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ABSTRACT

Labor Market Imperfections, Markups and Productivity in Multinationals and Exporters*

This paper examines the links between the internationalization mode of firms and market imperfections in product and labor markets. We develop a framework for modelling heterogeneity across firms in terms of (i) product market power (price-cost markups), (ii) labor market imperfections (workers' bargaining power during worker-firm negotiations or firm's degree of wage-setting power) and (iii) revenue productivity. We apply this framework to analyze whether the pricing behavior of firms in product and labor markets differs across firms that engage in different forms of internationalization. Engagement in international activities is found to matter for determining not only the type of imperfections in product and labor markets but also the degree of imperfections. Clear differences in behavior between firms that serve the foreign market either through exporting or through FDI are observed. Being an exporter introduces allocative inefficiencies in product as well as labor markets as we find export status to be positively correlated with both product market power (markups) and market power consolidated on the labor supply side (workers' bargaining power). But exporting firms where search frictions are inducing wages to vary with revenue are less able to exploit wage-setting power. Firms with foreign subsidiaries, on the other hand, seem to reduce price distortions in product and labor markets. In addition, we observe heterogeneous returns to being an exporter/MNE within an industry and also discern cross-industry differences.

JEL Classification: C23, D24, F14, F16, J50, L13

Keywords: rent sharing, monopsony, price-cost mark-ups, productivity, exporting, multinational firms, panel data

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1 Introduction

During the past decades, the relationship between globalization and wages has been at the center of debate in industrialized countries. A growing theoretical literature emphasizes trade-induced variation in firm-specific wages as one of the main drivers of increased wage inequality. This literature takes the seminal contribution of Melitz (2003) as a point of departure but abstains from the assumption that all workers are employed for a common wage and considers rent sharing to be the key mechanism through which trade-induced variation in rents is transmitted to variation in wages.

Building on Hopenhayn (1992) and Krugman (1980), the Melitz-model is characterized by firm heterogeneity in productivity and fixed export costs, and monopolistic competition and generates trade-induced shifts in the productivity distribution through selection of efficient firms into exporting and inefficient firms into exit. This model does not provide a model of income distribution as workers are symmetrically affected by trade liberalization because the labor market is frictionless and all workers are identical.

A recent theoretical literature on heterogeneous firms and trade has paid attention to the interaction between firms' selection and labor markets. There exist various heterogeneous-firms approaches to trade and wage inequality which all draw on imperfect factor markets but differ in terms of the rent-sharing mechanism between workers and firms that generate inter-firm wage dispersion even with ex ante identical workers. A first approach considers fair wages (Egger and Kreickemeier, 2009; Amiti and Davis, 2011) or efficiency wages (Davis and Harrigan, 2011) as a source of labor market imperfections, with productivity-specific wages resulting from a fair-wage effort mechanism in the former and different monitoring technologies in the latter. A second approach focuses on search and matching frictions such that ex-post bargaining over the surplus of production can potentially induce wages to vary with revenue across firms (Davidson *et al.*, 2008; Helpman *et al.*, 2010; Felbermayr *et al.*, 2011; Fajgelbaum, 2013; Coçsar *et al.*, 2016). A third approach considers firm-level unionization as a source of labor market imperfections, with decentralized collective bargaining producing inter-firm wage disparities (Montagna and Nocco, 2013).

On the empirical side, microeconometric studies testing some of the predictions of these (or extended) models can be classified in several groups. A first set of papers has established empirical support for Melitz's selection effect, i.e. the positive relationship between a firm's export or multinational enterprise (MNE) status and its productivity level.[1] A second set of papers has provided evidence of the theoretical conjecture that reductions in trade costs lead to a positive correlation between exports/FDI and wages.[2] A third, small set of papers has tested the prediction that ex-

[1]See e.g. the surveys of Helpman (2006) and Bernard *et al.* (2007, 2012) for evidence on the positive exporter productivity premium and Temouri *et al.* (2008) for evidence on the positive MNE productivity premium.

[2]See e.g. Harrison *et al.* (2011) for references on evidence of exporter wage premia and Malchow-Møller *et al.* (2013) and Konings *et al.* (2016) for references on evidence of MNE wage premia.

porters charge higher price-cost markups.[3] Imposing a particular rent-sharing mechanism on the data, a fourth set of papers has investigated the impact of openness on labor market imperfections.[4]

In spite of the aforementioned growing importance of labor market imperfections in theoretical trade models, no empirical study has so far investigated how product *and* labor market imperfections vary across firms that differ in terms of mode of internationalization. This paper serves the purpose of examining heterogeneity in product and labor market imperfections across exporters, non-exporters, MNEs and non-MNEs. We contribute to the empirical international trade literature and the econometric literature on identifying firm-specific market imperfections along various dimensions.

First, we develop an econometric framework that allows for three-dimensional firm heterogeneity: product market power (price-cost markups), labor market imperfections (workers' bargaining power during worker-firm negotiations or firm's degree of wage-setting power) and revenue total factor productivity (TFP). Rather than imposing a particular imperfect labor market model on the data, we let the data determine the type of competition prevailing in product and labor markets. We accomplish this by building on the econometric reduced-form productivity model with imperfect product and labor markets which has been developed in Dobbelaere and Mairesse (2013). As such, we derive product and labor market imperfection parameters and regression-based TFP measures from estimating firm production functions. The theoretical structural productivity model behind the econometric reduced-form productivity model nests two polar models of wage determination in imperfect labor markets in the seminal productivity model of Hall (1988) which allows to estimate price-cost markups: the strongly efficient bargaining model (one of the two canonical collective bargaining models; McDonald and Solow, 1981) allocates market power to employees through costs of firing, hiring and training while the static partial equilibrium monopsony model (Manning, 2003) allocates market power to employers through allowing workers to have heterogeneous preferences over workplace environments of different potential employers, which generates upward-sloping labor supply curves to individual firms.

The second contribution is to apply this framework to analyze the type and the degree of product and labor market imperfections in firms that differ in terms of internationalization, while accounting for

[3] This prediction can either be generated by heterogeneity on the supply side (productivity) as in e.g. Melitz and Ottaviano (2008) or by heterogeneity on the demand side (quality differences). See e.g. Loecker and Warzynski (2012), Kato (2014) and references in De Loecker *et al.* (2016) for empirical support based on the former and e.g. Hallak and Sivadasan (2009) and Kugler and Verhoogen (2012) for empirical support based on the latter. Forlani *et al.* (2016) explicitly account for heterogeneity on both the supply and the demand side.

[4] Relying on a collective bargaining framework, several studies have shown evidence of a relationship between international trade and workers' bargaining power using either firm panel data (e.g. Brock and Dobbelaere, 2006; Dumont *et al.*, 2006; Abraham *et al.*, 2009, Boulhol *et al.*, 2011 and Ahsan and Mitra, 2014) or matched employer-employee data (e.g. Felbermayr *et al.*, 2014). Relying on a search-and-matching framework, Davidson *et al.* (2014) examine the impact of openness on the degree of matching between workers and firms using matched employer-employee data, while Lu *et al.* (2017) investigate how liberalization of inward foreign direct investment affects firm's monopsony power using firm panel data.

differences in revenue productivity. Using an unbalanced panel of 7,458 manufacturing firms covering the period 1994-2012 in Japan, we consider exporters, non-exporters, MNEs and non-MNEs. As such, our analysis aims at improving our understanding of the wage determination process in firms that engage differently in international activities through discerning whether either market power on the supply side of labor or market power on the demand side of labor is predominantly responsible for introducing allocative inefficiencies through distorting factor prices. We might expect the precise form of firm-worker rent sharing to be different across, e.g., exporters and MNEs. Exporting firms, which are relatively more productive, might charge higher markups and realize higher rents, and might be willing to share part of these rents with their workers according to a surplus-sharing rule, thereby increasing market power on the labor supply side. Intra-firm competition in multinationals, triggered by the threat to transfer production, R&D or some other tasks to a competing subsidiary, is likely to increase intra-firm labor replacement. As such, MNEs could have considerable monopsony power in the labor market, implying that market power could be consolidated on the labor demand side. To examine the link between the internationalization mode of firms and the type of competition prevailing in product and labor markets, we estimate (two-equation) probit models. To obtain a detailed picture of the relationship between export/FDI behavior and the degree of product and labor market imperfections, we apply quantile regression techniques which allow to investigate how the impact of export/MNE status varies along the conditional distribution of either product or labor market imperfections.

Our main findings are summarized as follows. First, we find that engagement in international activities not only matters for determining the type of imperfections in product and labor markets but also for determining the degree of imperfections. Second, we observe clear differences in behavior between firms that serve the foreign market either through exporting or through FDI. Third, we show that differences in product and labor market imperfections between exporters (MNEs) and non-exporters (non-MNEs) vary across firms. In addition, we reveal heterogeneous returns to being an exporter/MNE within an industry and also discern cross-industry differences.

Focusing on differential impacts on the type of imperfections, we find that being an exporter increases the likelihood of being characterized by imperfect competition in the product market. Exporting firms are more likely to share rents based on the bargaining power of workers, but less likely to share rents based on the elasticity of the labor supply curve facing an individual employer. As such, workers' bargaining power rather than search frictions seems to be important in generating wage dispersion across exporting firms.

Focusing on differential impacts on the degree of imperfections, we find that being an exporter introduces allocative inefficiencies in product as well as labor markets as export status appears to be positively correlated with both product market power (markups) and market power consolidated on the labor supply side (workers' bargaining power). Interestingly, export status is positively correlated with the wage elasticity of a firm's labor supply curve. This indicates that exporting firms where search frictions are inducing wages to vary with revenue, are less able to exploit wage-setting power. Firms with foreign subsidiaries seem to reduce price distortions in product and labor markets. A negative correlation is observed between MNE status and markups. A potential explanation is that MNEs also perform service activities where price competition might be fierce, thereby lowering markups. Likewise, MNE status and workers' bargaining power is negatively correlated. This could be explained by the fact that offshoring could increase substitution between domestic and foreign workers. This might in turn flatten the labor demand curve and shift bargaining power over rent distribution from labor towards capital in MNEs that enjoy extra-normal profits.

The plan of the article is as follows. Section 2 presents the main ingredients of the theoretical structural productivity model with imperfect product and labor markets. Section 3 discusses our econometric model and the estimation procedure. Section 4 presents the Japanese firm panel data. Section 5 examines how the type of competition prevailing in product and labor markets varies across firms that differ in terms of engagement in international activities. Section 6 investigates potential links between internationalization and firms' degree of product and labor market imperfections. Section 7 concludes.

2 Theoretical structural productivity model with imperfect product and labor markets

A firm i at time t produces output using the following production technology:

$$Q_{it} = Q_{it}(N_{it}, M_{it}, K_{it}) \tag{1}$$

with (N_{it}, M_{it}) a vector of static inputs in production free of adjustment costs (labor and intermediate inputs) and K_{it} capital treated as a dynamic input in production (predetermined in the short run).

We assume that (i) $Q_{it}(\cdot)$ is continuous and twice differentiable with respect to its arguments, (ii) a firm takes the input price of materials as given, (iii) firms produce in a homogeneous good industry and compete in quantities (play Cournot)[5] and (iv) producers active in the market are maximizing short-run profits.

Let us turn to the oligopolistic firm's short-run profit maximization problem. Firm i's short-run profits, Π_{it}, are given by:

$$\Pi_{it} = R_{it} - W_{it}N_{it} - J_{it}M_{it} \tag{2}$$

[5] This assumption is consistent with only observing a domestic industry-wide output price index and not firm-specific output prices (see infra).

with $R_{it} = P_t Q_{it}$ an increasing and concave revenue function, P_t the price of the homogenous good at time t, and W_{it} and J_{it} the firm's input prices for N and M, respectively, at time t.

Firm i must choose the optimal quantity of output and the optimal demand for intermediate inputs and labor. The optimal output choice Q_{it} satisfies the following first-order condition:

$$\frac{P_t}{(C_Q)_{it}} = \left(1 + \frac{s_{it}}{\eta_t}\right)^{-1} = \mu_{it} \tag{3}$$

with $(C_Q)_{it} = \frac{\partial C_{it}}{\partial Q_{it}}$ the marginal cost of production, $s_{it} = \frac{Q_{it}}{Q_t}$ the market share of firm i, $\eta_t = \frac{\partial Q_t}{\partial P_t}\frac{P_t}{Q_t}$ the own-price elasticity of industry demand and μ_{it} firm i's price-cost markup. Under Cournot competition, differences in price-cost mark-ups across firms are generated by differences in productivity and market structure (s_{it}, η_t).

The first-order condition for the optimal choice of intermediate inputs is given by setting the marginal revenue product of intermediate inputs equal to the price of intermediate inputs:

$$(Q_M)_{it} = \frac{J_{it}}{P_t}\left(1 + \frac{s_{it}}{\eta_t}\right)^{-1} \tag{4}$$

Inserting Eq. (3) in Eq. (4) and multiplying both sides by $\frac{M_{it}}{Q_{it}}$ yields:

$$(\varepsilon_M^Q)_{it} = \mu_{it} s_{Mit} \tag{5}$$

From Eq. (5), it follows that profit maximization implies that optimal demand for intermediate inputs is satisfied when a firm equalizes the output elasticity with respect to intermediate inputs, denoted by $(\varepsilon_M^Q)_{it} = \frac{\partial Q_{it}}{\partial M_{it}}\frac{M_{it}}{Q_{it}}$, to the price-cost mark-up μ_{it} multiplied by the share of intermediate input expenditure in total sales, denoted by $s_{Mit} = \frac{J_{it}M_{it}}{P_t Q_{it}}$.

Firm i's optimal demand for labor depends on the characteristics of its labor market. We distinguish three labor market settings (LMS): perfect competition or right-to-manage bargaining (PR), strongly efficient bargaining (EB) and static partial equilibrium monopsony (MO).

Under PR, labor is unilaterally determined by firm i from short-run profit maximization, which implies the following first-order condition:

$$(\varepsilon_N^Q)_{it} = \mu_{it} s_{Nit} \tag{6}$$

with $(\varepsilon_N^Q)_{it} = \frac{\partial Q_{it}}{\partial N_{it}}\frac{N_{it}}{Q_{it}}$ the output elasticity with respect to labor and $s_{Nit} = \frac{W_{it}N_{it}}{P_t Q_{it}}$ the share of labor expenditure in total sales. In the perfectly competitive labor market model, a firm takes the exogenously-determined market wage as given. A profit-maximizing firm always chooses employment such that the marginal revenue product of labor equals the wage (Eq. (6)). In the right-to-manage bargaining model, the firm and its workers bargain over any surplus in order to determine the wage (Nickell and Andrews, 1983). The firm continues to choose the number of workers it wishes to employ once wages have been determined by the bargaining process, which implies the same static first-order condition for labor as in the perfectly competitive labor market model.

Under EB, the risk-neutral firm and its risk-neutral workers negotiate simultaneously over wages and employment in order to maximize the joint surplus of their economic activity (McDonald and Solow, 1981). An efficient wage-employment pair is obtained by maximizing a generalized Nash product[6] with respect to the wage rate and labor. The following first-order condition with respect to wages must hold at an interior optimum:

$$W_{it} = \overline{W}_{it} + \gamma_{it} \left[\frac{R_{it} - W_{it}N_{it} - J_{it}M_{it}}{N_{it}} \right] \tag{7}$$

where $\gamma_{it} = \frac{\phi_{it}}{1-\phi_{it}}$ is the relative extent of rent sharing and $\phi_{it} \in [0, 1]$ the part of economic rents going to the workers.

The first-order condition for labor is given by:

$$W_{it} = (R_N)_{it} + \phi_{it} \left[\frac{R_{it} - (R_N)_{it}N_{it} - J_{it}M_{it}}{N_{it}} \right] \tag{8}$$

with $(R_N)_{it} = \frac{\partial R_{it}}{\partial N_{it}}$ the marginal revenue product of labor.

An efficient wage-employment pair is given by solving simultaneously the first-order conditions with respect to the wage rate and labor. As such, the equilibrium condition is given by:

$$(R_N)_{it} = \overline{W}_{it} \tag{9}$$

Eq. (9) traces out the locus of efficient wage-employment pairs, known as the contract curve. Given that $\mu_{it} = \frac{P_t}{(R_Q)_{it}}$ in equilibrium, with $(R_Q)_{it} = \frac{\partial R_{it}}{\partial Q_{it}}$ the marginal revenue, we obtain the following expression for the output elasticity with respect to labor by combining Eqs. (7) and (9):

$$(\varepsilon_N^Q)_{it} = \mu_{it}s_{Nit} - \mu_{it}\gamma_{it}(1 - s_{Nit} - s_{Mit}) \tag{10}$$

So far, we have assumed that there is a potentially infinite supply of employees wanting a job in the firm. A small wage cut by the employer will result in the immediate resignation of all existing workers. However, under MO, the labor supply facing an individual employer might be less than perfectly elastic because workers might have heterogeneous preferences over workplace environments of different potential employers (Manning, 2003). Such heterogeneity in e.g. firm location or job characteristics (corporate culture, starting times of work) makes workers to view employers as imperfect substitutes. This in turn gives employers non-negligible market power over their workers.

