.01)
$\ln L_{it-1}$	-0.00	-0.08**
	(0.02)	(0.03)
crisis	0.01***	0.01*
	(0.00)	(0.00)
Observations	769	767
$Within R^2$	0.05	-0.08
Dependent variable: Productivity $\Delta \ln z_{it}$		
$\Delta \ln \theta_{it}^{HIC}$	0.01	0.38**
	(0.15)	(0.17)
$\Delta \ln \theta_{it}^{LMY}$	0.19**	0.06
	(0.07)	(0.05)
$\Delta \ln D_{it}$	0.03	0.02
	(0.03)	(0.03)
$\ln z_{t-1}$	-0.22***	-0.19***
	(0.02)	(0.02)
$\ln \theta_{it-1}^{HIC}$	-0.04	0.01
	(0.03)	(0.05)
$\ln \theta_{it-1}^{LMY}$	0.05***	0.03
	(0.01)	(0.02)
$\ln L_{it-1}$	0.13***	0.19***
	(0.05)	(0.07)
$\ln \frac{w_{it-1}}{\text{PPI}_{it-1}}$	-0.05**	-0.05**
	(0.02)	(0.02)
crisis	-0.07***	-0.07***
	(0.01)	(0.01)
Observations	769	767
$Within R^2$	0.24	0.25
Dependent variable: Markup $\Delta \ln \mu_{it}$		
$\Delta \ln \theta_{it}^{HIC}$	0.01	-0.06
	(0.07)	(0.05)
$\Delta \ln \theta_{it}^{LMY}$	-0.07*	-0.05***
	(0.04)	(0.02)
$\Delta \ln D_{it}$	-0.01	0.00
	(0.01)	(0.01)
$\ln \mu_{it-1}$	-0.28***	-0.29***
	(0.03)	(0.02)
$\ln \theta_{it-1}^{HIC}$	-0.01	-0.01
	(0.01)	(0.01)
$\ln \theta_{it-1}^{LMY}$	-0.01	-0.01**
	(0.01)	(0.00)
$\ln L_{it-1}$	0.01	0.03
	(0.02)	(0.02)
crisis	0.00	-0.00
	(0.00)	(0.00)
Observations	810	808
$Within R^2$	0.08	0.19
Import indicator	gross	VA
Specification	IV	IV
Country x sect. fixed eff.	yes	yes

Note: Standard errors in parentheses. *, ** and *** denote statistical significance at the 10%, 5% and 1% levels.

