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

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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 (2008) theoretical framework and its empirical setup by Chen *et al.* (2004, 2009). Our contribution is twofold. Conversely to existing works on the effects of globalisation, we use novel trade indicators that account for the development of global value chains (GVC). 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. 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.

Keywords: Inflation, Trade openness, Competition, Markups, Productivity, Input-Output Tables and Analysis
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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 five countries of the Euro Area[1], while taking into account 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 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 nine manufacturing industries in five Euro Area countries (Austria, Germany, Spain, France and Italy) over the period 1995-2014, which allows us to control for the Great Recession.

Our main findings are that trade pro-competitive effect is variable across sectors. When significant, in most cases, trade openness is positively correlated with labour productivity and negatively correlated with markup, in line with the theoretical predictions of the Melitz and Ottaviano (2008) model. An increase in labour productivity and a decrease in markup are negatively related to production price. Unlike Chen *et al.* (2009), we do not find reversal effects of trade in the short- and in the long-run.

The novelty of our paper is threefold. First, we carry out a sector-by-sector analysis to shed light on sectors in which price competition is dominant in the context of globalisation. Since our model focuses on price-competition, it means that tougher competition would induce a lower price and lower markup. Second, unlike the existing papers on the same subject, we consider developments in global value chains (GVC), by measuring trade in value added terms. 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 competitive effect. 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. Finally, we go beyond Melitz and Ottaviano (2008) theoretical framework to account for the lack of strong competitive effects of globalisation in some sectors on price, markup and labour productivity. For instance firms can maintain high level of prices if they increase the quality of their products, hold a monopoly position or reduce their costs by specialising in a certain stage of the production process.

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. Section 7 concludes.

[1] Our analysis covers Austria, France, Germany, Italy and Spain.

2 Review of literature

Globalisation and increased trade disrupt the economic environment and interconnections between countries can make an economy less sensitive to domestic factors. Romer (1993) finds a robust, statistically significant and strong relationship between the average rates of inflation and the degree of openness of economy. The idea stems from Kydland and Prescott (1977): benefits of a surprise inflation by central banks are decreasing with the degree of openness since a surprise monetary expansion is related to a stronger depreciation and effects of depreciation are more serious in an open economy. More recently, Benigno and Faia (2010) find an increased link between the domestic inflation and global factors by identifying two pass-throughs: first, a larger impact of the import prices on the overall price level due to an increase in the number of foreign products in domestic markets; and an increase in the dependence of the pricing strategies of domestic firms on foreign components.

Traditional international trade theories such as Ricardo or Hecksher-Ohlin models mainly focus on interindustry 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 country level. The 2004 version uses a simultaneous equations system and the 2009 version an error correction model to assess the pro-competitive effects of increased import penetration (as a measure of trade openess). 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 too distant from the frontier that firms are discouraged to invest in quality.

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 enhancing 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 in each sector is derived from a quasi-linear preferences over a continuum of varieties indexed by ω and given by:

$$U^i = \alpha \int_{\omega\in\Omega} q^i_\omega d\omega - \frac{1}{2}\gamma \int_{\omega\in\Omega} (q^i_\omega)^2 d\omega - \frac{1}{2}\eta \left(\int_{\omega\in\Omega} q^i_\omega d\omega\right)^2 \tag{1}$$

where q^i_ω represents the agent's consumption level of each variety ω. 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 sectoral consumption level $Q^i = \int_{\omega\in\Omega} q^i_\omega d\omega$.

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

$$\max_{\{q^i_\omega\}_{\omega\in\Omega}} U^i \text{ subject to}$$

$$R > \int_{\omega\in\Omega} p_\omega q^i_\omega d\omega$$

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

Solving the consumer's problem leads to: $p_\omega = \alpha - \gamma q^i_\omega - \eta Q^i$. In the limit case where $\gamma = 0$, prices then only depend on the aggregate quantity of varieties supplied to market. By defining the aggregate sectoral price index, $\overline{p} = \frac{1}{N}\int_{\omega\in\Omega} p_\omega d\omega$, aggregate production for a consumer i can be defined: $Q^i = \frac{(\alpha-\overline{p})N}{\gamma+\eta N\overline{p}}$ where N is the number of firms supplying to the domestic market. Both domestic and foreign firms compete for a variety ω in the 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 gives total demand in the home country for variety ω as:

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

Demand for each variety is linear in prices (equation 2), but unlike the classic monopolistically competitive setup *à la* Dixit and Stiglitz (1977), the price elasticity of demand depends on the number of firms 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 and is perfectly mobile domestically between firms in the same sector, but not across countries. International wage differences are therefore possible in each sector. As a result, the variation in labour costs across firms in a sector solely stem from technological reasons, *i.e.* differences in sectoral productivity. In contrast, sectoral unit costs vary across countries due to differences in wages and technology. Entering a differentiated product sector entails fixed costs including the firms' expenses in research and development and production start-up costs. After entering, 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-valorum* cost (also called, "iceberg costs") $\tau^* > 1$, reflecting transportation costs or tariffs determined in the foreign economy. Production for domestic markets has unit cost c and for exports $\tau^* c$. Transportation costs for foreign goods entering the domestic economy are symmetrically denoted by τ. Firms' entry and exit 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.* $\tau = \tau^*$[2]. Domestic firms' profit $\Pi_D(c)$ and foreign firms' $\Pi_X(c)$ are given by:

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

Profit maximisation problems for the domestic and foreign firms are given by:

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

Assuming that markets are segmented, each firm separately maximises its profit across countries based on the demand for the variety (equation 2) derived in the previous section. 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, cut-off cost c_D expresses the threshold such that for firms with $0 \leq c < c_D$ produce to supply to the market whereas for firms with $c > c_D$ stop producing and leave the market. Since $p_{\max}$ corresponds to the maximum price that consumers are willing to

[2]This assumption will be further analysed in section ??.

pay to get a variety (consumer side) and c_D is the cost above which, firms stop supplying to the market (firm side), at the equilibrium, $c_D = p_{\max}$. In other words, c_D is the unit cost of the firm which is indifferent between staying and leaving the market. As its price is directly driven down by its marginal cost, the marginal firm achieves its zero profit at $p(c_D) = c_D$. Likewise the marginal exporting domestic firms has costs $c_X = \frac{c_D^*}{\tau}$. 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 each sector is assumed to follow a Pareto distribution with cumulative distribution function $G(c) = \left(\frac{c}{c_M}\right)^k$, with k a parameter measuring the dispersion of cost draws and $c \in [0, c_M]$. In this setup, $1/c_M$ represents the lower bound of productivity of the sector. To allow 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).

The Pareto assumption simplifies the expressions for the aggregate sectoral price index $\overline{p}$ and average cost $\overline{c}$, given by:

$$\overline{c} = \frac{1}{G(c_D)} \int_0^{c_D} c\, dG(c) = \frac{k}{k+1} c_D \tag{7}$$

$$\overline{p} = \frac{1}{G(c_D)} \int_0^{c_D} p(c)\, dG(c) = \frac{2k+1}{2(k+1)} c_D \tag{8}$$

With markups for domestic sales equal to $\mu_\omega = p_\omega - c_\omega$, average sector markups are:

$$\overline{\mu} = \frac{1}{2(k+1)} c_D \tag{9}$$

Using the previous theoretical framework and equations (8), (7) and (9), price is linked to the cost and the markups, which are both related to the marginal cost c_D.

$$\begin{cases} \overline{p} = \frac{2k+1}{2(k+1)} c_D = \overline{c} + \overline{\mu} \\ \overline{c} = \frac{k}{k+1} c_D \\ \overline{\mu} = \frac{1}{2(k+1)} c_D \end{cases}$$

Until now, the theoretical framework accounts for the long-run relationship. We now introduce Melitz and Ottaviano (2008) approach to explain dynamic effects of trade liberalisation.

3.3 Short-run implications

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

$$N = \frac{2\gamma(k+1)}{\eta}\left(\frac{\alpha}{c_D} - 1\right) \tag{10}$$

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 aggrgated demand Q^i and lower number of varieties. This characterises the demand side of the economy.

In the short run, firm location is fixed and the decision is whether to produce or not and which markets to supply, *i.e.* the number of firms located in each economy is assumed to be constant.

$$N = \overline{N}_{SR} G(c_D) + \overline{N}^*_{SR} G^*\left(\frac{c_D}{\tau}\right)$$

Using Pareto distribution, the previous equation gives :

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

From the previous equation, c_D for the short-run can be deduced:

$$N = \left(\frac{\overline{N}_{SR}}{c^k_M} + \frac{1}{\tau^k} \frac{\overline{N}^*_{SR}}{(c^*_M)^k}\right) c^k_D \tag{11}$$

In the short run, as cut-off costs c_D directly depend on the number of firms N and the trade costs τ, so do unit costs c, markup μ and prices p. The increase in c_D is associated with an incrase in the number of firms. The above equations characterise the supply side of the economy and firms production decisions. The larger the level of cut-off costs c_D, the larger the number of producing firms. Changes in transport costs τ also affect firms' production decisions and the marginal costs and thus, modify the number of firms supplying to domestic and foreign markets. For instance, a decrease in transport costs leads to a lower c_D and consequently to lower price, costs and markups, implying pro-competitive effects of globalisation.

3.4 Long-run implications

Equation (10) derived from the consumer side is still valid to characterise the demand side of the economy. In the long run, firms can decide to relocate elsewhere, and incur the fixed costs f_E or f^*_E. On the long run, the number of firms located in a country is determined by free entry and the zero profit condition:

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

Combining with $\Pi_D(c) = (p_D(c) - c) * q_D(c)$ and $\Pi_X(c) = (p_X(c) - c\tau) * q_X(c)$, it is possible to solve the system of equations to obtain c_D as an expression of τ, c_M, c^*_M and L as well as for c^*_D. On the long run, c_D does not depend on N but on characteristics of an economy.

Letting N_{LR} and N^*_{LR} denote the endogenous long run equilibrium number of firms located in each country. The total number of firms is the sum of the domestic and foreign firms with costs below the threshold level. The proportion of firms with marginal cost below c_D is given by $G(c_D)$.

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

Using Pareto distribution, the previous equation gives :

$$N = N_{LR} \left(\frac{c_D}{c_M}\right)^k + N^*_{LR} \frac{1}{\tau^k} \left(\frac{c_D}{c^*_M}\right)^k$$

However, the number of firms supplying to domestic market and to foreign market are no longer fixed and vary on the firm entry and exit. Free entry of domestic firms in a country implies zero expected profit. Using the Pareto distribution, zero expected profit conditions in each country pin down closed form solutions for N_{LR} and N_{LR}^*. Recall that $c_X = c_D^*/\tau$ to obtain the following expressions for the costs of the marginal form:

$$\begin{aligned} c_D^{k+2} &= \frac{\phi(\tau)}{(1-\tau^{-2k})L}\left[1 - \frac{1}{(\tau)^k}\left(\frac{c_M^*}{c_M}\right)^k\right] \\ &= \frac{\phi(\tau)}{L}\left[\frac{1-(\tau\lambda)^{-k}}{1-\tau^{-2k}}\right] \end{aligned} \tag{12}$$

where $\phi(\tau) = 2(k+1)(k+2)c_M^k f_E(\tau)$ and $\lambda = c_M/c_M^*$. The cut-off cost is pinned down by the distribution of costs (c_M), the level of fixed costs ($\phi(\tau)/c_M^k$), market size (L) and trade costs (τ). From system of equations, we deduce that in the short-run, costs, markups and hence prices all depend also depend on market size (L) and trade costs (τ).

Depending on the variations of trade costs τ, trade liberalisation can have either anti-competitive or pro-competitive effects. Indeed, a fall in domestic trade costs leads to a upward shift in marginal costs and in equilibrium, to a fall in N. This decrease in the number of firms implies higher prices, higher markups and higher costs. Given this, the long run effect of trade liberalisation can be ambiguous, depending on the relative transport costs between domestic and foreign economy.

