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

Raphaël S.-H. Lee[†], Mathilde Pak[‡]

December 4, 2017

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 trade indicators to 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. The effects of trade are particularly strong in sectors with low concentration and pro-competitive effects are more significant when using import penetration in value-added terms.

Keywords: Inflation, Trade openness, Competition, Markups, Productivity, Input-Output Tables and Analysis
JEL codes: D57, E31, F12, F14, L16

[1]We are particularly grateful to Natalie CHEN and Jean IMBS for their helpful insights, Hélène ERKELL-ROUSSE and Pierre RALLE for their valuable comments on our first draft, Claire BIDAULT for her insight on French data. We also would like to thank Juan CARLUCCIO for his discussoin and other participants at INSEE-DESE internal seminar (Paris, 2016).

[2]Insee-DESE & Crest-LMA - raphael.lee@insee.fr

[3]OECD.When this study was conducted Insee-DESE & Crest-LMA & Université Paris-Dauphine, PSL Research University - mathilde.pak@oecd.org

Contents

1 Introduction 3

2 Review of literature 4

3 Theoretical framework 5
- 3.1 Consumer behaviour 5
- 3.2 Firm behaviour 6
- 3.3 Short-run implications 8
- 3.4 Long-run implications 8
- 3.5 Differentiated model 9

4 Empirical framework 10
- 4.1 Empirical setup 10
- 4.2 Empirical model 11
- 4.3 Instrumenting openness 11

5 A preliminary investigation: descriptive analysis 13
- 5.1 Data processing 13

6 Descriptive Statistics 14
- 6.1 Trends analysis 14
- 6.2 Sectoral dynamics 15
- 6.3 Sectoral openness 16
- 6.4 Origin of imports 16

7 Estimation 17
- 7.1 Pooled sample 18
- 7.2 Sectoral Approach 18
  - 7.2.1 Gross import penetration ratio 18
  - 7.2.2 Value added import penetration ratio 19
  - 7.2.3 Participation to GVC 22
- 7.3 Low Wage Countries (LWC) 25
- 7.4 Robustness 29

8 Concluding remarks 30

A Data description 32
- A.1 Sector aggregation 32
- A.2 Classification harmonization 32

B Value added import penetration 34

C HHI construction 35

D Global Value Chain 35

E Stationarity tests 37

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 the Euro Area, while taking into account firm 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 sectoral data on prices, markups, productivity, the number of domestically producing firms and the market size, we attempt to assess and quantify the pro-competitive effects of trade openness, as measured by import penetration in domestic markets. We use a cross section of ten manufacturing industries in five Euro Area countries (Austria, Germany, Spain, France and Italy). Our data covers the period 1995-2013, 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 opposite effects of trade in the short- and in the long-run.

The novelty of our paper is twofold. First, we carry out a sectoral analysis to shed light on sectors in which price competition is dominant in the context of globalisation. Indeed, our model mainly focuses on the price-competition, which 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.

As our paper is based on the Melitz and Ottaviano (2008) model, the focus is on the competitive effect of globalisation occurs on prices. However, firms can opt for different strategies. They can maintain high level of prices, if they choose to compete on the quality of their products, if they hold a monopoly position, or if they manage to reduce their costs by specialising in a certain stage of the production process. They can also benefit from tariff barriers and regulations set by countries to protect their market share. Given this, we attempt to measure how quality factors can mitigate the competitive effect of globalisation or how globalisation can enhance the quality factor in the extension.

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 their importance to competitiveness. In addition, the increasing importance of global value chains has made the analysis of international trade more complex and traditional measures of trade are unable to take into account the full interdependence of markets and economies.

The remainder of this paper is as follows. Section 2 presents a review of the related literature. Section 3 exposes the theoretical framework leading to the empirical model we introduce in section 4. Section 5 deals with descriptive analysis and introduces preliminary results from a principal component analysis, while section **??** gives away results from our baseline estimation using gross import penetration ratio and compare them with the estimation using value added import penetration ratio.

2 Review of literature

Globalisation and increased trade disrupt the economic environment and interconnections between countries can make economy less sensitive to domestic factors. Indeed, Romer (1993) finds a robust, statistically significant and large relationship between the average rates of inflation and the degree of openness of economy. The idea stems from Kydland and Prescott (1977) according to which benefits of a surprise inflation by central banks are decreasing in the degree of openness since a surprise monetary expansion is related to a stronger depreciation and damages 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 Heckshler-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 the monopolistic competition *à la* Dixit and Stiglitz (1977), Krugman (1980) introduced the new trade theory based on intra-industry trade. Since, instead of considering national comparative advantage, industries become the determining actors of trade. Melitz (2003) is the seminal paper building 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 and Rodrik (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:

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

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.* $\tau = \tau^*$[1]. Domestic firms' profit $\Pi_D(c)$ and foreign firms' $\Pi_X(c)$ are given by:

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

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

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 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 $\phi(\tau) = 2(k+1)(k+2)c^k_M f_E(\tau)$ 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 ($\phi(\tau)/c^k_M$), 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:

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

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. To assess the pro-competitive effect of trade liberalisation, an error-correction model is used. It allows to study the short run and long run dynamics of prices, productivity and markups. We then introduce assumptions we make to adapt the theoretical model, as well as the issues related to such assumptions.