Table 5: Sectoral regression by import origins

	1012 Food	1315 Textile	1618 Wood	2021 Chemicals	2223 Rubber	2425 Metals	2627 ICT	2800 Machinery	2930 Transport
Dependent variable: Price $\Delta \ln ppi_{it}$									
$\Delta \ln \theta_{it}^{HIC}$	-0.19***	0.30	-0.08	-0.13	0.04	0.24	-0.40**	-0.03	-0.22
	(0.07)	(0.24)	(0.19)	(0.13)	(0.10)	(0.17)	(0.19)	(0.09)	(0.17)
$\Delta \ln \theta_{it}^{LMY}$	-0.05	-0.18***	-0.04	-0.02	-0.10***	0.09*	0.01	-0.03*	-0.13**
	(0.05)	(0.06)	(0.05)	(0.04)	(0.02)	(0.05)	(0.03)	(0.02)	(0.06)
$\Delta \ln D_{it}$	0.00	0.02	-0.04	-0.02	0.04	0.02	0.02	0.04	-0.01
	(0.03)	(0.04)	(0.04)	(0.04)	(0.04)	(0.05)	(0.05)	(0.03)	(0.05)
$\ln \frac{\text{PPI}_{it-1}}{\text{PPItot}_{t-1}}$	-0.32***	-0.25**	-0.46***	-0.20***	-0.16***	-0.13*	-0.07	-0.58***	-0.21**
	(0.07)	(0.11)	(0.12)	(0.07)	(0.05)	(0.07)	(0.05)	(0.09)	(0.09)
$\ln \theta_{it-1}^{HIC}$	-0.05	0.03	-0.00	-0.03	0.03	0.12	-0.20**	0.11**	-0.09
	(0.05)	(0.04)	(0.13)	(0.06)	(0.06)	(0.10)	(0.10)	(0.04)	(0.06)
$\ln \theta_{it-1}^{LMY}$	0.04	-0.02	-0.07***	-0.00	-0.01	0.01	-0.03*	-0.04***	-0.02
	(0.03)	(0.02)	(0.02)	(0.02)	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)
$\ln L_{it-1}$	-0.13*	-0.07	0.01	0.00	0.01	0.01	-0.03	0.03	-0.02
	(0.07)	(0.07)	(0.07)	(0.06)	(0.04)	(0.08)	(0.06)	(0.06)	(0.07)
crisis	0.01*	0.02	-0.01	-0.01	0.02***	0.01	0.01	0.01	0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Observations	89	88	85	89	89	81	81	76	89
$Within R^2$	0.35	0.21	0.24	0.08	0.39	0.27	-0.08	0.48	0.06
Dependent variable: Productivity $\Delta \ln z_{it}$									
$\Delta \ln \theta_{it}^{HIC}$	0.10	-0.00	0.07	0.15	0.28	0.44	-0.29	-0.13	-0.12
	(0.18)	(0.36)	(0.32)	(0.30)	(0.31)	(0.46)	(0.50)	(0.25)	(0.29)
$\Delta \ln \theta_{it}^{LMY}$	0.05	0.25*	0.11	0.22**	0.11*	0.14	0.15**	0.11**	0.08
	(0.09)	(0.13)	(0.09)	(0.10)	(0.06)	(0.13)	(0.07)	(0.05)	(0.15)
$\Delta \ln D_{it}$	0.04	-0.09	0.01	-0.02	-0.00	-0.03	-0.03	0.07	0.10
	(0.06)	(0.08)	(0.06)	(0.12)	(0.10)	(0.13)	(0.10)	(0.11)	(0.12)
$\ln z_{t-1}$	-0.42***	-0.49***	-0.21***	-0.35***	-0.18***	-0.34***	-0.20***	-0.37***	-0.29***
	(0.08)	(0.11)	(0.08)	(0.08)	(0.07)	(0.08)	(0.07)	(0.09)	(0.10)
$\ln \theta_{it-1}^{HIC}$	0.08	0.06	0.01	-0.12	0.05	0.31	-0.30	-0.30**	-0.20
	(0.12)	(0.09)	(0.23)	(0.14)	(0.20)	(0.27)	(0.26)	(0.12)	(0.14)
$\ln \theta_{it-1}^{LMY}$	-0.07	-0.02	0.06	0.17***	0.04	0.06	0.01	0.11***	0.04
	(0.07)	(0.03)	(0.04)	(0.06)	(0.03)	(0.05)	(0.03)	(0.03)	(0.03)
$\ln L_{it-1}$	0.36**	0.39**	0.07	-0.10	-0.04	0.01	0.27*	0.06	0.34
	(0.17)	(0.16)	(0.21)	(0.17)	(0.13)	(0.25)	(0.14)	(0.20)	(0.25)
$\ln \frac{w_{it-1}}{\text{PPI}_{it-1}}$	0.16	-0.32***	-0.06	0.02	0.03	-0.23***	-0.01	-0.10	0.18
	(0.10)	(0.11)	(0.08)	(0.14)	(0.08)	(0.08)	(0.07)	(0.11)	(0.13)
crisis	-0.05***	-0.07***	-0.04***	-0.03	-0.07***	-0.10***	-0.06***	-0.09***	-0.14***
	(0.02)	(0.02)	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)
Observations	89	88	85	89	89	81	81	76	89
$Within R^2$	0.36	0.46	0.32	0.21	0.38	0.57	0.29	0.48	0.38
Dependent variable: Markup $\Delta \ln \mu_{it}$									
$\Delta \ln \theta_{it}^{HIC}$	-0.31**	0.19	0.05	-0.12	-0.04	-0.24*	-0.12	-0.03	0.04
	(0.13)	(0.14)	(0.12)	(0.11)	(0.09)	(0.14)	(0.12)	(0.07)	(0.09)
$\Delta \ln \theta_{it}^{LMY}$	0.03	-0.02	-0.05*	-0.06*	-0.06***	-0.02	-0.02	-0.03	-0.04
	(0.07)	(0.04)	(0.03)	(0.04)	(0.02)	(0.04)	(0.02)	(0.02)	(0.04)
$\Delta \ln D_{it}$	-0.02	0.03	0.00	-0.04	0.01	0.00	-0.02	0.03	-0.02
	(0.04)	(0.03)	(0.02)	(0.04)	(0.03)	(0.04)	(0.03)	(0.03)	(0.04)
$\ln \mu_{it-1}$	-0.17**	-0.70***	-0.63***	-0.43***	-0.34***	-0.29***	-0.27***	-0.41***	-0.37***
	(0.07)	(0.13)	(0.13)	(0.10)	(0.08)	(0.08)	(0.09)	(0.08)	(0.09)
$\ln \theta_{it-1}^{HIC}$	-0.11	-0.01	0.05	-0.01	0.01	-0.02	-0.03	-0.02	0.01
	(0.08)	(0.03)	(0.08)	(0.05)	(0.05)	(0.08)	(0.05)	(0.03)	(0.04)
$\ln \theta_{it-1}^{LMY}$	0.05	-0.01	-0.03***	-0.01	-0.01	-0.01	-0.00	-0.01	0.00
	(0.05)	(0.01)	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)
$\ln L_{it-1}$	-0.10	0.07*	0.09*	-0.02	-0.04	0.00	0.01	0.04	0.05
	(0.11)	(0.04)	(0.05)	(0.05)	(0.03)	(0.08)	(0.04)	(0.05)	(0.05)
crisis	0.00	0.00	0.00	0.00	-0.00	-0.01	0.00	0.01*	-0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Observations	90	90	90	90	90	90	90	88	90
$Within R^2$	0.04	0.17	0.46	0.30	0.41	0.25	0.20	0.32	0.18
Import indicator	VA	VA	VA	VA	VA	VA	VA	VA	VA
Specification	IV	IV	IV	IV	IV	IV	IV	IV	IV
Country fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes

Note: Standard errors in parentheses. *, ** and *** denote statistical significance at the 10%, 5% and 1% levels.