3.5 Differentiated model

Following the theoretical framework, price, costs and markup are linked via the cut-off cost c_D. In the long-run, the cut-off cost is given by equation (12). Total differentiating the system of equations with respect to λ, τ and τ^* leads to:

$$\begin{cases} \hat{p} = \frac{\overline{c}}{\overline{c}+\overline{\mu}}\hat{c} + \frac{\overline{\mu}}{\overline{c}+\overline{\mu}}\hat{\mu} \\ \hat{c} = a\hat{\lambda} + b\hat{\tau} + h\hat{L} \\ \hat{\mu} = a\hat{\lambda} + b\hat{\tau} + h\hat{L} \end{cases}$$

with

$$\begin{cases} a = \frac{k}{k+2}\frac{(\lambda\tau)^{-k}}{1-(\lambda\tau)^{-k}} \\ b = \frac{1}{k+2}\left(\frac{\phi'(\tau)\tau}{\phi(\tau)} + k\frac{(\tau\lambda)^{-k}}{1-(\lambda\tau)^{-k}} - k\frac{(\tau)^{-2k}}{1-(\tau)^{-2k}}\right) \\ h = \frac{-1}{k+2} \end{cases}$$

4 Empirical framework

In this section, we adapt the theoretical framework to more estimable models based on Chen *et al.* (2009). The pro-competitive effect of trade liberalisation is assessed through an error-correction model, which enables to distinguish the short run from the long run dynamics of prices, productivity and markups. We then introduce and discuss assumptions we made to adapt the theoretical model.

4.1 Empirical setup

As highlighted in Chen *et al.* (2009), domestic and foreign transport costs, τ and τ^*, are key variables characterising trade liberalisation. However, since reliable estimates of trade costs are difficult to obtain at the sectoral level, like in Chen *et al.* (2009), we use the import penetration ratio as a measure of openness. It is defined as the weight of imports in total domestic demand and enables to proxy the degree of import competition within a country.

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

Since $p_D(c) = \frac{1}{2}(c_D + c)$ and $p_X(c) = \frac{1}{2}(c_X^* + c)$, under the Pareto distribution, it implies:

$$\theta = \frac{1}{1 + \left[\frac{1}{\tau^k}\left(\frac{c_M}{c_M^*}\right)^k\right]^{-1}} \tag{13}$$

Domestic openness falls with the transport costs applied to foreign imports, and increases with domestic relative costs. We use these expressions to replace trade costs with directly observable import shares in each of our equations for prices, markups and productivity.

By rearranging terms in equation (13), the previous equations yield:

$$\frac{1}{\tau^k}\left(\frac{c_M}{c_M^*}\right)^k = \frac{\theta}{1-\theta} \tag{14}$$

These expressions highlight that trade costs can be approximated by a ratio of import penetration, assumming $\frac{c_M}{c_M^*}$ does not change over time. c_M represents the cut-off cost, which stems from the zero-profit condition.

Cost function of firms are not easily observable and due the data accuracy and availability issues, productivity variable is used to make the model estimable. Assuming that unit costs depend only on wages and a negative relationship between cost and productivity variable, we define productivity z based on the following expression: $z = \frac{w}{c}$ where w denotes the nominal wage. Since w is fixed and $1/c$ follows Pareto distribution and using the expression of $\bar{c}$, $\bar{z}$ is given by:

$$\bar{z} = \frac{k^2}{k^2-1} \frac{1}{(c_M/c_D)^k - 1} \frac{w}{\bar{c}} = \frac{k}{k-1} \frac{1}{(c_M/c_D)^k - 1} \frac{w}{c_D}$$

$\bar{z}$ is inversely proportional to c_D. Furthermore, the relationship translates the fact that in the short-run, given the assumption that the number of firms is fixed, the equillibrium determines the number of firms and the cut-off cost c_D. If the degree of openness increases (via a decrease in τ), it increases the number of firms and accordingly, increases productivity and decreases markup level. In the long-run, firms can flexibly reallocate and consequently, c_D is determined by structural aspects of economies.

4.2 Empirical model

Following the theoretical framework, the "direct" effect of globalisation can be measured through the markup and cost channels. Prices can be decomposed into markup and productivity effects. In order to distinguish short-run from long-run effects, we use the error correction model.

We clean prices from monetary policy effects, by estimating relative prices, *i.e.* for a given industry, we divide its nominal production price by the total manufacturing price. Monetary base variables would have been more adapted to correct prices. However since our scope of countries cover European Eurozone countries, monetary base data per country is not available.

Based on the assumptions made in the previous section, unit costs are replaced by productivity. In the short-run, c_D can be replaced with expressions from equation (11). By using the expression given in equation (14), it is possible to express the previous system with the openness (θ).

Our empirical model implies an error correction model with the number of firms D in the short-run and the market size L in the long-run. For labour productivity, the remuneration level is included in addition to the other explanatory variables. To account for the technological progress of $\frac{c_M}{c_M^*}$, we add sector and country dummies. The effect of trade on our three variables of interest is thus assessed through the following equations

$$\begin{cases} \Delta \ln p_{ijt} = \alpha_0 + \alpha_1 \ln \theta_{ijt} + \alpha_2^z \Delta \ln D_{ijt} + \beta \left[\ln p_{ijt-1} + \gamma_0 + \gamma_1 t + \gamma_2 \ln \ln \theta_{ijt-1} + \gamma_3 \ln L_{ijt-1} \right] + \varepsilon_{ijt} \\ \Delta \ln z_{ijt} = \alpha_0^z + \alpha_1^z \Delta \ln \theta_{ijt} + \alpha_2^z \Delta \ln D_{ijt} + \beta^z \left[\ln z_{ijt-1} + \gamma_0^z + \gamma_1^z t + \gamma_2^z \ln \theta_{ijt-1} + \gamma_3^z \ln L_{ijt-1} + \gamma_4^z \ln w_{ijt-1} \right] + \epsilon_{ijt} \\ \Delta \ln \mu_{ijt} = \alpha_0^\mu + \alpha_1^\mu \Delta \ln \theta_{ijt} + \alpha_2^\mu \Delta \ln D_{ijt} + \beta^\mu \left[\ln \mu_{ijt-1} + \gamma_0^\mu + \gamma_1^\mu t + \gamma_2^\mu \ln \theta_{ijt-1} + \gamma_3^\mu \ln L_{ijt-1} \right] + \nu_{ijt} \end{cases}$$

where α_0 is the intercept, θ_{ijt} the import penetration ratio of country i in sector j at time period t and D_{ijt} the number of domestic firms. L_{ijt} is the size of the market (measured by the gross domestic product) and w_{ijt} is the real remuneration level. We also include country, sector fixed effects. Finally, a dummy for the crisis period[3] is added to account for the Great Recession.

4.3 Instrumenting openness

As underlined in Chen *et al.* (2004, 2009), approximating trade costs with openness in our model also introduce endogeneity, 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, a number of instruments are chosen 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 the costs of transport, we use traditional tariff and non-tariff barrier variables as well as some competitiveness variables.

For tariff barriers, we use a bulkiness variable and apparent tariff rate. 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 US exports which are computed as the sum of the exports of the countries in scope minus those of the country. The formal expression is given as follows:

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

where i indexes country, j sector, t time period and $valX$ and $volX$ designate respectively the exports in value and in weight (tons).

[3] 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.

Since our database contains Eurozone 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:

$$\tilde{\tau} = \frac{\sum_{k \in K_j} \tau_{ijkt} m_{ijkt}}{\sum_{k \in K_j} m_{ijkt}} \text{ where } m_{ijkt} \text{ designates import of country } i \text{ in sector } j \text{ of variety } k \text{ at time } t$$

The higher the apparent tariff rate is, the more countries import products which have high tariff rate. It can be 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 we use gravity variables. 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 national products) and inversely proportional to the distance separating these two countries:

$$G_{ijt} = \sum_{k \neq i} \frac{RGDP_{kjt}}{d_{ikt}} \text{ where } RGDP_{kjt} \text{ designates the real GDP of country } k \text{ in sector } j \text{ at time } t$$

Finally we add competitiveness variables since increased competitiveness can also reduce trade costs. The real effective exchange rate is a traditional competitiveness indicator. Since it is built as a weighted[4] average of bilateral exchange rates, it takes into account a set of exchange rates – and thus, better reflects the value of a currency – and the trade structure of the country.

Following Martin and Mejean (2014), we include the Balassa index which measures revealed comparative advantage by comparing a country's export shares in an industry to the reference area's average export shares enables to compute the revealed comparative advantage of country i compared to the reference area a:

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

5 A preliminary investigation: descriptive analysis

5.1 Data processing

Our sample covers five Euro Area countries (Austria, France, Germany, Italy and Spain), eight manufacturing sectors[5] over the period 1995-2014. Our country selection is based on data availability on the one hand and the fact that those five selected countries represent 61% of the GDP of European Union and around 85% of the GDP of the Eurozone on the other hand. We combine data from Eurostat, OECD, WIOD and BACH (See Appendix A for further details on our dataset).

Firm data at a sector level. For our price data, we use annual producer price index in manufacturing industry for domestic market. Labour productivity is measured as the ratio of real value added to total employment, as provided by Eurostat. Instead of the number of foreign exporting firms, we use its relationship to the number of active domestic firms provided by

[4] In our paper, we use double-weighting (Turner and Van't dack, 1993) method to build the variable.

[5] See Table 11 in Appendix A

Eurostat Structural Business Survey (SBS) database.

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. It covers eleven European countries[6]. 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. But for most countries, subsets of the total population are available and large companies are generally over represented[7].

Markups represent the market power of a firm, i.e. its ability to set and sustain its price above its marginal costs. It is 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):

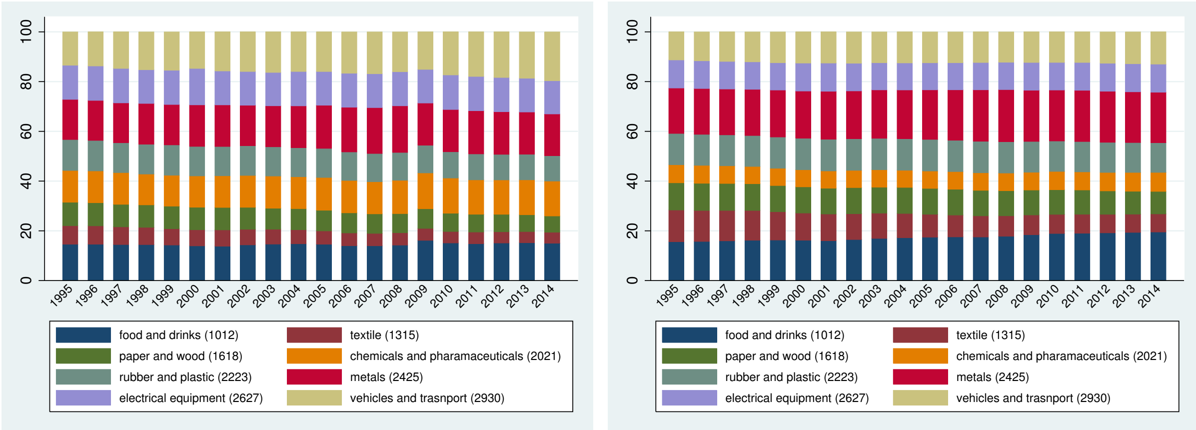
$$\mu_{ijt} = \left[\frac{\text{unit price}}{\text{unit variable costs}}\right]_{ijt} = \left[\frac{\text{turnover}}{\text{total variable costs}}\right]_{ijt}$$

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 (see Appendix B for a more detailed presentation).

[6] 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.