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, 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. Symmetric effects hold for foreign openness. 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. As Schwerhoff and Sy (2014) assume a time trend to capture technological progress, when applicable, we assume a time trend evolution. Although approximate it is, by substituting transport costs τ with the import penetration ratio, the equations become estimable.

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 teh fact that in the short run, given the assumption that the number of firms is fixed and 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 through the markup and cost channels. Prices can be decomposed into markup and productivity effects. Our theoretical framework lends itself to a simultaneous equations system. In order to estimate, we use the error correction model.

Given this, we choose to estimate the effect of globalisation on prices through a simultaneous equations approach. We also 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.

Using the assumptions made in the previous section, productivity is substituted to the cost. 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. Also, for labour productivity, the remuneration level is included. To account for the technological progress of $\frac{c_M}{c_M^*}$, we add sector and country dummies as well as a time trend when it is applicable. All in all, our simultaneous equations system suggests the following log-linear expression:

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

where α_0 is an intercept, θ_{ijt} the import penetration ratio of country i in sector j at time period t, D_{ijt} the number of domestic firms, L_{ijt} the market size (measured by the gross domestic product) and w_{ijt} the real remuneration level. We allow for country fixed effects and time dummies, which are selected based on observed shocks and exogeneous events.

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.

To tackle the endogeneity issues, 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 appeal to 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). This would then reduce incentives to import. The bulkiness is built 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).

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:

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

The higher the apparent tariff rate is, the more the country imports products which have high tariff rate. It can be a proxy for the degree of protection of the domestic suppliers. It is hence expected to be negatively correlated to import penetration in final demand.

We use gravity variables for non-tariff barrier. 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:

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

Finally we add competitiveness variables since increased competitiveness also can reduce trade costs. The real effective exchange rate is a traditional competitiveness indicator. Since it is built as a weighted[2] 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:

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

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

5 A preliminary investigation: descriptive analysis

5.1 Data processing

Our sample covers five Euro Area countries (Austria, France, Germany, Italy and Spain), ten manufacturing sectors[3] and over the period 1995 to 2013 for most countries. We combine data from Eurostat, OECD, WIOD and BACH (See Appendix A for further details on our dataset). More specifically, 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 and total employment, as provided by Eurostat. The number of active firms is also provided by Eurostat Structural Business Survey (SBS) database. Since we do not have access to the number of foreign exporting firms, we use this variable for N. 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.

To define the gross import penetration ratio, we use data from Eurostat and OECD STAN Bilateral Trade Database in goods. 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 sectoral output net of exports. For the value added import penetration, we use WIOD Input-Output Tables. 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). At the moment, we use Input-Output Tables from the 2013 release which includes data from 1995 to 2011 in NACE Rev. 1. We will update these data using the 2016 release, which are from 2000 to 2014 and in NACE Rev. 2.

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[4]. However 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 overrepresented[5].

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):

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

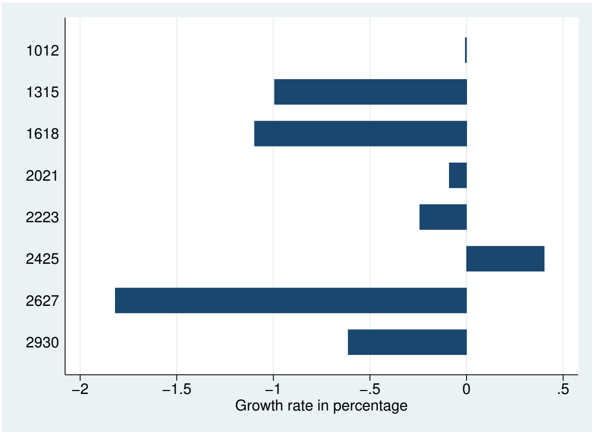
[3] See Table 9 in Appendix A

[4] Austria, Belgium, Czech Republic, France, Germany, Italy, the Netherlands, Poland, Portugal, Slovakia and Spain. Denmark, Luxembourg, Romania and Turkey are expected to join the BACH database in the coming years.

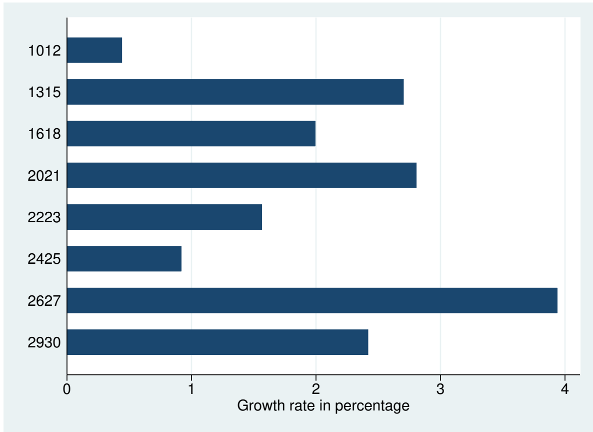
[5] In the case of Italy, the entire population of non-financial corporations is well covered in the manufacturing sector.