6.4 Robustness

6.4.1 GVC participation

GVC participation is computed by Wang *et al.* (2016), using the 2013 edition of WIOD Input-Output Tables. It indicates how much a country is integrated in international trade, or more precisely, in global value chains. It is defined as the sum of domestic value added embodied in foreign exports (forward linkage) and foreign value added embodied in domestic exports (backward linkage). Forward linkage measures the extent to which exports have become more vertically specialised and backward linkage measures the extent to which intermediate inputs to produce exports have been offshored. Participation to the GVCs differs from the previous indicators of trade openness defined as import penetration in final demand by Chen *et al.* (2004, 2009) to fit Melitz and Ottaviano (2008) theoretical framework. However Auer *et al.* (2017) find evidence that global supply chain integration has a higher power in explaining domestic inflation. Since Jonson and Noguera (2012) and Andrews *et al.* (2018) argue that GVC indicators better capture this integration, we consider using GVC participation as a measure to test the robustness of our previous results based on import penetration.

Compared to the gross and value-added import penetration, regressions using the GVC indicator seem to yield similar results. As for the price, the short-run effect of the import penetration is significant with expect sign in all the sectors except the sector of wood and paper (1618, not significant) and the sector of metals (2425), significant but with the positive coefficient). However, its long-run effect on prices is less clear.

In the case of productivity, the effect of openness is significant with expected sign in all the sectors except in the sectors of food and drinks (1012), textile (1315), chemicals and pharmaceuticals (2021), machinery (2800) and vehicles and transport (2930). The long run effect is less clear.

When significant, markup is also negatively correlated with openness, often in the long run and short run. However, the magnitude of the long-run coefficient is smaller. Our estimation yields a significant effect in the sector of food and drinks (1012), wood and paper (1618), rubber and plastic (2223) and metals (2425).

6.4.2 Total factor productivity instead of labour productivity

The use of labour productivity (defined as the ratio of value-added to employment) may be questioned since it is one proxy for the productivity in general. More broadly, most indicators of productivity have strengths and weaknesses. In this regard, we carry out the robustness test using another indicator of the productivity, namely the total factor productivity calculated with the employment level and the capital stock in the EU KLEMS database. Our conclusion remains stable in the short run. The coefficients are significant in the same sectors. Nevertheless, in the long run, the effect of trade is openness is less clear when using the TFP.