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

5.2 Sectoral dynamics



(a) VA

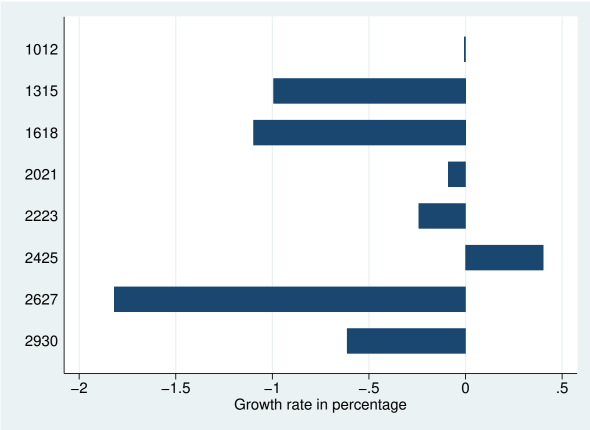
(b) Employment

Figure 1: Dynamics of sectoral shares per industry over time

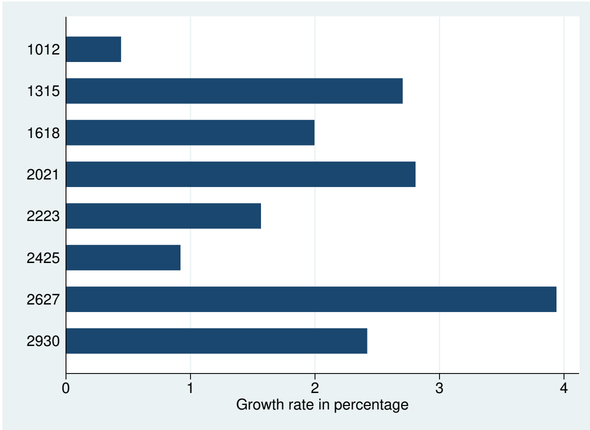
Figure 1 displays the shares of manufacturing sectors from 1995 to 2014 in terms of value added and employment. Since we focus on the sectoral heterogeneity, the shares are computed after summing up the variable (in current value) over the set of countries. In general, the sectoral shares remain rather 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 shares of sectors within the economy is of high interest. Indeed, a declining sector may behave differently towards trade openness. For instance, some sectors can be regarded as strategic sectors and thus, they may be protected from the foreign competition. This may cancel out or mitigate productivity gains or crowding out of less productive firms. In our model, it can appear as a decline in productivity while the openness is increasing within the sector.

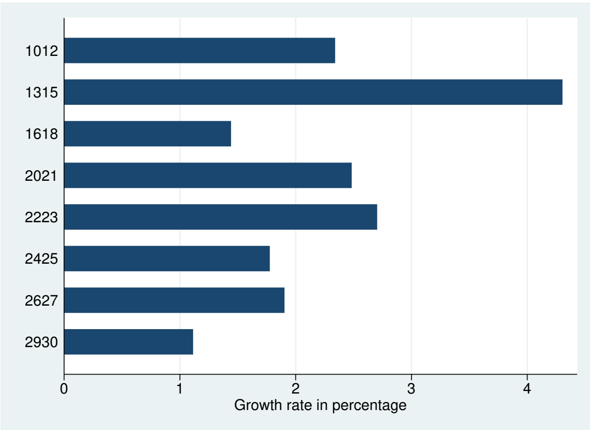
5.3 Trends analysis



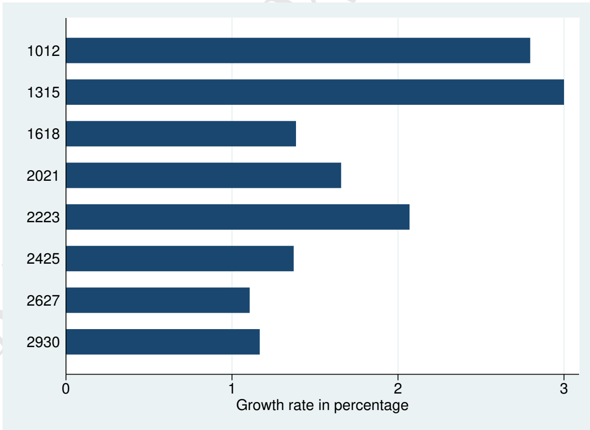
(a) Relative Production price



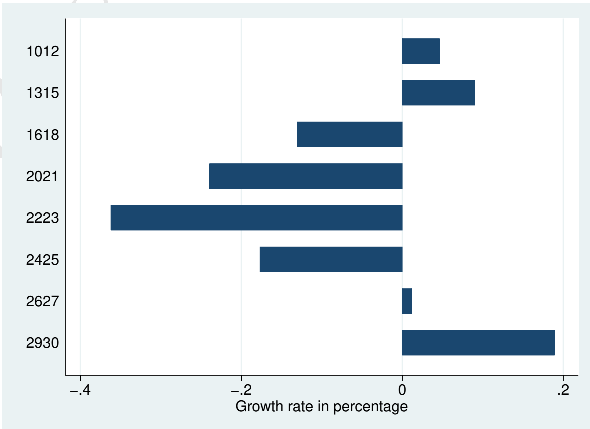
(b) Labour productivity



(c) Gross import penetration



(d) VA import penetration



(e) Markups

Figure 2: Time trends (controlled for country fixed effects)

In this section, we study the long-term dynamics of our key variables. Figure 2 displays the coefficients obtained by regressing key variables on time trends for the period 1995-2014 while controlling for country fixed effects. It 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. However these figures only provide statistical correlations with respect to the time trend and further analysis is required.

Relative production price has most decreased in the sectors of textile (1315), wood and paper (1618), electrical equipments (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 accross industries : 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). A thriving literature promotes the use of value added to measure trade flows, namely in order to account for the interdependencies and the fragmentation of the production process. In this regard, a larger increase in VA import penetration than in gross import penetration may imply a more important fragmentation in the production process.

Finally, markups are characterised by a decreasing dynamics. Markups have been increasing in the sectors of food and drinks (1012), textile (1315), electrical equipments (2627) and vehicles and transport (2930). 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. One can notice a decrease in price in the sectors of textile (1315) and vehicles and transport (2930) while markups have increased. One possible explanation would be that surviving firms are characterised by higher markups due to their comparative davantages.

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 further 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 globasliation 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 and the equation is similar to that of Chen *et al.* (2009). Since the period 1995-2014 include the 2007 financial crisis and global recession, we add a crisis dummy for the period 2007-2009 to capture the global trade and economic slowdown. When estimating with gross import penetration, the OLS and IV regressions provide similar results with expected effets on productivity and markups *i.e.* positive for the productivity and negative for the markups. However, the effect of openness is not significant on prices (table 1). When using VA import penetration in the pooled sample regression, the results are improved. Indeed, 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. For the whole economy, an increase in trade openness has some results predicted by the theoretical framework. However, the pro-competitive effects is not identified in the long-run and given this, we pursue our investigation by taking into account the sectoral heterogeneity.

Table 1: Pooled sample regression - gross import penetration

	(1) Price	(2) Productivity	(3) Markup	(4) Price (IV)	(5) Productivity (IV)	(6) Markup (IV)
$\ln \frac{\text{PPI}_{it-1}}{\text{PPItot}_{t-1}}$	-0.12***			-0.12***		
	(0.02)			(0.02)		
$\ln z_{t-1}$		-0.16***			-0.14***	
		(0.02)			(0.02)	
$\ln \mu_{it-1}$			-0.28***			-0.27***
			(0.03)			(0.03)
$\Delta \ln \theta_{it}$	0.02	0.10**	-0.05***	0.01	0.38***	-0.07**
	(0.02)	(0.04)	(0.01)	(0.03)	(0.09)	(0.03)
$\ln \theta_{it-1}$	-0.01	0.02	-0.00	0.00	-0.08	0.02
	(0.01)	(0.02)	(0.01)	(0.02)	(0.07)	(0.02)
crisis	0.01***	-0.08***	0.00	0.01***	-0.08***	0.00
	(0.00)	(0.01)	(0.00)	(0.00)	(0.01)	(0.00)
$\Delta \ln D_{it}$	0.01	0.00	-0.01	0.00	0.05	-0.02
	(0.01)	(0.03)	(0.01)	(0.02)	(0.04)	(0.01)
$\ln L_{it-1}$	-0.03***	0.23***	-0.01	-0.05**	0.37***	-0.03*
	(0.01)	(0.04)	(0.01)	(0.02)	(0.09)	(0.02)
$\ln \frac{w_{it-1}}{\text{PPI}_{it-1}}$		-0.05**			-0.09***	
		(0.02)			(0.04)	
Import indicator	gross	gross	gross	gross	gross	gross
Specification	OLS	OLS	OLS	IV	IV	IV
Country fixed effects	yes	yes	yes	yes	yes	yes
Observations	691	720	720	691	720	720
R^2	0.10	0.26	0.16	0.09	0.17	0.14

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 2: Pooled sample regression - VA import penetration

	(1) Price	(2) Productivity	(3) Markup	(4) Price (IV)	(5) Productivity (IV)	(6) Markup (IV)
$\ln \frac{\text{PPI}_{it-1}}{\text{PPItot}_{t-1}}$	-0.12***			-0.11***		
	(0.02)			(0.02)		
$\ln z_{t-1}$		-0.15***			-0.15***	
		(0.02)			(0.02)	
$\ln \mu_{it-1}$			-0.28***			-0.26***
			(0.03)			(0.03)
$\Delta \ln \theta_{it}$	-0.04**	0.17***	-0.11***	-0.16***	0.64***	-0.15***
	(0.02)	(0.05)	(0.02)	(0.05)	(0.12)	(0.04)
$\ln \theta_{it-1}$	0.00	0.02	-0.02***	0.03	-0.01	0.00
	(0.01)	(0.02)	(0.01)	(0.02)	(0.06)	(0.02)
crisis	0.01***	-0.08***	-0.00	0.01*	-0.06***	-0.00
	(0.00)	(0.01)	(0.00)	(0.00)	(0.01)	(0.00)
$\Delta \ln D_{it}$	0.00	-0.00	-0.01	-0.00	0.02	-0.02
	(0.01)	(0.03)	(0.01)	(0.01)	(0.04)	(0.01)
$\ln L_{it-1}$	-0.05***	0.24***	0.00	-0.07***	0.29***	-0.02
	(0.01)	(0.04)	(0.01)	(0.02)	(0.07)	(0.02)
$\ln \frac{w_{it-1}}{\text{PPI}_{it-1}}$		-0.05***			-0.06***	
		(0.02)			(0.02)	
Import indicator	VA	VA	VA	VA	VA	VA
Specification	OLS	OLS	OLS	IV	IV	IV
Country fixed effects	yes	yes	yes	yes	yes	yes
Observations	691	720	720	691	720	720
R^2	0.10	0.27	0.20	0.03	0.15	0.18

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

6.1.2 Sector-by-sector approach

In this section, the estimation is carried out by sector separately. 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). The short-run coefficient of openness is negative and significant only in the sectors of food and drinks (1012), electrical equipment (2627) and textile while the coefficient is positive for the sector of metals (2425).

As for productivity, when significant, openness is positively correlated in the sectors of wood and paper (1618), metals (2425) and electrical equipment (2627) in the short-run. In the long run, it is positively correlated to productivity in the sector of textile (1315) and negatively correlated in the sector of vehicles and transport (2930). Like the pooled sample regressions, we add the crisis dummy to capture the plunge in productivity at the wake of the global financial crisis.

As for markups, when significant, the coefficient of openness is negative, namely in the sectors of metals (2425), wood and paper (1618) and food and drinks (1012). 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 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. Furthermore, they assume that the country produces from the beginning to the end whereas the global trend in terms of the production process is to divide into various tasks and intermediate components. To overcome such issues, an alternative indicator of openness using value added can be used.