[6] The generalized Nash product is written as: $\Omega_{EB} = \left\{ N_{it}W_{it} + \left(\overline{N}_{it} - N_{it}\right) \overline{W}_{it} - \overline{N}_{it}\overline{W}_{it} \right\}^{\phi} \left\{ R_{it} - W_{it}N_{it} - J_{it}M_{it} \right\}^{1-\phi_{it}}$ with $\overline{N}_{it}$ the competitive employment level, $\overline{W}_{it}$ the workers' alternative wage and $\phi_{it} \in [0, 1]$ the part of economic rents going to the workers or the degree of workers' bargaining power during worker-firm negotiations.

Let us assume that the monopsonist firm is constrained to set a single wage for all his workers and faces labor supply $N_{it}(W_{it})$, which is an increasing function of the wage W. Both $N_{it}(W_{it})$ and the inverse of this relationship $W_{it}(N_{it})$ are referred to as the labor supply curve of this firm. The monopsonist firm's objective is to maximize its short-run profit function $\Pi_{it} = R_{it} - W_{it}(N_{it})N_{it} - J_{it}M_{it}$, taking the labor supply curve as given. Maximizing this profit function with respect to labor gives the following first-order condition:[7]

$$(R_N)_{it} = (W_N)_{it}N_{it} + W_{it}(N_{it}) \tag{11}$$

Rewriting Eq. (11) gives:

$$W_{it} = \beta_{it}(R_N)_{it} \tag{12}$$

with $\beta_{it} = \frac{W_{it}}{(R_N)_{it}} = \frac{(\varepsilon_W^N)_{it}}{1+(\varepsilon_W^N)_{it}}$. $\beta_{it} \leq 1$ represents the wage markdown and $(\varepsilon_W^N)_{it} = \frac{\partial N_{it}(W_{it})}{\partial W_{it}}\frac{W_{it}}{N_{it}} \in \Re_+$ the wage elasticity of the labor supply curve that firm i faces, measuring the degree of wage-setting power that firm i possesses. Perfect competition corresponds to the case where $\left(\varepsilon_W^N\right)_{it} = \infty$, hence $(R_N)_{it} = W_{it}$. Under monopsony, $(\varepsilon_W^N)_{it}$ is finite and the labor supply curve that firm i faces is upward sloping, hence, the firms sets $W_{it} < (R_N)_{it}$. As such, the degree of firm i's wage-setting power decreases in the wage elasticity of its labor supply curve.

Rewriting Eq. (12) and using that $(R_N)_{it} = \frac{P_t(Q_N)_{it}}{\mu_{it}}$ with $(Q_N)_{it}$ the marginal product of labor, gives the following expression for the elasticity of output with respect to labor:

$$(\varepsilon_N^Q)_{it} = \mu_{it}s_{Nit}\left(1 + \frac{1}{(\varepsilon_W^N)_{it}}\right) \tag{13}$$

Using the first-order condition for intermediate inputs, we obtain an expression for firm i's price-cost markup (μ_{it}) and using the first-order conditions for intermediate inputs and labor, we define firm i's parameter of product and labor market imperfections (ψ_{it}), which we label firm i's joint market imperfections parameter, as follows:

$$\mu_{it} = \frac{(\varepsilon_M^Q)_{it}}{s_{Mit}} \tag{14}$$

$$\begin{aligned}
\psi_{it} &= \frac{(\varepsilon_M^Q)_{it}}{s_{Mit}} - \frac{(\varepsilon_N^Q)_{it}}{s_{Nit}} && (15)\\
&= 0 \quad \text{if LMS=PR} && (16)\\
&= \mu_{it}\gamma_{it}\left[\frac{1 - s_{Nit} - s_{Mit}}{s_{Nit}}\right] > 0 \quad \text{if LMS=EB} && (17)\\
&= -\mu_{it}\frac{1}{(\varepsilon_W^N)_{it}} < 0 \quad \text{if LMS=MO} && (18)
\end{aligned}$$

[7] From Eq. (11), it follows that profit maximization implies that the optimal demand for labor is satisfied when a firm equalizes the marginal revenue product of labor to the marginal cost of labor. The latter is higher than the wage paid to the new worker $W_{it}(N_{it})$ by the amount $(W_N)_{it}N_{it}$ because the firm has to increase the wage paid to all workers it already employs whenever it hires an extra worker.

3 Econometric model

In order to obtain consistent estimates of the output elasticities $(\varepsilon_N^Q)_{it}$ and $(\varepsilon_M^Q)_{it}$, we only consider production functions with (i) a scalar Hicks-neutral productivity term which is observed by the firm but unobserved by the econometrician (denoted by ω_{it}) and (ii) common technology parameters, governing the transformation of inputs to units of output, across a set of producers (denoted by the vector $\boldsymbol{\beta}$). These two assumptions imply the following expression for the production function:

$$Q_{it} = F(N_{it}, M_{it}, K_{it}; \boldsymbol{\beta}) \exp(\omega_{it}) \tag{19}$$

In order to obtain consistent estimates of the production function coefficients ($\boldsymbol{\beta}$) for each of the 15 two-digit industries that we consider (see infra), we need to control for unobserved productivity shocks ω_{it}, which are potentially correlated with the firm's input choices. We apply the estimation procedure proposed by Ackerberg *et al.* (2015) using the insight that optimal input choices hold information about unobserved productivity. We denote the logarithms of Q_{it}, N_{it}, M_{it} and K_{it} by q_{it}, n_{it}, m_{it} and k_{it}, respectively.

We impose the following timing assumptions. Capital k_{it} is assumed to be decided a period ahead (at $t-1$) because of planning and installation lags. Labor is "less variable" than material. More precisely, n_{it} is chosen by firm i at time $t-b$ $(0 < b < 1)$, after k_{it} being chosen at $t-1$ but prior to m_{it} being chosen at t. This assumption is consistent with firms needing time to train new workers, with firms facing significant hiring or firing costs for labor, or with labor contracts being long term as e.g. in unionized firms/industries.

We assume that unobservable productivity (ω_{it}) evolves according to an endogenous first-order Markov process. In particular, we allow a firm's decision to import to endogenously affect future productivity. This allows us to decompose ω_{it} into its conditional expectation given the information known by the firm in $t-1$ (denoted I_{it-1}) and a random innovation to productivity (denoted ξ_{it}):

$$\begin{aligned} \omega_{it} &= \mathrm{E}[\omega_{it} | I_{it-1}] + \xi_{it} \\ &= \mathrm{E}[\omega_{it} | \omega_{it-1}, IMP_{it-1}] + \xi_{it} \\ &= g(\omega_{it-1}, IMP_{it-1}) + \xi_{it} \end{aligned} \tag{20}$$

with IMP_{it-1} the import status of firm i at period $t-1$ and $g(\cdot)$ a general function. ξ_{it} is assumed to be mean independent of the firm's information set at $t-1$.

Given these timing assumptions, firm i's intermediate input demand at t depends directly on n_{it} chosen prior to m_{it}, i.e. the input demand function for m_{it} is conditional on n_{it}:[8]

$$m_{it} = m_t(n_{it}, k_{it}, IMP_{it}, \omega_{it}) \tag{21}$$

[8]By allowing for observed shifters (here IMP_{it}) that enter the optimal demand function for m_{it}, but are excluded from the production function, we solve the non-identification problem of the output elasticity with respect to materials and, hence, are in a position to apply the control function approach for the estimation of a gross output production function (see Ghandi

Eq. (21) shows that firm i's intermediate input demand decision is a function of the state variables n_{it}, k_{it}, IMP_{it} and ω_{it}. It is crucial that ω_{it} is the only unobservable entering the intermediate input demand function. This scalar unobservable assumption together with the assumption that $m_t(\cdot)$ is strictly increasing in ω_{it} conditional on n_{it}, k_{it} and IMP_{it} (strict monotonicity assumption)[9], allow to invert ω_{it} as a function of observables:

$$\omega_{it} = m_t^{-1}(m_{it}, n_{it}, k_{it}, IMP_{it}) \tag{22}$$

Considering the logarithmic version of Eq. (19) and allowing for an idiosyncratic error term including non-predictable output shocks and potential measurement error in output and inputs (ϵ_{it}) gives:

$$y_{it} = f(n_{it}, m_{it}, k_{it}; \boldsymbol{\beta}) + \omega_{it} + \epsilon_{it} \tag{23}$$

where $y_{it} = q_{it} + \epsilon_{it}$ with ϵ_{it} assumed to be mean independent of current and past input choices.[10]

We approximate $f(\cdot)$ by a second-order polynomial where all logged inputs, logged inputs squared and interaction terms between logged inputs are included (translog production function):

$$y_{it} = \beta_0 + \beta_n n_{it} + \beta_m m_{it} + \beta_k k_{it} + \beta_{nn} n_{it}^2 + \beta_{mm} m_{it}^2 + \beta_{kk} k_{it}^2 + \beta_{nm} n_{it} m_{it} + \beta_{nk} n_{it} k_{it} + \beta_{mk} m_{it} k_{it} + \omega_{it} + \epsilon_{it} \tag{24}$$

where β_0 has to be interpreted as the mean efficiency level across firms.

Substituting Eq. (22) in Eq. (24) results in a first-stage equation of the form:

$$y_{it} = f_{it} + m_t^{-1}(m_{it}, n_{it}, k_{it}, IMP_{it}) + \epsilon_{it} = \varphi_t(n_{it}, k_{it}, m_{it}, IMP_{it}) + \epsilon_{it} \tag{25}$$

which has the purpose of separating ω_{it} from ϵ_{it}, i.e. eliminating the portion of output y_{it} determined by unanticipated shocks at time t, measurement error or any other random noise (ϵ_{it}).

Hence, the first stage involves using Eq. (25) and the moment condition $\mathrm{E}[\epsilon_{it}|I_{it}] = 0$, with I_{it} the firm's information set at t, to obtain an estimate $\widehat{\varphi}_{it}$ of the composite term $\varphi_t(n_{it}, k_{it}, m_{it}, IMP_{it}) = f_{it} + m_t^{-1}(m_{it}, n_{it}, k_{it}, IMP_{it})$, which represents output net of ϵ_{it}. In our application, estimation of Eq. (25) is implemented by regressing output on a second-order polynomial series expansion where all logged inputs, logged inputs squared and interaction terms between logged inputs are included. To allow for time variation in φ_t, these polynomial terms are interacted with a time trend.

et al., 2017). Intuitively, the non-identification problem would arise under $m_{it} = m_t(n_{it}, k_{it}, \omega_{it})$, because in that case, the only intermediate input demand shifter aside from the other inputs in the production functions would be ω_{it}. As the elasticity of output with respect to intermediate inputs is identified with how output varies with m_{it}, holding fixed (n_{it}, k_{it}), the only source of variation in m_{it} (namely ω_{it}) would also simulteaneously shift output, causing the elasticity of output with respect to materials to be unidentified.

[9] Melitz and Levinsohn (2006) show that this strict monotonicity assumption holds as long as more productive firms do not set inordinately higher markups than less productive firms. Under Cournot competition, lower marginal costs (higher ω_{it}) lead to an increase in a firm's usage of intermediate inputs at any level of residual demand.

[10] Note that $(\varepsilon_N^Q)_{it} = \frac{\partial \ln F(\cdot)}{\partial \ln N_{it}}$ and $(\varepsilon_M^Q)_{it} = \frac{\partial \ln F(\cdot)}{\partial \ln M_{it}}$. These output elasticities are by definition independent of a firm's productivity shock.

Given a particular set of parameters $\boldsymbol{\beta}$, we can compute (up to a scalar constant) an estimate of ω_{it}:

$$\begin{aligned}\widehat{\omega}_{it}(\boldsymbol{\beta}) &= \widehat{m}_t^{-1}(m_{it}, n_{it}, k_{it}, IMP_{it}) \\ &= \widehat{\varphi}_{it} - \beta_0 - \beta_n n_{it} - \beta_m m_{it} - \beta_k k_{it} - \beta_{nn} n_{it}^2 - \beta_{mm} m_{it}^2 - \beta_{kk} k_{it}^2 \\ &\quad -\beta_{nm} n_{it} m_{it} - \beta_{nk} n_{it} k_{it} - \beta_{mk} m_{it} k_{it}\end{aligned} \tag{26}$$

In order to implement the second stage and to identify the production function coefficients, we need to recover the innovation to productivity ξ_{it} to form moments on. Using Eq. (26), a consistent (non-parametric) approximation to $\mathrm{E}[\omega_{it}|\omega_{it-1}, IMP_{it-1}]$ is given by the predicted values from regressing nonparametrically $\widehat{\omega}_{it}(\boldsymbol{\beta})$ on $\widehat{\omega}_{it-1}(\boldsymbol{\beta})$ and IMP_{it-1}. The residual from this regression provides us with an estimate of ξ_{it}.

Given the timing assumptions on input use, the following population moment conditions can be defined: $\mathrm{E}[\xi_{it}(\beta)\mathbf{d}] = 0$ where the set of instruments is:

$$\mathbf{d}_{it} = \left\{n_{it-1}, m_{it-1}, k_{it}, n_{it-1}^2, m_{it-1}^2, k_{it}^2, n_{it-1}m_{it-1}, n_{it-1}k_{it}, m_{it-1}k_{it}\right\} \tag{27}$$

Exploiting these moment conditions, we can now estimate the production function coefficients $\boldsymbol{\beta}$ using standard GMM and rely on block bootstrapping for the standard errors. The estimated production function coefficients $\widehat{\boldsymbol{\beta}}$ are then used together with data on inputs to compute the output elasticities at the firm-year level. In particular, we calculate the elasticity of output with respect to labor at the firm-year level as:

$$(\widehat{\varepsilon}_N^Q)_{it} = \widehat{\beta}_n + 2\widehat{\beta}_{nn} n_{it} + \widehat{\beta}_{nm} m_{it} + \widehat{\beta}_{nk} k_{it} \tag{28}$$

Similarly, we calculate the elasticity of output with respect to material at the firm-year level as:[11]

$$(\widehat{\varepsilon}_M^Q)_{it} = \widehat{\beta}_m + 2\widehat{\beta}_{mm} m_{it} + \widehat{\beta}_{mn} n_{it} + \widehat{\beta}_{mk} k_{it} \tag{29}$$

Using the shares of labor and intermediate input expenditure in total sales, s_{Nit} and s_{Mit}, respectively, and our estimates of the output elasticities, $(\widehat{\varepsilon}_N^Q)_{it}$ and $(\widehat{\varepsilon}_M^Q)_{it}$, we are able to compute $\widehat{\mu}_{it}$ and $\widehat{\psi}_{it}$. Since we only observe $Y_{it} = Q_{it}\exp(\epsilon_{it})$, we do not observe the correct expenditure shares for N_{it} and M_{it}. We can recover an estimate of ϵ_{it} from the first stage to adjust the expenditure shares as follows:[12]

$$\widehat{s}_{Nit} = \frac{W_{it}N_{it}}{P_t \frac{Y_{it}}{\exp(\epsilon_{it})}} \tag{30}$$

$$\widehat{s}_{Mit} = \frac{J_{it}M_{it}}{P_t \frac{Y_{it}}{\exp(\epsilon_{it})}} \tag{31}$$

[11] Under a Cobb-Douglas production function, $(\varepsilon_N^Q)_{it}$ and $(\varepsilon_M^Q)_{it}$ would be equal to $\widehat{\beta}_n$ and $\widehat{\beta}_m$, respectively.

[12] This correction is important as it eliminates any variation in expenditure shares that comes from variation in output not correlated with $\varphi_t(\cdot)$.

Using Eqs. (28), (29), (30) and (31), we compute $\widehat{\mu}_{it}$ and $\widehat{\psi}_{it}$ as follows:

$$\widehat{\mu}_{it} = \frac{(\widehat{\varepsilon}_M^Q)_{it}}{\widehat{s}_{Mit}} \tag{32}$$

$$\widehat{\psi}_{it} = \frac{(\widehat{\varepsilon}_M^Q)_{it}}{\widehat{s}_{Mit}} - \frac{(\widehat{\varepsilon}_N^Q)_{it}}{\widehat{s}_{Nit}} \tag{33}$$

Based on the estimates $\widehat{\mu}_{it}$ and $\widehat{\psi}_{it}$, we are able to determine the product market setting PMS $\in$ {PC,IC} and the labor market setting LMS $\in$ {PR,EB,MO} of firm i at time t and hence, firm i's regime of competitiveness R $\in \Re =$ {PC-PR,IC-PR,PC-EB,IC-EB,PC-MO,IC-MO} at time t as follows. We first compute the 95% two-sided confidence intervals (CI) for μ_{it} and $gap_{Nit} = \frac{(\varepsilon_N^Q)_{it}}{\widehat{s}_{Nit}}$.

