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International Trade and Firm-level Markups when Location and Quality Matter

Flora Bellone, Patrick Musso, Lionel Nesta & Frederic Warzynski

Highlights

- We estimate firm-level markups and test some micro-level predictions of a model of international trade with heterogeneous firms and endogenous markups.

- We use a theoretical framework extended Melitz and Ottaviano (2008) model that features both quality and spatial differentiation across firms.

- We draw a map of markup distribution and export participation in France.

- We find that firm markups are positively related to firm productivity and negatively related to the toughness of local competition.

- We find evidence that markups are higher for exporters, what appears to indicate that the quality-enhancing channel overbalances the price-depressing channel of global competition.

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▊ Abstract

In this paper, we estimate firm-level markups and test some micro-level predictions of a model of international trade with heterogeneous firms and endogenous markups. Our theoretical framework is an extended version of the Melitz and Ottaviano (2008) (MO) model that features both quality and spatial differentiation across firms. In line with our model, we find that firm markups are positively related to firm productivity and negatively related to the toughness of local competition. Considering the relationship between firm markups and exports, we find evidence that markups are higher for exporters, what appears to indicate that the quality-enhancing channel overbalances the price-depressing channel of global competition.

▊ Keywords

Mark-ups, International Trade, Productivity.

▊ JEL

F14, D24.

International trade and firm-level markups when location and quality matter[1]

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1. Introduction

A recent literature has investigated pricing heterogeneity between firms and its implications for the measurement of total factor productivity (TFP) (see e.g. Foster, Haltiwanger and Syverson, 2008; De Loecker, 2011) and the existence of wide TFP dispersion even within precisely defined industries (see e.g. Syverson, 2011). Yet, one related topic that remains relatively understudied is how markups differ between firms within and between industries and across locations, i.e. how heterogenous are markups. This paper studies markup heterogeneity between firms and tries to test recent theoretical predictions using a sample of French manufacturing firms.

New models of international trade with heterogeneous firms (see e.g. Melitz, 2003 and Bernard, Eaton, Jensen and Kortum, 2003) have been quite successful explaining some patterns relating export behavior to productivity. However, the first generation of models was unable to offer a satisfactory explanation of markup heterogeneity, as they rested on extreme assumptions about the nature of competition (monopolistic competition à la Dixit-Stiglitz with no implications for markup heterogeneity, or pure Bertrand competition with limited insight on the determinants of firms' markups). More recently, Melitz and Ottaviano (2008, MO henceforth) have proposed a more realistic and yet tractable model relaxing these assumptions and generating a rich set of predictions on firm mark-ups.

In this paper, we build on this new line of modeling to frame an empirical investigation on the determinants of firm-level markups. We use an augmented version of the MO model which allows for a rich set of variables as determining endogenous firm markups. In the original trade model by

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MO, the average mark-up that a firm charges depends on four main determinants: the firm relative efficiency compared to its domestic and foreign competitors; the size of its domestic and export markets; the intensity of import competition; and the level of trade costs.

We extend the MO framework following two recent contributions: Antoniades (2013) who introduces quality differentiation across firms into the MO framework; and Combes et al. (2012) who present a spatial version of the MO model in which a firm location matters to its relative performance. This theoretical framework generates several testable implications about the determinants of firm markups.

To test for these predictions, we follow a two-step empirical strategy. We first estimate firm-level markups using a flexible methodology suggested by De Loecker and Warzynski (2012) and apply it on a large sample of French manufacturing firms from 1998 to 2007. Second, we relate firm markups to characteristics both at the firm level (firm productivity, export participation, and measures of average wealth and average export distance on the markets where firms export) and at the level of the competitive environment level (the size of local markets and import penetration ratio at the industry level).

In line with our theoretical framework, we find that firm markups are positively related to firm productivity and negatively related to the toughness of local competition, and to the degree of import penetration. We also find that firms' markups are positively related to export participation. However, we go one step further in providing some evidence that the markup of exporters is positively related to the average wealth of the countries where they export and to the average distance where they export, suggesting quality differentiation across markets, in line with previous research (e.g. Manova and Zhang, 2012; Crozet et al., 2012).

We show that these findings are consistent with our extended MO model under the assumption that French exporters enjoy on average a quality advantage over their foreign competitors. Indeed, in this case, global competition has two counterbalancing effects on domestic exporting firms. On the one hand, it has a price-depressing effect because of freight cost absorption (and this effect is stronger the more distant are the export markets). On the other hand, it has a price-increasing effect that operates through a quality-enhancing channel (and this effect is stronger the larger is the export markets size). All in all, our empirical findings seems to support the view that, for French firms, the scope for quality differentiation is higher on their export markets than on their local markets.

We also generate a few findings that contribute to a better understanding of the economic geography of markups. First, we plot the weighted average of markups by employment area and document the spatial heterogeneity in markups, following Combes et al. (2012) description of the spatial distribution of productivity. Second, we use a measure of domestic market size that is location specific and depends negatively on the distance to potential consumers and competitors, as advocated in several recent papers (see e.g. Combes et al., 2008; Barde, 2010). As expected, this measure of size is negatively related to markups.

Our paper can be related to several recent theoretical and empirical developments regarding firms' pricing decisions and differences between markets. First, various authors have stressed the importance of quality sorting, i.e. exporting firms are more likely to ship high quality goods to more distant markets (see e.g. Johnson, 2012; Hallak and Sivadasan, 2009; Crozet et al., 2012; Martin and Mayneris, 2014) and might also price discriminate and charge higher prices on richer markets where consumers' willingness to pay is higher. Manova and Zhang (2012) provide empirical evidence of this hypothesis for China. Using French data, Martin (2012) shows that firms charge higher free-on-board prices for similar products on more distant markets. However, these results do not necessarily imply that firms charge higher markups on more distant markets as they also have to incur specific trade costs to access those markets. In our analysis, we focus on the markup as our variable of interest and try to determine which factors are related to higher firm markups.

Second, various papers have investigated the impact of trade liberalization on firm markups.[2] The most closely related to our work, Chen et al. (2009) conduct a similar analysis using sectoral data for seven EU countries, focusing on the macro-level implication of the MO model and mostly documenting the impact of import competition on average industry markups. Behrens et al. (forthcoming) develop an alternative general equilibrium model of monopolistic competition that generates endogenous markups and simulate the effect of an hypothetical abolition of the Canada-US border. They find that consumers' exposure to market power would be substantially reduced, especially in the smaller economy, Canada. They also find that how markups respond to increased competition depends on firm's productivity and location. Our approach is complementary to these papers, as we estimate markups using firm-level data, test additional micro-level implications from the extended MO model while focusing on one large European country.

The paper is organized as follows. Section 2 describes an extended version of the MO model featuring location and quality differentiation across firms, and highlights its micro-level implications for the determinants of firm markups. Section 3 introduces our empirical methodology to estimate firm-level markups and to relate those estimates to the variables of interest according to the extended MO framework. Section 4 describes the firm-level and industry level data that we use and how we generate our variables. Section 5 presents and discusses our main results. Section 6 concludes.

2.   The theoretical framework

Starting from the original MO model, let us consider a global economy with two countries producing and consuming both a traditional good sold on perfectly competitive markets and a manufactured good sold on monopolistic competitive markets. Both countries, named Home (H) and Foreign (F), are assumed to share identical preferences and production technologies. They may otherwise differ in terms of their size, their firm distributions and their relative ability to upgrade the quality of their products.

Borrowing to Antoniades (2013), we assume that, in the global economy, the product of the manu-

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[2]See Levinsohn (1993) and Harrison (1994) for early contributions.

facturing industry is both horizontally and vertically differentiated in a continuum of varieties indexed by $i \in \Omega$. Specifically, in each country, the representative consumer is endowed with a linear utility function of the following type:

$$U = q_0^c + \alpha \int_{i \in \Omega} q_i^c \, di + \alpha \int_{i \in \Omega} z_i \, di - \frac{1}{2}\gamma \int_{i \in \Omega} (q_i^c)^2 \, di - \frac{1}{2}\gamma \int_{i \in \Omega} (z_i)^2 \, di + \gamma \int_{i \in \Omega} (q_i^c z_i) \, di$$
$$- \frac{1}{2}\eta \left\{ \int_{i \in \Omega} \left(q_i^c - \frac{1}{2}z_i \right) di \right\}^2 \tag{1}$$

where q_0^c and q_i^c represent the individual's consumption of the homogenous traditional good and each variety i of the differentiated manufactured goods, respectively. The quality of each variety is given by z_i. The non-negative parameters α and η capture the degree of substitution between each variety and the traditional good, and the non-negative parameter γ captures the degree of differentiation among varieties. This utility function yields linear market demand system for the subset of manufactured varieties consumed on a given market. Specifically, the inverse demand for each variety is given by:

$$p_i = \alpha - \gamma q_i^c + \gamma z_i - \eta Q^c \tag{2}$$

where $Q^c = \int_{i \in \Omega} \left(q_i^c - \frac{1}{2}z_i \right) di$, which yields the following demand for each variety consumed in a market of size L:

$$q_i = L q_i^c = \frac{\alpha L}{\eta N + \gamma} - \frac{L}{\gamma}p_i + L z_i + \frac{\eta N L}{\gamma(\eta N + \gamma)}\overline{p} - \frac{1}{2}\frac{\eta N L}{\eta N + \gamma}\overline{z} \tag{3}$$

where N is the number of varieties consumed on that market, $\overline{p} = (1/N) \int_{i \in \Omega^*} p_i \, di$ is the average price, $\overline{z} = (1/N) \int_{i \in \Omega^*} z_i \, di$ is the average quality, and $\Omega^* \subset \Omega$ is the subset of varieties consumed.