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 import 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 not significant in the sectors of wood and paper (1618) and chemicals and pharmaceuticals (2021). Sectors in which an increase in openness has no effect on the productivity are the sectors of food and drinks (1012), chemicals and

Table 3: Sectoral regression using gross import penetration

	(1) 1012	(2) 1315	(3) 1618	(4) 2021	(5) 2223	(6) 2425	(7) 2627	(8) 2930
				Price $\Delta \ln ppi_{it}$				
$\Delta \ln \theta_{it}$	-0.38***	-0.24*	-0.04	0.08	-0.02	0.24***	-0.18**	-0.05
	(0.09)	(0.13)	(0.10)	(0.09)	(0.06)	(0.05)	(0.08)	(0.14)
$\Delta \ln D_{it}$	-0.07**	-0.00	0.01	-0.03	0.03	0.08*	0.02	0.00
	(0.03)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.05)
$\ln ppi_{it-1}$	-0.15*	-0.36***	-0.30***	-0.17***	-0.21***	-0.19**	-0.16***	-0.17**
	(0.08)	(0.10)	(0.10)	(0.06)	(0.06)	(0.08)	(0.06)	(0.07)
$\ln \theta_{it-1}$	0.03	-0.04	-0.13**	-0.02	-0.02	0.00	-0.15*	-0.01
	(0.03)	(0.03)	(0.07)	(0.03)	(0.02)	(0.04)	(0.09)	(0.10)
$\ln L_{it-1}$	-0.07**	-0.12*	-0.08*	0.01	-0.02	0.03	-0.04	-0.10
	(0.03)	(0.06)	(0.05)	(0.03)	(0.03)	(0.03)	(0.05)	(0.07)
crisis	0.01	0.01	0.00	-0.01	0.02***	0.01*	0.00	0.03***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
				Productivity $\Delta \ln z_{it}$				
$\Delta \ln \theta_{it}$	0.42	0.14	0.36***	-0.18	0.19	0.42***	0.43**	0.13
	(0.25)	(0.25)	(0.11)	(0.25)	(0.15)	(0.12)	(0.18)	(0.47)
$\Delta \ln D_{it}$	0.14*	-0.11	0.05	-0.03	0.01	-0.01	0.04	0.19
	(0.08)	(0.07)	(0.06)	(0.12)	(0.10)	(0.12)	(0.11)	(0.15)
$\ln z_{it-1}$	-0.33***	-0.64***	-0.34***	-0.25***	-0.22***	-0.27***	-0.10	-0.32***
	(0.09)	(0.09)	(0.08)	(0.09)	(0.07)	(0.08)	(0.06)	(0.11)
$\ln \theta_{it-1}$	-0.10	0.13**	0.07	0.09	0.07	0.12	-0.15	-0.66*
	(0.06)	(0.05)	(0.08)	(0.10)	(0.05)	(0.09)	(0.16)	(0.40)
$\ln w_{it-1}$	-0.16**	-0.34***	-0.25***	0.12	-0.03	-0.22**	-0.16*	0.01
	(0.08)	(0.07)	(0.07)	(0.10)	(0.08)	(0.10)	(0.09)	(0.13)
$\ln L_{it-1}$	0.58***	0.30**	0.54***	0.04	0.10	0.38**	0.50***	1.00**
	(0.17)	(0.13)	(0.13)	(0.18)	(0.11)	(0.15)	(0.14)	(0.44)
crisis	-0.06***	-0.06***	-0.04***	-0.05***	-0.08***	-0.09***	-0.07***	-0.17***
	(0.02)	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)	(0.02)	(0.04)
				Markup $\Delta \ln \mu_{it}$				
$\Delta \ln \theta_{it}$	-0.22*	0.05	-0.09**	0.03	-0.05	-0.12***	0.02	0.13
	(0.12)	(0.08)	(0.04)	(0.08)	(0.05)	(0.04)	(0.05)	(0.14)
$\Delta \ln D_{it}$	-0.02	0.03	-0.01	-0.06*	0.00	0.00	-0.04	-0.01
	(0.04)	(0.02)	(0.02)	(0.04)	(0.04)	(0.04)	(0.03)	(0.04)
$\ln \mu_{it-1}$	-0.20***	-0.63***	-0.78***	-0.44***	-0.33***	-0.27***	-0.32***	-0.39***
	(0.07)	(0.11)	(0.10)	(0.10)	(0.10)	(0.08)	(0.09)	(0.11)
$\ln \theta_{it-1}$	-0.07**	0.00	-0.06**	0.01	-0.01	-0.00	0.06	0.00
	(0.03)	(0.02)	(0.03)	(0.03)	(0.02)	(0.03)	(0.04)	(0.09)
$\ln L_{it-1}$	0.03	0.03	0.01	-0.06*	-0.07***	-0.02	-0.04	0.08
	(0.05)	(0.04)	(0.02)	(0.03)	(0.02)	(0.03)	(0.04)	(0.06)
crisis	-0.00	0.00	0.00	0.01	0.00	-0.01	0.01*	-0.01
	(0.01)	(0.01)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Import indicator	gross	gross	gross	gross	gross	gross	gross	gross
Specification	IV	IV	IV	IV	IV	IV	IV	IV
Country fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
Time fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
Observations	89	88	85	89	89	81	81	89

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 4: Sectoral regression using VA import penetration

	(1) 1012	(2) 1315	(3) 1618	(4) 2021	(5) 2223	(6) 2425	(7) 2627	(8) 2930
				Price $\Delta \ln ppi_{it}$				
$\Delta \ln \theta_{it}$	-0.32***	-0.59***	-0.17*	0.18	-0.29***	0.33***	-0.38***	-0.47**
	(0.07)	(0.21)	(0.10)	(0.23)	(0.07)	(0.06)	(0.11)	(0.21)
$\Delta \ln D_{it}$	-0.02	-0.02	-0.03	-0.05	0.00	0.06	0.02	-0.00
	(0.03)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.05)
$\ln ppi_{it-1}$	-0.29***	-0.36***	-0.32***	-0.18**	-0.17***	-0.18**	-0.11***	-0.23***
	(0.08)	(0.10)	(0.09)	(0.08)	(0.06)	(0.08)	(0.04)	(0.08)
$\ln \theta_{it-1}$	0.03	-0.01	-0.14**	-0.06	-0.00	0.03	-0.23***	-0.15**
	(0.02)	(0.03)	(0.07)	(0.05)	(0.03)	(0.06)	(0.09)	(0.07)
crisis	0.01	0.01	-0.01	-0.00	0.01	0.02*	-0.00	0.00
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
$\ln L_{it-1}$	-0.07**	-0.23***	-0.08*	0.04	-0.03	0.02	-0.04	-0.08*
	(0.03)	(0.07)	(0.04)	(0.04)	(0.03)	(0.04)	(0.05)	(0.05)
				Productivity $\Delta \ln z_{it}$				
$\Delta \ln \theta_{it}$	0.26*	0.35	0.48***	-0.26	0.54***	0.67***	0.90***	0.67
	(0.15)	(0.33)	(0.13)	(0.57)	(0.18)	(0.16)	(0.28)	(0.56)
$\Delta \ln D_{it}$	0.07	-0.10	0.03	0.02	0.04	0.01	0.02	0.12
	(0.07)	(0.08)	(0.06)	(0.11)	(0.10)	(0.11)	(0.11)	(0.14)
$\ln z_{it-1}$	-0.38***	-0.57***	-0.34***	-0.25***	-0.19***	-0.31***	-0.15***	-0.36***
	(0.08)	(0.09)	(0.08)	(0.08)	(0.06)	(0.08)	(0.05)	(0.13)
$\ln \theta_{it-1}$	-0.07	0.08*	0.15*	0.21	0.12	0.43***	-0.04	-0.30
	(0.05)	(0.04)	(0.08)	(0.15)	(0.07)	(0.14)	(0.20)	(0.28)
$\ln w_{it-1}$	-0.10	-0.34***	-0.24***	0.05	-0.03	-0.27***	-0.15	0.04
	(0.06)	(0.08)	(0.07)	(0.10)	(0.08)	(0.09)	(0.09)	(0.13)
$\ln L_{it-1}$	0.49***	0.39***	0.48***	0.09	0.06	0.31**	0.53***	0.78**
	(0.14)	(0.12)	(0.13)	(0.18)	(0.12)	(0.14)	(0.15)	(0.39)
crisis	-0.06***	-0.06***	-0.03**	-0.06***	-0.06***	-0.09***	-0.04*	-0.09**
	(0.02)	(0.02)	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)	(0.05)
				Markup $\Delta \ln \mu_{it}$				
$\Delta \ln \theta_{it}$	-0.21**	-0.03	-0.13**	-0.09	-0.22***	-0.22***	-0.05	0.04
	(0.09)	(0.09)	(0.05)	(0.21)	(0.06)	(0.05)	(0.08)	(0.18)
$\Delta \ln D_{it}$	-0.01	0.03	-0.02	-0.06*	-0.01	0.01	-0.02	-0.01
	(0.04)	(0.02)	(0.02)	(0.04)	(0.03)	(0.04)	(0.03)	(0.04)
$\ln \mu_{it-1}$	-0.19***	-0.60***	-0.72***	-0.47***	-0.36***	-0.34***	-0.29***	-0.38***
	(0.07)	(0.12)	(0.11)	(0.09)	(0.11)	(0.10)	(0.09)	(0.09)
$\ln \theta_{it-1}$	-0.06**	0.00	-0.07**	-0.01	-0.03	-0.07	-0.01	-0.03
	(0.02)	(0.01)	(0.03)	(0.04)	(0.04)	(0.06)	(0.07)	(0.05)
$\ln L_{it-1}$	0.04	0.01	0.01	-0.05	-0.07***	0.01	0.01	0.08**
	(0.04)	(0.03)	(0.02)	(0.04)	(0.02)	(0.04)	(0.04)	(0.04)
crisis	-0.00	0.00	-0.00	0.01	-0.01	-0.01	0.01	-0.01
	(0.01)	(0.01)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Import indicator	VA	VA	VA	VA	VA	VA	VA	VA
Specification	IV	IV	IV	IV	IV	IV	IV	IV
Country fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
Time fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
Observations	90	90	90	90	90	90	90	90

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

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) and metals (2425).

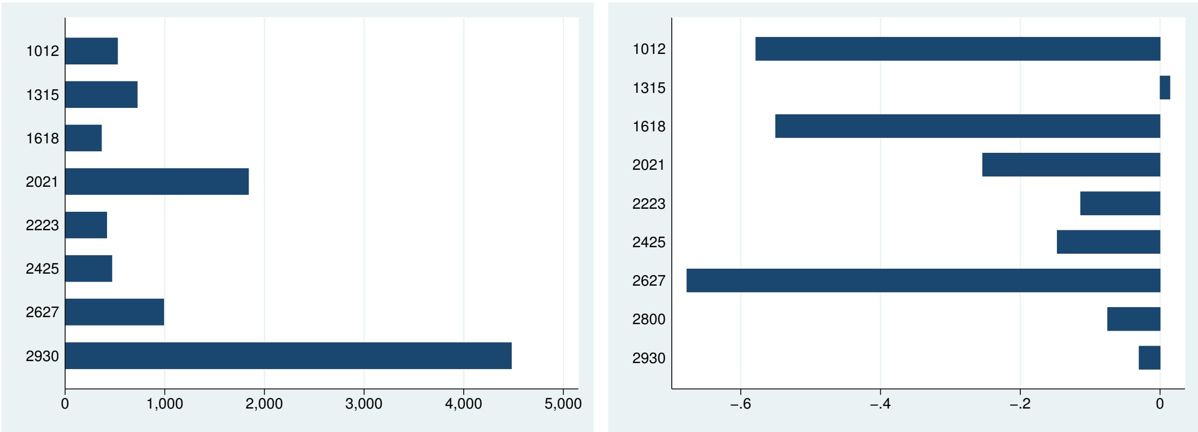
6.2 Effects of firm concentration and product quality

Information on the firm concentration measured by the Herfindahl-Hirschmann Index (HHI) and quality changes[8] (figure ??) 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). In this regard, a part of answer to the absence of the effect of trade openness may be attributed to the high firm concentration that would offset or mitigate the competitive effect of openness. The sectors of food and drinks (1012) and textile (1315) display also a slighly 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 contribute to the weak effect of trade openness on productivity and markups. To recap, our theoretical prediction holds if openness is translated into a larger market with a larger number of firms. Yet, if the market is highly concentrated, domestic firms may be large and may be resistant to the adjustment caused by a tougher competition exerted from the foreign firms. In other words, domestic firms may adjust slowly to the trade openness and thus, the effects of trade openness can be weakened. According to our estimates, high sector concentration has significant anti-competitive effects on productivity and markup in the short-run but not in the long-run. It dampens competitive effects of trade on productivity and offset its effect on markups.

Finally, the sectors of wood and paper (1618) and electrical equipment (2627) have weak effects of trade openness on both prices and productivity. However, they are characterised by low firm concentration level and stable quality dynamics. In other words, factors other than the firm concentration and the quality dynamics would be behind this weak effect of the trade. As for the sector of wood and paper (1618), the part of answer can be found in the weight of those sectors in the economy insofar as its share has been declining during the whole period (figure 1).

Finally, in addition to the firm concentration and the quality dynamics, the origin country of the imports can be another factor that can explain the low effect of trade in the sector of textile (1315). The sector of textile is characterised by a very proportion of imports from the low income countries.commentaire : citer un graphique

[8]Details of the indicators will be added in the appendix.