95% confidence interval for μ_{it}:

$$\left[\widehat{\mu}_{it} - 1.96 \times \widehat{\sigma}_{\widehat{\mu}_{it}}, \widehat{\mu}_{it} + 1.96 \times \widehat{\sigma}_{\widehat{\mu}_{it}}\right] = \left[A_{\widehat{\mu}_{it}}, B_{\widehat{\mu}_{it}}\right] \tag{34}$$

with $\widehat{\sigma}_{\widehat{\mu}_{it}}$ the standard error of $\widehat{\mu}_{it}$, which is an estimator of the standard deviation of the sampling distribution of $\widehat{\mu}_{it}$.

95% confidence interval for gap_{Nit}:

$$\left[\widehat{gap}_{Nit} - 1.96 \times \widehat{\sigma}_{\widehat{gap}_{Nit}}, \widehat{gap}_{Nit} + 1.96 \times \widehat{\sigma}_{\widehat{gap}_{Nit}}\right] = \left[A_{\widehat{gap}_{Nit}}, B_{\widehat{gap}_{Nit}}\right] \tag{35}$$

with $\widehat{\sigma}_{\widehat{gap}_{Nit}}$ the standard error of $\widehat{gap}_{Nit}$.

To determine firm i's PMS at time t, we use the 95% CI for μ_{it}. If the lower bound of the 95% CI ($A_{\widehat{\mu}_{it}}$) is lower than or equal to unity, firm i is characterized to be perfectly competitive (PC) at time t. If $A_{\widehat{\mu}_{it}}$ exceeds unity, firm i is characterized by imperfect competition (IC) at time t.

To determine firm i's LMS at time t, we compare the 95% CIs for gap_{Nit} and μ_{it}. In particular, firm i

- is characterized by perfect competition/right-to-manage bargaining (PR) at time t if the 95% CIs for gap_{Nit} and μ_{it} overlap which implies that $\widehat{\mu}_{it}$ is not significantly different from $\widehat{gap}_{Nit}$, hence $\widehat{\psi}_{it} = 0$ at the 5% significance level.
- is characterized by efficient bargaining (EB) at time t if $A_{\widehat{\mu}_{it}} > B_{\widehat{gap}_{Nit}}$, hence $\widehat{\psi}_{it} > 0$ at the 5% significance level.
- is characterized by monopsony (MO) at time t if $A_{\widehat{gap}_{Nit}} > B_{\widehat{\mu}_{it}}$, hence $\widehat{\psi}_{it} < 0$ at the 5% significance level.

Once firm i's regime at time t is determined, we are able to quantify market power in product and labor markets. As explained in Section 2, the product and labor market imperfection parameters are derived from the estimated joint market imperfections parameter $\widehat{\psi}_{it}$ and their respective standard errors are computed using the Delta method (Wooldridge, 2002).

4 Data

Our data come from the Basic Survey of Japanese Business Structure and Activities (BSJBSA) compiled by the Ministry of Economy, Trade, and Industry (METI) in Japan. The purpose of this survey is to capture an overall picture of Japanese corporate activities, including globalization and diversification, as well as basic corporate characteristics, including sales, costs, profits, employment, assets and debt. The survey is compulsory for firms with more than 50 employees and with capital of more than 30 million yen in both manufacturing and some service industries such as wholesale trade, retail trade, and information and communication. In this study, we focus on manufacturing firms only.

In the BSJBSA, an industry classification code is assigned to each firm based on their main activities. For example, let us assume that a firm engages in both manufacturing and wholesale trade activities. If its largest revenue comes from manufacturing activities, the firm is classified as a manufacturing firm. This implies that manufacturing firms do not necessarily engage in manufacturing activities only. Some firms switch from one industry to another during the sample period. Although switching behavior of firms is an important issue, we assign each firm to the industry to which it belongs most frequently during our sample period.

The variables involved in our regression analyses are defined and measured in the following way. Output (Q) is defined as real gross output measured by nominal sales divided by an industry-wide gross output price index. Labor (N) refers to the average number of permanent workers. Material input is defined as intermediate consumption deflated by an industry-wide intermediate consumption price index. The capital stock (K) is measured by the real capital stock computed from tangible assets and investment based on the perpetual inventory method. The price deflators are obtained from the Japan Industrial Productivity (JIP) 2014 database, which was compiled by RIETI and Hitotsubashi University.[13] The shares of labor (s_N) and material input (s_M) are constructed by dividing respectively the firm total labor cost and undeflated intermediate consumption by the firm undeflated production. The cost of capital is defined as the user cost of capital times the real capital stock. The user cost of capital is computed from the investment goods price deflator times the sum of the interest rate and the depreciation rate minus changes in the investment goods price. In addition, we use the firm's age and its share of non-production workers as controls in the regression models, where the latter is defined as the ratio of non-production workers to total employees. We calculate the Herfindahl-Hirschman index (HHI) at the industry-year level to obtain a measure of market concentration.

We first deleted firm-year observations with cost shares greater than or equal to one and smaller than or equal to zero. In order to remove outliers, we also disregarded firm-year observations with cost

[13] For more details on the JIP database, see Fukao *et al.* (2007).

shares in the bottom 1% and top 1% of the respective industry-year distributions. We selected firms that survive at least two consecutive years because lagged inputs are needed to construct moment conditions in our estimation framework. We obtain an unbalanced estimation sample consisting of 64,481 observations for 7,458 firms over the years 1994-2012, which we decompose into 15 two-digit industries. Table A.1 in Appendix reports the panel structure of the estimation sample. Table A.2 reports the number of observations and firms by industry.

In addition to standard firm accounting information and the control variables mentioned above, the BSJBSA also provides information on firms' export and import behavior and foreign direct investment (FDI). A firm reporting positive exports is classified as an exporter. Multinational enterprises (MNEs) consist of two types of firms: foreign-owned firms and Japanese firms that engage in FDI. A foreign-owned firm is defined as a firm with a foreign capital share greater than 50% and with headquarters located outside of Japan. A firm that has at least one foreign affiliate is regarded as a firm engaging in FDI.[14] From Table A.2 in Appendix, it follows that a minority of firms within an industry export and/or have networks of foreign affiliates: the overall share of manufacturing firms that export is 25% and 16% of firms are identified as MNEs. 46% of exporters are MNEs and 73% of MNEs are exporting. There is considerable variation in export market participation rates and in the importance of FDI as a mode of serving the foreign market across manufacturing industries. In particular, the share of exporters ranges from only 6% in wood, wooden products and furniture to 50% in chemicals. Likewise, the share of MNEs ranges from only 4% in pulp, paper and paper products to 27% in chemicals. The shares of exporting and importing firms are significantly positively correlated across industries. Approximately 71% of exporters and 53% of MNEs also import. These findings are consistent with evidence in a wide range of other countries (see e.g. Mayer and Ottaviano, 2008; World Trade Organization, 2008; Bernard *et al.*, 2012).

Table 1 reports the means, standard deviations and quartile values of our variables for the total estimation sample and split according to international activity. In the total estimation sample, real firm output, labor, materials and the Solow residual or conventional TFP measure have been stable over the considered period while capital has decreased at an average annual growth rate of 4.3%. On average, firm age equals 45 years, 35% of total employees are non-production workers and the price-cost margin amounts to 22%. Consistent with previous studies, our data reveal that exporters are systematically different from non-exporters. Among manufacturing firms, exporters pay higher wages, are larger, older, more capital-intensive, employ more non-production workers and are more productive. Table 1 also reveals that MNEs show the same performance differences as exporters.

<Insert Table 1 about here>

Table A.3 in Appendix confirms these observations by summarizing the average percent difference for a particular characteristic between either exporters and non-exporters, or between MNEs and

[14] If foreign-owned firms also have foreign affiliates outside Japan, they are not classified as FDI firms but as foreign-owned firms. In the BSJBSA, a Japanese foreign affiliate is defined as an affiliate with a capital share of more than 20%.

non-MNEs. The set of characteristics include the logarithms of firm size (employment), value added per worker, TFP, average wages, capital per worker, share of non-production workers and price-cost markups. The firm-year varying TFP and markup estimates are obtained by estimating translog production functions separately for each of our 15 industries. In order to ensure that the strict monotonicity assumption between productivity and intermediate inputs holds, we follow e.g. De Loecker and Warzynski (2012) and Ahsan and Mitra (2014) by ruling out inordinately high markups in the remainder of our empirical analysis.[15]

All results in column (1) of Table A.3 are from bivariate OLS regressions of a firm characteristic on a dummy variable indicating either a firm's export status or a firm's MNE status. Column (2) includes industry fixed effects and the logarithm of firm size as additional controls. Column (1) shows that there are substantial mean differences between exporters and non-exporters, and between MNEs and non-MNEs. As export/MNE participation is correlated with industry characteristics and firm size, the inclusion of industry fixed effects and firm size in column (2) reduces the magnitude of these coefficients. Exporters remain different from non-exporters even within the same disaggregated industry: Exporters are more productive by 13% for value added per worker and by 2.0 % for total factor productivity, they pay higher wages by approximately 9% and are relatively more capital- and skill-intensive than non-exporters by approximately 7% and 30%, respectively. MNEs exhibit similar performance differences as exporters. One difference, though, is that there does not seem to be significant markup differences between exporters and non-exporters within the same industry whereas markups appear to be approximately 6% lower in MNEs. One tentative explanation is that MNEs might also engage in service activities where price competition is more likely to be the dominant form of competition. This could generate the negative MNE markup premium, despite the observed positive productivity differential between MNEs and non-MNEs.

Table A.4 in Appendix illustrates large variation in mean TFP and markup differences across industries. Column (1) again reports these differences without conditioning on additional covariates while column (2) includes the logarithm of firm size as an additional covariate. Controlling for firm size, we observe a significantly positive exporter productivity premium in about two thirds of the industries with this premium varying between 0.5% (transport equipment) and 5.1% (electrical machinery), whereas we do not find significant mean differences in markups between exporters and non-exporters (except for 2 industries). Similarly, the significantly positive MNE productivity premium holds for two thirds of the industries and ranges between 0.4% (food products and beverages) and 9.5% (electrical machinery). Consistent with the finding for all manufacturing firms (see Table A.3), average markups in non-MNEs appear to be higher than in MNEs in two thirds of the industries.

[15] In particular, we trimmed the parameter estimates of μ_{it} and gap_{Nit} at the 1^{st} and 99^{th} percentiles of the respective industry-year distributions to remove outliers.

To examine firm-level persistence in the mode of serving the foreign market, we looked at one-year transition probability rates from period t to period $t+1$ of internationalization types across states over the considered period. The states are either defined as exporters and non-exporters, or as MNEs and non-MNEs. We find strong persistence in internationalization types among all manufacturing firms as we observe the highest values on the diagonal for each state: 96.7% of exporters and 94.1% of non-exporters, and 98.2% of MNEs and 97% of non-MNEs remain in their initial state.

5 Firm heterogeneity in regimes of competitiveness

Based on the estimates of μ_{it} and ψ_{it}, we obtain firm-year varying product market settings, labor market settings and regimes. We first examined firm-level persistence in the type of competition prevailing in product and labor markets and, hence, in the regime of competitiveness by investigating one-year transition probability rates across respective states over the period, where the states are defined as {PC,IC} in the case of PMS, {PR,EB,MO} in the case of LMS and {PC-PR,IC-PR,PC-EB,IC-EB,PC-MO,IC-MO} in the case of R. At the overall level, we find rather strong persistence in types of competitiveness as we observe the highest values on the diagonal for each regime. In particular, the fraction of firms remaining in their initial state ranges between 70% (PC-PR) and 93% (PC-MO). However, firm-year transitions appear to be important and the degree of persistence in regimes varies considerably across industries.[16]

We then determined the firm-specific PMS, LMS and regime by retaining the relevant type (PMS/LMS/R) that occurs most frequently in order to examine the link between the internationalization mode of firms and the type of product and labor market competition in a descriptive way. Table A.5 in Appendix presents the percentage of firms belonging to each of the six regimes of competitiveness for different subsets of firms. Among all manufacturing firms, about 25% are characterized by perfect competition and 75% by imperfect competition in the product market. The dominant labor market setting is efficient bargaining (EB; 42% of the firms), followed by perfect competition/right-to-manage bargaining (PR; 30% of the firms) and monopsony (MO; 28% of the firms). As such, the predominant regimes are IC-EB (42% of the firms), IC-PR (18% of the firms) and IC-MO (15% of the firms).

Let us now focus on the prevalence of regimes across firms that differ in terms of international activities. Comparing firms that differ according to export status reveals that a larger fraction of exporters are characterized by PMS=IC (79% of exporters compared to 67% of non-exporters). Exporters are dominantly characterized by efficient bargaining (46% of exporting firms) and far less so by monopsony (only 22% of exporting firms) whereas the three labor market settings are more evenly distributed among non-exporters. As such, market power on the supply side seems to be

[16] For example, in transport equipment, only 14% of firms characterized by PC-PR stay in their initial state while in iron and steel, this holds for as much as 96% of firms typified by PC-MO.

predominantly responsible for introducing allocative inefficiencies through distorting factor prices among exporters. The distribution of product and labor market settings and regimes across MNEs (non-MNEs) is very similar to the one across exporters (non-exporters).

Table A.6 in Appendix shows considerable heterogeneity in regimes across and within manufacturing industries. On the product market side, the fraction of firms being characterized by perfect competition ranges between 0.2% (transport equipment) and 85% (iron and steel). On the labor market side, only 1.8% of firms within machinery are characterized by LMS=PR while this is true for 77% of firms in non-ferrous metals. The fraction of firms where market power is consolidated on the labor supply side (LMS=EB) varies between 1.6% (iron and steel) and 81% (transport equipment). Firms in industries manufacturing either wood, paper products or electrical machinery do not appear to have wage-setting power whereas the fraction of firms characterized by monopsony is 95% in machinery. Within industries, we observe large variation in regimes. For example, 37% of the firms in non-metallic mineral products are characterized by R=IC-PR, 29% by R=IC-EB, 22% by R=IC-MO and 8% by R=PC-MO whereas 83% of the firms in transport equipment belong to R=IC-EB.

The descriptive analysis presented above does not give a detailed picture on potential differences in firms' regimes across modes of internationalization for two main reasons. First, it does not exploit time variation in a firm's product and labor market setting. Second, it does not take into account correlations between firm observables and a firm's export/MNE status which could partially account for differences between exporters and non-exporters and/or between MNEs and non-MNEs. Indeed, firm i's product market setting at time t might depend on its engagement in international activities, other observable characteristics as well as unobservable factors ϵ such as managerial ability. To allow the marginal effect of being an exporter (MNE) to depend on MNE (EXP) status, we include an interaction term which is the product of the binary variables export status and MNE status. Suppressing firm and time subscripts (i and t, respectively) for simplicity, we thus have:

$$PMS^* = \beta_0 + \beta_1 \text{EXP} + \beta_2 \text{MNE} + \beta_3 (\text{EXP} \times \text{MNE}) + \beta_4 \widehat{\omega} + \mathbf{z}\beta_z + \epsilon \tag{36}$$

with EXP export status, MNE MNE status and $\widehat{\omega}$ estimated TFP.[17] The vector $\mathbf{z}$ comprises firm-year varying variables such as a firm's size (number of workers), age, the share of non-production workers, the Herfindahl-Hirschman index, a set of time dummies and industry fixed effects. Table A.7 in Appendix reports cross-correlations between these variables. In order to investigate the link between the internationalization mode of firms and the likelihood of being characterized by imperfect competition in the product market, we specify the following probit model:

$$\Pr(\text{PMS=IC}|\mathbf{x}) = \Phi(\mathbf{x}\beta) \tag{37}$$

[17] Since productivity is inherently a relative concept, we normalize the firm-year productivity-level estimates in the remaining regression models.

The baseline category is PMS=PC and the vector $\mathbf{x}$ includes the regressors specified in Eq. (36).

Whether market power in firm i in period t is consolidated on either the supply side or the demand side of labor might be influenced by common observable as well as unobservable factors such as a firm's corporate culture. To take into account the full covariance structure and to investigate the link between the internationalization mode of firms and the likelihood of being characterized by either efficient bargaining or monopsony, we specify the following two-equation multivariate probit model:

$$\begin{aligned} LMS_m^* &= \mathbf{x}_m\beta_m + \epsilon_m, \qquad m = 1, 2 \\ LMS_m &= I(LMS_m^* > 0), \quad m = 1, 2 \\ \boldsymbol{\epsilon} &= (\epsilon_1, \epsilon_2)\prime \sim N(0, \Sigma) \end{aligned} \tag{38}$$

where $LMS_1 = \Pr(\text{LMS=EB}|\mathbf{x})$ and $LMS_2 = \Pr(\text{LMS=MO}|\mathbf{x})$. The baseline category is LMS=PR. We include the same regressors as in the univariate probit model (Eq. (37)).