Table 6: Sectoral regression using GVC indicators

	Pooled All	1012 Food	1315 Textile	1618 Wood	2021 Chemicals	2223 Rubber	2425 Metals	2627 ICT	2800 Machinery	2930 Transport
					Dependent variable: Price $\Delta \ln ppi_{it}$					
$\Delta \ln \theta_{it}$	-0.11***	-0.29***	-0.24***	-0.05	0.13**	-0.22***	0.27***	-0.14*	-0.21***	-0.41***
	(0.03)	(0.05)	(0.08)	(0.08)	(0.06)	(0.06)	(0.07)	(0.08)	(0.08)	(0.15)
$\Delta \ln D_{it}$	0.00	0.01	0.01	-0.02	-0.04	0.01	0.07	-0.01	0.01	0.01
	(0.01)	(0.02)	(0.03)	(0.04)	(0.04)	(0.03)	(0.04)	(0.04)	(0.03)	(0.05)
$\ln \frac{PPI_{it-1}}{PPItot_{t-1}}$	-0.13***	-0.34***	-0.39***	-0.26***	-0.12**	-0.17***	-0.19**	-0.12***	-0.32***	-0.29***
	(0.02)	(0.06)	(0.09)	(0.08)	(0.06)	(0.04)	(0.07)	(0.04)	(0.07)	(0.09)
$\ln \theta_{it-1}$	-0.00	0.05***	-0.08**	-0.07	0.00	-0.00	0.00	-0.07*	-0.02	-0.14**
	(0.01)	(0.01)	(0.04)	(0.04)	(0.02)	(0.02)	(0.03)	(0.04)	(0.03)	(0.06)
$\ln L_{it-1}$	-0.04***	-0.05*	-0.15***	-0.07*	-0.02	-0.02	0.03	-0.05	-0.10***	-0.04
	(0.01)	(0.03)	(0.04)	(0.04)	(0.03)	(0.02)	(0.03)	(0.04)	(0.03)	(0.05)
crisis	0.01***	0.01	-0.01	-0.00	-0.00	0.01**	0.02	0.01	0.01*	0.01
	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Observations	769	89	88	85	89	89	81	81	78	89
$Within R^2$	0.12	0.45	0.28	0.16	0.16	0.48	0.30	0.23	0.49	0.17
					Dependent variable: Productivity $\Delta \ln z_{it}$					
$\Delta \ln \theta_{it}$	0.35***	0.11	0.25	0.37***	0.24	0.50***	0.58***	0.45***	0.40	0.63
	(0.07)	(0.11)	(0.19)	(0.11)	(0.17)	(0.16)	(0.15)	(0.17)	(0.25)	(0.44)
$\Delta \ln D_{it}$	0.02	0.06	-0.12	0.07	-0.00	0.00	0.09	0.02	0.10	0.07
	(0.03)	(0.06)	(0.08)	(0.06)	(0.11)	(0.09)	(0.12)	(0.10)	(0.10)	(0.13)
$\ln z_{t-1}$	-0.17***	-0.43***	-0.50***	-0.16***	-0.25***	-0.16***	-0.27***	-0.18***	-0.27***	-0.25***
	(0.02)	(0.08)	(0.10)	(0.06)	(0.07)	(0.06)	(0.09)	(0.06)	(0.08)	(0.09)
$\ln \theta_{it-1}$	0.03	-0.09**	-0.04	0.02	0.12*	0.13	0.21**	0.07	0.04	0.12
	(0.02)	(0.04)	(0.09)	(0.07)	(0.07)	(0.09)	(0.09)	(0.09)	(0.08)	(0.17)
$\ln L_{it-1}$	0.21***	0.30***	0.37***	0.24**	0.16	-0.02	-0.00	0.35***	0.36**	0.33
	(0.04)	(0.09)	(0.11)	(0.11)	(0.15)	(0.09)	(0.14)	(0.12)	(0.15)	(0.21)
$\ln \frac{w_{it-1}}{PPI_{it-1}}$	-0.05**	0.14	-0.29***	-0.12*	0.03	0.06	-0.13	-0.05	-0.02	0.19
	(0.02)	(0.10)	(0.10)	(0.07)	(0.15)	(0.09)	(0.09)	(0.06)	(0.10)	(0.15)
crisis	-0.07***	-0.05***	-0.06***	-0.03**	-0.04**	-0.06***	-0.09***	-0.04**	-0.10***	-0.13***
	(0.01)	(0.01)	(0.02)	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)
Observations	769	89	88	85	89	89	81	81	78	89
$Within R^2$	0.28	0.39	0.42	0.29	0.19	0.45	0.55	0.25	0.45	0.25
					Dependent variable: Markup $\Delta \ln \mu_{it}$					
$\Delta \ln \theta_{it}$	-0.10***	-0.18***	-0.03	-0.09**	0.00	-0.19***	-0.18***	-0.03	-0.08	0.05
	(0.02)	(0.06)	(0.05)	(0.04)	(0.05)	(0.05)	(0.04)	(0.05)	(0.07)	(0.11)
$\Delta \ln D_{it}$	-0.01	0.00	0.03	-0.02	-0.07*	0.00	0.00	-0.02	0.03	-0.01
	(0.01)	(0.04)	(0.02)	(0.02)	(0.04)	(0.03)	(0.03)	(0.03)	(0.03)	(0.04)
$\ln \mu_{it-1}$	-0.29***	-0.19***	-0.64***	-0.73***	-0.47***	-0.39***	-0.32***	-0.30***	-0.31***	-0.38***
	(0.02)	(0.07)	(0.11)	(0.10)	(0.09)	(0.08)	(0.08)	(0.08)	(0.08)	(0.09)
$\ln \theta_{it-1}$	-0.02**	-0.04*	-0.02	-0.05***	-0.01	-0.03	-0.03	0.00	-0.03	0.02
	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.04)
$\ln L_{it-1}$	0.01	0.04	0.04	0.02	-0.05	-0.06***	-0.00	0.00	0.04	0.05
	(0.01)	(0.04)	(0.02)	(0.02)	(0.03)	(0.02)	(0.03)	(0.03)	(0.03)	(0.04)
crisis	-0.00	-0.00	-0.00	-0.00	0.01	-0.01	-0.01	0.01	0.01	-0.01
	(0.00)	(0.01)	(0.01)	(0.00)	(0.01)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)
Observations	810	90	90	90	90	90	90	90	90	90
$Within R^2$	0.20	0.25	0.34	0.48	0.31	0.47	0.34	0.20	0.20	0.20
Import indicator	GVC	GVC	GVC	GVC	GVC	GVC	GVC	GVC	GVC	GVC
Specification	IV	IV	IV	IV	IV	IV	IV	IV	IV	IV
Country fixed effects	no	yes	yes	yes	yes	yes	yes	yes	yes	yes
Country x sect. FE	yes	no	no	no	no	no	no	no	no	no

Note: Standard errors in parentheses. *, ** and *** denote statistical significance at the 10%, 5% and 1% levels.