6 Descriptive Statistics

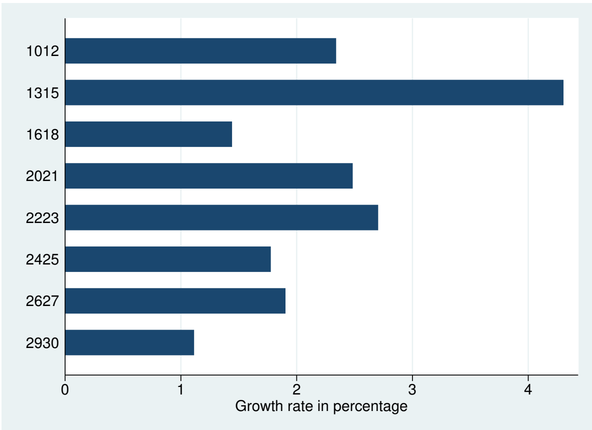
6.1 Trends analysis



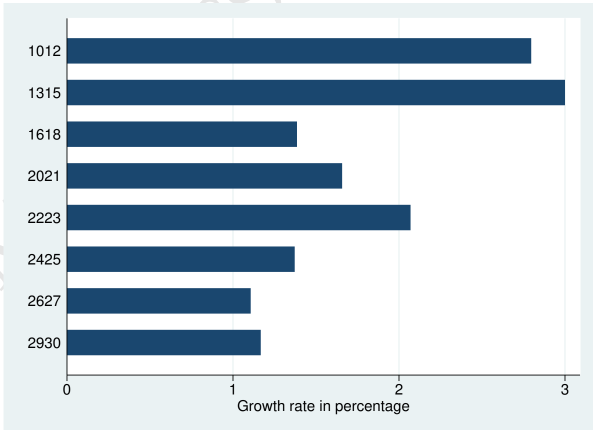
(a) Relative PPI



(b) Labour productivity



(c) Gross import penetration



(d) VA import penetration

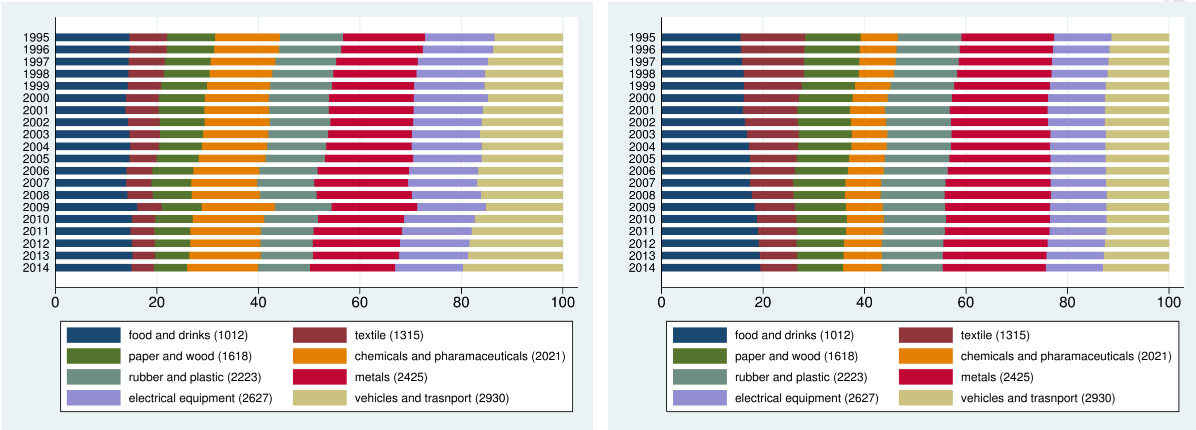
Figure 1: Time trends (controlled for country fixed effects)

In this section, we study the long-term dynamics of our key varaibles. Figure 1 displays the coefficients obtained by regressing key variables on time trends while controlling for country fixed effects. It can be interpreted as a long-term time trend. By using all the information available during the sample period, the results are more robust to outliers. Neverertheless, one should keep in mind that 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 inreased in the sector of metals (2425). Apart from the sector of food and drinks (1012) and metals (2425), labour productivity has significantly increased in all sectors. The growth has been the highest in the sectors of electrical equipments (2627), textile (1315), chemicals and pharmaceuticals (2021) and of vehicles and transport (2930).

Both gross and VA import penetrations have been increasing over time. The dynamics are similar for both measures. However, the adjustments in time trends are different across industries. The openness is higher for the sector of foods and drinks (1012) when measuring in value-added terms whereas that is lower for the sector of metals (2425) and electrial equiments (2627). A thriving literature promotes the use of value added to measure the trade flows, namley in order to account for the interdependencies and the fragmentation of the production process. In thie regard, a larger change between gross and VA import penetration may imply a more important fragmentation in the production process.