Table 2 presents the marginal effect of the regressors in the univariate and the multivariate probit models. As such, columns 1 and 4 report how much the (conditional) probability of being characterized by PMS=IC changes when the value of a regressor changes, holding all other regressors constant whereas columns 2-3 and 5-6 show how much the likelihood of being characterized by either LMS=EB or LMS=MO changes. Accounting for the use of a generated regressor, we employ block bootstrapping for statistical inference.

We consider two specifications. The baseline specification (specification 1) permits testing the hypothesis that the effect of serving the foreign market through exporting (FDI) is the same for MNEs and non-MNEs (exporters and non-exporters) whereas specification 2 does not include the interacted regressor. The parameters of interest are β_1, β_2 and β_3.

The estimates of the baseline specification indicate that the coefficient on the interaction term (EXP×MNE) is not significantly different from zero in both the univariate and bivariate probit models. Therefore, we rely on the estimates of specification 2 and focus the discussion on our variables of interest. Being an exporter increases the likelihood of being characterized by imperfect competition in the product market by 1.4 percentage points. This finding is consistent with empirical support of the prediction that exporters charge higher price-cost markups relative to non-exporters. Being an exporter increases the likelihood of being characterized by LMS=EB by 3.7 percentage points whereas it decreases the likelihood of being characterized by LMS=MO by 2.4 percentage points. Put differently, exporting firms are more likely to share rents based on the bargaining power of workers, but less likely to share rents based on the elasticity of the labor supply curve facing an individual employer. This former rent-sharing mechanism could be explained by the fact that exporters, which are relatively more productive, charge higher markups and realize higher rents, are willing to share part of these rents with their workers according to a surplus-sharing rule.

When focusing on correlations between being an MNE and the likelihood of being characterized by PMS=IC, LMS=EB or LMS=MO, respectively, we get a completely different picture. We interpret this as evidence of clear differences in behavior between firms that serve the foreign market either through exporting or through FDI. More precisely, being an MNE decreases the probability of being characterized by imperfect competition in the product market by 2.3 percentage points. Being a firm that serves the foreign market through FDI decreases the likelihood of being characterized by LMS=EB by 5.8 percentage points whereas it increases the likelihood of being characterized by LMS=MO by 2.0 percentage points. The latter finding is compatible with MNEs having considerable monopsony power in the labor market due to e.g. high intra-firm labor replacement in such firms.

<Insert Table 2 about here>

Table A.8 in Appendix reports variation in correlations between the probability of being characterized by PMS=IC, PMS=EB or PMS=MO and firm observables across industries. Using our baseline specification, we present the marginal effects of export status, MNE status and the interacted regressor EXP×MNE in the univariate and multivariate probit models.[18] Three findings stand out.

First, we find that engagement in international activities matters for determining the type of competition in product and labor markets within quite a few industries. More precisely, we find a significantly positive correlation between being an exporter and the probability of being characterized by imperfect competition in the product in six out of fifteen industries, in particular industries manufacturing textiles and wearing apparel, wood, wooden products and furniture, publishing and printing, petroleum and coal products, transport equipment, and other manufacturing (industries $J = \{2, 3, 5, 7, 14, 15\}$). We observe a significantly positive correlation between being an exporter and being characterized by LMS=EB in three industries (food products and beverages, chemicals, and petroleum and coal products). A significantly negative correlation is observed between being an exporter and the probability of being characterized by LMS=MO in four industries (food products and beverages, textiles and wearing apparel, chemicals, and non-ferrous metals). In non-metallic mineral products, non-ferrous metals and machinery, there is a significantly negative correlation between being an MNE and being characterized by PMS=IC whereas a significantly positive correlation is found in publishing and printing, and transport equipment. A significantly negative correlation is found between being an MNE and having either market power on the labor supply side (in textiles and wearing apparel, non-ferrous metals, and electrical machinery) or market power on the labor demand side (in other manufacturing).

[18] The marginal effects of the other covariates are available upon request.

Second, the effect of engagement in international activities on the type of competition in product and labor markets within industries clearly differs between firms that serve the foreign market either through exporting or through FDI in the majority of industries. This finding is based on testing the equality of marginal effects of export status and MNE status.

Third, the hypothesis that the effect of being an exporter is the same for MNEs and non-MNEs, or put differently, the effect of being an MNE is the same for exporters and non-exporters on the probability of being characterized by PMS=IC (LMS=EB or LMS=MO, respectively) is rejected at conventional significance levels in 33% of the industries (21% or 33% of the industries, respectively). For example, we find a large, significantly negative marginal effect of the interacted regressor on the probability of being characterized by PMS=IC in industries manufacturing textiles, wooden products, and publishing and printing (industries $J = \{2, 3, 5\}$). As such, within these industries, we observe a large significantly positive correlation between being an exporter that does not engage in FDI and the probability of being characterized by PMS=IC while the correlation is close to zero or even negative for exporters that engage in FDI. Likewise, the correlation between a non-exporting MNE and the likelihood of being characterized by PMS=IC is zero or slightly positive whereas a large significantly negative correlation is observed for exporting MNEs within these industries.

6 Market imperfections and export/MNE status

To get a first insight into the link between the internationalization type of firms and the degree of product and labor market imperfections, Table A.9 in Appendix reports median values of estimated parameters – markups (μ), labor market imperfections (workers' bargaining power ϕ or the wage elasticity of a firm's labor supply curve ε_w^N) and productivity (ω)– for subsets of firms within a particular regime. We define subsets of firms based on their engagement in international activities.

Let us focus the discussion on the regimes characterized by imperfect competition in product as well as labor markets. Conditional on being characterized by R=IC-EB, we find that the median value of markup estimates is lower for exporters relative to non-exporters (1.42 versus 1.55). When comparing MNEs to non-MNEs, this discrepancy is larger (1.35 versus 1.56). In addition, workers in MNEs seem to have a slightly lower bargaining power than in non-MNEs (median value of 0.27 for the former and 0.30 for the latter). Offshoring could increase substitution between domestic and foreign workers, thereby flattening the labor demand curve and, therefore, shifting bargaining power over rent distribution from labor towards capital in MNEs that enjoy extra-normal profits (Rodrick, 1997; Slaughter, 2001; Senses, 2010).

Interestingly, the opposite picture appears when comparing subsets of firms, conditional on being characterized by R=IC-MO. Irrespective of whether firms serve the foreign market either through exporting or through FDI, we find that firms that engage in international activities seem to have larger market power in both product and labor markets. More specifically, the median value of markups is 1.21 for exporters compared to 1.16 for exporters and the median value of an individual firm's labor supply elasticity is 1.48 for exporters compared to 1.72 for non-exporters, implying that exporters have larger wage-setting power. On the labor side, the discrepancy is even larger when comparing MNEs to non-MNEs (median value of ε_w^N is 1.32 for the former and 1.74 for the latter).

The observed differences in the degree of market imperfection parameters discussed so far could, however, partly been driven by correlations between firm observables and a firm's export/MNE status. To address this concern, we examine the links between the internationalization mode of firms and the degree of market imperfections within a regression framework. We first estimate the average effect of export/MNE status (and other independent variables) on the degree of product and labor market imperfections in a 'representative enterprise'. As such, we define the following regression models:[19]

$$\ln \widehat{\mu}_{it+1} = \alpha_0 + \alpha_1 \mathrm{EXP}_{it} + \alpha_2 \mathrm{MNE}_{it} + \alpha_3 \left(\mathrm{EXP} \times \mathrm{MNE}\right)_{it} + \alpha_4 \widehat{\omega}_{it} + \alpha_5 \mathrm{IMR}_{it} + \mathbf{z}_{it}\alpha_z + \zeta_{it} \quad (39)$$

$$\ln \left(\frac{\widehat{\phi}_{it+1}}{1 - \widehat{\phi}_{it+1}} \right) = \alpha_0 + \alpha_1 \mathrm{EXP}_{it} + \alpha_2 \mathrm{MNE}_{it} + \alpha_3 \left(\mathrm{EXP} \times \mathrm{MNE}\right)_{it} + \alpha_4 \widehat{\omega}_{it} + \alpha_5 \mathrm{IMR}_{it} + \mathbf{z}_{it}\alpha_z + \zeta_{it} \quad (40)$$

$$\ln(\widehat{\varepsilon}_w^N)_{it+1} = \alpha_0 + \alpha_1 \mathrm{EXP}_{it} + \alpha_2 \mathrm{MNE}_{it} + \alpha_3 \left(\mathrm{EXP} \times \mathrm{MNE}\right)_{it} + \alpha_4 \widehat{\omega}_{it} + \alpha_5 \mathrm{IMR}_{it} + \mathbf{z}_{it}\alpha_z + \zeta_{it} \quad (41)$$

with IMR the inverse Mills ratio from the respective probit model, which we include to account for selection bias, and the vector $\mathbf{z}$ comprising the same regressors as in Section 5. Because the effect of our regressors of interest might not be instantaneous, we use the one-year lead of the dependent variables. To deal with generated regressands and regressors, we use block bootstrapping for statistical inference. As the share of rents captured by the workers (ϕ) lies within the $[0, 1]$-range, we use a logit transformation to model the bargaining power of workers.

Table 3 presents the average effect of the regressors in the three regression models. Similar to the probit models specified above, we consider two specifications. The baseline specification (specification 1) permits testing the hypothesis that the effect of serving the foreign market through exporting (FDI) is the same for MNEs and non-MNEs (exporters and non-exporters) whereas specification 2 does not include the interacted regressor. The parameters of interest are α_1, α_2 and α_3.

The estimates of the baseline specification indicate that the coefficient on the interaction term (EXP×MNE) is not significantly different from zero in the three regression models. Therefore, we rely on the estimates of specification 2 and focus on our regressors of interest. Conditional on being

[19] One could argue that observable firm characteristics might correlate with unobserved firm characteristics such as managerial ability or workplace environment, which would favor applying a fixed effects estimator. However, this would render the interpretation of the effect of e.g. being an exporter difficult. This is because when firm fixed effects are included, identification originates from changes in export status, implying that the benchmark would also comprise continuing exporters.

characterized by PMS=IC, we observe a significantly positive correlation between export status and product market power ($\widehat{\mu}$). Conditional on being characterized by LMS=EB, we find a significantly positive correlation between export status and labor market power consolidated on the labor supply side ($\widehat{\phi}$). This might be interpreted as exporters being willing to share a larger part of increased rents with their workers. Conditional on being characterized by LMS=MO, we detect a significantly positive correlation between export status and the wage elasticity of a firm's labor supply curve, implying that exporters are less able to exploit wage-setting power. Based on hypothesis testing, we clearly reject the equality of the estimated coefficients on export status and MNE status in each of the three regression models. In fact, the opposite picture appears for firms that engage in FDI. More precisely, we observe a significantly negative correlation between MNE status and either product market power or workers' bargaining power. The former finding could be explained by the fact that MNEs might also engage in service activities where price competition is fierce whereas the latter again confirms that (the threat of) relocating plants from home to foreign countries might involve organizational changes that reduce workers' bargaining power.

<Insert Table 3 about here>

Table A.10 in Appendix presents cross-industry variation in the average effects of regressors of interest (EXP, MNE and EXP×MNE) in the baseline specification for each regression model (Eqs. (39)-(41)). Our main findings are the following. First, engagement in international activities matters for determining the degree of imperfections in product and labor markets within quite a few industries. This particularly holds for the correlations between export status and the respective product and labor market imperfection parameters. Overall, the statistically significant correlations between either export or MNE status and estimated parameters of imperfections in product and labor markets are qualitatively similar to the ones where all industries are pooled (Table 3). Second, the effect of engagement in international activities on the degree of product and labor market imperfections clearly differs between firms that serve the foreign market either through exporting or through FDI in the majority of industries. This differential effect is most pronounced in the regression model of the firm's wage-setting power $\left(\widehat{\varepsilon}_w^N\right)$. Third, the hypothesis that the effect of being an exporter is the same for MNEs and non-MNEs, or the effect of being an MNE is the same for exporters and non-exporters is rejected at conventional significance levels in 20% of the industries for the regression model of a firm's markup. This is only true in 14% of the industries for the regression model of workers' bargaining power but holds in 56% of the industries for the regression model of a firm's wage-setting power. For example, we find a large, significantly negative coefficient of the interacted regressor in the latter regression model in industries manufacturing food products and beverages, chemicals, iron and steel, and other manufacturing (industries $J = \{1, 6, 9, 15\}$). As such, in these industries, we observe a large significantly positive correlation between being an exporter that does not engage in FDI and a firm' labor supply elasticity while the correlation is much lower or even negative for exporters that engage in FDI. Likewise, the correlation between a non-exporting

MNE and a firm' labor supply elasticity is zero or positive whereas a large significantly negative correlation is observed for exporting MNEs in these industries.

The exclusive focus on mean effects may be misleading. Given that we acknowledge that firms are heterogeneous, we expect, e.g., differences in markups or workers' bargaining power between exporters and non-exporters to vary across firms. In order to study the impact of regressors, in particular engagement in international activities, on different quantiles of the outcome distribution where the vector of outcomes $\mathbf{y} = \{\ln \widehat{\mu}, \ln\left(\frac{\widehat{\phi}}{1-\widehat{\phi}}\right), \ln(\widehat{\varepsilon}_w^N)\}$, we use quantile regression techniques to model the conditional outcome distribution at various quantiles τ $(0 < \tau < 1)$, conditional on the regressors $\mathbf{x}$. As such, we provide a complete picture of the relationship between $\mathbf{y}$ and $\mathbf{x}$. The use of quantile regression techniques entails two other major advantages. First, while the optimal properties of standard regression estimators are not robust to modest departures from normality, quantile regression results are characteristically robust to outliers and heavy-tailed distributions of $\mathbf{y}$. Second, estimation and inference are distribution-free: quantile regression avoids the restrictive assumption that the error terms are *iid* at all points of the conditional distribution.

The quantile regression model, first introduced in Koenker and Bassett's (1978) seminal contribution, that we estimate is written as:

$$y_{it+1} = \mathbf{x}_{it}\beta_\tau + \zeta_{\tau it} \quad \text{with} \quad Q_\tau\left(y_{it+1}|x_{it}\right) = \mathbf{x}_{it}\beta_\tau \tag{42}$$

where y_{it+1} is the one-year lead of the dependent variable, $\mathbf{x}_{it}$ a vector of regressors, β_τ the vector of parameters to be estimated and $\zeta_{\tau it}$ the error term. $Q_\tau\left(y_{it+1}|x_{it}\right)$ denotes the τ^{th} conditional quantile of y_{it+1} given x_{it}. The quantile regression estimator of β_τ solves the following minimization problem:

$$\beta_\tau = \arg\min_\beta \left\{ \sum_{it\in\{it:y_{it+1}\geq \mathbf{x}_{it}\beta\}} \tau|y_{it+1} - \mathbf{x}_{it}\beta| + \sum_{it\in\{it:y_{it+1}< \mathbf{x}_{it}\beta\}} (1-\tau)\,|y_{it+1} - \mathbf{x}_{it}\beta| \right\} \tag{43}$$

The minimization problem (Eq. (43)) is formulated as a linear function of parameters and can be solved efficiently by linear programming methods. We use the simplex method which yields a solution in a finite number of iterations and is suitable for moderate data size (Koenker and D'Orey, 1987). Inference is based on bootstrapped standard errors from individual resampling which avoids direct estimation of the variance-covariance matrix. As one increases τ continuously from 0 to 1, one traces the entire conditional distribution of y, conditional on x (Buchinsky, 1994).

In our study, the parameter estimate for the k^{th} exogenous variable, let's say export status (EXP_{it}), on e.g. a firm's markup ($\ln \widehat{\mu}_{it+1}$) is interpreted as the marginal change in markup due to being an exporter conditional on being on the τ^{th} quantile of the distribution. This is also called the τ^{th} quantile return to exporting. We are particularly interested in how these returns change along the distribution. Similar to the OLS regression models, we consider three outcomes: $\mathbf{y} = \{\ln \widehat{\mu}, \ln\left(\frac{\widehat{\phi}}{1-\widehat{\phi}}\right), \ln(\widehat{\varepsilon}_w^N)\}$ and, depending on the outcome, we use the same set of regressors $\mathbf{x}$ as in specifications (39)-(41).

Table 4 reports the pooled simultaneous-quantile regression (QR) results of our baseline specification for the 10^{th}, 25^{th}, 50^{th}, 75^{th} and 90^{th} percentiles of the respective outcome distributions.[20] Graph 1 displays the estimated coefficients for our variables of interest (EXP, MNE and EXP×MNE) across all quantiles, together with the 95% confidence intervals. For comparison, the OLS estimates and their 95% confidence intervals are presented as dashed horizontal lines. Clearly, OLS estimates, making inferences about 'the average enterprise', mask important aspects of the relationship between our main variables and the three outcomes.