Table 7: Regressions at sector-level using VA openness and TFP (instrumented)

	Pooled All	1012 Food	1315 Textile	1618 Wood	2021 Chemicals	2223 Rubber	2425 Metals	2627 ICT	2800 Machinery	2930 Transport
	Dependent variable: TFP $\Delta TFPe$									
$\Delta \ln \theta_{it}$	0.45***	0.23	0.29	0.38**	0.06	0.41**	0.53***	0.53*	0.39*	0.25
	(0.11)	(0.16)	(0.22)	(0.15)	(0.39)	(0.18)	(0.19)	(0.30)	(0.22)	(0.40)
$\Delta \ln D_{it}$	0.02	0.06	-0.10	-0.03	0.02	0.04	0.12	-0.02	0.05	0.06
	(0.03)	(0.07)	(0.07)	(0.06)	(0.11)	(0.09)	(0.11)	(0.10)	(0.09)	(0.11)
$\ln TFP_{it-1}$	-0.17***	-0.24***	-0.47***	-0.15***	-0.41***	-0.13**	-0.25***	-0.16***	-0.41***	-0.12
	(0.02)	(0.08)	(0.09)	(0.06)	(0.09)	(0.06)	(0.08)	(0.06)	(0.11)	(0.10)
$\ln \theta_{it-1}$	0.05*	0.01	-0.08*	0.28***	0.07	0.10	0.25**	0.24	-0.04	0.06
	(0.03)	(0.04)	(0.05)	(0.11)	(0.10)	(0.09)	(0.12)	(0.20)	(0.08)	(0.17)
$\ln L_{it-1}$	0.10***	0.02	0.25**	-0.03	0.19	-0.10	-0.09	0.15	0.33**	0.12
	(0.03)	(0.10)	(0.10)	(0.08)	(0.14)	(0.08)	(0.12)	(0.11)	(0.14)	(0.14)
$\ln \frac{w_{it-1}}{PPI_{it-1}}$	-0.02	0.14	-0.20***	0.05	0.02	0.05	-0.11	0.01	0.01	0.01
	(0.02)	(0.11)	(0.06)	(0.06)	(0.15)	(0.09)	(0.08)	(0.07)	(0.09)	(0.12)
crisis	-0.06***	-0.04**	-0.06***	-0.02*	-0.06***	-0.06***	-0.08***	-0.04**	-0.06***	-0.11***
	(0.01)	(0.02)	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)	(0.02)	(0.02)	(0.03)
Observations	751	87	86	83	87	87	79	79	76	87
$Within R^2$	0.25	0.18	0.44	0.20	0.35	0.40	0.56	0.19	0.46	0.29
Import indicator	VA	VA	VA	VA	VA	VA	VA	VA	VA	VA
Specification	IV	IV	IV	IV	IV	IV	IV	IV	IV	IV
Country fixed effects	no	yes	yes	yes	yes	yes	yes	yes	yes	yes
Country x sect. FE	yes	no	no	no	no	no	no	no	no	no

Note: Standard errors in parentheses. *, ** and *** denote statistical significance at the 10%, 5% and 1% levels.

7 Concluding remarks

The pro-competitive effect of globalisation has long been of economic, social and political interest. This paper presents an empirical version *à la* Chen *et al.* (2004, 2009) of the Melitz and Ottaviano (2008) model in order to assess the pro-competitive effects of globalisation on price, productivity and markup in nine manufacturing sectors of five Euro Area countries.

Our contribution is based on carrying out a sectoral analysis using various trade indicators. Namely, we use the gross import penetration and that measured in terms of value added. To build the VA indicator, we use a recently published World Input-Output Database (WIOD) based on the Stehrer (2012) method. To go further, we use the GVC indicators presented in Wang *et al.* (2016).

In this paper, we find that trade-induced effects are better captured by the VA indicators, which can be regarded as a complementary approach to traditional gross import penetration indicators. We put forward firm-level concentration, quality upgrading and the weight of sectoral value added as explaining factors to low competitive effect of trade. Higher firm concentration reduces the trade-induced pro-competitive effects. Similarly, in sectors which weight is declining, the competitive effects are blurred.

The approach chosen in this paper could be subject to further investigation. Our next step is to control for the potential quality upgrading in response to trade liberalisation. Our theoretical framework and the empirical estimation only focus on price competition and do not account for quality competition. However, when facing tougher competition, instead of decreasing prices, firms can protect their market shares by improving the quality of their product, i.e. favour their intensive development over their extensive development. For instance, Dinopoulos and Unel (2013) show that markups and quality are endogeneous. Another step would be to further investigate determinants hindering the process of intra-sector reallocations across firms described in the theoretical framework. Such determinants include within-sector firm concentration or policies like high level of entry barriers.