6.2 Sectoral dynamics



(a) VA

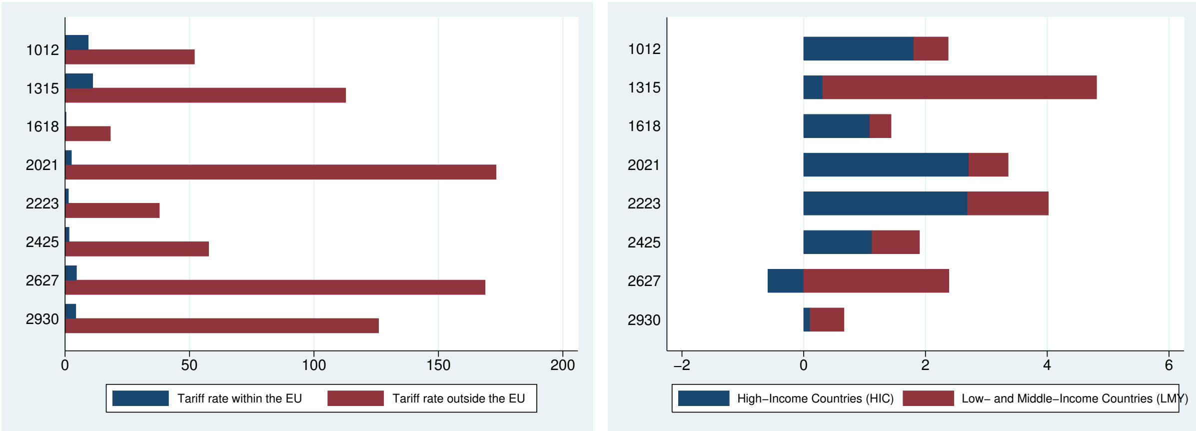
(b) Employment

Figure 2: Dynamics of sectoral weights per industry over time

Figure 2 displays the dynamics of weights of manufacturing sectors from 1995 to 2014. In general, the sectoral share remains rather stable over time. Nevertheless, the share of the sector of textile (1315), wood and paper (1618) and of rubber and plastic (2223) have decreased over the period 1995-2014 whereas 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, public authoritieis can subsidise, thus cancelling out the productivity gains or crowding out of less productive firms in order to protect a declining sector. In our model, it can appear as a decline in productivity while the openness is increasing within the sector.

6.3 Sectoral openness



(a) Tariff rate

(b) Gross import penetration

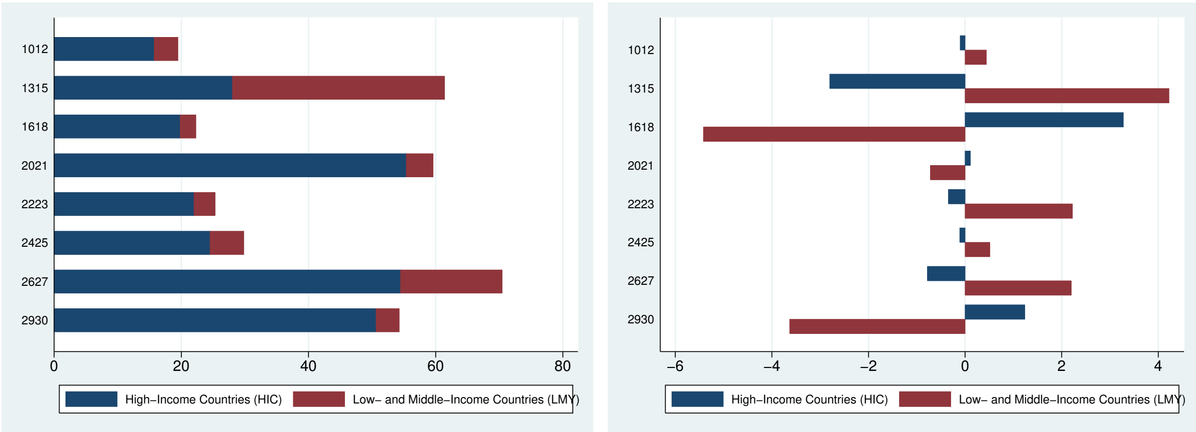
Figure 3: Average annual growth over 2000-2014

Figure 3 present the tariff rate applied to imports inside and outside the European Union (EU) (left) and growth in total import penetration over 2000-2014 and contribution of the imports from High-Income Countries (HIC) and Low- and Middle-Income Countries . As regards the import tariff rates, there is two levels of heterogeneity. First, the import tariff rate is virtually at zero within the EU countries whereas the import rate applicable (defined by the WTO) is much higher. The contribution of imports from HIC and LMY varies across industries. The contribution of the imports from high-income countries has been particularly strong in the sectors of food and drinks (1012), wood and paper (1618) and chemicals and pharmaceuticals (2021). On the contrary, the contribution of import penetration from LMY is high in the sectors of textile (1315), electrical equipments (2627) and vehicles and transport (2930).

6.4 Origin of imports

Another factor that should be taken into account is the origin of imports. Our theoretical framework does not entirely address the question of structural differences across countries. 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.

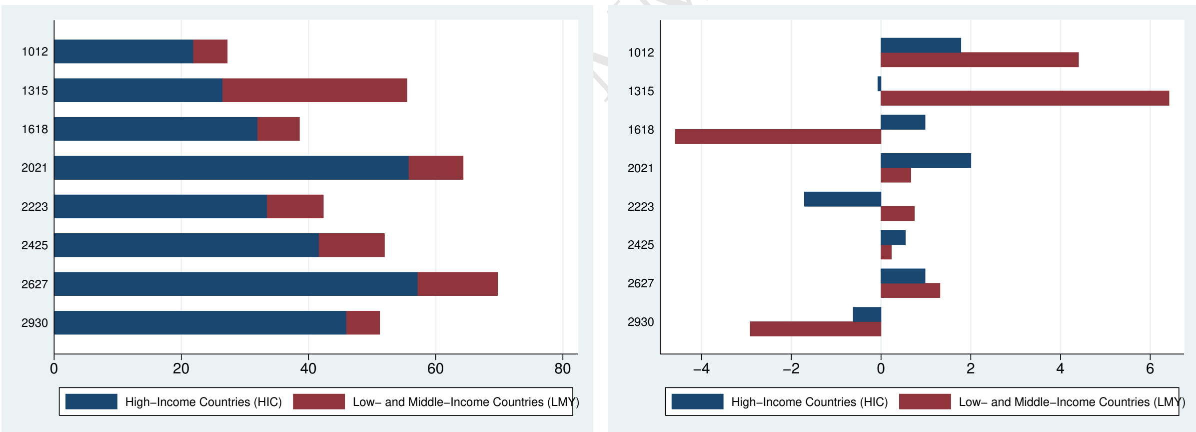
As displayed in figure 4, not only is the level of the import penetration different, the composition of the imports is also heterogeneous. Among the sectors with high openness such as the sectors of textile (1315), chemicals and pharmaceuticals (2021), electrical equipments (2627) and vehicles and transport (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.