The left part of Table 4 and Graph 1(a) reveal a heterogeneous pattern for the effect of export/MNE status upon markups at different quantiles. Being an exporter yields significantly positive returns along the conditional markup distribution. The estimates point to increasing returns to exporting up to the 80^{th} percentile, after which the positive returns start to decrease slightly. Hence, it seems that exporting firms that are already successful in charging relatively high markups are able to exploit their advantage of serving a foreign market, except at the very top of the distribution. Contrary to exporter returns, MNE returns are significantly negative along the full conditional markup distribution. The negative MNE returns are rather stable up to the 80^{th} percentile, after which they increase steeply in absolute value. The coefficient of the interacted regressor is estimated to be significantly negative between the 30^{th} and 75^{th} percentiles, and increases in absolute value as we move up the distribution. This implies that the positive exporter returns are largest for exporters that do not engage in FDI whereas exporter returns are close to zero for exporters that engage in FDI. Likewise, negative returns for non-exporting MNEs are smaller in absolute value than negative returns for exporting MNEs.

The middle part of Table 4 and Graph 1(b) highlight non-linearities in the returns to being an exporter/MNE along the conditional workers' bargaining power distribution. Returns to exporting are significantly positive along the full conditional distribution. Firms yield increasing exporter returns up to the 30^{th} percentile, stable returns between the 30^{th} and 75^{th} percentiles and again increasing returns from the 75^{th} percentile onwards. Firms with high workers' bargaining power seem to benefit most from being an exporter. In contrast, MNE returns are significantly negative along the full conditional distribution and at an increasing rate between the 20^{th} and 40^{th} percentiles and at the top of the distribution. The effect of being an exporter (MNE) does not seem to depend on MNE (export) status, except at the 30^{th} percentile.

[20] We estimated pooled simultaneous-quantile regressions for $\tau \in \{0.05, 0.10, 0.20, 0.25, 0.30, 0.40, 0.50, 0.60, 0.70, 0.75, 0.80, 0.90, 0.95\}$. Table 4 shows results for selected quantiles.

The right part of Table 4 and Graph 1(c) show heterogeneous effects of export/MNE status upon labor supply elasticity estimates at different quantiles. More precisely, we observe non-linearities in the returns to exporting. The estimated coefficient for export status is significantly positive along the full distribution. The returns to exporting first increase up to the 30^{th} percentile, decrease between the 30^{th} and 70^{th} percentiles and increase again from the 70^{th} percentile onwards. In contrast, the estimated coefficient for MNE status is significantly negative from the 10^{th} percentile onwards and increases in absolute value, reaching the most negative return at the upper quantiles. Hence, firms in the upper part of the distribution seem to benefit most from being an MNE in terms of wage-setting power. Similar to the quantile regression results for the regression model of workers' bargaining power, the coefficient of the interacted regressor is not significantly different from zero across quantiles.

<Insert Table 4 and Graph 1 about here>

While Graph 1 already suggests a heterogeneous pattern for the effect of export/MNE status upon our market imperfection parameters, Table 4 presents additional tests to validate these inferences. For each of our main regressors, we run F-tests to test the equality of coefficients (*i*) across all quantiles, (*ii*) at the median and the tails, and (*iii*) at the tails. Differential effects across the conditional markup distribution are most pronounced as the three F-tests reject the equality of the coefficients of export and MNE status and the interacted regressor at the 1% significance level, except for differential impacts of export status at both tails of the conditional markup distribution. In contrast, the impact of our regressors upon the workers' bargaining power does not differ that much across quantiles, which is corroborated by the F-tests. Finally, the three F-tests suggest statistically significant differential effects of export status on a firm' labor supply elasticity, which confirms the observed non-linearities in the returns to exporting along the conditional labor supply elasticity distribution.

Table A.11 in Appendix reports cross-industry variation in how returns to being an exporter/MNE change along the conditional distribution of our three outcomes $\left(\ln \widehat{\mu}, \ln\left(\frac{\widehat{\phi}}{1-\widehat{\phi}}\right), \ln(\widehat{\varepsilon}_w^N)\right)$. We observe heterogeneous returns within an industry and also discern cross-industry differences. The within-industry variation explains why we do not detect statistically significant *average* returns in *all* industries (see Table A.10).[21] We selected industries for which we found statistically significant estimated coefficients at different points of the conditional outcome distributions for our variables of interest (EXP and MNE) and displayed these coefficient estimates in Graph A.1-A.3 in Appendix, where each graph focuses on one of the outcomes $\left(\ln \widehat{\mu}, \ln\left(\frac{\widehat{\phi}}{1-\widehat{\phi}}\right), \ln(\widehat{\varepsilon}_w^N)\right)$. We restrict the discussion to these selected industries.

[21] For example, the statistically insignificant average impact of being an exporter on markups in textiles and wearing apparel (industry 2) can be explained by the fact that firms up to the 60^{th} percentile experience significantly positive returns whereas firms in the upper tail yield insignificantly negative returns.

Focusing on the impact of export status at different points of the conditional markup distribution, we observe a positive exporter premium along most quantiles in industries manufacturing food products and beverages, textiles and wearing apparel, publishing and printing, chemicals, petroleum and coal products, non-metallic mineral products, fabricated metal products, transport equipment, and other manufacturing (industries $J = \{1, 2, 5, 6, 7, 8, 11, 14, 15\}$). In contrast, firms in machinery (industry 12) experience negative exporter returns along the full distribution and most negative ones in the tails. Focusing on the impact of MNE, we find negative MNE returns along most quantiles for firms in industries manufacturing textiles and wearing apparel, non-metallic mineral products, non-ferrous metals, machinery, and electrical machinery (industries $J = \{2, 8, 10, 12, 13\}$).

We classify industries in two groups in order to provide a more complete picture of export/MNE returns along the conditional workers' bargaining power distribution. The first group includes industries manufacturing petroleum and coal products, fabricated metal products, and transport equipment (industries $J = \{7, 11, 14\}$). Firms in these industries yield positive exporter returns along most quantiles. The second group includes industries $J = \{1, 2, 13\}$. Firms in food products and beverages (industry 1) experience a negative impact of export status in upper quantiles, whereas negative exporter returns are found for firms in the upper quantiles in textiles and wearing apparel (industry 2), and electrical machinery (industry 13). Firms in pulp, paper and paper products (industry 4), electrical machinery (industry 13), and transport equipment (industry 14) experience negative MNE returns along most quantiles whereas we find positive MNE returns, and most pronounced so in the tails, for firms in fabricated metal products (industry 11).

Focusing on exporter returns along the conditional distribution of a firm's labor supply elasticity, we observe positive returns along the full conditional distribution for firms in industries $J = \{1, 6, 9, 12\}$. MNEs seem to have more wage-setting power along most quantiles in non-metallic mineral products (industry 8) and machinery (industry 12) whereas the opposite holds for firms in iron and steel (industry 9).

7 Conclusion

Do the type and degree of labor market imperfections vary across firms that differ in terms of internationalization? In spite of the growing importance of labor market imperfections in recent international trade theory, this question has not been answered so far. Microeconometric studies in the field have predominantly provided evidence of the well-established productivity premium of firms with international activities relative to firms serving only domestic markets and have recently focused on the underlying sources of this productivity advantage.

This paper examines the links between the internationalization type of firms and market imperfections using Japanese firm-level data over the period 1994-2012. Our contribution to the empirical international trade literature and the econometric literature on identifying market imperfections is twofold. First, we develop a framework for modelling heterogeneity across firms in terms of (i) product market power (price-cost markups), (ii) labor market imperfections (workers' bargaining power during worker-firm negotiations or a firm's degree of wage-setting power) and (iii) revenue productivity. Second, we apply this framework in order to examine whether the type and the degree of market power in product and labor markets depends on a firm's international behavior, while accounting for differences in revenue productivity. We consider two main forms of internationalization: exports and foreign direct investment. As such, we are able to improve our understanding of the wage determination process of firms that engage differently in international activities.

We observe clear differences in behavior between firms that serve the foreign market either through exporting or through FDI. In particular, we find that being an exporter increases the likelihood of being characterized by imperfect competition in the product market. Exporting firms are more likely to share rents based on the bargaining power of workers, but less likely to share rents based on the elasticity of the labor supply curve facing an individual employer. As such, workers' bargaining power rather than search frictions seems to be important in generating wage dispersion across exporting firms.

Engagement in international activities not only matters for determining the type of imperfections in product and labor markets but also for determining the order of magnitude of these imperfections. In particular, we find that being an exporter introduces allocative inefficiencies in product as well as labor markets as export status appears to be positively correlated with both product market power (markups) and market power consolidated on the labor supply side (workers' bargaining power). Interestingly, export status is positively correlated with the wage elasticity of a firm's labor supply curve. This implies that exporting firms where search frictions are inducing wages to vary with revenue, are less able to exploit wage-setting power. Differential impacts are found for MNEs. Firms with foreign subsidiaries seem to reduce price distortions in product and labor markets. A negative correlation is observed between MNE status and markups, and between MNE status and workers' bargaining power.

Finally, acknowledging that firms are heterogeneous, our quantile regression results confirm that differences in product and labor market imperfections between exporters and non-exporters, and between MNEs and non-MNEs vary across firms. In addition, we observe heterogeneous returns to being an exporter/MNE within an industry and also discern cross-industry differences.

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Table 1: Descriptive statistics: Total estimation sample, and by export and MNE status, 1994-2012

Total	Mean	Sd.	Q_1	Q_2	Q_3	N
Real firm output growth Δq_{it}	-0.004	0.130	-0.070	-0.001	0.063	64,481
Labor growth rate Δn_{it}	-0.010	0.081	-0.045	-0.008	0.028	64,481
Material growth rate Δm_{it}	-0.012	0.141	-0.085	-0.009	0.062	64,481
Capital growth rate Δk_{it}	-0.043	0.132	-0.105	-0.088	-0.052	64,481
Labor share in nominal sales s_{Nit}	0.197	0.086	0.136	0.185	0.246	64,481
Material share in nominal sales s_{Mit}	0.582	0.168	0.477	0.604	0.706	64,481
$1 - s_{Nit} - s_{Mit}$	0.221	0.135	0.119	0.194	0.295	64,481
Average wage W_{it}	5.224	1.690	4.061	5.031	6.183	64,481
Number of workers N_{it}	433	1,849	85	143	301	64,481
Age	45	18	34	46	56	64,481
Exporter dummy EXP_{it}	0.310	0.463	0	0	1	64,481
Importer dummy IMP_{it}	0.270	0.444	0	0	1	64,481
MNE dummy MNE_{it}	0.226	0.418	0	0	0	64,481
Export-sales ratio	0.032	0.097	0.000	0.000	0.006	64,481
Herfindahl-Hirschman Index HHI_{Jt}	0.070	0.043	0.031	0.067	0.103	64,481
Capital intensity	1.617	0.853	1.131	1.657	2.164	64,481
Share of non-production workers	0.348	0.239	0.167	0.299	0.479	64,481
Labor productivity	32.580	23.320	18.742	26.405	39.049	64,481
SR_{it}	0.014	0.073	-0.021	0.016	0.052	64,481
Exporters	Mean	Sd.	Q_1	Q_2	Q_3	N
Real firm output growth Δq_{it}	0.001	0.136	-0.066	0.006	0.074	19,998
Labor growth rate Δn_{it}	-0.007	0.077	-0.039	-0.005	0.028	19,998
Material growth rate Δm_{it}	-0.009	0.145	-0.084	-0.005	0.070	19,998
Capital growth rate Δk_{it}	-0.041	0.133	-0.106	-0.088	-0.047	19,998
Labor share in nominal sales s_{Nit}	0.196	0.081	0.137	0.184	0.244	19,998
Material share in nominal sales s_{Mit}	0.592	0.157	0.496	0.613	0.706	19,998
$1 - s_{Nit} - s_{Mit}$	0.212	0.128	0.118	0.185	0.280	19,998
Average wage W_{it}	5.915	1.667	4.726	5.774	6.940	19,998
Number of workers N_{it}	873	3,148	126	253	626	19,998
Age	49	18	39	51	60	19,998
Exporter dummy EXP_{it}	1.000	0.000	1	1	1	19,998
Importer dummy IMP_{it}	0.645	0.479	0	1	1	19,998
MNE dummy MNE_{it}	0.552	0.497	0	1	1	19,998
Export-sales ratio	0.105	0.151	0.010	0.043	0.134	19,998
Herfindahl-Hirschman Index HHI_{Jt}	0.072	0.043	0.028	0.074	0.103	19,998
Capital intensity	1.733	0.798	1.247	1.766	2.259	19,998
Share of non-production workers	0.398	0.228	0.218	0.364	0.547	19,998
Labor productivity	36.273	22.795	21.824	30.417	44.390	19,998
SR_{it}	0.016	0.075	-0.020	0.019	0.057	19,998
Non-exporters	Mean	Sd.	Q_1	Q_2	Q_3	N
Real firm output growth Δq_{it}	-0.007	0.127	-0.071	-0.004	0.058	44,483
Labor growth rate Δn_{it}	-0.011	0.083	-0.048	-0.009	0.028	44,483
Material growth rate Δm_{it}	-0.014	0.139	-0.086	-0.011	0.059	44,483
Capital growth rate Δk_{it}	-0.044	0.131	-0.104	-0.088	-0.056	44,483
Labor share in nominal sales s_{Nit}	0.198	0.088	0.135	0.185	0.248	44,483
Material share in nominal sales s_{Mit}	0.578	0.172	0.468	0.599	0.706	44,483
$1 - s_{Nit} - s_{Mit}$	0.225	0.138	0.120	0.198	0.303	44,483
Average wage W_{it}	4.914	1.606	3.844	4.732	5.773	44,483
Number of workers N_{it}	236	611	77	120	218	44,483
Age	43	17	32	44	54	44,483
Exporter dummy EXP_{it}	0.000	0.000	0	0	0	44,483
Importer dummy IMP_{it}	0.101	0.301	0	0	0	44,483
MNE dummy MNE_{it}	0.079	0.270	0	0	0	44,483
Export-sales ratio	0.000	0.000	0.000	0.000	0.000	44,483
Herfindahl-Hirschman Index HHI_{jt}	0.069	0.043	0.031	0.063	0.104	44,483
Capital intensity	1.565	0.872	1.081	1.611	2.115	44,483
Share of non-production workers	0.325	0.240	0.146	0.270	0.442	44,483
Labor productivity	30.920	23.363	17.586	24.729	36.246	44,483
SR_{it}	0.013	0.072	-0.021	0.015	0.050	44,483

Table 1 - Continued: Descriptive statistics: Total estimation sample, and by export and MNE status, 1994-2012

MNEs	Mean	Sd.	Q_1	Q_2	Q_3	N
Real firm output growth Δq_{it}	0.001	0.133	-0.062	0.007	0.071	14,557
Labor growth rate Δn_{it}	-0.006	0.079	-0.038	-0.005	0.028	14,557
Material growth rate Δm_{it}	-0.008	0.141	-0.079	-0.003	0.068	14,557
Capital growth rate Δk_{it}	-0.043	0.127	-0.105	-0.087	-0.048	14,557
Labor share in nominal sales s_{Nit}	0.180	0.074	0.127	0.170	0.222	14,557
Material share in nominal sales s_{Mit}	0.614	0.151	0.525	0.636	0.723	14,557
$1 - s_{Nit} - s_{Mit}$	0.206	0.124	0.116	0.178	0.269	14,557
Average wage W_{it}	6.019	1.791	4.734	5.882	7.128	14,557
Number of workers N_{it}	1,208	3,738	165	375	904	14,557
Age	52	18	42	52	62	14,557
Exporter dummy EXP_{it}	0.758	0.428	1	1	1	14,557
Importer dummy IMP_{it}	0.660	0.474	0	1	1	14,557
MNE dummy MNE_{it}	1.000	0.000	1	1	1	14,557
Export-sales ratio	0.097	0.151	0.000	0.032	0.127	14,557
Herfindahl-Hirschman Index HHI_{Jt}	0.074	0.045	0.028	0.074	0.109	14,557
Capital intensity	1.817	0.770	1.316	1.824	2.310	14,557
Share of non-production workers	0.397	0.232	0.215	0.364	0.545	14,557
Labor productivity	39.496	24.312	23.797	33.239	48.827	14,557
Non-MNEs	Mean	Sd.	Q_1	Q_2	Q_3	N
Real firm output growth Δq_{it}	-0.006	0.129	-0.071	-0.004	0.060	49,924
Labor growth rate Δn_{it}	-0.010	0.082	-0.047	-0.009	0.028	49,924
Material growth rate Δm_{it}	-0.013	0.141	-0.087	-0.011	0.060	49,924
Capital growth rate Δk_{it}	-0.043	0.133	-0.105	-0.089	-0.055	49,924
Labor share in nominal sales s_{Nit}	0.202	0.088	0.139	0.190	0.254	49,924
Material share in nominal sales s_{Mit}	0.573	0.171	0.463	0.593	0.699	49,924
$1 - s_{Nit} - s_{Mit}$	0.225	0.138	0.121	0.199	0.303	49,924
Average wage W_{it}	4.992	1.586	3.925	4.831	5.877	49,924
Number of workers N_{it}	207	337	78	121	219	49,924
Age	43	17	32	44	54	49,924
Exporter dummy EXP_{it}	0.179	0.384	0	0	0	49,924
Importer dummy IMP_{it}	0.156	0.363	0	0	0	49,924
MNE dummy MNE_{it}	0.000	0.000	0	0	0	49,924
Export-sales ratio	0.014	0.064	0.000	0.000	0.000	49,924
Herfindahl-Hirschman Index HHI_{Jt}	0.069	0.043	0.031	0.065	0.103	49,924
Capital intensity	1.559	0.867	1.077	1.611	2.113	49,924
Share of non-production workers	0.333	0.239	0.154	0.281	0.456	49,924
Labor productivity	30.564	22.628	17.747	24.684	35.976	49,924
SR_{it}	0.014	0.073	-0.021	0.016	0.052	49,924

Note: $SR_{it} = \Delta q_{it} - s_{Nit}\Delta n_{it} - s_{Mit}\Delta m_{it} - (1 - s_{Nit} - s_{Mit})\Delta k_{it}$.