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A Data description and classification harmonization

A.1 Data description

Variable	Description	Source
Producer price	Producer price index (2010 = 100) in manufacturing industry for domestic market. Sector producer prices are expressed relative to the producer price of the total manufacturing.	Eurostat (Short-term statistics)
Labour productivity	Ratio of value added in volume to total employment (employees and self-employed)	Eurostat (National accounts)
Markup	Ratio of turnover to total variable costs	BACH
Gross import penetration	Ratio of gross imports to domestic final demand (defined as the output plus imports minus exports)	OECD STAN Bilateral Trade Database for trade flows and Eurostat (National accounts) for sector output
Value added import penetration	Foreign value added embodied in the final domestic demand; see C for further details	WIOD (2013 and 2016)
GVC participation	Sum of foreign value added embodied in domestic exports (backward linkage) and domestic value added embodied in foreign exports (forward linkage) over value added; see E for further details	Wang *et al.* (2016, 2017)
Number of enterprises	Number of enterprises active during at least a part of the reference period	Eurostat (Structural Business Survey)
Size of the country	GDP in volume	Eurostat (National accounts)
Real remuneration	Compensation of employees deflated by producer price index	Eurostat (National accounts, Short-term statistics)
Bulkiness	Ratio of exports in value to exports in volume (weight in kg)	Eurostat (COMEXT)
Apparent tariff rate	Import-weighted tariff rates of the European Union at the sector-level	WTO-TRAINS, Eurostat (COMEXT)
Gravity	Weighted average of industry value added share over total value added, where the weight is defined as the distance between two countries	Eurostat and CEPII
Real Effective Exchange Rate	Weighted average of HCPI-based nominal effetive exchange rates	Updated from Darvas (2012)
Balassa index	Ratio of a country's export share in an industry to the Euro area's average export shares	Eurostat
HHI	Herfindahl-Hirschmann Index; see D for further details	CompNet
Export quality	Estimates based on sector-specific quality-augmented gravity equations	Henn *et al.* (2013)
TFP	Total factor productivity	EU KLEMS

Table 8: Data source

Code	Description (NACE Rev. 2)
Food (1012)	Food products, beverages and tobacco products
Textile (1315)	Textiles, apparel, leather and related productsr
Wood (1618)	Wood and paper products, and printing
Chemicals (2021)	Chemicals and chemical products; Pharmaceuticals, medicinal chemical and botanical products
Rubber (2223)	Rubber and plastics products, and other non-metallic mineral products
Metals (2425)	Basic metals and fabricated metal products
ICT (2627)	Computer, electronic and optical products; Electrical equipment
Machinery (2800)	Machinery and equipment
Transport (2930)	Transport equipment

Note: In the case of variables from BACH database, 1012 does not include tobacco (C12).

Table 9: Manufacturing sector aggregation

A.2 Classification harmonization

Matching trade and firms data to national account data is a difficult task, as different classifications (good-, product- and activity-based) and vintages coexist. Since most our data are classified according to the NACE Rev.2 economic activity-level classification, we nee to match data classified at good- or product-level. For this exercise, we use theoretical transition matrices based on *ad hoc* correspondence tables provided by Eurostat and the United Nations.

The main difficulty is that correspondence tables do not provide unique associations between codes. More specifically, a single code α of the initial classification can correspond to $n \geq 2$ codes of the final classification ($A_1, A_2, ..., A_n$). To disaggregate α into $A_1, A_2, ..., A_n$, we divide the observation classified in α by n, *i.e.* $1/n$ of α goes to each A_i with $i \in [1, n]$.

Trade data. External gross trade data are classified at different level depending on the sources. Total exports and imports, as well as intermediate imports, come from OECD databases (STAN and bilateral trade by end-of-use). These data are classified in ISIC4, which presents direct correspondence with Nace Rev.2. The bulkiness index and tariff rates are estimated with data classified in HS (Harmonized Commodity Description and Coding System, managed by the World Customs Organisation).

The following figures illustrate the steps to convert goods-level data for trade into NACE Rev.2 classification:

$$N^{goods}_{HS2012} \Rightarrow N^{goods}_{HS2007} \Rightarrow N^{products}_{CPA2008} \Rightarrow N^{activity}_{NACErev2}$$

Value added import penetration is computed with WIOD editions of 2013 and 2016. Data of the 2013 edition cover the period 1995-2011 and are in NACE Rev.1, while data of the 2016 edition cover the period 2000-2014 in NACE Rev. 2. Computing long series over the period 1995-2014 require two steps. First, data of the 2013 edition are converted into NACE Rev.2 using an approximated correspondence table [11]. Second, data of the 2016 edition are backward-extrapolated over the period 1995-1999 using changes in the data from the first step.

Firms data: In the case of the number of enterprises and the markup, we use firms data (Eurostat SBS for the first and BACH for the second). These data are broken into two vintage:

[11] http://www.oecd.org/sti/ind/TiVA_2015_Guide_to_Country_Notes.pdf

one in NACE Rev.1 (before 2005 for SBS and 2000 for BACH) and one in NACE Rev.2. To work with long series we rely on correspondences between NACE Rev.1 and NACE Rev.2 provided Eurostat. Unlike the two previous conversions, we do not rely on theoretical correspondene but on a ”linguistic” correspondence, like Auer *et al.* (2013). When a a single code α corresponds to $n \geq 2$ codes of the final classification $(A_1, A_2, ..., A_n)$, we choose the class that best matched the label of α. For instance, the class 29.13 (Manufacture of taps and valves) in NACE Rev.1 corresponds to both classes 28.14 (Manufacture of other taps and valves) and 33.12 (Repair of machinery). As 28.14 corresponds better to 29.13, 28.14 is used as the exact reference of 29.13 in NACE Rev.2.