Since demand is linear, there is a maximum bound to the price p_i, that firms can charge and face positive demand. This choke price p^{max} occurs where demand $q_i = 0$. At the equilibrium, the subset Ω^* of varieties which will be consumed is the largest subset of Ω that satisfies

$$p_i \leq \frac{1}{\eta N + \gamma}(\gamma\alpha + \gamma(\eta N + \gamma)z_i + \eta N\overline{p} - \frac{1}{2}\eta N\gamma\overline{z}) \equiv p_i^{max} \tag{4}$$

where p_i is the delivered price of variety characterised by quality z_i sold on the market, N is the (endogenous) measure of consumed varieties, and p_i^{max} represents the price bound at which demand for a variety i is driven to 0.

Equation (4) shows why both markets and firms characteristics jointly determine firm markups in a MO type model. First, for a given level of product differentiation γ, a larger number of competing varieties, N, a lower average price, $\overline{p}$, or an higher average quality, $\overline{z}$, induce a decrease in the price bound p_i^{max} and an increase in the price elasticity of demand, ϵ_i, at any given p_i. This is what we can call a "tougher competitive environment" in this quality augmented version of the MO model.

Second, for a given toughness of competition, a more efficient firm or a firm selling a product of higher quality will face a lower price elasticity of demand. Specifically, given quality, ϵ_i monotonically increase with p_i while, given efficiency, p_i^{max} increases with quality z_i.

On the supply side, we assume that both the traditional and the manufactured goods consumed in the domestic economy can be supplied by domestic firms and by exporters located abroad. Both goods are produced with labor as a unique factor of production. The typical traditional firm in the global economy produces under constant return to scale using one unit of labor per unit of output. The typical manufacturing firm produces under increasing return to scale. It has to pay a fixed entry fee, f_E on its local market, and then it will draw a productivity parameter that determines its marginal cost c.[3] In this setting, a firm with high marginal cost (low productivity) will no longer survive. The remaining firms will maximise their profits by taking, on each market, the number of competitors N, the average price $\overline{p}$, and the average level of quality upgrade $\overline{z}$ as given. Firms will also choose the optimal level of quality upgrade on each market it sells.

Specifically, following Antoniades (2013) we pose that the cost function of a typical active firm of marginal cost c, in the global economy, is given by:

$$TC_i = c_i q_i + \theta_i (z_i)^2 \tag{5}$$

where the first term captures the variable costs of production and the second term captures the firm-specific cost of quality upgrading which is assumed to be invariant to output and convex to the level of quality.[4] The parameter θ_i is going to be a key determinant of a firm markup. Indeed, all else equal, a firm with a high ability to upgrade the quality of its product (relatively to its competitors) will be able to sell more on a given market.

We now turn to the spatial dimension of our model. Starting from the standard MO model, we assume that workers and firms are immobile between countries, and that the domestic and the foreign markets are segmented by iceberg transport costs. Specifically, we pose that the overall cost of a delivered unit with cost c from H to F is $\tau_{HF} c$ with $\tau_{HF} > 1$. Following Combes et al. (2012),[5] we first assume that firms and workers in H are attached to R different sub areas which differ in terms of their given population size.[6] Let L_r^H be the market size of the sub area r in the

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[3]As usual in this literature, firms are supposed to learn about their marginal cost of production, c, only after having incurred the fixed entry cost f_E. We also follow the literature in assuming that a firm has to be active at home to export.

[4]As in Antoniades (2013), we will soon make the simplifying assumption that θ_i is common to all firms operating in a same country. An interesting extension would be to consider θ as location or firm specific.

[5]Their model is dedicated to study the interplay between selection and agglomeration effects. Here we abstract from the agglomeration component as our focus is on the determinants of firm markups rather than on the determinants of firm productivity. Basically, agglomeration economies would make a given c firm located in a larger area systematically more productive than its counterpart located in a smaller area. In our empirical exercise, we will systematically control for the productivity of the firm.

[6]To keep the model simple enough, we do not add a spatial dimension to the foreign economy. However, in our empirical analysis, we will consider the average distance of the destination markets of exporting firms. For an extension

domestic economy such that $L^H = \sum_{r=1}^{R} L_r^H$.[7] Second, we assume that local areas are segmented by infranational iceberg costs. Specifically, we pose that the overall cost of a delivered unit with cost c from a local area r to a local area l is $\tau_{rl}c$ with $\tau_{rl} > 1 \ \forall \ r \neq l$, and $\tau_{rl} = 1$ for $r = l$. We then make two simplifying assumptions as regards infra-national and international transport costs. First, we assume that domestic firms, while differentiated by their locations, share the same cost of delivering the foreign market.[8] Second, we assume that infranational transport costs are always smaller than international transport costs. Specifically, we pose $\tau_{rl} < \tau_{HF} \ \forall \ r,l \in [0, R]$.

Within our theoretical framework, a domestic exporting firm will face a different cutoff rule on each of the local markets, and on the export market. More specifically, these (endogenous) cost cutoffs must satisfy:

$$\begin{cases} c_{rl} = sup\{c : \pi_{rl}(c, z) > 0\} = \dfrac{p_l^{max}}{\tau_{rl}}, \\[3mm] c_X = sup\{c : \pi_{HF}(c, z) > 0\} = \dfrac{p_F^{max}}{\tau_{HF}}, \end{cases} \tag{6}$$

where c_{rl} and c_X denote the upperbound costs *exclusive of trade costs*, for a firm located in area r selling on a local market l and abroad, respectively. $\pi_{rl}(c, z)$, and $\pi_{HF}(c, z)$ are the profits earned by a firm with location r, cost c, and (endogenous) quality z, on the local market l, and on the export market, respectively. Finally, p_l^{max}, and p_F^{max} are the upper bound prices on the local market l, and the foreign market, respectively.[9]

Equation (6) has important implications about the toughness of competition that a domestic firm faces on the different markets where it sells.

Let us first consider *local competition* that we define as the competition that takes place within the domestic economy on each of the local markets separately. For perfectly symmetrical areas (especially, with identical market size), p_l^{max} is the same $\forall \ l$. Infranational trade costs are the unique source of variation in the cost cutoffs c_{rl}. A firm of location r will then face a tougher competitive environment on more distant local markets simply because it has to pay additional transport costs. However, if areas differ in terms of their market sizes, two competing effects will prevail besides the freight cost absorption effect. On the one hand, a larger market will allow more varieties to compete which tends to depress the price any given firm can charge on that market. On the other hand, a larger market will give more incentives to invest in quality upgrading as it is

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of the MO framework to multi destinations (and multi-products) exporting firms, see Mayer, Melitz and Ottaviano (2014).

[7]Implicitly, we assume that the number of potential active firms in each location is high enough for the actual number of active firms in a given area to be endogenously determined by the market size of the local area.

[8]As a corollary, we assume that each area within the domestic economy is identically reachable by a foreign firm. An interesting extension of the present framework would consist in differentiating areas by their export facilities and/or import exposure. This is left for further research.

[9]Note that, compared to (4), the upper bound prices are no longer firm specific as a firm quality upgrade level z is endogenously chosen by the firm so that $z_i = 0$ when $q_i = 0$. See Antoniades (2013) and Baller (2013) for a similar argument.

more easy to recover the fixed cost of quality upgrade on a large market. As we will show below by following Antoniades (2013), depending on the preference parameters, this quality enhancing effect can counterbalance the price depressing effect of a larger market.

Let us next consider *global competition* that we define as competition on the export market. In some respects, global competition is not different from local competition. For perfectly symmetrical market sizes, $L^F = L^H_r$, the cost cutoff c_X will be lower than any of the cutoffs c_{rl} only because international transport costs are higher than infra-national transport costs. In other words, for any domestic firm, competition will be tougher on the foreign market because of higher transport costs. However, if the foreign market size is large compared to any of the local market size, then the same counterbalancing effects, i.e. a price depressing effect and a quality enhancing effect, prevail which can potentially make p_F^{max} lower than any (or some) of the p_l^{max} despite the higher transport costs.

However, global competition differs more substantially from local competition in a more subtle way. In a recent contribution, Behrens et al. (forthcoming) show how a firm average markup can ambiguously change, after a trade liberalization experiment, depending on the firm productivity and location in a context of multiple asymmetric regions (but without quality differentiation). Specifically, they show that trade liberalization can lead firms to decrease their markups on domestic sales but to increase their markups on cross-border sales as the productivity advantage of domestic firms can be magnified by foreign competition. In our setting, we are going to emphasize differences between countries, not in terms of relative productivity, but in terms of their relative ability to upgrade product quality. Specifically, if all firms from a domestic economy share a higher ability to upgrade the quality of their product compared to their foreign competitors, then global competition induces an additional channel through which domestic exporting firm may charge higher markups on their export sales.