(a) Firm concentration (HHI index in level)

(b) Quality change (annual growth)

Sources: CompNet databases.
Notes: Quality change is computed following Martin et Mejean (2013)

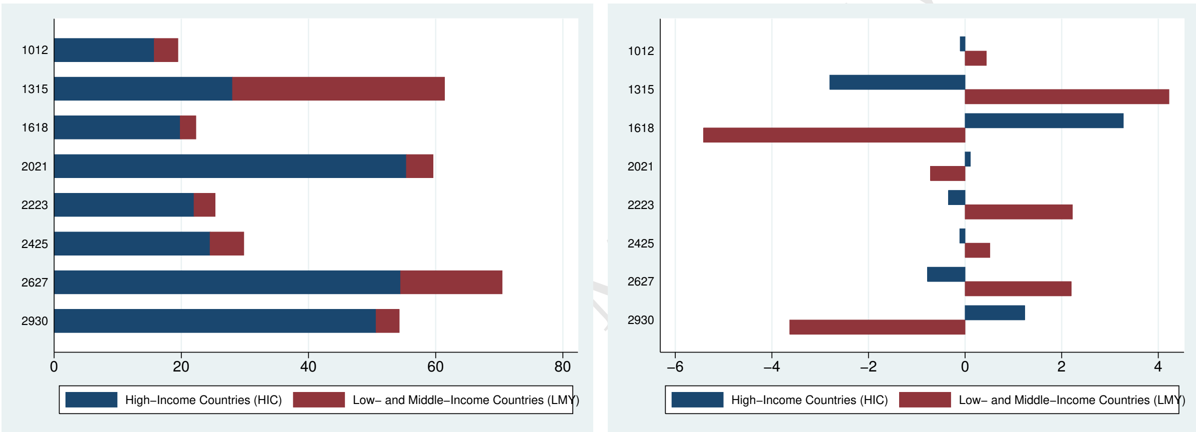
Figure 3: Firm concentration and quality change (average over time)

6.3 Alternate measures of trade openness

6.3.1 Origin of imports - low- and middle-income countries

Another driver that should be taken into account is the origin of imports. As underlined by Auer *et al.* (2013a), competition with low-wage countries entails changes in inflationary pressure in Europe. Our theoretical framework does not entirely address the question of structural differences across countries. However, 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 classificatin given by the World Bank[9], we distinguish high-income countries from low- and middle-income countries.

As displayed in figure 4, not only is the level of the import penetration different, the composition of the imports is also heterogeneous. Among the sectors with high openness such as the sectors of textile (1315), chemicals and pharmaceuticals (2021), electrical equipments (2627) and vehicles and transport (2930), the share of low- and middle-income countries is high in the sectors of textile and electrical equipments while it is very low in the two others.



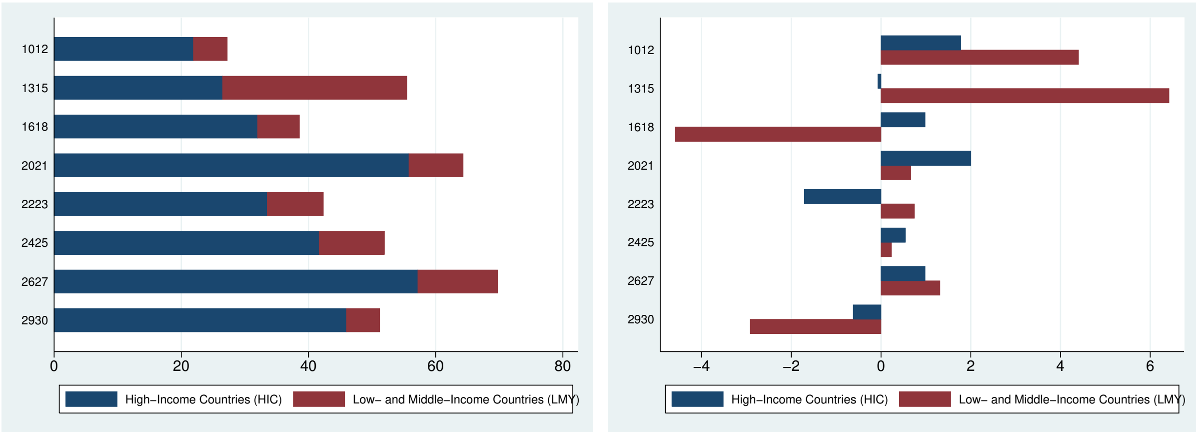
(a) Gross import penetration ratio (average over time)

(b) Annual average growth of the gross import penetration over 2000-2014

Figure 4: Origins of imports (gross measures) - distinction between Low-, Middle- and High-Income countries

Figure 5 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 imports from different type of countries are strongly affected. Figures 4 and 5 highlight the importance of considering the VA measures.

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



(a) VA import penetration ratio (average over time)

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

Figure 5: Origins of imports (VA measures) - distinction between Low-, Middle- and High-Income countries

In this section, we distinguish imports from low- and middle-income countries (LMY) from those from high-income countries (HIC). As a matter of fact, Auer and Fischer (2010) et Auer *et al.* (2013b) found that the imports from low-wage countries bring out a disinflationary effect. The effect of competition may differ depending on the origin of the imports. 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. For each regression, we distinguish again gross and VA import penetration.

For the pooled sample, openness as regards low- and middle-income countries is negatively correlated with the price and markup levels whereas the openness as regards high income countries is positively correlated. This results holds for both gross and VA import penetration. When using gross import penetration ration, productivity decreases with the imports from high income countries and increases with the imports from low- and middle-income countries. However, surprisingly, when using the value-added indicator, productivity only increases with the imports from low- and middle-income countries.

When carrying out the estimation at the sector level, the gross openness towards high-income countries and the openness towards low- and middle-income countries often have opposite effects. Just like the pooled sample regression case, import penetration from high-income countries is positively correlated with markups and prices when significant while the import penetration from low- and middle-income has pro-competitive effects *i.e.* a decrease in prices and markups and an increase in productivity. Estimation with VA import penetration ratio yields more significant coefficients.

6.3.2 GVC participation

GVC participation is computed by Wang *et al.* (2016), using the 2013 edition of WIOD Input-Output Tables. Participation to GVCs 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. Thus, it indicates how much a country is integrated in the international trade, or more precisely, in the global value chain.

Table 5: Pooled sample regression (instrumented) - LWC

	(1) Price	(2) Productivity	(3) Markup	(4) Price (VA)	(5) Productivity (VA)	(6) Markup (VA)
$\ln \frac{\text{PPI}_{it-1}}{\text{PPItot}_{t-1}}$	-0.28***			-0.21***		
	(0.11)			(0.05)		
$\ln z_{t-1}$		-0.25***			-0.21***	
		(0.08)			(0.03)	
$\ln \mu_{it-1}$			-0.26***			-0.26***
			(0.04)			(0.03)
$\Delta \ln \theta_{it}^{HIC}$	0.65***	-0.73**	0.22*	0.56***	-0.03	0.05
	(0.19)	(0.30)	(0.13)	(0.14)	(0.21)	(0.07)
$\Delta \ln \theta_{it}^{LMY}$	-0.33***	0.56***	-0.16***	-0.19***	0.20***	-0.09***
	(0.09)	(0.14)	(0.06)	(0.03)	(0.04)	(0.02)
$\ln \theta_{it-1}^{HIC}$	-0.15	-0.07	-0.03	0.15**	-0.22**	-0.02
	(0.12)	(0.11)	(0.05)	(0.06)	(0.10)	(0.03)
$\ln \theta_{it-1}^{LMY}$	-0.12*	0.12*	-0.00	-0.06**	0.07**	-0.02
	(0.06)	(0.07)	(0.03)	(0.02)	(0.03)	(0.01)
crisis	-0.01	-0.05***	-0.00	0.01**	-0.07***	-0.00
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)
$\Delta \ln D_{it}$	0.09	0.02	-0.01	0.05**	-0.01	0.00
	(0.06)	(0.06)	(0.03)	(0.02)	(0.04)	(0.01)
$\ln L_{it-1}$	0.42*	-0.07	0.02	0.17*	0.10	0.06
	(0.25)	(0.22)	(0.14)	(0.09)	(0.11)	(0.05)
$\ln \frac{w_{it-1}}{\text{PPI}_{it-1}}$		-0.04			-0.05**	
		(0.03)			(0.02)	
Observations	691	720	720	691	720	720
R^2	-5.40	-0.74	-0.74	-1.26	0.18	0.06

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 6: Sectoral regression using gross import penetration

	(1) 1012-IV	(2) 1315-IV	(3) 1618-IV	(4) 2021-IV	(5) 2223-IV	(6) 2425-IV	(7) 2627-IV	(8) 2930-IV
$\ln \frac{\text{PPI}_{it-1}}{\text{PPItot}_{t-1}}$	-0.17	-0.37	-0.33***	-0.18**	-0.14*	-0.23**	-0.05	-0.76
	(0.12)	(0.24)	(0.11)	(0.07)	(0.08)	(0.10)	(0.07)	(0.58)
crisis	-0.00	-0.00	0.00	0.00	0.00	0.01	-0.00	-0.04
	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.08)
$\Delta \ln \theta_{it}^{HIC}$	-0.18	0.76**	-0.04	0.02	0.34***	-0.06	-0.14	0.37
	(0.20)	(0.31)	(0.19)	(0.09)	(0.12)	(0.12)	(0.11)	(0.55)
$\Delta \ln \theta_{it}^{LMY}$	-0.20**	-0.57***	-0.03	0.10**	-0.22***	0.10*	-0.09*	-0.03
	(0.09)	(0.19)	(0.07)	(0.05)	(0.06)	(0.06)	(0.05)	(0.08)
$\ln \theta_{it-1}^{HIC}$	-0.24*	-0.00	0.08	-0.11**	0.04	-0.36**	-0.18**	-0.48
	(0.13)	(0.10)	(0.10)	(0.05)	(0.07)	(0.16)	(0.08)	(0.55)
$\ln \theta_{it-1}^{LMY}$	0.13*	-0.14**	-0.11***	0.04**	-0.04	0.15**	-0.02	-0.19
	(0.07)	(0.07)	(0.04)	(0.02)	(0.03)	(0.06)	(0.02)	(0.18)
$\Delta \ln D_{it}$	-0.01	-0.05	0.01	-0.05	0.10*	0.09	0.01	0.20
	(0.05)	(0.08)	(0.05)	(0.05)	(0.05)	(0.06)	(0.05)	(0.25)
$\ln L_{it-1}$	-0.05	0.34	0.01	-0.08	0.06	-0.29**	-0.03	0.99
	(0.04)	(0.25)	(0.06)	(0.05)	(0.08)	(0.13)	(0.08)	(1.07)
$\ln z_{t-1}$	-0.44***	-0.73***	-0.33***	-0.24**	-0.26***	-0.18	-0.18**	-0.28***
	(0.12)	(0.17)	(0.08)	(0.11)	(0.08)	(0.13)	(0.08)	(0.11)
crisis	-0.06***	-0.04*	-0.04***	-0.05**	-0.06***	-0.12***	-0.05**	-0.14***
	(0.02)	(0.02)	(0.01)	(0.02)	(0.02)	(0.04)	(0.02)	(0.04)
$\Delta \ln \theta_{it}^{HIC}$	-0.09	-0.53	0.23	-0.17	-0.26	0.82	0.15	-0.33
	(0.42)	(0.54)	(0.23)	(0.23)	(0.25)	(0.54)	(0.25)	(0.49)
$\Delta \ln \theta_{it}^{LMY}$	0.29*	0.65**	0.09	0.09	0.32**	-0.15	0.17*	0.02
	(0.17)	(0.29)	(0.10)	(0.12)	(0.14)	(0.23)	(0.10)	(0.09)
$\ln \theta_{it-1}^{HIC}$	-0.40*	0.37**	-0.05	0.07	-0.48*	-0.06	-0.08	-0.37
	(0.22)	(0.19)	(0.14)	(0.12)	(0.27)	(0.32)	(0.12)	(0.34)
$\ln \theta_{it-1}^{LMY}$	0.18	0.05	0.06	0.00	0.21**	0.03	0.03	0.05
	(0.12)	(0.13)	(0.06)	(0.05)	(0.09)	(0.13)	(0.04)	(0.07)
$\Delta \ln D_{it}$	0.13	0.06	0.05	-0.06	-0.04	0.15	0.07	0.15
	(0.10)	(0.11)	(0.06)	(0.12)	(0.13)	(0.23)	(0.10)	(0.14)
$\ln L_{it-1}$	0.66***	0.30	0.48***	-0.01	-0.19	0.36	0.42***	0.32
	(0.20)	(0.55)	(0.14)	(0.19)	(0.19)	(0.26)	(0.16)	(0.60)
$\ln \frac{w_{it-1}}{\text{PPI}_{it-1}}$	-0.21**	-0.47**	-0.25***	0.14	-0.27*	-0.18	-0.26**	0.05
	(0.11)	(0.20)	(0.07)	(0.12)	(0.15)	(0.12)	(0.13)	(0.12)
$\ln \mu_{it-1}$	-0.14	-0.63***	-0.83***	-0.38***	-0.10	-0.23**	-0.28***	-0.24
	(0.09)	(0.12)	(0.11)	(0.10)	(0.17)	(0.10)	(0.10)	(0.18)
crisis	-0.00	-0.00	0.00	0.01	-0.01	0.00	0.01	-0.02
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
$\Delta \ln \theta_{it}^{HIC}$	0.28	0.19	-0.12	-0.01	0.23*	-0.16	-0.06	0.07
	(0.21)	(0.12)	(0.09)	(0.08)	(0.13)	(0.16)	(0.10)	(0.18)
$\Delta \ln \theta_{it}^{LMY}$	-0.24**	-0.09	0.01	-0.04	-0.14***	0.03	0.00	0.04
	(0.10)	(0.08)	(0.04)	(0.04)	(0.05)	(0.06)	(0.03)	(0.03)
$\ln \theta_{it-1}^{HIC}$	0.14	-0.00	-0.12*	-0.02	0.08	0.11	-0.02	-0.13
	(0.12)	(0.04)	(0.06)	(0.04)	(0.09)	(0.09)	(0.04)	(0.13)
$\ln \theta_{it-1}^{LMY}$	-0.13*	-0.02	0.02	0.01	-0.03	-0.04	0.01	-0.03
	(0.07)	(0.02)	(0.02)	(0.01)	(0.03)	(0.03)	(0.01)	(0.03)
$\Delta \ln D_{it}$	0.01	0.01	-0.01	-0.06	0.03	-0.05	-0.03	0.03
	(0.05)	(0.03)	(0.03)	(0.04)	(0.05)	(0.06)	(0.03)	(0.05)
$\ln L_{it-1}$	0.07	0.09	-0.02	-0.06	0.02	0.03	-0.08	0.27
	(0.05)	(0.09)	(0.03)	(0.04)	(0.09)	(0.07)	(0.06)	(0.18)
Observations	90	90	90	90	90	90	90	90