B Stationarity tests

Panel-data Dickey-Fuller test is carried out with one lag and without trend. The null hypothesis is that all the series do have a unit root and the alternative hypothesis is that at least one series does not have a unit root. Two lags are selected.

Table 10: Dickey-Fuller test - Production price

		Statistics	p-value
Inverse chi-squared(100)	P	52.9274	0.9916
Inverse normal	Z	3.5391	0.9998
Inverse logit t(254)	$L*$	3.5050	0.9997
Modified inv. chi-squared	P_m	-2.1403	0.9838

p-statistic requires number of panels to be finite.
Other statistics are suitable for finite or infinite number of panels..

Table 11: Dickey-Fuller test - Labour productiviy

		Statistics	p-value
Inverse chi-squared(100)	P	29.4975	1.0000
Inverse normal	Z	5.9884	1.0000
Inverse logit t(254)	$L*$	6.1766	1.0000
Modified inv. chi-squared	P_m	-3.9926	1.0000

p-statistic requires number of panels to be finite.
Other statistics are suitable for finite or infinite number of panels..

Table 12: Dickey-Fuller test - Markup

		Statistics	p-value
Inverse chi-squared(100)	P	67.0142	0.8496
Inverse normal	Z	0.8467	0.8014
Inverse logit t(254)	$L*$	0.8869	0.8119
Modified inv. chi-squared	P_m	-1.0266	0.8477

p-statistic requires number of panels to be finite.
Other statistics are suitable for finite or infinite number of panels..

C Value added import penetration

Value added import penetration is defined as the foreign value added embodied in the final demand, based on Stehrer (2012) and TiVA's approach. More precisely, this indicator measure how much value added of all trade partners is contained in the final demand of a country.

Based on the Input-Output approach, we have the following equilibrium:

$$x = ic + f = A.x + f = L.f \tag{18}$$

with x, ic and f $NK \times 1$ vectors of respectively gross output, intermediate consumption and final demand (with N being the number of countries and K the number of products). Note that x includes both domestic production and imports. A is a $NK \times NK$ matrix of technical input-output coefficients (or direct requirement coefficients), with element a_{ij} denoting the ratio of input i used to produce j per unit of j gross output. $L = (I - A)^{-1}$ is called the Leontief inverse.

The value added is related to gross output through the following relation $va = V.x$ where va denotes a $NK \times 1$ vector of value added and V a diagonalized $NK \times NK$ matrix of value added share of gross output. Stehrer (2012) illustrates his calculations with an example of trade between three countries r, s and t.

$$\begin{bmatrix} va^r \\ va^s \\ va^t \end{bmatrix} = \begin{bmatrix} v^r & 0 & 0 \\ 0 & v^s & 0 \\ 0 & 0 & v^t \end{bmatrix} \begin{bmatrix} L^{rr} & L^{rs} & L^{rt} \\ L^{sr} & L^{ss} & L^{st} \\ L^{tr} & L^{ts} & L^{tt} \end{bmatrix} \begin{pmatrix} f^{rr} + f^{rs} + f^{rt} \\ f^{sr} + f^{ss} + f^{st} \\ f^{tr} + f^{ts} + f^{tt} \end{pmatrix} \tag{19}$$

where f^{cc} $(c = r, s, t)$ is a $K \times 1$ vector of country c final demand for domestic products, and $f^{cc'}$ $(c \neq c')$ is a $K \times 1$ vector of country c' final demand for country c products. $f^{cc} + f^{c'c} + f^{c''c}$ represents the final domestic demand of country c

We now consider trade between countries r and s. From the previous relation, country s value added can be written as a sum of three terms:

$$va^s = v^s(L^{ss}f^{ss} + L^{sr}f^{rs} + L^{st}f^{ts}) + v^s(L^{sr}f^{rr} + L^{ss}f^{sr} + L^{st}f^{tr}) + v^s(L^{sr}f^{rt} + L^{ss}f^{st} + L^{st}f^{tt})$$

where each term respectively represents the country s value added included in (domestic and imported) final demand of country s, r and t. More precisely, the "value added import of r from s" is the second term of the sum, that is the value added from s included in r final demand:

$$t_M^{rs} = v^s L^{sr} f^{rr} + v^s L^{ss} f^{sr} + v^s L^{st} f^{tr}$$

The first term accounts for the value added created in country s to satisfy country r's domestic demand, the second term denotes value added created in country s to satisfy country r's demand for final products imported from country s and the third term denotes the value added created in country s to satisfay country r's demand for final products imported from country t.