Testable micro-level implications on the determinants of firm markups

As emphasized above, in a general equilibrium monopolistic competition model with variable demand elasticity, heterogenous firms, endogenous quality and multiple asymmetric regions, markups at the firm-level are determined in complicated ways. They depend not only on the firm characteristics but also on which markets the firm sells its products and on the relative importance of domestic versus foreign markets. In this subsection, we impose some restrictions on the values of a few parameters in order to derive simple testable implications about the determinants of firm markups.

As a benchmark case, let us first reduce our parameter values to nest the original MO model. We then assume no quality differentiation across firms ($z_i = 0 \; \forall \; i$), no infra-national transport costs ($\tau_{rl} = 1 \; \forall \; r$ and $\forall \; l$) and perfectly symmetric countries (same distributions of marginal costs, $G^H(c) = G^F(c)$, and same market sizes, $L^H = L^F = L$). In this setting, the local domestic markets are no longer segmented, and the optimal *delivered* price and output levels of a domestic firm of cost efficiency c, can be written as function of two cutoffs: the cutoff on the domestic

market, c_D and the cutoff on the foreign market c_X.

$$\begin{cases} p(c) = \frac{1}{2}(c_D + c), & q(c) = \frac{L}{2\gamma}(c_D - c) \\ p_{HF}(c) = \frac{\tau_{HF}}{2}(c_X + c), & q_{HF}(c) = \frac{L}{2\gamma}\tau_{HF}(c_X - c) \end{cases}$$

As shown by MO, this yields the following maximized operating profit levels:

$$\begin{cases} \pi(c) = \frac{L}{4\gamma}(c_D - c)^2 \\ \pi_{HF}(c) = \frac{L}{4\gamma}\tau_{HF}(c_X - c)^2 \end{cases}$$

from which it is easy to state that, all else equal (i.e. for $c_X = c_D/\tau_{HF}$), any exporting domestic firm get larger profits at home than abroad. This property naturally extends to firm markups

$$\begin{cases} \mu(c) = p(c) - c = \frac{1}{2}(c_D - c) \\ \mu_{HF}(c) = p_{HF}(c) - \tau_{HF}c = \frac{\tau_{HF}}{2}(c_X - c) \end{cases} \tag{7}$$

which can be rewritten

$$\begin{cases} \mu(c) = \frac{1}{2}(c_D - c) \\ \mu_{HF}(c) = \frac{1}{2}(c_D - \tau_{HF}c) \end{cases} \tag{8}$$

by considering that $c_X = c_D/\tau_{HF}$ in the perfectly symmetrical case.

In this benchmark case, straightforward implications about the determinants of firm markups are as follows: first, a firm average markup is positively related to firm productivity (through c); second, a firm average markup does not depend on the firm location at home; third a firm average markup is negatively related to market size L (through both c_D and c_X); fourth, a firm charges a higher mark-up at home than abroad.[10]

Let us now consider the general case with both quality differentiation across firms and spatial differentiation across the domestic firms. Markets sizes can now differ both within and across countries. We only impose the restriction that, for a domestic firm in H, the export market size, L^F, is larger than any of the local market sizes, L_r^H. We also maintain the simplifying assumption that, in all locations, firms share the same distributions of marginal costs, $G_r^H(c) = G^F(c) = G(c)$. However, H and F can now differ according to the relative ability of their firms to upgrade their product quality. Specifically, we pose $\theta_{HF} < \theta_{HH}$ which means that the cost a domestic firm producing in H has to pay to upgrade the quality of its product relatively to its competitors abroad (θ_{HF}) is lower than the cost it has to pay to upgrade the quality of its product relatively to its

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[10]This prediction is reminiscent of Brander and Krugman (1983) who originally demonstrated that in presence of imperfect competition and costly trade, firms are incited to charge lower markups on export markets than at home, although this works through a different mechanism.

competitors at home (θ_{HH}).[11] In other words, domestic firms are assumed to be endowed from a competitive advantage in terms of perceived product quality, over their foreign competitors.[12]

Under these specific assumptions and given the linearity and separability of the model, we can solve for the optimal prices and the optimal qualities firms set on each market sequentially. First, firms set, on each market, their output price as a markup over its marginal cost for a given level of quality upgrade. Following Antoniades (2013), we can express the optimal *delivered* price and output levels of a domestic firm located in r and producing with cost efficiency c and (endogenous) quality z as follows

$$
\begin{cases}
p_{rl}(c, z) = \frac{1}{2}(c_{Drl} + c) + \frac{\gamma}{2}z, & q_{rl}(c, z) = \frac{L_r^H}{2\gamma}(c_{Drl} - c) + \frac{L_r^H}{2}z \\
p_{HF}(c, z) = \frac{\tau_{HF}}{2}(c_X + c) + \frac{\gamma}{2}z, & q_{HF}(c, z) = \frac{L^F}{2\gamma}\tau_{HF}(c_X - c) + \frac{L^F}{2}z
\end{cases}
$$

for the domestic local market l and the export market, F, respectively.

This yields the following equations for profits:

$$
\begin{cases}
\pi_{rl}(c, z) = \frac{L_r^H}{4\gamma}(c_{Drl} - c)^2 + \frac{L_r^H}{2}z(c_{Drl} - c) + \frac{\gamma L_r^H}{4}(z)^2 - \theta_{HH}(z)^2 \\
\pi_{HF}(c, z) = \frac{L^F}{4\gamma}\tau_{HF}^2(c_X - c)^2 + \frac{L^F}{2}\tau_{HF}z(c_{HF} - c) + \frac{\gamma L^F}{4}(z)^2 - \theta_{HF}(z)^2
\end{cases}
$$

Next, the firms choose, on each market, the optimal quality upgrade by maximising the profit functions above, separately on each market. The optimal qualities $z*_{rl}$ and $z*_X$ are then given by

$$
\begin{cases}
z_{rl}^* = \lambda_{rl}(c_{Drl} - c) \\
z_X^* = \lambda_X \tau_X(c_X - c)
\end{cases}
\tag{9}
$$

where $\lambda_{rl} = L_r^H / (4\theta_{HH} - L_r^H \gamma)$ and $\lambda_X = L^F / (4\theta_{HF} - L^F \gamma)$ denote, respectively, the scope for quality differentiation in the domestic local area l and in the export market, from the point of view of a domestic firm operating in local area r, which faces cost of quality upgrade θ_{HH} on its domestic market and θ_{HF} on its export market.[13]

Equation (9) states that the optimal product quality a firm can set on a given market is a function of two components: the scope for quality differentiation, λ, the firm faces on this given market, and the productivity of the firm, c, relative to the cost threshold prevailing on that market. Secondly, it defines the scope of quality differentiation as a function of the market size, L, the cost of quality upgrade θ, and the degree of differentiation among varieties, γ. Firms benefiting from a relatively low cost of quality upgrade and operating in relatively large and differentiated markets, will benefit

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[11]We made the simplifying assumption that the ability to upgrade product quality do not differ across the different location within the home economy.

[12]For instance, think of a firm benefiting from the reputation of its home country in terms of product quality. The firm would find it easy to upgrade the quality of its product relatively to its competitors abroad by simply making more ostensible the origin of its product.

[13]To ensure that all qualities are positive, we follow Antoniades (2013) in imposing restrictions on the parameters such that all λ's are positive.

from a relatively large scope of quality differentiation because it will be easier for them to recover the fixed cost of quality upgrading. Under the assumptions that L^F is larger than L_r^H ($\forall r$), and that $\theta_{HH} < \theta_{HF}$, Equation (9) then states that, for a given domestic firm operating from H, the scope for quality differentiation is likely to be higher on its export market than on any of its local domestic markets.

We complete the model by substituting the optimal values of z^* into the price equations in order to get the new markup equations[14]:

$$
\begin{cases}
\mu_{rl}(c) = \frac{1}{2}(c_{rl} - c) + \frac{1}{2}\gamma\lambda_{rl}(c_{rl} - c) \\
\mu_{HF}(c) = \frac{\tau_{HF}}{2}(c_X - c) + \frac{1}{2}\lambda_X\tau_X(c_X - c)
\end{cases}
\tag{10}
$$

Equations (10) show that, in a setting with endogenous quality choice, the scope for quality differentiation scales up firm markups. Since in such a setting, competition affects both the cost threshold and the scope for quality differentiation, its impact on the firm markup will vary across markets and firms. First, for a firm of given cost c, local competition will be *tougher* than global competition as long as λ_X is high enough compared to λ_{rl}. Indeed, in such a case, the higher scope for quality differentiation on the export market will overbalance the fact that the cost cutoff is lower on the export market (compared to the local market). Second, global competition will affect differently heterogeneous firms. To demonstrate this point, let us consider two domestic firms, named 1 and 2, operating in the same local area, r, but with different costs. We assume that both firms are efficient enough to overcome both the cost threshold on a typical local destination and the cost threshold on the export market. Specifically, we pose $c_1 \leq c_2 \leq c_X \leq c_{rl}$. In this setting, the large size and the low cost of quality upgrading which, in our framework, characterize the export market, will make the quality ladder to pivot clockwise (relatively to the quality ladder on a typical local market). This is illustrated in Figure 1 adapted from Antoniades (2013).