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 7: Sectoral regression using VA import penetration

	(1) 1012-IV	(2) 1315-IV	(3) 1618-IV	(4) 2021-IV	(5) 2223-IV	(6) 2425-IV	(7) 2627-IV	(8) 2930-IV
$\ln \frac{\text{PPI}_{it-1}}{\text{PPItot}_{t-1}}$	-0.34***	0.02	0.13	-0.18**	-0.16***	-0.12	0.03	-0.47*
	(0.08)	(0.20)	(0.31)	(0.07)	(0.05)	(0.08)	(0.09)	(0.26)
crisis	0.01*	0.03**	0.02	-0.00	0.02***	0.01	0.01	-0.01
	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.04)
$\Delta \ln \theta_{it}^{HIC}$	-0.17**	0.20	1.06**	0.07	0.05	0.36**	-0.74*	-0.30
	(0.07)	(0.19)	(0.48)	(0.21)	(0.12)	(0.15)	(0.38)	(0.39)
$\Delta \ln \theta_{it}^{LMY}$	-0.07**	-0.32***	-0.35***	-0.01	-0.12***	0.04	0.01	-0.13
	(0.03)	(0.09)	(0.13)	(0.04)	(0.02)	(0.04)	(0.05)	(0.08)
$\ln \theta_{it-1}^{HIC}$	-0.05	-0.19*	0.46*	-0.10	0.09	0.18	-0.32**	-0.18
	(0.05)	(0.11)	(0.24)	(0.07)	(0.12)	(0.16)	(0.15)	(0.13)
$\ln \theta_{it-1}^{LMY}$	0.05	0.00	-0.04	0.01	-0.02	-0.01	-0.00	-0.10
	(0.03)	(0.02)	(0.04)	(0.02)	(0.01)	(0.02)	(0.03)	(0.07)
$\Delta \ln D_{it}$	0.01	-0.05	0.12	-0.03	0.05	0.04	0.04	0.02
	(0.03)	(0.05)	(0.09)	(0.05)	(0.04)	(0.05)	(0.06)	(0.07)
$\ln L_{it-1}$	-0.15**	-0.05	0.28**	-0.01	0.01	0.10	-0.12	0.25
	(0.08)	(0.09)	(0.14)	(0.07)	(0.04)	(0.10)	(0.12)	(0.25)
$\ln z_{t-1}$	-0.37***	-0.38***	-0.36***	-0.26***	-0.22***	-0.29***	-0.13*	-0.37**
	(0.09)	(0.14)	(0.08)	(0.08)	(0.08)	(0.09)	(0.07)	(0.17)
crisis	-0.06***	-0.08***	-0.03***	-0.06**	-0.06***	-0.08***	-0.04*	-0.09
	(0.02)	(0.02)	(0.01)	(0.02)	(0.02)	(0.02)	(0.03)	(0.06)
$\Delta \ln \theta_{it}^{HIC}$	0.34*	-0.55	0.29	-0.32	0.26	0.48	0.97**	0.45
	(0.21)	(0.35)	(0.25)	(0.57)	(0.34)	(0.42)	(0.45)	(0.73)
$\Delta \ln \theta_{it}^{LMY}$	0.02	0.29*	0.10	0.02	0.13**	0.13	0.10	0.10
	(0.07)	(0.17)	(0.07)	(0.11)	(0.06)	(0.10)	(0.08)	(0.19)
$\ln \theta_{it-1}^{HIC}$	-0.06	0.25	0.07	0.18	-0.14	0.06	-0.03	-0.29
	(0.15)	(0.21)	(0.14)	(0.21)	(0.30)	(0.52)	(0.17)	(0.27)
$\ln \theta_{it-1}^{LMY}$	-0.01	0.06**	0.04	0.03	0.05	0.09*	-0.02	0.03
	(0.10)	(0.03)	(0.03)	(0.06)	(0.04)	(0.05)	(0.06)	(0.06)
$\Delta \ln D_{it}$	0.08	-0.06	0.01	0.00	-0.01	-0.01	-0.01	0.14
	(0.08)	(0.09)	(0.06)	(0.13)	(0.11)	(0.12)	(0.12)	(0.13)
$\ln L_{it-1}$	0.52***	-0.01	0.42***	0.06	0.02	0.09	0.58***	0.56
	(0.20)	(0.23)	(0.16)	(0.18)	(0.14)	(0.28)	(0.22)	(0.56)
$\ln \frac{w_{it-1}}{\text{PPI}_{it-1}}$	-0.13	-0.32***	-0.24***	0.05	-0.06	-0.22**	-0.12	0.07
	(0.10)	(0.10)	(0.07)	(0.12)	(0.09)	(0.10)	(0.13)	(0.12)
$\ln \mu_{it-1}$	-0.19***	-0.62***	-0.54***	-0.47***	-0.33***	-0.29***	-0.30***	-0.44***
	(0.07)	(0.14)	(0.13)	(0.11)	(0.08)	(0.09)	(0.09)	(0.13)
crisis	-0.01	0.00	0.01	0.01	-0.00	-0.01	0.01	0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
$\Delta \ln \theta_{it}^{HIC}$	-0.08	0.18*	0.13	0.12	-0.05	0.01	-0.01	0.30
	(0.11)	(0.10)	(0.11)	(0.24)	(0.10)	(0.15)	(0.12)	(0.33)
$\Delta \ln \theta_{it}^{LMY}$	-0.11**	-0.04	-0.09***	0.00	-0.06***	-0.06*	-0.02	-0.05
	(0.05)	(0.05)	(0.03)	(0.05)	(0.02)	(0.04)	(0.02)	(0.06)
$\ln \theta_{it-1}^{HIC}$	0.03	0.03	0.10	-0.10	0.06	0.31*	-0.00	0.00
	(0.07)	(0.04)	(0.07)	(0.09)	(0.09)	(0.19)	(0.05)	(0.07)
$\ln \theta_{it-1}^{LMY}$	-0.06	-0.00	-0.03***	0.01	-0.01	-0.03	0.01	0.02
	(0.05)	(0.01)	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)
$\Delta \ln D_{it}$	-0.00	0.04	0.01	-0.06	0.01	0.02	-0.02	-0.01
	(0.04)	(0.03)	(0.03)	(0.05)	(0.03)	(0.05)	(0.03)	(0.05)
$\ln L_{it-1}$	0.15	0.05	0.11**	-0.07	-0.05	0.14	-0.04	0.02
	(0.11)	(0.04)	(0.04)	(0.06)	(0.04)	(0.10)	(0.06)	(0.10)
Observations	89	88	85	89	89	81	81	89
R^2	0.28	-0.38	-1.23	-0.00	0.33	0.24	-0.70	-0.33

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Compared to the gross and value-added import penetration, regressions seem to provide with more significant effects when measured by the GVC participation indicator. 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 chemicals and pharmaceuticals (2021, not significant) and the sector of metals (2425, significant but with the positive coefficient). However, its long-run effect on prices is less clear.

The effect of openness is significant with expected sign in all the sectors except the sector of textile (1315), chemicals and pharmaceuticals (2021) and vehicls 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).