(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

7 Estimation

In this section, we build on the approach adopted in Chen *et al.* (2009). However, we estimate separately the effect of openness on our main variables of interest, which are prices, productivity and markups. Our theoretical framework implies that the effect of openness is negative on prices and markups and positive on productivity. Countries fixed effects are included to capture country-specific structural characteristics. A dummy for the period of crisis[6] is added to account

[6] After observing the productivity graphs, the period chosen to account for the crisis is 2008 - 2009. This choice is robust to one or two extra years around the period.

for the Great Recession.

7.1 Pooled sample

In the first place, the estimation is carried out with the pooled sample. Two indicators for the trade openness are used: gross import penetration and value-added import penetration (table 1). When estimating with gross import penetration, the effect of openness on prices is not significant and unclear. However, its effect is negative, as expected, when using VA import penetration. In both cases, the effect of trade openness on productivity and markups are significant and the coefficients have the expected sign, *i.e.* positive for the productivity and negative for the markups. This result is in line with the descriptive statistics. Productivity has a upward trend at both country and sector level whereas the dynamics of prices is more erratic. In addition, as highlighted in section "descriptive statistics", given the large heterogeneity across countries and industries, sectoral approach seems more accurate to study the effects of trade.

Table 1: Pooled sample regression (instrumented)

	(1) Price	(2) Productivity	(3) Markup	(4) Price (VA)	(5) Productivity (VA)	(6) Markup (VA)
$\ln \frac{\text{PPI}_{it-1}}{\text{PPItot}_{t-1}}$	-0.12***			-0.11***		
	(0.02)			(0.02)		
$\ln z_{t-1}$		-0.14***			-0.15***	
		(0.02)			(0.02)	
$\ln \mu_{it-1}$			-0.27***			-0.26***
			(0.03)			(0.03)
$\Delta \ln \theta it$	0.01	0.38***	-0.07**	-0.16***	0.64***	-0.15***
	(0.03)	(0.09)	(0.03)	(0.05)	(0.12)	(0.04)
$\ln \theta it-1$	0.00	-0.08	0.02	0.03	-0.01	0.00
	(0.02)	(0.07)	(0.02)	(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	0.05	-0.02	-0.00	0.02	-0.02
	(0.02)	(0.04)	(0.01)	(0.01)	(0.04)	(0.01)
$\ln L_{it-1}$	-0.05**	0.37***	-0.03*	-0.07***	0.29***	-0.02
	(0.02)	(0.09)	(0.02)	(0.02)	(0.07)	(0.02)
$\ln \frac{w_{it-1}}{\text{PPI}_{it-1}}$		-0.09***			-0.06***	
		(0.04)			(0.02)	
Observations	691	720	720	691	720	720
R^2	0.09	0.17	0.14	0.03	0.15	0.18

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

7.2 Sectoral Approach

7.2.1 Gross import penetration ratio

In this section, the estimation is carried out sector by sector. 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 1). The short-run coefficient of openness is negative and significant only in the sectors of food and drinks (1012) and electrical equipments (2627) while the coefficient is positive for the sector of metals (2425). Crisis dummy shows an inflationary effect during the period of crisis in the sectors of food and drinks (1012), rubber and plastic (2223) and vehicles and transport (2930).

As for productivity, when significant, openness is positively correlated in the sectors of wood and paper (1618), metals (2425), electrical equipment (2627) and vehicles and transport (2930) in the short-run and in the sectors of textile (1315), rubber and plastic (2223), metals (2425) in the log run. Crisis dummy captures 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 wood and paper (1618), metals (2425) and electrical equipments (2627). 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. The results of estimation are highly improved when using the import penetration measured in value added.

7.2.2 Value added import penetration ratio

In this part, the estimation is done with the VA import penetration. It has the advantage to better account for the real production process. The on-going globalisation implies an increase in the interconnections across countries. In fact, one country's import may already contain some value-added that is creased within the same importing country. This measurement issue can be addressed by measuing value added or in simple terms, the contribution of each country to the production of the good.

Table 3 displays a clearer effect of the VA import penetration on key variables. When significant, the sign of the coefficients corresponds to the expected one. Openness seems to affect prices and markups positively and more strongly in the short run. Its effect is significant both in the short run and in the long run for the productivity in most sectors. 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 sectors of food and drinks (1012), chemicals and pharmaceuticals (2021) and vehicles and transport (2930). Finally, sectors in which the effect on markups is significant and with the expected sign are the sectors of food and drinks (1012), wood and paper (1618) and metals (2425).