In such a setting, from the domestic exporting firms, the least productive ones respond to global competition by lowering quality, markups and prices on the export market (See the firm of given cost c_2 located in Area B on Figure 1). In contrast, the more productive firms respond by raising quality, markup and price on the export market (as exemplified by the firm of given cost c_1 located in Area A on Figure 1). Moreover, market shares rise for the firms that respond to competition by upgrading their product quality on the export market, but fall for all other firms. At the extreme, if all the domestic firms benefit from a very low cost of quality upgrade compared to their foreign competitors, the quality ladder of the export market will become very steep, still starting from the same point c_X. In this case, Area B will shrink and the number of domestic firms that will choose to downgrade their product quality on the export market will be very low, while the most productive firms will increase relatively more their qualities, markups and prices on the export markets.

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[14]For completeness, we report in Appendix A, the prices, quantities and profits equations in the open economy. We also solve for c_{rl} and c_X by relying on the simplifying assumption that the cost draws as come from the same Pareto parametrization whatever the firm location.
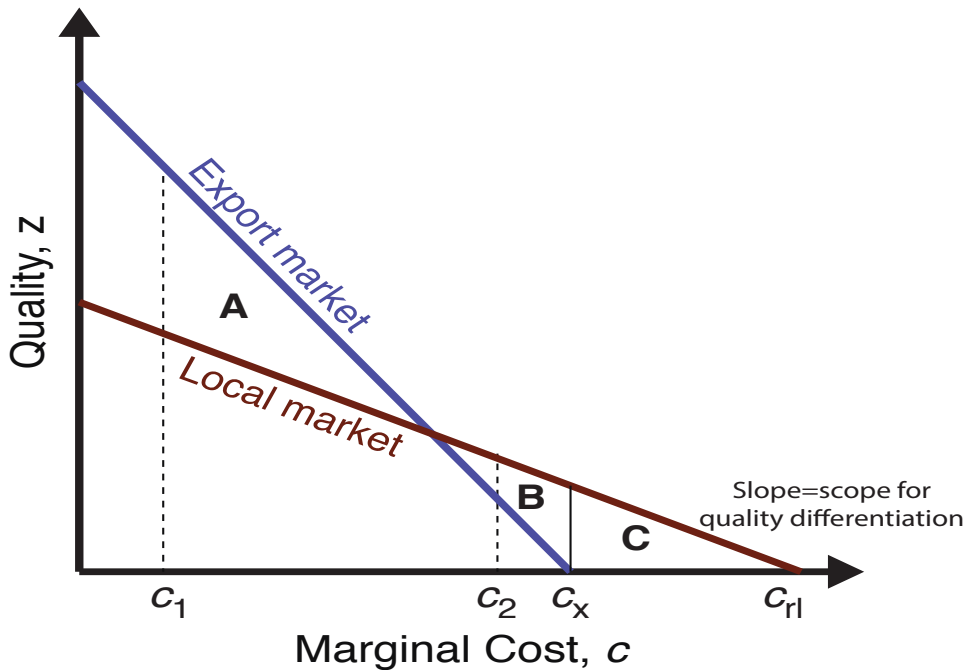
Figure 1 – Quality ladders: Export versus Local markets

It would be beyond the scope of this paper to fully derive the endogenous markets shares of a given firm in this spatially and quality differentiated global economy.[15] Indeed, in our general setting, no simple relationship exists between a firm average markup and its relative commitment in the local and export markets. However, under our specific assumptions about the relative size and the relative costs of quality upgrade, we can, at least, derive the four following testable implications on the determinants of firm markups:

Proposition 1: A firm average markup is positively related to firm productivity (through c);

Proposition 2: A firm average markup is negatively related to the toughness of local competition which is location specific (through L_r^H and τ_{rl});

Proposition 3: Firms are likely to charge higher markup abroad than at home if their scope for quality differentiation is higher on export markets (through $\lambda_{HF} > \lambda_{rl}$);

Proposition 4: The quality-enhancing effect of global competition is stronger for more efficient domestic firms.

In what follows, we test each of these predictions on a rich French firm-level dataset.

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[15]For a formal discussion on how firm markets shares of heterogenous firms respond to changing market conditions in a context of multiple asymmetric locations, see Behrens and al. (forthcoming).

3. The Empirical Model

The methodology used to estimate markups follows the standard approach proposed by Hall (1986, 1988) and recently extended by De Loecker and Warzynski (2012).

Assume the following value added function $Y = f(K, L)exp(\vartheta)$ where i is the firm index, t a time index, Y is value added, L is labor, K is capital and ϑ is a measure of technical efficiency.

Assume a Cobb-Douglas technology[16] and taking logs:

$$y_{it} = \beta_0 + \beta_L l_{it} + \beta_K k_{it} + \vartheta_{it} \tag{11}$$

where

$$\vartheta_{it} = \omega_{it} + \epsilon_{it} \tag{12}$$

where lower cases denote logs $(x = log(X), X = Y, L, K)$, ω is a measure of "true productivity" and ϵ is a true noise.

A common problem in this literature stems from the fact that the choice of inputs is probably correlated with TFP. One way to solve this problem is to use a control function approach as in Olley and Pakes (1996) or Levinsohn and Petrin (2003). Using materials to proxy for productivity, DLW pose:

$$m_{it} = m_t(k_{it}, \omega_{it}, ED_{it})$$

where ED_{it} is an export dummy. Then, they invert this function and write productivity as

$$\omega_{it} = h_t(m_{it}, k_{it}, ED_{it}) \tag{13}$$

It is important to note that the DLW methodology allow to control for exporting behavior in the first stage of the estimation algorithm.

Specifically, we start with the following estimation:

$$y_{it} = \phi_t(l_{it}, k_{it}, m_{it}, ED_{it}) + \epsilon_{it}$$

This generates an estimate of expected output $(\widehat{\phi}_{it})$ and ϵ_{it}. Define productivity as $\omega_{it}(\beta) = \widehat{\phi}_{it} - \beta_l l_{it} - \beta_k k_{it}$. Define then the law of motion for productivity:

$$\omega_{it} = g_t(\omega_{it-1}) + ED_{it} + \xi_{it}$$

For the last step of the estimation, we regress non parametrically $\omega_{it}(\beta)$ on its lag, and export behavior. This generates the innovation to productivity $\xi_{it}(\beta)$.

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[16]DLW also consider more flexible functional forms such as a translog function. We do not discuss this to simplify the description. All our results are robust when we use a translog version.

As suggested by Ackerberg, Caves and Frazer (2006), we use the following moments to obtain our estimates of the production function:

$$E\left(\xi_{it}(\beta)\begin{pmatrix} l_{it-1} \\ k_{it} \end{pmatrix}\right) = 0$$

To retrieve the markup, DLW uses the simple intuition that the output elasticity of a variable factor of production is equal to its share in total revenue multiplied by the markup. Indeed, standard cost minimization leads to the following result that:

$$\beta_{it}^X = \mu_{it}\alpha_{it}^X \tag{14}$$

where the output elasticity on an input X is denoted by β_{it}^X and the observed revenue share by α_{it}^X.

Most studies in this literature simply assume that μ_{it} takes the same value for a subset of firms, typically within a single industry and for a given period.[17] In other words, they estimate an average markup for the subset and period considered. The methodology used in the paper leads to a markup estimate at the firm level that varies by year.

Once we have estimated our firm-level time varying markup, we try to identify the relationship with a few variables suggested by the extended MO model.

We first consider firm productivity (TFP_{it}) that is directly recovered from our empirical exercise. The model predicts that more productive firms have higher markups.

We then consider the exporting status of the firm by using an export dummy. There are various elements that could explain why the export status could be related to the markup. As discussed in the previous section, a positive relationship could imply that the product quality of domestic producers on the markets where French firms export is lower on average, while the sign is expected to be negative if firms have to *cover* transport costs

According to the above predictions, the second step of our empirical methodology is to look at the relationship between firm-specific markups and productivity, market size and export participation as in the following:

$$\mu_{it} = \mu_0 + \mu_1\omega_{it} + \mu_2 MS_{lt} + \mu_3 ED_{it} + \mathbf{BC_{it}} + \mathbf{ffl_{it}} \tag{15}$$

where μit denotes the markup of firm i at time t, ω is firm TFP, MS is the size of the local market in which the firm is operating, and ED is a dummy variable set to unity if the firm exports at a given year, 0 otherwise. Vector $\mathbf{C}$ gathers a series of control variables and $\mathbf{B}$ is its associated vector of parameters. Vector $\mathbf{C}$ is composed as follows. First, it includes a measure of the import penetration ratio at the industry level. Second, Vector $\mathbf{C}$ also includes a description of the destination markets

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[17]Some studies allow β_{it} to vary according to some firm-level and time variant characteristics; e.g. Konings, Van Cayseele and Warzynski (2005) looked at the effect of ownership on markups and found that foreign and private domestic firms had higher markups than state firms. However, most of the other variables used in the analysis were at the sector level.

of French export at the firm level. Lastly, it comprises a full vector of industry-year interactions, controlling for year fixed effect specific to each sector.

Below we provide details on data sources and on the computations of the variables of interest.

4. Data

The study combines the French census FICUS with several additional database. FICUS (Fichier complet unifié de SUSE) is our main data set. It gathers the financial statements (balance sheet and income statement) of all companies in France.[18] The version at our disposal covers the period ranging from 1998 to 2007 and contains information about nominal gross output, a series of inputs including number of employees, intermediate inputs, capital and investments in capital goods, and also exports. We use this information along with industry level price indexes, depreciation rates, and worked hours, to compute the required variables for estimating simultaneously the firm markup and productivity along the DLW (2012) methodology (See Appendix B for a full description of our main variables). We focus our analysis on the manufacturing sector.