Table 2: Probit models on the likelihood of being characterized by PMS=IC and LMS={EB,MO}

	Specification 1 (baseline)			Specification 2		
	Pr(PMS=IC|**x**)[a]	Pr(LMS=EB|**x**)[b]	Pr(LMS=MO|**x**)[b]	Pr(PMS=IC|**x**)[a]	Pr(LMS=EB|**x**)[b]	Pr(LMS=MO|**x**)[b]
	dF/dx	dF/dx	dF/dx	dF/dx	dF/dx	dF/dx
Exporter dummy (EXP)	0.011	0.042***	-0.028***	0.014**	0.037***	-0.024***
	(0.007)	(0.013)	(0.007)	(0.006)	(0.011)	(0.005)
MNE dummy (MNE)	-0.030***	-0.047***	0.013	-0.023***	-0.058***	0.020***
	(0.010)	(0.018)	(0.010)	(0.005)	(0.012)	(0.008)
EXP×MNE	0.011	-0.021	0.013			
	(0.012)	(0.021)	(0.012)			
TFP	-0.020***	-0.017***	0.017***	-0.020***	-0.017***	0.017***
	(0.003)	(0.004)	(0.003)	(0.003)	(0.004)	(0.002)
HHI	0.131	0.420**	-0.286**	0.129	0.424**	-0.289**
	(0.138)	(0.193)	(0.142)	(0.138)	(0.193)	(0.142)
Size	-0.034***	-0.048***	0.021***	-0.034***	-0.048***	0.021***
	(0.003)	(0.005)	(0.003)	(0.003)	(0.005)	(0.003)
Age	0.0002	0.0017***	-0.0007***	0.0001	0.0016***	-0.0007***
	(0.0001)	(0.0003)	(0.0002)	(0.0001)	(0.0002)	(0.0001)
Share of non-production workers	-0.053***	-0.076***	0.030**	-0.053***	-0.076***	0.030**
	(0.012)	(0.017)	(0.012)	(0.012)	(0.017)	(0.011)
Time dummies	yes	yes	yes	yes	yes	yes
Industry dummies	yes	yes	yes	yes	yes	yes
Log likelihood	-16,575.3	-45,580.7		-16,576.8	-45,583.8	
Pseudo R^2	0.539			0.539		
N	64,481	64,481		64,481	64,481	

Notes: Significance level of ***1%, **5%, *10%. Bootstrapped standard errors (50 replications).
[a]: Marginal effects of univariate probit model. [b]: Marginal effects of bivariate probit model.

Table 3: Mean regression results (OLS)

	Specification 1 (baseline)			Specification 2		
Dependent variable	$\ln \widehat{\mu}_{it+1}$	$\ln\left(\frac{\widehat{\phi}_{it+1}}{1-\widehat{\phi}_{it+1}}\right)$	$\ln(\widehat{\varepsilon}_w^N)_{it+1}$	$\ln \widehat{\mu}_{it+1}$	$\ln\left(\frac{\widehat{\phi}_{it+1}}{1-\widehat{\phi}_{it+1}}\right)$	$\ln(\widehat{\varepsilon}_w^N)_{it+1}$
Exporter dummy (EXP)	0.030***	0.046	0.209***	0.027***	0.080*	0.201***
	(0.010)	(0.050)	(0.036)	(0.008)	(0.044)	(0.032)
MNE dummy (MNE)	-0.034***	-0.108**	-0.054	-0.040***	-0.124**	-0.073***
	(0.011)	(0.055)	(0.049)	(0.009)	(0.054)	(0.028)
EXP×MNE	-0.010	0.026	-0.032			
	(0.013)	(0.060)	(0.059)			
TFP	0.001	-0.049***	-0.301***	0.001	-0.052***	-0.302***
	(0.005)	(0.018)	(0.016)	(0.005)	(0.016)	(0.016)
HHI	0.433*	-0.633	6.957***	0.434*	-0.618	6.965***
	(0.244)	(0.553)	(0.753)	(0.244)	(0.727)	(0.741)
Size	-0.023***	-0.045	-0.343***	-0.024***	-0.059	-0.343***
	(0.004)	(0.041)	(0.017)	(0.004)	(0.044)	(0.017)
Age	0.0004**	-0.0006	0.004***	0.0004**	-0.0006	0.004***
	(0.0002)	(0.002)	(0.001)	(0.0002)	(0.002)	(0.001)
Share of non-production workers	-0.090***	0.274***	-0.166***	-0.090***	0.218***	-0.166***
	(0.016)	(0.079)	(0.053)	(0.016)	(0.073)	(0.052)
Inverse Mills ratio	0.101***	0.065	-0.925***	0.102***	0.216	-0.927***
	(0.032)	(0.360)	(0.166)	(0.032)	(0.375)	(0.163)
Time dummies	yes	yes	yes	yes	yes	yes
Industry dummies	yes	yes	yes	yes	yes	yes
Adjusted R^2	0.146	0.268	0.493	0.146	0.268	0.493
N	42,302	23,243	16,207	42,302	23,243	16,207

Notes: Significance level of ***1%, **5%, *10%. Standard errors are heteroskedasticity consistent and clustered by enterprises.

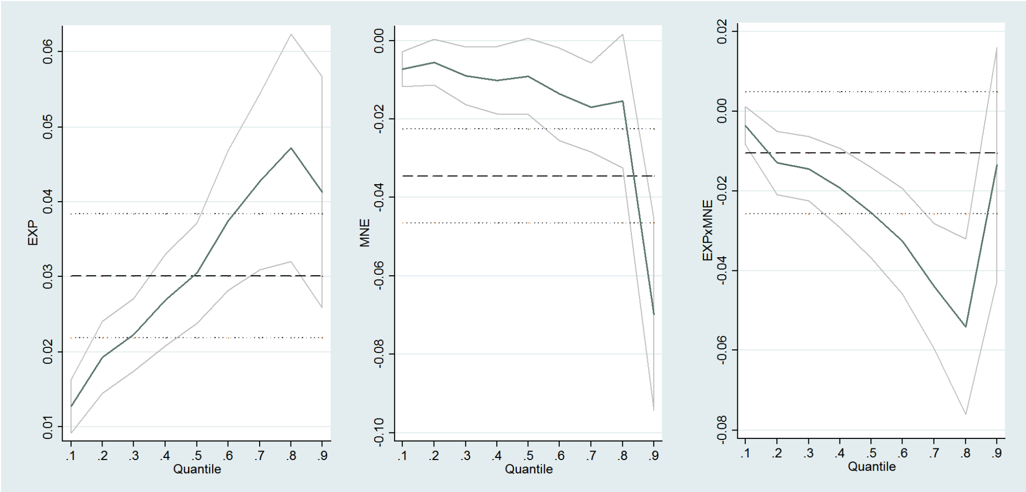
Table 4: Quantile regression (QR) results - Baseline specification

Regressor	Quantile	$\ln \widehat{\mu}_{it+1}$	$\ln\left(\frac{\widehat{\phi}_{it+1}}{1-\widehat{\phi}_{it+1}}\right)$	$\ln(\widehat{\varepsilon}_w^N)_{it+1}$
EXP	q10	0.013***	0.050*	0.161***
		(0.002)	(0.030)	(0.025)
	q25	0.021***	0.086***	0.215***
		(0.003)	(0.027)	(0.020)
	q50	0.031***	0.081***	0.169***
		(0.005)	(0.022)	(0.019)
	q75	0.044***	0.074***	0.152***
		(0.007)	(0.028)	(0.023)
	q90	0.041***	0.108***	0.178***
		(0.010)	(0.039)	(0.031)
F-test: Equality across all quantiles		0.000	0.961	0.000
F-test: Equality across q5, q50 and q95		0.000	0.541	0.000
F-test: Equality across q5 and q95		0.473	0.382	0.001
MNE	q10	-0.007***	-0.069*	-0.049
		(0.003)	(0.040)	(0.038)
	q25	-0.008**	-0.085***	-0.075**
		(0.003)	(0.033)	(0.033)
	q50	-0.009*	-0.119***	-0.081**
		(0.005)	(0.029)	(0.034)
	q75	-0.019**	-0.109***	-0.115***
		(0.007)	(0.034)	(0.039)
	q90	-0.070***	-0.145***	-0.117*
		(0.012)	(0.038)	(0.066)
F-test: Equality across all quantiles		0.000	0.444	0.599
F-test: Equality across q5, q50 and q95		0.000	0.116	0.783
F-test: Equality across q5 and q95		0.000	0.039	0.536
EXP×MNE	q10	-0.004	0.054	0.035
		(0.003)	(0.044)	(0.040)
	q25	-0.012***	0.038	-0.001
		(0.004)	(0.037)	(0.034)
	q50	-0.026***	0.010	-0.001
		(0.006)	(0.038)	(0.033)
	q75	-0.048***	-0.026	0.023
		(0.009)	(0.043)	(0.042)
	q90	-0.013	-0.051	0.074
		(0.014)	(0.058)	(0.079)
F-test: Equality across all quantiles		0.000	0.499	0.237
F-test: Equality across q5, q50 and q95		0.001	0.932	0.189
F-test: Equality across q5 and q95		0.042	0.714	0.780

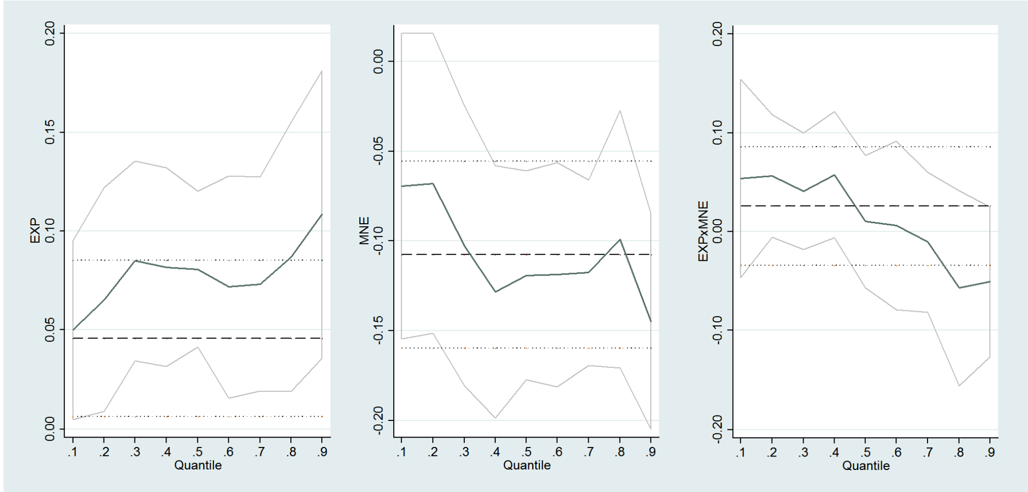
Notes: Significance level of ***1%, **5%, *10%. Bootstrapped standard errors (50 replications).
Results are based on pooled simultaneous-quantile regressions for
$\tau \in \{0.05, 0.10, 0.20, 0.25, 0.30, 0.40, 0.50, 0.60, 0.70, 0.75, 0.80, 0.90, 0.95\}$.
Results for other regressors and other quantiles are available upon request.
F-tests for equality of regression coefficients across specified quantiles, p-values are reported.

Graph 1: Average and quantile impact of export/MNE status on $\mathbf{y} = \{\ln \widehat{\mu}_{it+1}, \ln\left(\frac{\widehat{\phi}_{it+1}}{1-\widehat{\phi}_{it+1}}\right), \ln(\widehat{\varepsilon}_w^N)_{it+1}\}$

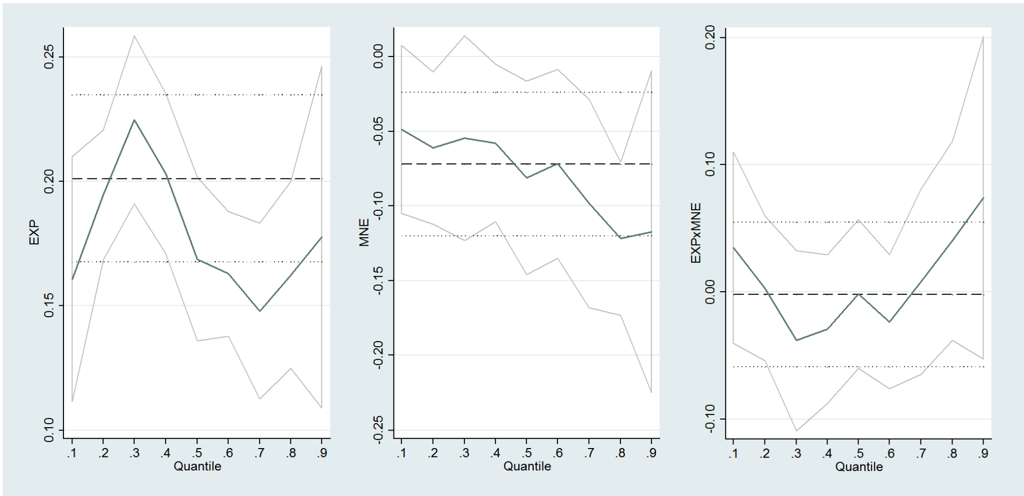
(a) Dep. var.: $\ln \widehat{\mu}_{it+1}$



(b) Dep. var.: $\ln\left(\frac{\widehat{\phi}_{it+1}}{1-\widehat{\phi}_{it+1}}\right)$



(c) Dep. var.: $\ln(\widehat{\varepsilon}_w^N)_{it+1}$



Notes: Solid lines represent coefficient estimates and 95% confidence intervals of quantile regressions.
For comparison, dashed lines mark coefficient estimates and 95% confidence intervals of OLS regressions.