The value added import of country r is then:

$$t_M^r = t_M^{rs} + t_M^{rt}$$

And the value added import penetration of country r is the ratio of the value added import of r to its final demand:

$$\theta_{VA}^r = \frac{t_M^r}{f^{rr} + f^{sr} + f^{tr}}$$

D HHI construction

Herfindahl-Hirschmann Index (HHI) is a measure of firm concentration computed from the market shares. For an intermediate industry level j, the HHI index is defined as $HHI_j = \sum_i (s_{ij})^2$ with $s_{ij} = \frac{Y_{ij}}{Y_j}$ is the ratio (in percent) of the industry i's productiont level the intermediate industry j's production.

CompNet database provides with the industry-level HHI at a more disaggregated level (double-digit) than our industry classification. To comply with our industry classification, industry-level HHIs from the CompNet database have been aggregated. Since CompNet database computes HHI based on firms' turnovers, we need the latter to compute the weight with the turnover. Since we do not possess the industry-level turnover values used in the CompNet database, we approximate with the PROD variable contained in the OECD STAN database using the following formula:

$$HHI = \sum_{j \in \text{industry}} \left(\frac{Y_j}{Y}\right)^2 HHI_j$$

where Y_j and HHI_j are respectively the CompNet industry (double-digit) level production and Y is the total production level in the manufacturing sector. In this paper, we focus on the sectoral heterogeneity. Given this, we have summed the production over the set of countries. HHI is rather stable over time except for the sectors of chemicals and pharmaceuticals (2021) et vehicles and transport (2930).

E Global Value Chain

Wang *et al.* (2016) define participation to global value chain as follows. Considering a country s, its gross output production X^s is the sum of domestic final demand, (final and intermediate) foreign demand and domestic inputs needed to satisfy final domestic and foreign demand, that is:

$$\begin{aligned} X^s &= A^{ss}X^s + \sum_{r \neq s}^{G} A^{sr}X^r + Y^{ss} + \sum_{r \neq s}^{G} Y^{sr} \\ &= A^{ss}X^s + Y^{ss} + E^{s*} \end{aligned}$$

where A^{ss} denotes domestic input coefficient matrix of country s, A^{sr} imported input coefficient matrix of country s from country r, Y^{ss} the domestic final demand of country s and Y^{sr} the final foreign demand addressed to s from country r. $E^{sr} = A^{sr}X^r + Y^{sr}$ are gross exports from country s to country r and $E^{s*} = \sum_{r \neq s}^{G} E^{sr}$ is the total gross exports of country s.

By rearranging terms,

$$X^s = (1 - A^{ss})^{-1}(Y^{ss} + E^{s*}) = \underbrace{L^{ss}}_{\text{local Leontief inverse}} (Y^{ss} + E^{s*})$$

By breaking down the total gross export into exports of intermediate, final goods and the final destination,

$$L^{ss}E^{s*} = L^{ss}\sum_{r \neq s}^{G} Y^{sr} + L^{ss}\sum_{r \neq s}^{G} A^{sr}\sum_{u}^{G} B^{ru}\sum_{t}^{G} Y^{ut}$$

Using all the previous relationships and by multiplying with the direct value-added matrix $\hat{V}$, value-added in an industry within country is given by:

$$
\begin{aligned}
(VA^s)' &= \hat{V}^s X^s \\
&= \hat{V}^s L^{ss} Y^{ss} + \hat{V}^s L^{ss} \sum_{r \neq s}^{G} Y^{sr} + \hat{V}^s L^{ss} \sum_{r \neq s}^{G} A^{sr} \sum_{u}^{G} B^{ru} \sum_{t}^{G} Y^{ut} \\
&= \underbrace{\hat{V}^s L^{ss} Y^{ss}}_{V\_D} + \underbrace{\hat{V}^s L^{ss} \sum_{r \neq s}^{G} Y^{sr}}_{V\_RT} + \underbrace{\hat{V}^s L^{ss} \sum_{r \neq s}^{G} A^{sr} L^{rr} Y^{rr}}_{V\_GVC\_R} \\
&\quad + \underbrace{\hat{V}^s L^{ss} \sum_{r \neq s}^{G} A^{sr} \sum_{u}^{G} B^{ru} Y^{us}}_{V\_GVC\_D} + \underbrace{\hat{V}^s L^{ss} \sum_{r \neq s}^{G} A^{sr} \left(\sum_{u}^{G} B^{ru} \sum_{t \neq s}^{G} Y^{ut} - L^{rr} Y^{rr} \right)}_{V\_GVC\_F}
\end{aligned}
$$

where :

- V_D is the domestically produced and consumed value-added
- V_RT is the value-added embodied in exports of final goods
- $V\_GVC = \{V\_GVC\_R, V\_GVC\_D, V\_GVC\_F\}$ is the value-added embodied in exports of intermediate goods and services
- V_GVC_R value-added embodied in export of intermediate goods and services directly absorbed by partner country (implying a single border crossing)
- V_GVC_D value-added embodied in export of intermediate goods and services returned and consumed in the domestic economy
- V_GVC_F value-added embodied in export of intermediate goods and services indirectly absorbed by partner country and re-exported to a third country

In this paper, we use V_GVC as an indicator of the participation to the GVC.

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