In addition to FICUS, we also exploit information provided by French customs between 1998 and 2007. The data set provides information on exports by all companies operating in France. Of particular importance to our study, export value is available by product and destination country. This allows us to recover, for a particular year, any firm's structure of exports in terms of destination countries.

At the industry level, we obtained data on imports and production at the 2-digit NACE Rev. 1 from the STructural ANalysis (STAN) database provided by the OECD. We also obtained data on the import price index, the export price index and the production price index at the 2-digit NACE Rev. 1.

To characterize the geography of exporting firms, we use two additional databases: the database GeoDist from CEPII in order to compute the average distance to export markets at the firm level (Mayer and Zignago, 2011) and version 6.3 of the Penn World Tables in order to measure the average wealth of the destination countries by means of GDP per capita (Heston, et al., 2009).

4.1. Construction of Our Explanatory Variables

Equation 15 stipulates that firm markups are related to the firm's level of productivity ω, its export status ED and the size of its domestic market MS.

A direct outcome of the DLW method is to provide a firm-year specific measure of both markups μ and total factor factor productivity ω (TFP), obtained from the Cobb Douglas specific laid out

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[18]It excludes firms with sales below 81,000 thousands euros in sectors such as catering, retailing and furniture rental. It also excludes firms active in some specific agricultural subsectors.

in Equation 11. In turn, variable ED is directly retrieved from the FICUS data, and is set to unity when firm export is positive, 0 otherwise.

The computation of the domestic market size MS is more demanding. Our measure of market size proxies the demand that a given company located in location l is facing. Hence, we augment our collection of data with information on revenues in France provided by the national statistical agency INSEE. All revenues are provided by year and by employment area, our proxy for location l. We compute a spatial structure of domestic demand as follows:

$$MS_{lt} = \sum_m ms_{mt} \times \tau_{m,l} \tag{16}$$

where subscript m denotes all geographical units, ms_{mt} is market size of location m at time t, and τ is the proximity between location m and l. The geographical units are the 348 French employment areas as defined in 1994. Proximity τ is derived from a spatial matrix $\mathbf{W}$ providing euclidian distances in kilometers between the centroids of each employment area.[19] We then transform the distance matrix into a proximity matrix normalized between 0 and 1 as follows:

$$\tau_{m,l} = 1 - \frac{D_{m,l}}{\max\{D\}} \tag{17}$$

Therefore, MS_{lt} measures the domestic demand faced by all firms located in employment area l at time t. Equation 17 implies a linear decaying weight proportional to the distance of the remote location. Observe that the weight is equal to unity when $D_{m,l} = 0$, which is the case only for $D_{l,l}$.

Following the same logic, we also compute a measure of competition by rival firms faced by a firm of given industry. To do so, we first compute N_{ilst}, the number of rival companies active in the same employment area l and in the same sector at 4-digit level s in year t. In order to account for firms' market shares, we sum sales y of all the other firms in a given area and industry. Second, similarly to the variable MS, we compute a spatial structure of domestic competition as follows:

$$COMP_{ilst} = \sum_{j \neq i} N_{jmst} \times y_{jmst} \times \tau_{m,l} \tag{18}$$

where j is an index for all firms in the same industry s. Contrary to MS (defined at the employment area level), the variable $COMP$ is firm specific. The reason is that N_{jlst}, the number of rival companies in sector s (weighted by their sales y) in location l does not include firm i. When instead $m \neq l$ which is the case for 347 of the 348 employment areas in France, then N_{jmst} boils down to N_{mst} and is common to all companies located in l.

Concerning the control variables, we measure the import penetration ratio (IPR) at the industry level such that $IPR_{jt} = M_{jt}/(Y_{jt} + M_{jt} - X_{jt})$, where M, X and Y stand for total imports, total exports and total sales of sector j, respectively, as provided by the STAN database.

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[19]We are extremely grateful to Sylvain Barde who graciously provided us with the spatial weight matrix $\mathbf{W}$. A thorough description of the matrix can be found in Barde (2010).

We also distinguish between the different explanations for an export effect. Ideally, to understand the link between firm markups and exporting activity along the lines of the MO model, we would like to use information on the quality and costs of exports. One way to proxy for quality of exports is to use information on the destination market. Imagine that a company exports to two markets, with a substantial gap in terms of wealth, as measured by GDP per capita. One could conjecture that exports to the wealthiest market be of higher quality that those to least wealthy. Based on this conjecture and leaving time aside, we measure the wealth of the firm-specific average destination market as follows:

$$cGDP_i^X = \sum_n s_{i,n}^X \times cGDP_n \tag{19}$$

where s^X is the share of destination market n in firm i overall export and $cGDP$ is GDP per capita of country n as provided by the Penn World Tables (Heston, et al., 2009). Superscript X simply recalls that the set of foreign markets is based on the use of export destinations, as provided by the French customs database. High (low) values of $cGDP^X$ imply that a given company reaches wealthy (rather poor) countries. For firms focusing on the domestic market exclusively, we set $cGDP^X$ to 0. We use this information as a proxy for the quality of exports and we expect a positive association between $cGDP^X$ and the markup.

We use information on the distance of destination markets in a similar fashion:

$$DIST_i^X = \sum_n s_{i,n}^X \times DIST_n \tag{20}$$

where s^X is defined as above and $DIST$ is the distance between Paris and the capital of destination market, retrieved from GeoDist (Mayer and Zignago, 2011). Because $s_{i,n}^X$ is time varying, $DIST_i^X$ is itself time varying, although obviously $DIST_n$ is fixed in time. This variable proxies the freight costs absorption faced by exporting firms but can also capture quality if firms ship higher quality products to more distant countries. We will therefore be careful when including both variables in the same specification. For firms focusing on the domestic market exclusively, we set $DIST^X$ to 0.

Summary statistics of all our variables are provided in Appendix B, both for the entire sample and by 2-digit NACE industry.

4.2. Empirical Specification

Once we have defined all our variables of interest, our preferred specification is the following:

$$\begin{aligned}
\mu_{it} = & \mu_0 + \mu_1 \omega_{it} + \mu_2 MS_{lt} + \mu_3 ED_{it} \\
& + \beta_1 \ln cGDP_{it}^X + \beta_2 \ln DIST_{it}^X + \beta_3 IPR_{jt} \\
& + \sum_s \beta_{j,t} \sum_t d_j \times d_t + \epsilon_{it}
\end{aligned} \tag{21}$$

where standard errors are clustered at the firm-level.

One additional difficulty that we face is that, due to the unit collinearity of IPR_{jt} with $d_j \times d_t$, we are unable to identify the parameter of our import competition variable. Therefore, we proceed in two-steps as follows:

$$
\begin{aligned}
\mu_{it} =& \mu_0 + \mu_1 \omega_{it} + \mu_2 MS_{lt} + \mu_3 ED_{it} \\
& + \beta_1 \ln cGDP_{it}^X + \beta_2 \ln DIST_{it}^X \\
& + \sum_s \beta_{j,t} \sum_t d_j \times d_t + \epsilon_{it}
\end{aligned}
\tag{22}
$$

and

$$
\hat{\beta}_{j,t} = \gamma_0 + \gamma_1 \times IPR_{jt} + \nu_{jt} \tag{23}
$$

The above imply that we retrieve the sector-year fixed effect predicted in the first step (Equation 22) and explain it as a function of the import penetration ratio in a second step (Equation 23).

Taking stock of our discussion, we expect μ_1 to be positive and μ_2 to be negative. We remain agnostic concerning μ_3 because whether markups in destination markets outweigh domestic markups is mainly a (firm-level) empirical issue. We expect β_1 to be positive because it proxies for the quality of firm export and β_2 to be negative because higher transport costs should induce lower firm markups (keeping in mind the caveat of using both distance and wealth in the same specification discussed above). Finally, we expect γ_1 to be negative as import competition should discipline domestic firms. Note that with the exception of the export dummy ED, IPR and the industry-year binary variables, all right-hand-side variables are entered in logs. Parameters μ_1, μ_2, β_1 and β_2 must therefore be interpreted as semi-elasticities.

We will also perform several robustness checks and additional tests by looking at various subsamples (exporters only, regressions by productivity quartile) and testing alternative specifications. We discuss these in the results section.

4.3. Summary Statistics on Markups

Columns 1 to 3 of table 1 shows the average markup by 2-digit industry for all firms, and also for exporters and non exporters (column 4 tests whether the difference between these two sets of firms are significant). We observe important differences between sectors: the lowest average markup is observed in the clothing and footwear industry, and the highest for electric and electronic components. In most industries, markups are significantly higher for exporters, in line with the previous literature.

Figure 2 shows the dynamic evolution of the average weighted markup over our period of analysis. We observe a gradual decline from 1999 to 2002, then a stabilization until 2006, before a sharp drop in 2007. Average productivity on the other hand increased by around 10% over the 10-year period, a relatively poor performance in terms of average growth per year.