Table 2: 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
$\ln \frac{\text{PPI}_{it-1}}{\text{PPItot}_{t-1}}$	-0.15*	-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)
$\Delta \ln \theta_{it}$	-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)
$\ln \theta_{it-1}$	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)
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)
$\Delta \ln D_{it}$	-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)
$\ln L_{it-1}$	-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)
$\ln z_{t-1}$	-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)
$\Delta \ln \theta_{it}$	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)
$\ln \theta_{it-1}$	-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)
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)
$\Delta \ln D_{it}$	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)
$\ln L_{it-1}$	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)
$\ln \frac{w_{it-1}}{\text{PPI}_{it-1}}$	-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)
$\ln \mu_{it-1}$	-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)
$\Delta \ln \theta_{it}$	-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)
$\ln \theta_{it-1}$	-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)
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)
$\Delta \ln D_{it}$	-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)
$\ln L_{it-1}$	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)
Observations	89	88	85	89	89	81	81	89

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 3: Sectoral regression using VA import penetration

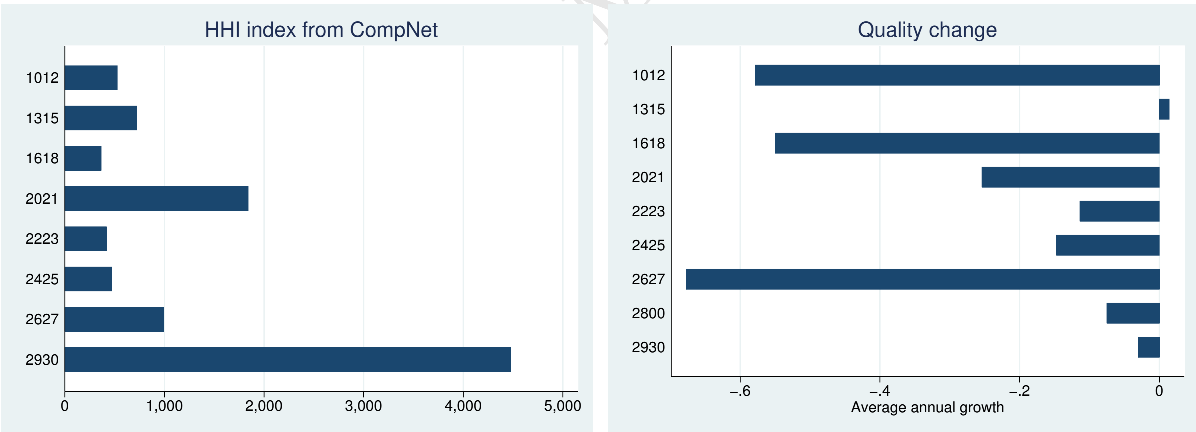
	(1) 1012-IV	(2) 1315-IV	(3) 1618-IV	(4) 2021-IV	(5) 2223-IV	(6) 2425-IV	(7) 2627-IV	(8) 2930-IV
$\ln \frac{\text{PPI}_{it-1}}{\text{PPItot}_{t-1}}$	-0.29***	-0.36***	-0.32***	-0.18**	-0.17***	-0.18**	-0.11***	-0.23***
	(0.08)	(0.10)	(0.09)	(0.08)	(0.06)	(0.08)	(0.04)	(0.08)
$\Delta \ln \theta_{it}$	-0.32***	-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)
$\ln \theta_{it-1}$	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)
$\Delta \ln D_{it}$	-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)
$\ln L_{it-1}$	-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)
$\ln z_{t-1}$	-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)
$\Delta \ln \theta_{it}$	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)
$\ln \theta_{it-1}$	-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)
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)
$\Delta \ln D_{it}$	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)
$\ln L_{it-1}$	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)
$\ln \frac{w_{it-1}}{\text{PPI}_{it-1}}$	-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)
$\ln \mu_{it-1}$	-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)
$\Delta \ln \theta_{it}$	-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)
$\ln \theta_{it-1}$	-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)
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)
$\Delta \ln D_{it}$	-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)
$\ln L_{it-1}$	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)
Observations	90	90	90	90	90	90	90	90

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

Information on the firm concentration measured by the Herfindahl-Hirschmann Index (HHI) and quality changes[7] (figure 6) provides further insight on those sectors with low effect of trade openness. The effect of trade is unclear in the sectors of chemicals and pharmaceuticals (2021) and vehicles and transport (2930) (table 3). Interestingly, those sectors also display the highest concentration ratio (HHI). In this regard, a part of answer to the absence of the effect of trade may be attributed to the high firm concentration that would offset or mitigate the competitive effect of openness. Sectors of food and drinks (1012) and textile (1315) display also a rather higher firm concentration level and this may explain 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, market can be larger while the number of firms remains stable. In this case, pro-competitive effects are weakened.

At last, 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 2).

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). As a matter of fact, the sector of textile is characterised by a very proportion of imports from the low income countries.



(a) HHI

(b) Quality change (annual growth)

Figure 6: Firm concentration and quality (average over time)

7.2.3 Participation to GVC

As presented in the data description, GVC indicators, also denoted the participation to the GVC, are computed as the sum of the domestic value added embodied in foreign exports (forward linkage) and foreign value added embodied in domestic exports (backward linkage) over the domestic value added. The former measures the vertical specialisation whereas the latter measures the level of the offshoring of the intermediate inputs to produce the exports. In the extension, we distinguish those two concepts of the GVC participation indicator so as to

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

assess how different their impacts are on our key dependent variables.