Table 8: Sector-level regression using BWP_tot

	(1) 1012-IV	(2) 1315-IV	(3) 1618-IV	(4) 2021-IV	(5) 2223-IV	(6) 2425-IV	(7) 2627-IV	(8) 2930-IV
$\ln \frac{\text{PPI}_{it-1}}{\text{PPItot}_{t-1}}$	-0.44***	-0.45***	-0.28***	-0.29***	-0.12**	-0.20***	-0.09	-0.05
	(0.08)	(0.09)	(0.09)	(0.09)	(0.05)	(0.08)	(0.06)	(0.10)
$\Delta \ln \theta_{it}$	-0.22***	-0.45***	-0.19**	-0.02	-0.28***	0.14***	-0.30***	-0.50***
	(0.05)	(0.08)	(0.07)	(0.05)	(0.04)	(0.03)	(0.06)	(0.10)
$\ln \theta_{it-1}$	-0.02	-0.03	-0.06	-0.08	0.01	0.06*	-0.13*	-0.11
	(0.05)	(0.07)	(0.07)	(0.06)	(0.03)	(0.04)	(0.08)	(0.07)
crisis	0.01**	-0.03***	-0.01	-0.00	-0.00	-0.01	-0.01	-0.00
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
$\Delta \ln D_{it}$	0.02	0.00	-0.04	-0.03	0.03	0.02	-0.04	0.02
	(0.02)	(0.03)	(0.05)	(0.04)	(0.03)	(0.04)	(0.04)	(0.04)
$\ln L_{it-1}$	-0.04	-0.21***	-0.09	0.04	-0.03	0.02	-0.01	-0.01
	(0.04)	(0.05)	(0.05)	(0.05)	(0.03)	(0.04)	(0.06)	(0.06)
$\ln z_{t-1}$	-0.33**	-0.49***	-0.48***	-0.26***	-0.23***	-0.42***	-0.14**	-0.24**
	(0.13)	(0.12)	(0.11)	(0.08)	(0.09)	(0.09)	(0.06)	(0.10)
$\Delta \ln \theta_{it}$	0.06	0.62***	0.36***	0.19	0.46***	0.43***	0.27	0.37
	(0.12)	(0.21)	(0.10)	(0.15)	(0.11)	(0.09)	(0.17)	(0.27)
$\ln \theta_{it-1}$	0.08	-0.23	0.06	0.12	0.14	0.13	-0.44*	-0.09
	(0.18)	(0.17)	(0.09)	(0.19)	(0.11)	(0.09)	(0.26)	(0.22)
crisis	-0.08***	-0.02	-0.02	-0.05**	-0.06***	-0.05**	-0.04	-0.11***
	(0.02)	(0.03)	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)	(0.04)
$\Delta \ln D_{it}$	0.03	-0.08	0.03	-0.02	-0.02	0.06	0.10	0.10
	(0.06)	(0.08)	(0.06)	(0.11)	(0.10)	(0.12)	(0.12)	(0.12)
$\ln L_{it-1}$	0.26	0.60***	0.78***	0.37*	0.07	0.23	0.78***	0.43**
	(0.22)	(0.16)	(0.17)	(0.22)	(0.12)	(0.17)	(0.25)	(0.22)
$\ln \frac{w_{it-1}}{\text{PPI}_{it-1}}$	-0.02	-0.18*	-0.41***	-0.11	-0.05	-0.18*	-0.10	0.13
	(0.07)	(0.10)	(0.09)	(0.14)	(0.08)	(0.10)	(0.13)	(0.11)
$\ln \mu_{it-1}$	-0.22**	-0.57***	-0.71***	-0.42***	-0.13	-0.20**	-0.28***	-0.46***
	(0.09)	(0.12)	(0.12)	(0.09)	(0.09)	(0.08)	(0.10)	(0.10)
$\Delta \ln \theta_{it}$	-0.28***	-0.08	-0.14***	-0.10**	-0.16***	-0.09***	-0.11**	0.08
	(0.09)	(0.05)	(0.04)	(0.05)	(0.04)	(0.03)	(0.05)	(0.10)
$\ln \theta_{it-1}$	-0.22**	0.03	-0.02	-0.00	0.02	0.01	-0.09	-0.08
	(0.11)	(0.05)	(0.04)	(0.06)	(0.03)	(0.03)	(0.08)	(0.07)
crisis	-0.00	-0.00	-0.01	0.00	-0.01	-0.01	-0.00	0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
$\Delta \ln D_{it}$	0.03	0.02	-0.02	-0.07*	-0.00	0.01	-0.03	-0.01
	(0.05)	(0.02)	(0.02)	(0.04)	(0.03)	(0.04)	(0.04)	(0.04)
$\ln L_{it-1}$	0.19**	-0.01	-0.01	-0.06	-0.08**	-0.04	0.08	0.10
	(0.09)	(0.03)	(0.03)	(0.05)	(0.03)	(0.04)	(0.07)	(0.06)
Observations	75	75	75	75	75	75	75	75
R^2	0.05	0.31	0.47	0.44	0.31	0.29	0.11	0.16

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 9: Sectoral regression using GVC indicators

	(1) 1012	(2) 1315	(3) 1618	(4) 2021	(5) 2223	(6) 2425	(7) 2627	(8) 2930
				Price $\Delta \ln ppi_{it}$				
$\Delta \ln \theta_{it}$	-0.22***	-0.11	-0.19**	0.01	-0.41***	0.20***	-0.39***	-0.73***
	(0.05)	(0.15)	(0.09)	(0.07)	(0.06)	(0.04)	(0.07)	(0.16)
$\Delta \ln D_{it}$	0.02	0.03	-0.03	-0.03	-0.02	0.05	-0.02	0.02
	(0.03)	(0.04)	(0.05)	(0.04)	(0.04)	(0.04)	(0.04)	(0.06)
$\ln ppi_{it-1}$	-0.45***	-0.80***	-0.28***	-0.25***	-0.16***	-0.27***	-0.13**	-0.22*
	(0.08)	(0.20)	(0.09)	(0.09)	(0.05)	(0.09)	(0.06)	(0.13)
$\ln \theta_{it-1}$	-0.05	0.53***	-0.11	-0.08	0.02	0.11**	-0.24***	-0.38***
	(0.05)	(0.20)	(0.07)	(0.06)	(0.04)	(0.05)	(0.08)	(0.14)
$\ln L_{it-1}$	-0.02	-0.43***	-0.06	0.02	-0.04	0.01	0.05	0.09
	(0.04)	(0.10)	(0.05)	(0.04)	(0.02)	(0.04)	(0.07)	(0.09)
crisis	0.02**	-0.01	-0.01	-0.00	-0.01	-0.00	-0.01	-0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
				Productivity $\Delta \ln z_{it}$				
$\Delta \ln \theta_{it}$	0.07	0.69**	0.49***	0.25	0.73***	0.62***	0.60***	0.94**
	(0.11)	(0.30)	(0.12)	(0.19)	(0.18)	(0.14)	(0.18)	(0.38)
$\Delta \ln D_{it}$	0.03	-0.11	0.05	-0.03	0.04	0.13	0.09	0.08
	(0.06)	(0.08)	(0.06)	(0.11)	(0.11)	(0.12)	(0.11)	(0.13)
$\ln z_{it-1}$	-0.35***	-0.45***	-0.42***	-0.23***	-0.14*	-0.40***	-0.13**	-0.30***
	(0.10)	(0.12)	(0.10)	(0.07)	(0.08)	(0.09)	(0.05)	(0.11)
$\ln \theta_{it-1}$	0.05	-0.03	0.08	0.18	0.01	0.14	-0.16	-0.01
	(0.12)	(0.30)	(0.10)	(0.21)	(0.12)	(0.11)	(0.23)	(0.32)
$\ln w_{it-1}$	-0.01	-0.21**	-0.36***	-0.11	-0.02	-0.18*	-0.14	0.10
	(0.07)	(0.09)	(0.10)	(0.14)	(0.10)	(0.11)	(0.13)	(0.12)
$\ln L_{it-1}$	0.27	0.51***	0.68***	0.33	0.11	0.26	0.61***	0.49
	(0.18)	(0.15)	(0.19)	(0.22)	(0.15)	(0.18)	(0.20)	(0.30)
crisis	-0.07***	-0.04	-0.02	-0.05**	-0.04*	-0.05	-0.04	-0.08*
	(0.02)	(0.03)	(0.02)	(0.02)	(0.02)	(0.03)	(0.02)	(0.04)
				Markup $\Delta \ln \mu_{it}$				
$\Delta \ln \theta_{it}$	-0.26***	-0.22**	-0.18***	-0.12*	-0.27***	-0.14***	-0.09	0.12
	(0.08)	(0.09)	(0.05)	(0.06)	(0.06)	(0.05)	(0.05)	(0.12)
$\Delta \ln D_{it}$	0.01	0.01	-0.04	-0.06*	-0.02	0.01	-0.04	-0.03
	(0.04)	(0.02)	(0.03)	(0.04)	(0.03)	(0.04)	(0.03)	(0.04)
$\ln \mu_{it-1}$	-0.20**	-0.76***	-0.71***	-0.41***	-0.37***	-0.25***	-0.28***	-0.43***
	(0.08)	(0.18)	(0.13)	(0.10)	(0.10)	(0.09)	(0.09)	(0.10)
$\ln \theta_{it-1}$	-0.14*	-0.16	0.01	0.01	0.02	-0.00	-0.01	-0.00
	(0.08)	(0.11)	(0.04)	(0.07)	(0.03)	(0.04)	(0.07)	(0.10)
$\ln L_{it-1}$	0.14*	0.02	-0.02	-0.07*	-0.10***	-0.03	0.02	0.04
	(0.08)	(0.03)	(0.03)	(0.04)	(0.03)	(0.04)	(0.06)	(0.07)
crisis	-0.01	-0.01	-0.01	0.00	-0.02**	-0.01	0.00	0.00
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Import indicator	GVC	GVC	GVC	GVC	GVC	GVC	GVC	GVC
Specification	IV	IV	IV	IV	IV	IV	IV	IV
Country fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
Time fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
Observations	75	75	75	75	75	75	75	75

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

6.4 Robustness

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

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	1012-IV	1315-IV	1618-IV	2021-IV	2223-IV	2425-IV	2627-IV	2930-IV
$\ln z_{t-1}$	-0.36***	-0.57***	-0.30***	-0.24***	-0.18***	-0.33***	-0.14***	-0.26***
	(0.08)	(0.09)	(0.07)	(0.07)	(0.06)	(0.08)	(0.04)	(0.08)
$\Delta \ln \theta_{it}$	-0.02	0.30**	0.19**	0.10	0.23**	0.60***	0.24	-0.17
	(0.09)	(0.13)	(0.08)	(0.17)	(0.10)	(0.13)	(0.16)	(0.17)
$\ln \theta_{it-1}$	-0.06*	0.06*	0.12*	0.16*	0.08	0.48***	0.00	-0.12
	(0.03)	(0.04)	(0.07)	(0.09)	(0.06)	(0.10)	(0.13)	(0.13)
crisis	-0.06***	-0.06***	-0.04***	-0.06***	-0.07***	-0.09***	-0.06***	-0.15***
	(0.01)	(0.02)	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)
$\Delta \ln D_{it}$	0.05	-0.10	0.01	-0.00	0.00	-0.00	-0.03	0.08
	(0.06)	(0.07)	(0.05)	(0.11)	(0.10)	(0.11)	(0.10)	(0.12)
$\ln L_{it-1}$	0.36***	0.41***	0.42***	0.15	0.08	0.31**	0.42***	0.41*
	(0.11)	(0.11)	(0.12)	(0.16)	(0.11)	(0.14)	(0.13)	(0.21)
$\ln \frac{w_{it-1}}{\text{PPI}_{it-1}}$	-0.05	-0.34***	-0.20***	0.04	-0.03	-0.29***	-0.14*	0.11
	(0.06)	(0.07)	(0.07)	(0.09)	(0.07)	(0.09)	(0.08)	(0.10)
lTFPe	-0.28***	-0.51***	-0.18***	-0.42***	-0.16***	-0.30***	-0.15***	-0.13
	(0.08)	(0.08)	(0.06)	(0.09)	(0.05)	(0.07)	(0.05)	(0.09)
$\Delta \ln \theta_{it}$	-0.06	0.21*	0.19*	0.07	0.09	0.46***	0.23	-0.07
	(0.09)	(0.12)	(0.10)	(0.17)	(0.10)	(0.14)	(0.17)	(0.17)
$\ln \theta_{it-1}$	-0.05	-0.04	0.15**	0.07	0.01	0.35***	0.11	-0.02
	(0.04)	(0.04)	(0.07)	(0.08)	(0.05)	(0.09)	(0.14)	(0.13)
crisis	-0.06***	-0.06***	-0.03**	-0.06***	-0.07***	-0.08***	-0.04**	-0.12***
	(0.02)	(0.01)	(0.01)	(0.02)	(0.01)	(0.02)	(0.02)	(0.02)
$\Delta \ln D_{it}$	0.05	-0.11*	-0.02	0.02	0.03	0.08	0.02	0.05
	(0.06)	(0.06)	(0.06)	(0.11)	(0.09)	(0.10)	(0.09)	(0.11)
$\ln L_{it-1}$	0.23*	0.24**	0.14	0.20	0.02	0.13	0.28**	0.11
	(0.13)	(0.09)	(0.09)	(0.18)	(0.10)	(0.14)	(0.13)	(0.18)
$\ln \frac{w_{it-1}}{\text{PPI}_{it-1}}$	-0.09	-0.25***	-0.09	0.01	-0.05	-0.21**	-0.13	0.02
	(0.07)	(0.06)	(0.06)	(0.10)	(0.07)	(0.09)	(0.09)	(0.11)
Observations	90	90	90	90	90	90	90	90

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

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 effect of globalisation on price, productivity and markup in ten sectors and 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 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 further the analysis by studying sectoral specificities such as firm-level concentration and the weight of the sector to study the trade-induced effects. 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. We are currently working on robustness checks and extension. Our next step is to control for the potential quality upgrading of trade liberalisation, using an indicator based on Martin and Mejean (2014) definition. As a matter of fact, our theoretical framework and the empirical estimation only focus on the price competition and do not account for quality competition. However, when facing tougher competition, instead of decreasing the price, firms can protect its market shares by improving the quality of its product, i.e. favour their intensive development over their extensive development. For instance, Dinopoulos and Unel (2013) show that markups and quality are endogoeneous. Second, response to trade openness may differ depending on the trade partners. For instance, Auer *et al.* (2013a) focus on the effect of trade with low-wage countries and find a negative effect on prices. Third, the position in GVC (upstream or downstream) also has an influence through trade costs (Koopman *et al.*, 2010), and hence on prices, markups and productivity. Finally, as mentioned in Chen *et al.* (2009), taking the labour productivity as a proxy of total productivity implicitly assumes the absence of differences in capital costs. This is a strong assumption given the existing international trade theories. Indeed, Auer and Fischer (2010) and Auer *et al.* (2013a), the factor intensity differs across countries and they find that price competition with low-wage countries is relatively more important in labour-intensive sectors. We could then introduce the intensity of investment in both tangibles and intangibles as a proxy for capital.