Figure 3 looks at the spatial distribution of markups by employment area, together with a few other variables. The figure on the upper left side looks at employment density, measured using our firm
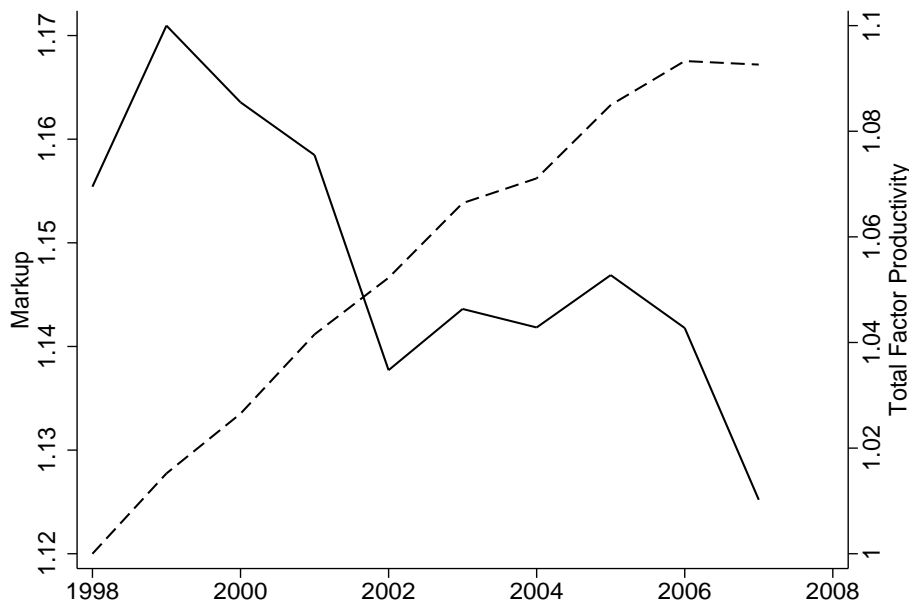
Figure 2 – The Dynamics of Markups (μ, left axis, solid line) and Total Factor Productivity (ω, base 1998 = 1, right axis, dashed line)

level dataset. The figure looks almost similar to the one depicted in Combes et al. (2012) where they used the French linked employer-employee dataset. On the upper right side, we plot the average productivity by area. Again, we can notice the similarity between our estimates and those of Combes et al. (2012), who used different methods of estimation.

The figure on the lower left side shows the export participation rate. We can observe a clear concentration along the Eastern border with Germany and Switzerland; and also in the Northern border with Belgium. Finally, the figure on the lower right side provides a picture of the spatial disctribution of markups across employment areas. This heterogeneity can be explained by various factors: industry specialization, toughness of local and international competition, productivity dispersion, etc...

Indeed, we find that these four variables are strongly correlated at the local level, as expected by the theories discussed in section 2. In the next section, we look at the micro-level evidence to try to distinguish between the different explanations for markup heterogeneity.

5.   Results

Table 2 shows our main results. We find a strong correlation between markups and productivity, as predicted by the MO framework. Our export dummy is also positively related to firm-level markup, which could indicate quality differences between exporters and non exporters. We also add size and a full set of industry-year interactive dummies as additional control variables.
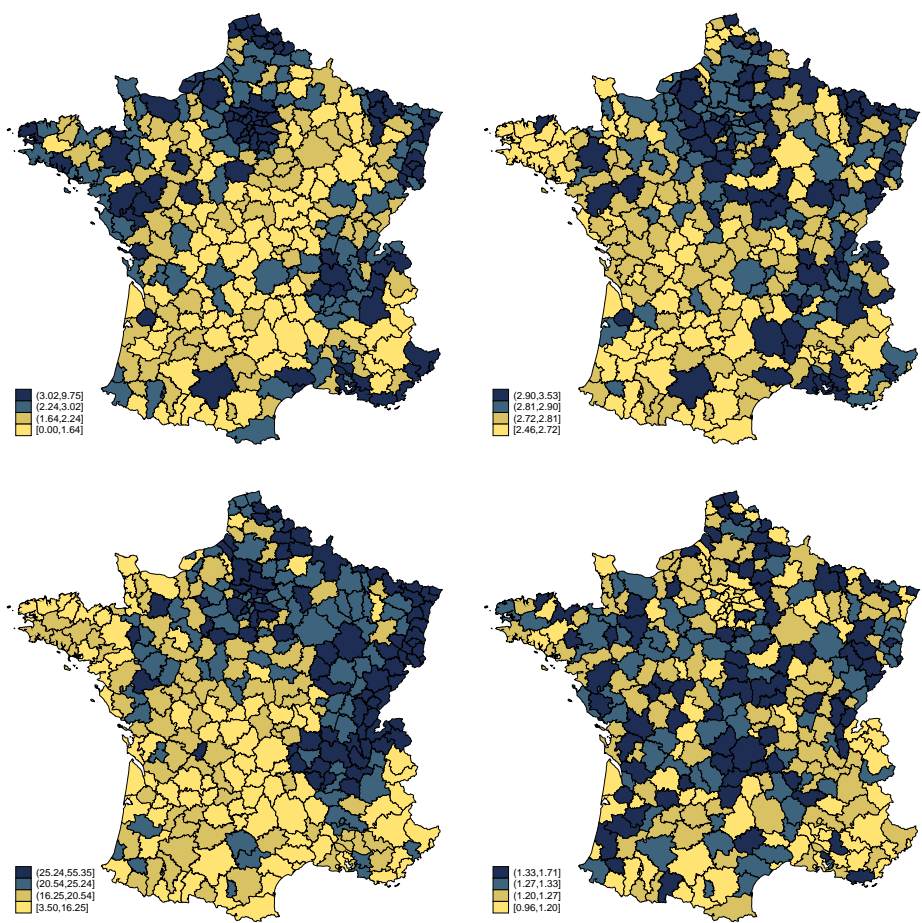
Figure 3 – Spatial distribution of employment density (log, top left); TFP (ω, top right); export participation rate (in percentage, bottom left); markups (μ, bottom right), by employment area

In order to better understand how quality differences could explain the export effect, we follow Manova and Zhang (2012) (MZ henceforth) and look at the relationship between markup and average distance where firms export (MZ look at the firm-product level, while we aggregate the export information at the firm-level from the customs data). We find a positive link between the markup and average distance (column 2), suggesting pricing-to-market and/or quality sorting across markets. In column 3, we replace average distance by the average GDP per capita on export markets. We find again a positive and significant effect. When we include both distance and GDP per capita (column 5), distance becomes negative while GDP per capita remains positive. This result could be explained by the strong correlation between the two variables, or could also suggest that firms absorb part of the freight costs when exporting to distant markets (conditional on wealth).

Since the effects of distance and wealth only truly concern exporting firms, we also replicated the specifications of columns 3 to 5 on the subsample of exporters only, and our results were qualitatively the same.

We next turn to our domestic market size variables. Starting with the revenue-based measure, we observe that our measure is negatively and strongly related the firms' markup. To understand the magnitude of the effect, moving from the 10%th to the 90%th percentile is associated with a decline of the markup by 0.05, a relatively large effect given an average markup of 1.15. The effect is similar when we measure market size based on competitors' sales. Therefore, our results indicate that local competition plays an important role in explaining the size of the markup, as does the destination where firms export.

Column 1 of table 3 analyzes the link between markups and import competition. To do this, we first estimate the industry-year effect, controlling for firm and market(s) characteristics, and then correlate it with the import penetration ratio. We find a negative and significant effect, suggesting imports discipline the pricing behavior of domestic firms.

Our two-step procedure can be replicated at the local level. In column 2, we follow a similar strategy and estimate an industry-employment area-year effect, and then correlate it with the average measure of competition based on other firms' sales. We find again a negative and significant relationship, although the coefficient is almost twice as large (this is understandable since we are no longer working at the firm level, but at the industry-area level). Last, in column 3, we estimate an employment area-year effect, and correlate it with our measure of market size based on consumers' revenue. We find again a negative and significant coefficient, suggesting markups are lower where demand is higher.

One more relationship predicted by the model, under our simplifying set of assumptions, is that more productive firms will be more likely to upgrade their quality, therefore more likely in a cross section to sell more differentiated products to more distant and richer destinations. This might indicate that markups will be more sensitive to the wealth where firms export. As a follow-up test, we look at the relationship between markups and wealth by productivity quartile. We divide firms in our sample in four quartiles based on their position in the productivity distribution and then run a regression

similar to the one in column 5 in table 2 by quartile.

Results are shown in table 4. First, we observe that the sensitivity of markups to wealth is higher for firms in the higher part of the distribution, as we had expected. We notice an opposite effect for distance. Meanwhile, the export dummy itself becomes smaller. This is in line with the idea that the price depressing effect of competition on export market is weaker for top competitors. Second, we can see that markups are more sensitive to domestic competition at the top of the distribution. This might indicate that more productive firms also operate in more competitive environement. The goodness of fit of our model also increases when we move from the bottom quartile to the top quartile.

We again tested whether this relationship was robust when we only looked at the subsample of exporters, and results were qualitatively similar.

6. Conclusion

In this paper, we provide micro-evidence that firms' markups can be related to their productivity, their export behavior, he characteristics of the destinations where they export and the level of (location specific) domestic competition. These results confirm micro-level implications from recent theoretical models of heterogeneous firms with variable markups, endogenous quality and both infranational and international trade costs.

Our results complement the findings of Combes et al. (2012) who documented the importance of agglomeration economies to explain spatial productivity differences. Our findings suggest that competition is more important in larger markets, and this affects the markups that firms are able to set.