Compared to the gross and value-added import penetration, results show 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 4: Sectoral regression using GVC indicators

	(1) 1012-IV	(2) 1315-IV	(3) 1618-IV	(4) 2021-IV	(5) 2223-IV	(6) 2425-IV	(7) 2627-IV	(8) 2930-IV
$\ln \frac{\text{PPI}_{it-1}}{\text{PPItot}_{t-1}}$	-0.45***	-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)
$\Delta \ln \theta_{it}$	-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)
$\ln \theta_{it-1}$	-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)
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)
$\Delta \ln D_{it}$	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)
$\ln L_{it-1}$	-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)
$\ln z_{t-1}$	-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)
$\Delta \ln \theta_{it}$	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)
$\ln \theta_{it-1}$	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)
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)
$\Delta \ln D_{it}$	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)
$\ln L_{it-1}$	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)
$\ln \frac{w_{it-1}}{\text{PPI}_{it-1}}$	-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)
$\ln \mu_{it-1}$	-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)
$\Delta \ln \theta_{it}$	-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)
$\ln \theta_{it-1}$	-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)
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)
$\Delta \ln D_{it}$	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)
$\ln L_{it-1}$	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)
Observations	75	75	75	75	75	75	75	75

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

7.3 Low Wage Countries (LWC)

In this section, we distinguish imports from low-wage countries (LMY) from those from high income countries (HIC). The pooled sample regression shows that 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 with the two variables. This results holds for both gross and VA import penetration. Similarly, productivity decreases with the import penetration as regards the high income countries whereas it increases as regards the low- and middle-income countries. On the whole, the effect is different depending on the origin of the imports.

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
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

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 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 against an increase in productivity.

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
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Estimation with VA import penetration ratio yields more significant coefficients. On the one hand, this method improves the coefficients that were with the gross import penetration. On the other hand, one can detect the effect of openness on other sectors.

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
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

7.4 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 stregnths 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 8: Regressions at sector-level using VA openness and TFP (instrumented)

	(1) 1012-IV	(2) 1315-IV	(3) 1618-IV	(4) 2021-IV	(5) 2223-IV	(6) 2425-IV	(7) 2627-IV	(8) 2930-IV
$\ln z_{t-1}$	-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
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

8 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. In a first step, we use OECD-STAN data to measure imports penetration in final demand. We can then directly compare our results with the existing literature on the same subject. In a second step, we use the update of World Input-Output Database (WIOD) through 2014 to build another value added imports penetration, based on Stehrer (2012) method.

The novelty of our paper is twofold. First, we carry out a sectoral analysis to shed light on sectors in which price competition is dominant over quality competition and believe in sectoral heterogeneity. Indeed, estimating on a pooled sample to obtain an economy-wide effect of globalisation may ignore the heterogeneity in technology, labour-capital allocation share and R&D status across sectors and countries. Consequently, it would conceal differences by averaging and smoothing the effects of trade. Furthermore, there is no reason why trade would affect all the sectors in a similar way. For some, price competition may be dominant but for the others, quality competition may be larger. As a result, an analysis at sectoral level enables to overcome such criticisms.

Second, unlike the existing papers we consider global value chains (GVC), by measuring value added imports penetration in final demand. Since gross imports are recorded each time they cross borders, they include re-exported imports and can hence overstate their importance to competitiveness. In addition, the increasing importance of global value chains (GVC) has made the analysis of international trade more complex and traditional measures of trade are unable to take into account the full interdependence of markets and economies. Indeed, we obtain stronger effects of openness using the GVC indicators.

In this paper, we find that trade-induced effects are better captured by the GVC indicators and the latter 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 first control for the potential quality upgrading of trade liberalisation, using an indicator based on Martin and Mejean (2014) definition. Even though our model captures price competition in some sectors, it only focuses on the price competition and does not account for quality competition. But 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.* (2013) 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.* (2013), 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
3133	Other and repair

Note: In the case of variables from BACH database, 1012 does not include tobacco (C12). In the case of trade variables and production prices for both Germany and Italy, 3133 does not include repair (C33).

Table 9: Manufacturing sector aggregation

A.2 Classification harmonization

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

The main difficulty is that correspondence tables do not provide unique associations between codes. More specifically, a single code α of the initial classification can correspond to $n \geq 2$ codes of the final classification ($A_1, A_2, \ldots, A_n$). To disaggregate α into $A_1, A_2, \ldots, A_n$, 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.* (2013). When a a single code α corresponds to $n \geq 2$ codes of the final classification $(A_1, A_2, ..., A_n)$, we choose the class that best matched the label of α. For instance, the class 29.13 (Manufacture of taps and valves) in NACE Rev.1 corresponds to both classes 28.14 (Manufacture of other taps and valves) and 33.12 (Repair of machinery). As 28.14 corresponds better to 29.13, 28.14 is used as the exact reference of 29.13 in NACE Rev.2.