Statistical appendix

Table A.1: Panel structure: Number of participations

# of participations				
	# obs.	%	# firms	%
2	1,074	1.7	1,046	14.0
3	1,817	2.8	886	11.9
4	1,757	2.7	566	7.6
5	2,297	3.6	551	7.4
6	2,043	3.2	384	5.1
7	2,117	3.3	333	4.5
8	2,138	3.3	294	3.9
9	2,418	3.7	283	3.8
10	1,824	2.8	178	2.4
11	2,310	3.6	212	2.8
12	2,168	3.4	186	2.5
13	1,949	3.0	155	2.1
14	2,198	3.4	165	2.2
15	2,153	3.3	150	2.0
16	2,332	3.6	154	2.1
17	2,679	4.2	167	2.2
18	4,369	6.8	257	3.4
19	26,838	41.6	1,491	20.0
Total	64,481	100.0	7,458	100.0

Table A.2: Repartition by industry, export and MNE status

	# obs.	%	# firms	%	% of exporters	% of MNEs
Total	64,481	100.0	7,458	100.0	24.7	15.4
Food products and beverages	8,644	13.4	957	12.8	10.1	7.5
Textiles and wearing apparel	3,345	5.2	498	6.7	13.0	13.8
Wood, wooden products, and furniture	1,014	1.6	176	2.4	5.8	9.8
Pulp, paper and paper products	2,362	3.7	251	3.4	7.2	4.0
Publishing and printing	4,030	6.2	438	5.9	6.3	6.3
Chemicals	5,869	9.1	557	7.5	50.4	26.5
Petroleum and coal products	4,065	6.3	458	6.1	23.3	19.3
Non-metallic mineral products	3,101	4.8	377	5.1	18.3	11.1
Iron and steel	2,213	3.4	240	3.2	23.1	15.6
Non-ferrous metals	1,659	2.6	183	2.5	31.5	18.5
Fabricated metal products	5,164	8.0	609	8.2	18.0	10.7
Machinery	7,005	10.9	797	10.7	43.8	20.3
Electrical machinery	6,054	9.4	820	11.0	29.0	16.5
Transport equipment	6,411	9.9	670	9.0	29.0	22.4
Other manufacturing	3,545	5.5	427	5.7	41.6	21.2
Exporters	19,998	31.0	1,859	24.9	100.0	45.5
Non-exporters	44,483	69.0	5,599	75.1	0.0	5.7
MNEs	14,557	22.6	1,163	15.6	72.7	100.0
Non-MNEs	49,924	77.4	6,295	84.4	16.1	0.0

Table A.3: Exporter and MNE premia

	Exporters		MNEs	
	(1)	(2)	(1)	(2)
$\ln(\text{employment}_{it})$	0.780***	-	1.113***	-
$\ln(\text{value added per worker}_{it})$	0.273***	0.129***	0.278***	0.122***
$\ln(\text{TFP}_{it}) = \widehat{\omega}_{it}$	0.139***	0.020***	0.111***	0.029***
$\ln(\text{wage}_{it})$	0.196***	0.085***	0.192***	0.066***
$\ln(\text{capital per worker}_{it})$	0.168***	0.069***	0.257***	0.097***
$\ln(\text{share of non-production workers}_{it})$	0.306***	0.300***	0.250***	0.255***
$\ln(\text{markup}_{it}) = \ln \widehat{\mu}_{it}$	-0.099***	-0.011	-0.121***	-0.059***
Additional covariates				
Industry fixed effects	No	Yes	No	Yes
$\ln(\text{employment})_{it}$	No	Yes	No	Yes

Notes: ***: Significance level of 1%. Each row summarizes the average percent difference for a particular characteristic between either exporters and non-exporters, or MNEs and non-MNEs . All results in column (1) are from bivariate OLS regressions of a firm characteristic on a dummy variable indicating either a firm's export status or a firm's MNE status. Colum (2) includes industry fixed effects and $\ln(\text{employment}_{it})$ as additional controls.

Table A.4: Exporter and MNE premia by industry

$\ln(\text{TFP}_{it}) = \widehat{\omega}_{it}$	Exporters		MNEs	
	(1)	(2)	(1)	(2)
Food products and beverages	-0.045***	0.006***	-0.081***	0.004**
Textiles and wearing apparel	0.003	0.021***	-0.002	0.016***
Wood, wooden products, and furniture	0.030*	0.003	0.047**	0.000
Pulp, paper and paper products	0.067***	0.032*	0.142***	0.036*
Publishing and printing	-0.122***	-0.027**	-0.131***	-0.004
Chemicals	0.000	0.011	0.005	0.027***
Petroleum and coal products	0.094***	0.011**	0.101***	0.017***
Non-metallic mineral products	-0.072***	0.001	-0.075***	0.019***
Iron and steel	0.102**	-0.020	0.185***	0.023
Non-ferrous metals	0.129***	0.012	0.144***	-0.012
Fabricated metal products	-0.021***	0.007***	-0.026***	0.013***
Machinery	0.004	0.027***	0.002	0.045***
Electrical machinery	0.207***	0.051***	0.311***	0.095***
Transport equipment	0.057***	0.005**	0.073***	0.013***
Other manufacturing	0.011***	0.009*	0.015***	0.013*
$\ln(\text{markup}_{it}) = \ln\widehat{\mu}_{it}$	Exporters		MNEs	
	(1)	(2)	(1)	(2)
Food products and beverages	0.008	0.034	-0.056***	-0.019
Textiles and wearing apparel	-0.045	-0.049	-0.083**	-0.096**
Wood, wooden products, and furniture	-0.053	-0.001	-0.205***	-0.135*
Pulp, paper and paper products	0.002	0.000	-0.102***	-0.113***
Publishing and printing	-0.109**	-0.078	-0.114***	-0.074
Chemicals	0.015	0.024	-0.035*	-0.040*
Petroleum and coal products	-0.029	-0.012	-0.081***	-0.070***
Non-metallic mineral products	0.015	0.051	-0.085**	-0.062
Iron and steel	-0.021	-0.024	-0.105**	-0.164***
Non-ferrous metals	-0.136***	-0.129***	-0.129***	-0.119**
Fabricated metal products	-0.043	-0.008	-0.095***	-0.056*
Machinery	-0.070***	-0.010	-0.112***	-0.019
Electrical machinery	-0.095***	-0.058**	-0.166***	-0.121***
Transport equipment	-0.046***	-0.002	-0.073***	-0.029
Other manufacturing	-0.050**	0.001	-0.111***	-0.050*

Notes: Significance level of ***1%, **5%, *10%. Each row summarizes the average percent difference for TFP (top) or markups (bottom) between either exporters and non-exporters, or MNEs and non-MNEs in a particular industry. All results in column (1) are from bivariate OLS regressions of each firm characteristic on a dummy variable indicating either a firm's export status or a firm's MNE status. Colum (2) includes $\ln(\text{employment}_{it})$ as an additional control.

Table A.5: Percentage of firms in each regime: Total and by export/MNE status

	# obs.	# firms	PC-PR	IC-PR	PC-EB	IC-EB	PC-MO	IC-MO
Total	64,481	7,458	12.0	17.9	1.6	42.0	11.0	15.4
Exporters	19,998	1,859	11.4	19.7	1.4	45.0	8.1	14.4
Non-exporters	44,483	5,599	12.8	13.5	2.0	36.1	18.2	17.5
MNEs	14,557	1,163	11.7	18.2	1.6	44.1	9.5	14.9
Non-MNEs	49,924	6,295	13.7	16.8	1.6	34.1	16.9	17.0

Notes: $R \in \Re = \{$PC-PR,IC-PR,PC-EB,IC-EB,PC-MO,IC-MO$\}$, with PMS $\in \{$PC,IC$\}$ and LMS $\in \{$PR,EB,MO$\}$. PC refers to perfect competition, IC to imperfection competition, PR to perfect competition/right-to-manage bargaining, EB to efficient bargaining and MO to monopsony.

Table A.6: Percentage of firms in each regime by industry

	# obs.	# firms	PC-PR	IC-PR	PC-EB	IC-EB	PC-MO	IC-MO
Total	6,4481	7,458	12.0	17.9	1.6	42.0	11.0	15.4
Food products and beverages	8,644	957	0.0	25.0	0.0	45.8	0.8	28.4
Textiles and wearing apparel	3,345	498	0.8	28.3	0.0	57.2	1.2	12.5
Wood, wooden products and furniture	1,014	176	10.2	13.6	0.0	76.1	0.0	0.0
Pulp, paper and paper products	2,362	251	37.5	17.9	8.0	36.7	0.0	0.0
Publishing and printing	4,030	438	2.7	37.9	0.0	59.1	0.0	0.2
Chemicals	5,869	557	0.0	4.5	0.0	19.6	2.9	73.1
Petroleum and coal products	4,065	458	16.2	8.3	2.0	72.1	1.5	0.0
Non-metallic mineral products	3,101	377	4.2	36.9	0.0	28.6	8.5	21.8
Iron and steel	2,213	240	12.5	10.4	0.0	2.9	72.9	1.3
Non-ferrous metals	1,659	183	45.9	30.1	0.0	22.4	1.6	0.0
Fabricated metal products	5,164	609	2.3	45.5	0.0	40.4	5.3	6.6
Machinery	7,005	797	0.0	1.4	0.0	3.1	67.9	27.6
Electrical machinery	6,054	820	66.3	3.4	11.3	18.9	0.0	0.0
Transport equipment	6,411	670	0.1	10.4	0.0	82.7	0.0	6.7
Other manufacturing	3,545	427	0.2	12.9	0.0	82.7	0.5	3.7

Notes: $R \in \Re = \{PC\text{-}PR, IC\text{-}PR, PC\text{-}EB, IC\text{-}EB, PC\text{-}MO, IC\text{-}MO\}$, with $PMS \in \{PC, IC\}$ and $LMS \in \{PR, EB, MO\}$.
PC refers to perfect competition, IC to imperfection competition,
PR to perfect competition/right-to-manage bargaining, EB to efficient bargaining and MO to monopsony.

Table A.7: Correlation matrix of variables in regression models

Total	TFP	EXP	MNE	EXP×MNE	IMP	IC	EB	MO	Size	HHI	Age	NonP
TFP	1											
Exporter dummy (EXP)	0.047**	1										
MNE dummy (MNE)	0.059**	0.523**	1									
EXP×MNE	0.071**	0.678**	0.842**	1								
Importer dummy (IMP)	0.052**	0.567**	0.475**	0.506**	1							
IC dummy (IC)	-0.031**	-0.100**	-0.075**	-0.078**	-0.093**	1						
EB dummy (EB)	-0.034**	-0.073**	-0.074**	-0.071**	-0.080**	0.381**	1					
MO dummy (MO)	0.078**	0.126**	0.085**	0.088**	0.093**	-0.245**	-0.531**	1				
Herfindahl-Hirschman Index (HHI)	0.033**	0.029**	0.047**	0.037**	-0.0007	-0.239**	0.007	-0.016**	1			
Number of workers (Size)	-0.083**	0.358**	0.461**	0.446**	0.297**	-0.039**	-0.068**	0.056**	0.025**	1		
Age	0.066**	0.173**	0.208**	0.205**	0.149**	0.0001	-0.020**	0.066**	0.017**	0.266**	1	
Share of non-production workers (NonP)	0.007	0.141**	0.111**	0.116**	0.165**	0.016**	-0.070**	0.098**	-0.070**	0.097**	0.136**	1

Note: **: Significance level of 5%.

Table A.8: Probit models on the likelihood of being characterized by PMS=IC and LMS={EB,MO}, by industry - Baseline specification

Regressor	EXP			MNE			EXP×MNE		
	Pr(PMS=IC|**x**)[a]	Pr(LMS=EB|**x**)[b]	Pr(LMS=MO|**x**)[b]	Pr(PMS=IC|**x**)[a]	Pr(LMS=EB|**x**)[b]	Pr(LMS=MO|**x**)[b]	Pr(PMS=IC|**x**)[a]	Pr(LMS=EB|**x**)[b]	Pr(LMS=MO|**x**)[b]
Industry	dF/dx	dF/dx	dF/dx	dF/dx	dF/dx	dF/dx	dF/dx	dF/dx	dF/dx
1	0.009	0.165***	-0.160***	0.000	-0.018	-0.047	-0.014	-0.202**	0.052
	(0.008)	(0.050)	(0.045)	(0.007)	(0.060)	(0.050)	(0.011)	(0.088)	(0.078)
2	0.188***	0.020	-0.118***	-0.008	-0.168***	0.002	-0.179***	0.144	0.131**
	(0.038)	(0.062)	(0.039)	(0.009)	(0.060)	(0.035)	(0.040)	(0.093)	(0.062)
3	0.643***	0.056		-0.051	-0.043		-0.607***	0.041	
	(0.131)	(0.166)		(0.058)	(0.085)		(0.139)	(0.193)	
4	-0.029	-0.115		0.034	0.012		0.013	0.040	
	(0.099)	(0.093)		(0.118)	(0.092)		(0.215)	(0.187)	
5	0.057***	0.070		0.050**	0.217		-0.232**	-0.812**	
	(0.017)	(0.200)		(0.020)	(0.215)		(0.110)	(0.382)	
6	0.007	0.086***	-0.120***	-0.015	-0.021	0.048	-0.007	-0.044	0.057
	(0.011)	(0.031)	(0.040)	(0.017)	(0.061)	(0.073)	(0.018)	(0.067)	(0.080)
7	0.120***	0.202***		-0.054	-0.035		-0.056	-0.159**	
	(0.042)	(0.044)		(0.052)	(0.056)		(0.063)	(0.068)	
8	0.357	0.048	-0.022	-0.565**	-0.060	0.092	0.373	0.043	-0.212**
	(0.291)	(0.047)	(0.055)	(0.278)	(0.075)	(0.066)	(0.490)	(0.085)	(0.101)
9	0.032		0.083	0.025		0.079	-0.090		-0.072
	(0.038)		(0.062)	(0.041)		(0.066)	(0.055)		(0.089)
10	-0.023	0.264		-0.174***	-1.027***		0.011	0.296	
	(0.051)	(0.247)		(0.059)	(0.322)		(0.088)	(0.392)	
11	0.062	0.061	-0.070*	0.012	-0.002	-0.024	0.021	-0.049	0.077
	(0.219)	(0.044)	(0.042)	(0.235)	(0.057)	(0.045)	(0.304)	(0.071)	(0.063)
12	-0.006	-0.009	0.013	-0.134***	-0.010	0.040	0.190***	0.012	-0.045
	(0.026)	(0.008)	(0.011)	(0.051)	(0.027)	(0.040)	(0.055)	(0.026)	(0.036)
13	0.005	-0.049		-0.034	-0.421***		-0.012	0.132	
	(0.024)	(0.096)		(0.045)	(0.161)		(0.050)	(0.188)	
14	0.002*	0.062	-0.024	0.005**	0.053	-0.026	-0.003**	-0.030	-0.006
	(0.001)	(0.039)	(0.020)	(0.002)	(0.034)	(0.020)	(0.002)	(0.050)	(0.029)
15	0.031***	0.049	-0.008	0.033	0.025	-0.081*	-0.024	-0.008	0.076*
	(0.011)	(0.041)	(0.019)	(0.024)	(0.073)	(0.042)	(0.026)	(0.080)	(0.044)

Notes: Significance level of ***1%, **5%, *10%. Bootstrapped standard errors (50 replications). [a]: Marginal effects of univariate probit model. [b]: Marginal effects of bivariate probit model, except for industries J ={3,4,5,7,9,10,13}. In industry 9, too few firms are characterized by LMS=EB, hence, marginal effects of the univariate probit model Pr(LMS=MO$|x$)= $\Phi(x\beta)$ are reported, while either none of the firms in industries J ={3,4,13} or too few firms in industries J ={5,7,10} are characterized by LMS=MO. Hence, for industries J ={3,4,5,7,10,13}, marginal effects of the univariate probit model Pr(LMS=EB$|x$)= $\Phi(x\beta)$ are reported.

Table A.9: Three-dimensional firm heterogeneity: Markups (μ), labor market imperfections (workers' bargaining power ϕ or the wage elasticity of a firm's labor supply curve ε_w^N), and productivity (ω)

R = PC-PR	μ	ψ	ω			R = IC-PR	μ	ψ	ω		
All firms	0.948	0.389	-0.256			All firms	1.256	0.048	0.003		
Exporters	0.902	0.388	0.036			Exporters	1.235	0.033	-0.120		
Non-exporters	0.965	0.390	-0.380			Non-exporters	1.262	0.053	0.039		
MNEs	0.914	0.345	0.205			MNEs	1.214	0.033	-0.141		
Non-MNEs	0.955	0.401	-0.385			Non-MNEs	1.266	0.051	0.033		
R = PC-EB	μ	ψ	ω	γ	ϕ	R = IC-EB	μ	ψ	ω	γ	ϕ
All firms	1.020	0.758	-0.047	1.243	0.555	All firms	1.518	0.713	-0.073	0.408	0.290
Exporters	0.989	0.738	0.077	1.207	0.543	Exporters	1.419	0.599	0.054	0.393	0.282
Non-exporters	1.030	0.767	-0.108	1.246	0.562	Non-exporters	1.554	0.769	-0.117	0.414	0.293
MNEs	0.985	0.730	0.183	1.149	0.546	MNEs	1.355	0.540	0.137	0.363	0.266
Non-MNEs	1.029	0.763	-0.111	1.276	0.556	Non-MNEs	1.560	0.769	-0.122	0.420	0.296
R = PC-MO	μ	ψ	ω	β	ε_w^L	R = IC-MO	μ	ψ	ω	β	ε_w^L
All firms	0.863	-1.713	0.159	0.332	0.542	All firms	1.175	-0.749	0.089	0.620	1.633
Exporters	0.858	-1.747	0.186	0.325	0.508	Exporters	1.214	-0.856	0.030	0.597	1.479
Non-exporters	0.869	-1.668	0.134	0.340	0.579	Non-exporters	1.156	-0.692	0.116	0.633	1.723
MNEs	0.834	-1.979	0.216	0.296	0.463	MNEs	1.201	-0.964	0.034	0.569	1.322
Non-MNEs	0.877	-1.595	0.129	0.354	0.593	Non-MNEs	1.167	-0.696	0.105	0.635	1.737
All regimes	μ	ψ	ω								
All firms	1.230	0.248	-0.031								
Exporters	1.181	0.102	0.048								
Non-exporters	1.254	0.299	-0.064								
MNEs	1.166	0.091	0.104								
Non-MNEs	1.252	0.288	-0.067								

Note: Median values of the relevant parameter estimates are reported.