As most of the previous literature, our approach suffers from several caveats, as we make use of proxies for quality and use aggregated measures of competition. Access to better data suggests room for improvement. First, recent papers have developed new methods for estimating product quality. Second, measures of productivity and marginal costs are likely to be highly sensitive to the quality choices made by the firms. Third, our measure of import competition is common to all firms within an industry, while in reality, firms might be affected differently depending on their product mix. In future research, we plan to construct more precise measures of productivity, quality and competition, and investigate how these variables jointly affect firms' pricing behavior.

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Table 1 – Export Premium for Markups, by Industry

	μ	μ_X	μ_{NX}	t_μ
All Manufacturing	1.148	1.173	1.136	-47.08
Agro-food	1.097	1.108	1.095	-6.144
Automobile	1.144	1.176	1.112	-11.55
Chemicals	1.304	1.329	1.259	-19.00
Clothing and footwear	0.964	0.978	0.945	-8.125
Electric and Electronic components	1.446	1.458	1.433	-4.291
Electric and Electronic equipment	1.427	1.397	1.442	10.930
House equipment and furnishings	1.210	1.218	1.206	-4.133
Machinery and mechanical equipment	1.150	1.174	1.134	-19.720
Metallurgy, Iron and Steel	1.043	1.039	1.048	5.133
Mineral industries	0.993	0.980	0.999	4.919
Pharmaceuticals	1.371	1.388	1.311	-6.920
Printing and publishing	1.182	1.168	1.189	6.958
Textile	1.191	1.207	1.164	-9.451
Transportation machinery	1.088	1.090	1.086	-0.593
Wood and paper	1.261	1.293	1.237	-18.31

All values display averages for the period 1998-2007.
Greek letter μ stands for markups.
Subscripts X and NX denote exporters and non exporters, respectively.
Letter t stands for Student t.

Table 2 – OLS Regressions. Dep.Var.: Markup μ

	(1)	(2)	(3)	(4)	(5)	(6)
TFP ω	0.311	0.315	0.315	0.315	0.311	0.313
	(0.004)***	(0.004)***	(0.004)***	(0.004)***	(0.004)***	(0.004)***
Export Dummy	0.008	-0.020	-0.024	-0.023	-0.023	-0.023
	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.002)***	(0.001)***
$DIST^X$		0.006		-0.002	-0.002	-0.002
		(0.000)***		(0.001)***	(0.001)***	(0.001)***
$cGDP^X$			0.005	0.007	0.007	0.007
			(0.000)***	(0.000)***	(0.000)***	(0.000)***
MS					-0.121	
					(0.005)***	
$COMP$						-0.018
						(0.001)***
μ_0	0.377	0.361	0.359	0.360	1.907	0.659
	(0.012)***	(0.012)***	(0.012)***	(0.012)***	(0.069)***	(0.026)***
Observations	730,868	730,868	730,868	730,868	595,968	730,858
Adjusted R2	0.154	0.156	0.157	0.157	0.136	0.158

Robust standard errors in parentheses, clustered at the firm-level. *** p<0.01, ** p<0.05, * p<0.1. All regressions include a full vector of industry-year dummies.

Table 3 – Two-Step Regressions

	(1)	(2)	(3)
	First Step (Eq.22) Dep.Var.: Markup μ		
TFP ω	0.311	0.281	0.312
	(0.004)***	(0.002)***	(0.005)***
Export Dummy	-0.023	-0.032	-0.020
	(0.002)***	(0.002)***	(0.002)***
$cGDP^X$	0.007	0.007	0.005
	(0.000)***	(0.000)***	(0.000)***
$DIST^X$	-0.002	-0.000	0.001
	(0.001)***	(0.001)	(0.001)
MS	-0.121		
	(0.005)***		
μ_0	1.907	0.452	0.366
	(0.069)***	(0.006)***	(0.013)***
Observations	595,968	730,868	730,868
Adjusted R2	0.136	0.105	0.218
	Second Step (Eq.23). Dep.Var.: $\hat{\beta}$		
LHS Var.	$j \times t$	$l \times t$	$j \times t \times l$
RHS Var.	IPR	MS	$COMP$
Parameter γ	-0.0859	-0.129	-0.037
	(0.030)***	(0.007)***	(0.003)***
Observations	152	2,728	78,926
Adjusted R2	0.044	0.112	0.257

Robust standard errors in parentheses, clustered at the firm-level. *** p<0.01, ** p<0.05, * p<0.1. Column 1 includes a full vector of industry-year dummies $j \times t$ in the first-step. Column 2 includes a full vector of year-employment area dummies $t \times l$ in the first-step. Column 3 includes a full vector of industry-year-employment area ($j \times l \times t$) dummies in the first-step. Step 2 also includes a full vector of industry dummy variables at the 3-digit level. Parameter γ_0 from the second-step estimation is not reported for simplicity.

Table 4 – OLS Regressions, by Productivity Quartile

	(1) $\omega \in Q_1$	(2) $\omega \in Q_2$	(3) $\omega \in Q_3$	(4) $\omega \in Q_4$
	First Step (Eq.22) Dep.Var.: Markup μ			
TFP ω	0.288 (0.012)***	0.322 (0.015)***	0.323 (0.019)***	0.288 (0.010)***
Export Dummy	-0.030 (0.003)***	-0.022 (0.003)***	-0.027 (0.002)***	-0.009 (0.003)***
MS	-0.049 (0.009)***	-0.124 (0.009)***	-0.150 (0.009)***	-0.174 (0.012)***
$cGDP^X$	0.004 (0.001)***	0.008 (0.001)***	0.007 (0.001)***	0.010 (0.001)***
$DIST^X$	0.001 (0.001)	-0.002 (0.001)	-0.002 (0.001)***	-0.006 (0.001)***
μ_0	1.099 (0.112)***	1.935 (0.118)***	2.196 (0.129)***	2.633 (0.156)***
Observations	159,134	156,485	155,148	125,201
Adjusted R2	0.045	0.065	0.117	0.164

Robust standard errors in parentheses, clustered at the firm-level. *** p<0.01, ** p<0.05, * p<0.1. All regressions include a full vector of industry-year dummies $j \times t$. Q_1, Q_2, Q_3 and Q_4 stand for first, second, third and fourth quartile, respectively.

Appendix

8.   Equilibrium values of c_{rl} and c_X in the open economy

For completeness, we derive the equilibrium values of the cost thresholds. We start by writing down the prices, quantities and profits of the typical domestic exporting firm located in area r:

$$
\begin{cases}
p_{rl}(c) = \frac{1}{2}(c_{rl} + c) + \frac{1}{2}\gamma\lambda_{rl}(c_{rl} - c) \\[4pt]
p_{HF}(c) = \frac{\tau_{HF}}{2}(c_X + c) + \frac{1}{2}\lambda_{HF}\tau_{HF}(c_X - c) \\[4pt]
q_{rl}(c) = \frac{L_r^H}{2\gamma}(1 + \gamma\lambda_{rl})(c_{rl} - c) \\[4pt]
q_{HF}(c) = \frac{L^F}{2\gamma}\tau_{HF}(1 + \gamma\lambda_{HF})(c_X - c) \\[4pt]
\pi_{rl}(c) = \frac{L_r^H}{4\gamma}(1 + \gamma\lambda_{rl})(c_{rl} - c)^2 \\[4pt]
\pi_{HF}(c) = \frac{L^F}{4\gamma}\tau_{HF}^2(1 + \gamma\lambda_{HF})(c_X - c)^2
\end{cases}
\tag{A-1}
$$

Considering next the free-entry condition, we derive the values of the cost thresholds that will prevail in equilibrium on each of the local markets and on the export market. Specifically, in equilibrium, the expected profit of a firm is 0. Therefore, for a typical domestic firm located in area $l \neq r$, the free entry condition requires

$$
f_E = \sum_{l=1}^{R}\left[\int_0^{c_{lr}} \pi_{lr}(c)dG(c)\right] + \int_0^{c_X} \pi_{HF}(c)dG(c)
\tag{A-2}
$$

Following MO and Antoniades, we assume that the cost draws come from a Pareto distribution given by $G(c) = \left(\frac{c}{c_m}\right)^k, c \in [0, c_m]$.[20] Let us then define c_l the cost threshold for a domestic firm located in l selling on its own local market, c_F the cost threshold for a foreign firm selling on its own domestic market, and c_{Fl} the cost threshold for a foreign firm selling on a local market l in H. Given the parametrization of the cost draws functions, the expressions for the profits in the local markets and in the export market, and given the fact that $c_{rl} = c_l/\tau_{rl}$ and $c_{Fl} = c_l/\tau_{FH}$,[21] we can re-write the free-entry condition for a typical domestic firm located in l as

$$
L_l^H(1 + \gamma\lambda_l)(c_l)^{k+2} + \sum_{r=1,r\neq l}^{R} L_r^H(1 + \gamma\lambda_{lr})(c_{lr})^{k+2}\rho^{lr} + L^F(1 + \gamma\lambda_{HF})(c_X)^{k+2}\rho^{HF} = \gamma\phi
\tag{A-3}
$$

where $\phi = 2c_m^k(k + 1)(k + 2)f_E$, $\rho^{lr} = (\tau_{lr})^{-k}$, $\rho^{HF} = (\tau_{HF})^{-k}$. In equation (A-3), λ_l, λ_{lr}, and λ_{HF} represent the scope for quality differentiation a firm localised in area l faces on its own local market, on other domestic markets, and on its export market, respectively.