B 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. $\begin{pmatrix} (f^{rc})^t & (f^{sc})^t & (f^{tc})^t \end{pmatrix}^t$

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:

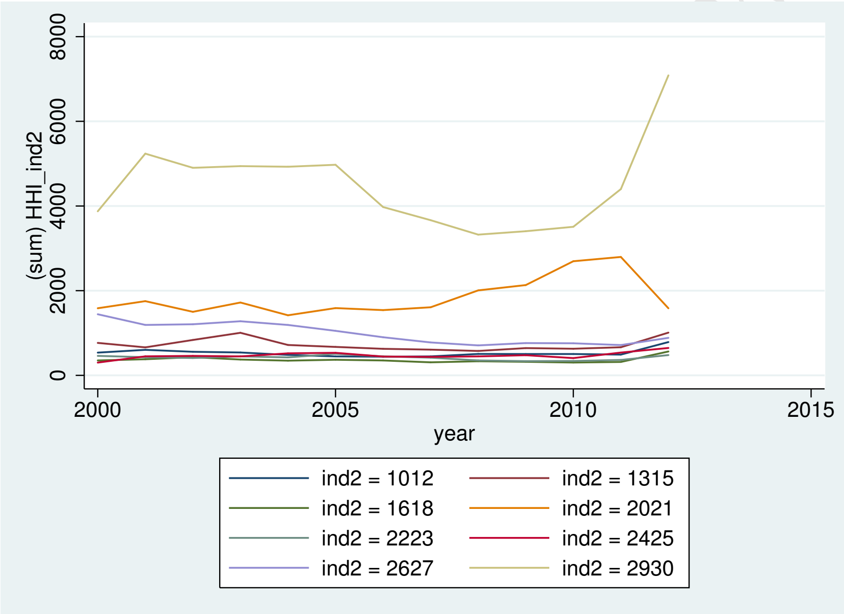
$$tshare_M^{rs} = \frac{t_M^{rs}}{\sum_{p=r,s,t} t_M^{rp}} \tag{19}$$

C HHI construction

Herfindahl-Hirschmann Index (HHI) is a measure of firm concentration, computed from the market shares defined as $HHI_j = \sum_i (s_{ij})^2$ with $s_{ij} = \frac{Y_{ij}}{Y_j}$ where i is the industry level and j is the intermediate industry level. To comply with our industry classification, industry-level HHIs have been aggregated at an intermediate level. CompNet computes HHI based on firms' turnovers. Since we do not possess 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 is the intermediate industry level production, Y total production level in the manufacturing sector and HHI_j is the industry-level. HHI is rather stable over time except for sectors of chemicals and pharmaceuticals (2021) et vehicles and transport (2930).



(a) HHI

Figure 7: Firm concentration

D Global Value Chain

From the input-output table, gross output production is related to the intermediate goods as follows:

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

where A^{ss} denotes domestic input coefficient matrix of country s and A^{sr} imported input coefficient matrix of country s from country r. $E^{s*} = \sum_{r \neq s}^{G} E^{sr}$ is the total gross exports of country s

and E^{sr} gross exports from country s to country r.

By rearranging terms,

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

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

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

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

$$\begin{aligned}
(Va^s)' &= \hat{V}^s X^s \\
&= \hat{V}^s L^{ss} Y^{ss} + \hat{V}^s L^{ss}\sum_{r\neq s}^{G} A^{sr}\sum_{u}^{G} B^{ru}\sum_{t}^{G} Y^{ut} \\
&= \underbrace{\hat{V}^s L^{ss} Y^{ss}}_{V_D} + \underbrace{\hat{V}^s L^{ss}\sum_{r\neq s}^{G} Y^{sr}}_{V_RT} + \underbrace{\hat{V}^s L^{ss}\sum_{r\neq s}^{G} A^{sr} L^{rr} Y^{rr}}_{V_GVC_R} \\
&+ \underbrace{\hat{V}^s L^{ss}\sum_{r\neq s}^{G} A^{sr}\sum_{u}^{G} B^{ru} Y_{us}}_{V_GVC_D} + \underbrace{\hat{V}^s L^{ss}\sum_{r\neq s}^{G} A^{sr}\left(\sum_{u}^{G} B^{ru}\sum_{t}^{G} Y^{ut} - L^{rr} Y^{rr}\right)}_{V_GVC_F}
\end{aligned}$$

- V_D domestically produced and consumed value-added
- V_RT value-added embodied in exports of final goods
- $V\_GVC = \{V\_GVC\_R, V\_GVC\_D, V\_GVC\_F\}$ 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

By considering the number of border crossings, $\_GVC$ can be divided into two types of value-added embodied in exports of intermediate goods and services: those with a single border-crossing (V_GVC_R), called "shallow" GVC participation and those with a multiple border-crossing (V_GVC_D and V_GVC_F), called "deep" GVC participation.

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 10: 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 11: 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 12: 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. (2013). Low-wage import competition, inflationary pressure, and industry dynamics in Europe. *European Economic Review*, **59**, 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.

Choi, I. (2001). Unit root tests for panel data. *Journal of International Money and Finance*, **20**, 249–272.

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*.

Javorsek, M. and Camacho, I. (2015). Trade in Value Added: Concepts, Estimation and Analysis. *TARTNeT Working Paper Series*, **150**.

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. and Rodrik, D. (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.

Schwerhoff, G. and Sy, M. (2014). The Non-Monetary Side of the Global Disinflation. *Open Economies Review*, **25**, 337–371.

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.