A Data description

A.1 Sector aggregation

Code (from NACE Rev. 2)	Description
1012	Food, drink and tobacco
1315	Textile and leather
1618	Wood, paper and printing
2000	Chemicals
2100	Pharmaceuticals
2223	Rubber and plastic
2425	Metals
2627	Electrical equipment (e.g. computers, optics)
2800	Machinery and equipment
2930	Motor vehicles and transport

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

Table 11: 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 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, tariff rates and export market shares 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:

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

Quality changes. Quality changes is defined from a consumption approach (*i.e.* in Classification of Individual Consumption by Purpose, COICOP). More precisely, quality changes is defined as changes in unit value of consumption minus changes in consumption price index (CPI) Martin and Mejean (2014). The construction of such a variable relies on the fact that CPI is considered as an ”ideal price” since it measures ”pure” price developments and is adjusted

from quality changes (Guédès, 2004). On the other side, unit value of consumption include both pure price developments and price developments related to quality changes.
The following figures illustrate the steps to convert COICOP data NACE Rev.2 classification:

$$N^{goods}_{COICOP2008} \Rightarrow N^{goods}_{HS2007} \Rightarrow N^{products}_{CPA2008} \Rightarrow N^{activity}_{NACErev2}$$

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: 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.* (2013a). 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 Value added import penetration

Conversely to OECD-WTO database on TiVA, the World Input-Output Database (WIOD) provides a time-series of world Input-Output tables (WIOTs) from 1995 to 2011. We define value added imports penetration 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:

$$x = ic + f = A.x + f = L.f \tag{15}$$

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, with element a_{ij} denoting the ratio of input used from an industry i in 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.

$$\begin{bmatrix} x^r \\ x^s \\ x^t \end{bmatrix} = \begin{bmatrix} v^r & v^s & v^t \end{bmatrix} \begin{bmatrix} L^{rr} & L^{rs} & L^{rt} \\ L^{sr} & L^{ss} & L^{st} \\ L^{tr} & L^{ts} & L^{tt} \end{bmatrix} \begin{pmatrix} f^{rr} + f^{rs} + f r^{rt} \\ f^{sr} + f^{ss} + f^{st} \\ f^{tr} + f^{ts} + f^{tt} \end{pmatrix} \tag{16}$$

$f^c = f^{cr} + f^{cs} + f r^{ct}$ $(c = r, s, t)$ is a $N \times 1$ vector of demand for final products which are produced in country c for both domestic use and exports. We are interested in the country c's final demand (doemstically and imported), i.e. $\begin{pmatrix} (f^{rc})^t & (f^{sc})^t & \left(f^{tc}\right)^t \end{pmatrix}^t$

We now consider trade between countries r and s in this setting of three countries. To compute the value added from country s included in country r's final demand - the value added import of r from s - we set to zero value added from countries s and t, and final demand from r and t:

$$t_M^{rs} = \begin{bmatrix} 0 & v^s & 0 \end{bmatrix} \begin{bmatrix} L^{rr} & L^{rs} & L^{rt} \\ L^{sr} & L^{ss} & L^{st} \\ L^{tr} & L^{ts} & L^{tt} \end{bmatrix} \begin{pmatrix} f^{rr} + 0 + 0 \\ f^{sr} + 0 + 0 \\ f^{tr} + 0 + 0 \end{pmatrix} \tag{17}$$

$$= v^s L^{sr} f^{rr} + v^s L^{ss} f^{sr} + v^s L^{st} f^{tr} \tag{18}$$

The first term in the second line 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 ratio of imports of r from country s on final demand of r in terms of value added is then defined as:

$$tshare_M^{rs} = \frac{t_M^{rs}}{\sum_{p=r,s,t} t_M^{rp}} \tag{19}$$

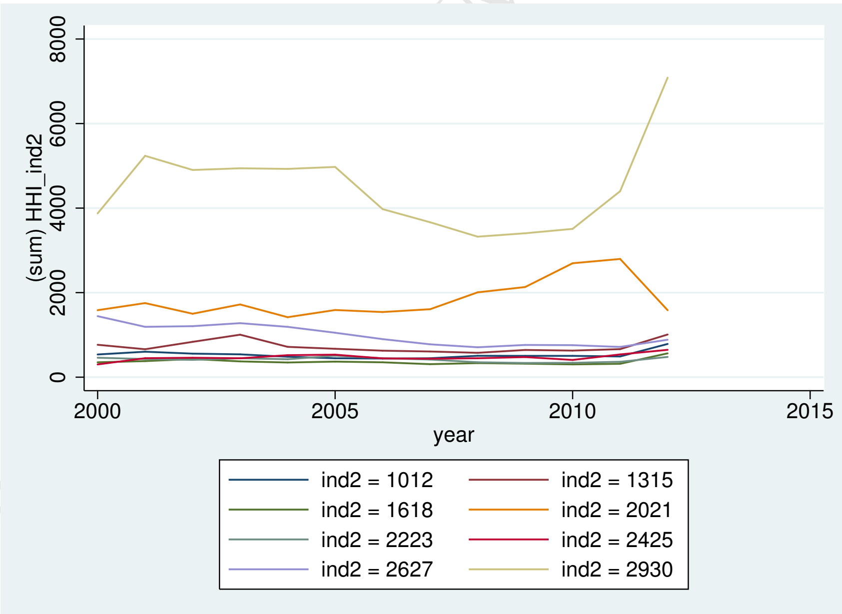
C HHI construction

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).



(a) HHI

Figure 6: Firm concentration

D Global Value Chain

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,

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

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.

E 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.

Table 12: Dickey-Fuller test - Production price

		Statistics	p-value
Inverse chi-squared(100)	P	83.4424	0.8839
Inverse normal	Z	4.5041	1.0000
Inverse logit t(254)	$L*$	4.2534	1.0000
Modified inv. chi-squared	P_m	-1.1708	0.8792

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

Table 13: Dickey-Fuller test - Labour productiviy

		Statistics	p-value
Inverse chi-squared(100)	P	8509963	0.8396
Inverse normal	Z	1.031	0.8485
Inverse logit t(254)	$L*$	1.0707	0.8573
Modified inv. chi-squared	P_m	-0.9902	0.8390

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

Table 14: Dickey-Fuller test - Markup

		Statistics	p-value
Inverse chi-squared(100)	P	105.2287	0.3407
Inverse normal	Z	0.4250	0.6646
Inverse logit t(254)	$L*$	0.1323	0.5526
Modified inv. chi-squared	P_m	0.3697	0.3558

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

References

Acemoglu, D. (2003). Patterns of Skill Premia. *The Review of Economic Studies*, **70** (2), 199–230.

Aghion, P., Bloom, N., Blundell, R., Griffith, R. and Howitt, P. (2005). Competition and Innovation: an Inverted-U Relationship. *Quarterly Journal of Economics*, **120** (2), 701–728.

—, Blundell, R., Griffith, R., Howitt, P. and Prantl, S. (2006). The Effects of Entry on Incumbent Innovation and Productivity. *NBER Working Paper*, (12027).

Ahn, J., Dabla-Norris, E., Duval, R., Hu, B. and Njie, L. (2016). Reassessing the Productivity Gains from Trade Liberalization. *IMF Working Paper/16/77*.

Auer, R. and Fischer, A. M. (2010). The effect of low-wage import competition on U.S. inflationary pressure. *Journal of Monetary Economics*, **57**, 491–503.

Auer, R. A., Degen, K. and Fischer, A. M. (2013a). Low-wage import competition, inflationary pressure, and industry dynamics in Europe. *European Economic Review*, **59**, 141–166.

—, — and — (2013b). Low-wage import competition, inflationary pressure, and industry dynamics in Europe. *European Economic Review*, **59** (C), 141–166.

Baghli, M., Cette, G. and Sylvain, A. (1998). Les déterminants du taux de marge en France et quelques autres grands pays industrialisés: analyse empirique sur la période 1970-2000. *Economie & Prévision*, **158** (2), 1–25.

Bellone, F., Musso, P., Nesta, L. and Warzynski, F. (2014). International Trade and Firm-level Markups when Location and Quality Matter. *CEPII Working Paper*, (15).

Benigno, P. and Faia, E. (2010). Globalization, Pass-Through and Inflation Dynamics. *NBER Working Paper*, **15842**.

Bernard, A. B., Jensen, J. B., Redding, S. J. and Schott, P. K. (2012). The Empirics of Firm Heterogeneity and International Trade. *Annual Review of Economics*, **4** (1), 283–313.

Chaney, T. (2013). The Gravity Equation in International Trade: an Explanation. *NBER Working Paper*, **19285**.

Chen, N., Imbs, J. and Scott, A. (2004). Competition, globalisation and the decline of inflation. *CEPR Discussion Paper Series*, (4695), 1–61.

—, — and — (2009). The dynamics of trade and competition. *Journal of International Economics*, **77**, 50–62.

Dinopoulos, E. and Unel, B. (2013). A simple model of quality heterogeneity and international trade. *Journal of Economic Dynamics and Control*, **37** (1), 68–83.

Dixit, A. and Stiglitz, J. (1977). Monopolistic Competition and Optimum Product Diversity. *The American Economic Review*, **67** (3), 297–308.

Guédès, D. (2004). Impact des ajustements de qualité dans le calcul de l'indice des prix à la consommation. *Documents de Travail de la Direction des Statistiques Démographiques et Sociales*, **F0404**.

Hummels, D. (2001). Toward a Geography of Trade Costs. *Purdue University, mimeo*.

Kasahara, H. and Lapham, B. (2013). Productivity and the decision to import and export: Theory and evidence. *Journal of International Economics*, **89** (2), 297–316.

— and RODRIGUE, J. (2008). Does the use of imported intermediates increase productivity? Plant-level evidence. *Journal of Development Economics*, **87** (1), 106–118.

KOOPMAN, R., POWERS, W., WHANG, Z. and WEI, S.-J. (2010). Give Credit Where Credit Is Due: Tracing Value Added in Global Production Chains. *NBER Working Paper Series*, **16426**.

KRUGMAN, P. (1980). Scale Economies, Product Differentiation, and the Pattern of Trade. *American Economic Association*, **70** (5), 950–959.

KYDLAND, F. and PRESCOTT, E. (1977). Rules Rather than Discretion: The Inconsistency of Optimal Plans. *The Journal of Political Economy*, **85** (3), 473–492.

MARTIN, J. and MEJEAN, I. (2014). Low-wage country competition and the quality content of high-wage country exports. *Journal of International Economics*, **93**, 140–152.

MCMILLAN, M., RODRIK, D. and VERDUZCO-GALLO, I. (2014). Globalization, Structural Change, and Productivity Growth, with an Update on Africa. *World Development*, **63**, 11–32.

MELITZ, M. J. (2003). The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity. *Econometrica*, **71** (6), 1695–1725.

— and OTTAVIANO, G. I. P. (2008). Market Size, Trade, and Productivity. *Review of Economic Studies*, **75**, 295–316.

OTTAVIANO, G., TABUCHI, T. and THISSE, J.-F. (2002). Agglomeration and Trade Revisited. *International Economic Review*, **43** (2), 409–435.

ROMER, D. (1993). Openness and Inflation: Theory and Evidence. *The Quarterly Journal of Economics*, **CVIII** (4), 869–903.

STEHRER, R. (2012). *Trade in Value Added and the Valued Added in Trade*. wiiw Working Papers 81, The Vienna Institute for International Economic Studies, wiiw.

TURNER, P. and VAN'T DACK, J. (1993). Measuring International Price and Cost Competitiveness. *BIS Economic Papers*, **39**, 1–152.

WANG, Z., WEI, S.-J., YU, X. and ZHU, K. (2016). Characterizing global value chains. In *19th Annual Conference on Global Economic Analysis, Washington, DC*.