---

[20] Recall than we assumed symmetrical distributions across locations such that $G_r^H(c) = G^F(c) = G(c) \ \forall \ r \in [1, R]$

[21] Recall that we made the simplifying assumption that each local area l is reachable by a foreign firm at the price of the same transport cost determined by τ_{FH}.

The free-entry condition for a typical foreign firm is given by

$$L^F(1+\gamma\lambda_F)(c_F)^{k+2} + \sum_{l=1}^{R} L_l^H(1+\gamma\lambda_{Fl})(c_l)^{k+2}\rho^{FH} = \gamma\phi \tag{A-4}$$

where ϕ is defined as before and $\rho^{FH} = (\tau_{FH})^{-k}$. In this equation, λ_F and λ_{Fl} denote the scope of quality differentiation for a foreign firm on its own domestic market and on each of its (localized) export markets, respectively. This yields a system of $R+1$ equations and $R+1$ unknowns which we solve for the R c_{Hl}'s and for the unique c_F which represent, respectively, the cost thresholds for domestic firms selling on their own local market and the foreign cost threshold for foreign firms selling on their own market:

$$c_l = \left(\frac{\gamma\phi}{L_l^H}\left[\frac{(1+\gamma\lambda_F) - \sum_{r=1,r\neq l}^{R}(\rho^{lr}(1+\gamma\lambda_{lr})) - \rho^{HF}(1+\gamma\lambda_{HF})}{(1+\gamma\lambda_l)(1+\gamma\lambda_F) + \sum_{r=1,r\neq l}^{R}(\rho^{rl}\rho^{lr}(1+\gamma\lambda_l)(1+\gamma\lambda_{lr}) + \rho^{FH}\rho^{HF}(1+\gamma\lambda_{HF})(1+\gamma\lambda_{Fl})}\right]\right)^{1/(k+2)} \tag{A-5}$$

and

$$c_F = \left(\frac{\gamma\phi}{L^F}\left[\frac{\sum_{l=1}^{R}(1+\gamma\lambda_l) - \sum_{l=1}^{R}\rho^{Fl}(1+\gamma\lambda_{Fl})}{\sum_{l=1}^{R}(1+\gamma\lambda_F)(1+\gamma\lambda_l) + \sum_{l=1}^{R}\rho^{HF}\rho^{Fl}(1+\gamma\lambda_{HF})(1+\gamma\lambda_{Fl})}\right]\right)^{1/(k+2)} \tag{A-6}$$

Finally, it is easy to retrieve the specific cost thresholds a firm of given location r faces on each on the local markets it serves and on the export market. Specifically, we have

$$\begin{aligned} c_{rl} &= c_l/\tau_{rl} \\ c_X &= c_F/\tau_{HF} \end{aligned} \tag{A-7}$$

Altogether, equations (A-5) and (A-6), and (A-7) show how location characteristics of both the local markets and the foreign market, along with trade barriers, determine the cost thresholds on each market. In each location r, only the firms with a marginal cost, c, lower than the cost threshold of any of its potential destination markets will serve that specific market. On each market, firms will choose an optimal price, quantity and endogenous quality for their product. Some of them, the most efficient ones, will upgrade the quality of their product and set higher markups on larger markets. Moreover, this quality-enhancing channel of market size will be stronger the higher is the relative ability of the firm to quality differentiate its product relatively to its competitors. The other firms, the less efficient ones, will degrade the quality of their product and set lower markups on larger markets because of the price-depressing effect of a tougher competitive environment.

9. Data Appendix

All nominal output and inputs variables are available at firm level. Industry level data are used for price indexes, worked hours and depreciation rates.

Output. Our Output variable, y, is Gross output deflated using sectoral price indexes published by INSEE (French System of National Accounts).

Labor. We define our labor variable, l, as the number of effective workers (i.e. number of employees plus number of outsourced workers minus workers taken from other firms) multiplied by the average worked hours. The annual series for worked hours are available at the 2-digit industry level and provided by *GGDC Groningen Growth Development Center*). This choice was made because there are no data in the EAE survey on hours worked.

Capital input Capital stocks, k, are computed from investment and book value of tangible assets (we rely on book value reported at the end of the accounting exercise), following the traditional permanent inventory methodology

$$K_t = (1 - \delta_{t-1}) \, K_{t-1} + I_t \tag{B-1}$$

where δ_t is the depreciation rate and I_t is real investment (deflated nominal investment). Both investment price indexes and depreciation rates are available at the 2-digit industrial classification from the INSEE data series.

Intermediate inputs. Intermediate inputs, m, are defined as purchases of materials and merchandise, transport and travel, and miscellaneous expenses. They are deflated using sectoral price indexes for intermediate inputs published by INSEE (French System of National Accounts).

Revenue shares.

To compute the labour revenue share, we rely on the variable "labour compensation" in the EAE survey. This value includes total wages paid to salaries, plus income tax withholding, and is used to approximate the theoretical variable α_{it}^L.

Table .1 – Descriptive Statistics

Variable	Obs	Mean	Median	St.dev.	P_5	P_{95}
y	865,370	6.670	6.323	1.609	4.687	9.773
l	865,384	2.565	2.387	1.376	0.455	5.113
m	865,384	4.804	4.542	2.186	1.259	8.735
k	865,384	5.153	4.887	1.744	2.728	8.459
ALP (log)	865,384	3.274	3.256	0.502	2.510	4.107
Markup μ	865,384	1.148	1.110	0.351	0.638	1.801
TFP ω	865,384	2.737	2.730	0.329	2.284	3.333
Export Dummy	865,384	0.338	0.000	0.473	0.000	1.000
MS	696,421	12.68	12.69	0.157	12.40	12.92
IPR	722,048	0.281	0.187	0.183	0.101	0.606
$COMP$	865,384	16.22	16.35	0.815	14.74	17.25
$cGDP^X$	865,384	6,484	0.000	11,945	0.000	32,633
$DIST^X$	865,384	720.1	0.000	1,885	0.000	4,695

All values display averages for the period 1998-2007. P_5 and P_{95} stand for 5th and 95th percentile, respectively. Variables y, l, m, k stand for production, labor, materials and capital stock (in logs). ALP: Labour Productivity, in logs. MS, IPR, $COMP$, $cGDP^X$, $DIST^X$ stand for market size, import penetration ratio, domestic competition, average wealth (in 2005 PPP dollars) and average distance (in kilometers) to destination countries. See text for their definition and measures.

Table .2 – Descriptive Statistics, by Industry

	Obs	Firm	PR	IPR	$cGDP^X$	$DIST^X$
All manufacturing	865,384	165,572	0.338	0.281	6,484	720.1
Agro-food	255,678	54,576	0.112	0.189	2,389	204.3
Automobile	11,094	1,849	0.501	0.472	9,154	1,120
Chemicals	39,364	6,544	0.652	0.372	13,219	1,394
Clothing and footwear	28,412	6,362	0.579	0.706	10,779	1,373
Electric and Electronic components	16,410	3,180	0.530	0.547	10,229	1,441
Electric and Electronic equipment	39,502	8,166	0.340	0.534	5,939	1,019
House equipment and furnishings	61,973	12,523	0.342	0.536	7,592	871
Machinery and mechanical equipment	108,714	19,633	0.389	0.359	6,686	905
Metallurgy, Iron and Steel	116,984	18,920	0.456	0.169	7,699	772
Mineral industries	32,670	5,666	0.296	0.186	7,351	730
Pharmaceuticals	7,391	1,352	0.783	0.539	16,631	2,684
Printing and publishing	69,478	12,956	0.330	0.099	5,797	589
Textile	22,334	3,954	0.625	0.576	12630	1290
Transportation machinery	7,581	1,553	0.555	0.430	10,516	1,535
Wood and paper	47,799	8,338	0.426	0.263	9,294	686

All values display averages for the period 1998-2007.
PR: Participation Rate to export markets.
See previous footnote table for definition of variables.

10.   Robustness

Table .3 – OLS Regressions, by Productivity Quartile. Exporters only

	(1) $\omega \in Q_1$	(2) $\omega \in Q_2$	(3) $\omega \in Q_3$	(4) $\omega \in Q_4$
	Dep.Var.: Markup μ			
TFP ω	0.390 (0.018)***	0.440 (0.028)***	0.406 (0.028)***	0.390 (0.015)***
MS	-0.102 (0.016)***	-0.144 (0.017)***	-0.149 (0.015)***	-0.235 (0.018)***
$cGDP^X$	0.005 (0.001)***	0.010 (0.001)***	0.007 (0.001)***	0.011 (0.001)***
$DIST^X$	0.000 (0.001)	-0.001 (0.001)	-0.001 (0.001)	-0.007 (0.001)***
μ_0	1.498 (0.211)***	1.841 (0.223)***	1.903 (0.202)***	3.069 (0.240)***
Observations	40,662	47,081	62,158	55,757
Adjusted R2	0.113	0.134	0.181	0.185

Robust standard errors in parentheses, clustered at the firm-level. *** p<0.01, ** p<0.05, * p<0.1. All regressions include a full vector of industry-year dummies $j \times t$ in the first-step. Second step results not displayed for sake of simplicity. Q_1, Q_2, Q_3 and Q_4 stand for first, second, third and fourth quartile, respectively.