Table A.10: Mean regression results (OLS), by industry - Baseline specification

	Dependent variable	$\ln \widehat{\mu}_{it+1}$			$\ln \left(\frac{\widehat{\phi}_{it+1}}{1-\widehat{\phi}_{it+1}} \right)$			$\ln(\widehat{\varepsilon}_w^N)_{it+1}$		
Industry	Name	EXP	MNE	EXP×MNE	EXP	MNE	EXP×MNE	EXP	MNE	EXP×MNE
1	Food products and beverages	0.057**	-0.011	-0.030	-0.321	0.111	0.280	1.775***	0.335	-0.820***
		(0.027)	(0.017)	(0.035)	(0.584)	(0.138)	(0.773)	(0.664)	(0.220)	(0.278)
2	Textiles and wearing apparel	0.021	-0.090**	0.116	-0.269*	-0.284	0.127	-0.389	-0.072	0.609*
		(0.040)	(0.041)	(0.075)	(0.156)	(0.235)	(0.250)	(0.265)	(0.121)	(0.316)
3	Wood, wooden products, and furniture	0.040	-0.055	-0.144	-0.160	0.018	0.348			
		(0.178)	(0.092)	(0.233)	(0.177)	(0.158)	(0.248)			
4	Pulp, paper and paper products	0.191	-0.191	-0.125	0.117	-0.290	0.411			
		(0.161)	(0.124)	(0.128)	(0.302)	(0.251)	(0.291)			
5	Publishing and printing	0.051	-0.044	-0.118	-0.330	0.449	0.062			
		(0.074)	(0.054)	(0.090)	(0.487)	(0.550)	(0.389)			
6	Chemicals	0.052**	0.015	-0.072*	1.249*	-0.961	-0.992**	1.106***	-0.069	-0.466***
		(0.021)	(0.036)	(0.037)	(0.748)	(0.768)	(0.475)	(0.226)	(0.138)	(0.179)
7	Petroleum and coal products	0.136***	-0.016	-0.141**	0.344*	-0.143	-0.138			
		(0.049)	(0.039)	(0.056)	(0.188)	(0.138)	(0.180)			
8	Non-metallic mineral products	0.101	-0.081	0.034	0.132	-0.211	0.012	0.051	-0.272**	0.414
		(0.062)	(0.080)	(0.083)	(0.123)	(0.233)	(0.248)	(0.098)	(0.128)	(0.254)
9	Iron and steel	0.370**	0.168	-0.406				0.182**	0.159***	-0.329***
		(0.178)	(0.218)	(0.432)				(0.081)	(0.059)	(0.086)
10	Non-ferrous metals	-0.120**	-0.373***	0.245***	0.156	0.168	0.021			
		(0.051)	(0.113)	(0.086)	(0.201)	(0.715)	(0.358)			
11	Fabricated metal products	0.031	-0.035	0.004	0.368***	0.157	-0.317	0.130	0.063	0.013
		(0.029)	(0.036)	(0.047)	(0.117)	(0.175)	(0.197)	(1.239)	(0.600)	(1.388)
12	Machinery	-0.051**	-0.233	0.338	0.049	0.541***	-0.272	0.125***	-0.130*	0.122
		(0.023)	(0.186)	(0.215)	(0.186)	(0.177)	(0.265)	(0.041)	(0.069)	(0.084)
13	Electrical machinery	0.008	-0.166**	0.005	-0.243*	-1.672***	0.572**			
		(0.040)	(0.077)	(0.089)	(0.127)	(0.582)	(0.270)			
14	Transport equipment	0.017	-0.016	0.006	0.393***	-0.562***	0.033	1.479	-0.393	-0.265
		(0.018)	(0.021)	(0.025)	(0.135)	(0.177)	(0.147)	(1.883)	(0.325)	(0.742)
15	Other manufacturing	0.039	-0.034	-0.023	0.062	0.031	-0.288	2.402*	20.719*	-19.940*
		(0.028)	(0.035)	(0.041)	(0.168)	(0.200)	(0.233)	(1.255)	(10.641)	(10.231)

Notes: Significance level of ***1%, **5%, *10%. Standard errors are heteroskedasticity consistent and clustered by enterprises. In industry 9, too few firms are characterized by LMS=EB, hence, no average effects are reported for the regression model of the workers' bargaining power ($\widehat{\phi}$), while either none of the firms in industries $J = \{3,4,13\}$ or too few firms in industries $J = \{5,7,10\}$ are characterized by LMS=MO. Hence, for industries $J = \{3,4,5,7,10,13\}$, no average effects are reported for the regression model of the firm's labor supply elasticity ($\widehat{\varepsilon}_w^N$).

Table A.11: Quantile regression (QR) results, by industry - Baseline specification

Dep. var: $\ln\widehat{\mu}_{it+1}$	EXP					MNE					EXP×MNE				
Industry	q10	q25	q50	q75	q90	q10	q25	q50	q75	q90	q10	q25	q50	q75	q90
1	0.045***	0.038***	0.064***	0.067***	0.062	0.007	0.010	0.008	-0.009	-0.051***	-0.026**	-0.032**	-0.048**	-0.077***	-0.013
	(0.005)	(0.009)	(0.017)	(0.020)	(0.038)	(0.010)	(0.006)	(0.008)	(0.018)	(0.017)	(0.011)	(0.013)	(0.023)	(0.026)	(0.051)
2	0.039***	0.060***	0.031**	0.025	0.042	-0.023***	-0.037***	-0.073***	-0.122***	-0.137**	-0.034**	-0.003	0.058***	0.181***	0.218*
	(0.012)	(0.016)	(0.015)	(0.035)	(0.095)	(0.006)	(0.009)	(0.017)	(0.026)	(0.058)	(0.015)	(0.022)	(0.020)	(0.054)	(0.129)
3	-0.050*	-0.059	-0.106	0.199	0.389**	0.038	0.027	-0.077	-0.101	-0.291**	0.001	0.008	0.040	-0.317*	-0.264
	(0.027)	(0.042)	(0.096)	(0.180)	(0.157)	(0.027)	(0.038)	(0.053)	(0.097)	(0.148)	(0.040)	(0.046)	(0.090)	(0.179)	(0.223)
4	0.054	0.064	0.132	0.255*	0.232	-0.023	-0.058	-0.097	0.005	-0.309*	-0.055	0.004	-0.102	-0.435**	-0.065
	(0.041)	(0.045)	(0.101)	(0.150)	(0.197)	(0.033)	(0.048)	(0.082)	(0.159)	(0.174)	(0.051)	(0.043)	(0.110)	(0.180)	(0.203)
5	0.026**	0.045**	0.003	0.126**	0.136	0.000	-0.016	-0.045*	-0.067	-0.070	-0.062***	-0.088***	-0.076	-0.143*	-0.300**
	(0.012)	(0.018)	(0.030)	(0.054)	(0.097)	(0.015)	(0.015)	(0.027)	(0.049)	(0.051)	(0.022)	(0.025)	(0.049)	(0.083)	(0.122)
6	0.032***	0.045***	0.055***	0.054***	0.073***	0.002	0.016	0.039***	0.016	0.033	-0.017	-0.045***	-0.091***	-0.233***	-0.135***
	(0.007)	(0.006)	(0.008)	(0.016)	(0.023)	(0.009)	(0.011)	(0.012)	(0.013)	(0.025)	(0.011)	(0.012)	(0.014)	(0.040)	(0.031)
7	0.023**	0.030**	0.103***	0.258***	0.371***	-0.014	-0.012	-0.010	-0.019	-0.094**	-0.011	-0.024	-0.102***	-0.096***	-0.243***
	(0.009)	(0.014)	(0.019)	(0.031)	(0.046)	(0.010)	(0.018)	(0.023)	(0.026)	(0.045)	(0.010)	(0.021)	(0.029)	(0.019)	(0.054)
8	0.063***	0.075***	0.133***	0.125***	0.074	-0.054***	-0.018	-0.042	-0.132*	-0.167***	0.051*	0.013	0.003	0.046	0.029
	(0.015)	(0.020)	(0.022)	(0.035)	(0.068)	(0.020)	(0.047)	(0.036)	(0.071)	(0.058)	(0.027)	(0.053)	(0.041)	(0.082)	(0.074)
9	0.046	0.074	0.107	0.186	0.608*	0.078	0.003	0.053	-0.017	0.225	-0.142	0.053	0.246	0.285	0.011
	(0.062)	(0.064)	(0.104)	(0.216)	(0.337)	(0.076)	(0.103)	(0.100)	(0.200)	(0.281)	(0.172)	(0.205)	(0.346)	(0.546)	(0.791)
10	-0.002	0.007	-0.023	-0.170***	-0.319***	-0.103***	-0.128***	-0.298***	-0.570***	-0.720***	0.023	0.038	0.113**	0.358***	0.690***
	(0.016)	(0.019)	(0.024)	(0.038)	(0.053)	(0.032)	(0.045)	(0.073)	(0.127)	(0.178)	(0.027)	(0.036)	(0.049)	(0.078)	(0.169)
11	0.006	0.027***	0.031***	0.058***	0.044	-0.021**	-0.019	-0.003	0.012	-0.060	0.011	-0.018	-0.053**	-0.058**	0.071
	(0.008)	(0.006)	(0.011)	(0.019)	(0.035)	(0.008)	(0.014)	(0.020)	(0.018)	(0.039)	(0.012)	(0.016)	(0.022)	(0.029)	(0.048)
12	-0.010**	-0.029***	-0.033**	-0.031	-0.100**	-0.026	-0.121*	-0.205***	-0.385***	-0.346	0.035	0.163*	0.295***	0.502***	0.517*
	(0.005)	(0.009)	(0.014)	(0.029)	(0.044)	(0.039)	(0.071)	(0.076)	(0.146)	(0.274)	(0.053)	(0.091)	(0.096)	(0.178)	(0.305)
13	-0.021	-0.012	-0.001	0.054	-0.027	-0.062***	-0.136***	-0.197***	-0.196	-0.197	-0.008	-0.008	0.086	-0.035	-0.072
	(0.014)	(0.018)	(0.042)	(0.063)	(0.056)	(0.022)	(0.045)	(0.076)	(0.144)	(0.214)	(0.039)	(0.040)	(0.085)	(0.160)	(0.243)
14	0.017***	0.008	0.022***	0.041***	0.017	-0.003	-0.011	-0.006	-0.007	-0.018	-0.005	0.001	-0.023**	-0.019	0.034
	(0.005)	(0.005)	(0.006)	(0.012)	(0.017)	(0.005)	(0.007)	(0.007)	(0.012)	(0.018)	(0.007)	(0.009)	(0.009)	(0.019)	(0.031)
15	0.004	0.007	0.028**	0.098***	0.064**	-0.024	-0.013	-0.038*	-0.013	-0.055	0.042*	0.019	-0.003	-0.110***	-0.085*
	(0.008)	(0.009)	(0.013)	(0.023)	(0.028)	(0.023)	(0.012)	(0.022)	(0.035)	(0.046)	(0.023)	(0.013)	(0.024)	(0.041)	(0.044)

Table A.11 - Continued: Quantile regression (QR) results, by industry - Baseline specification

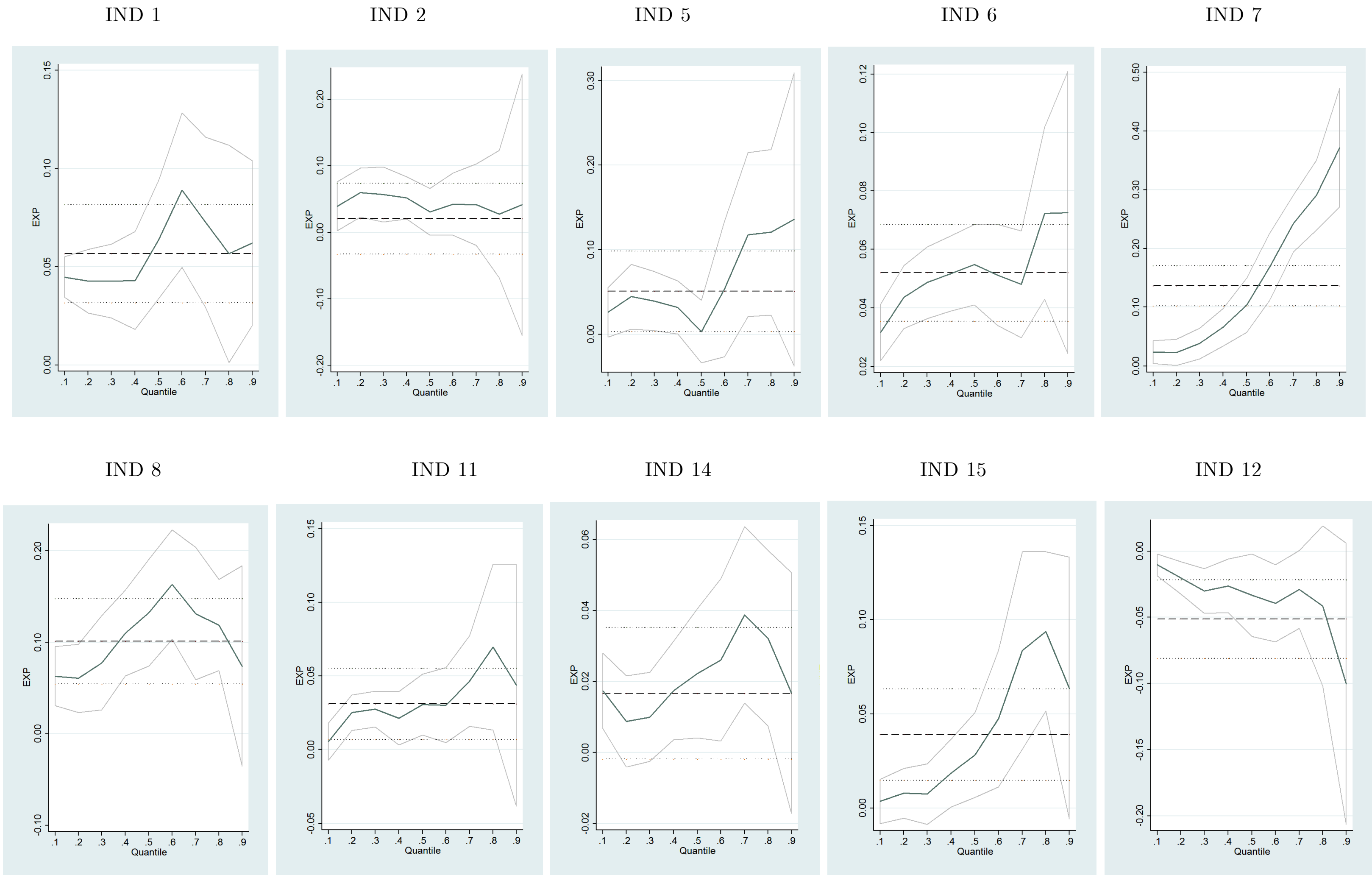
Dep. var: $\ln\left(\frac{\widehat{\phi}_{it+1}}{1-\widehat{\phi}_{it+1}}\right)$	EXP					MNE					EXP×MNE				
Industry	q10	q25	q50	q75	q90	q10	q25	q50	q75	q90	q10	q25	q50	q75	q90
1	-1.015**	-0.878***	-0.711*	0.108	0.241	0.210*	0.211***	0.113	0.089	0.056	1.123*	0.925**	0.863*	-0.243	-0.432
	(0.451)	(0.301)	(0.422)	(0.339)	(0.605)	(0.112)	(0.068)	(0.086)	(0.094)	(0.099)	(0.600)	(0.397)	(0.521)	(0.452)	(0.760)
2	0.030	-0.238***	-0.385***	-0.236**	0.125	-0.108	-0.161	-0.165	-0.781***	-0.259	0.152	0.316**	0.136	0.365	-0.572
	(0.162)	(0.073)	(0.102)	(0.114)	(0.323)	(0.142)	(0.127)	(0.140)	(0.203)	(0.181)	(0.228)	(0.147)	(0.130)	(0.243)	(0.416)
3	-0.415**	-0.217*	-0.204	-0.003	-0.133	0.202*	0.057	0.079	0.052	-0.013	0.470	0.380	0.272	0.188	0.175
	(0.203)	(0.131)	(0.182)	(0.193)	(0.203)	(0.113)	(0.113)	(0.143)	(0.103)	(0.111)	(0.300)	(0.237)	(0.252)	(0.206)	(0.258)
4	0.494**	0.209	0.020	-0.130	-0.092	-0.265**	-0.303*	-0.123	-0.291**	-0.392	0.489**	0.612***	0.319	0.319*	0.510
	(0.207)	(0.208)	(0.211)	(0.169)	(0.310)	(0.131)	(0.161)	(0.223)	(0.135)	(0.288)	(0.192)	(0.177)	(0.222)	(0.184)	(0.401)
5	-0.086	-0.363***	-0.125	-0.270	-0.974**	0.167	0.281*	0.078	0.419	1.298**	-0.131	0.114	-0.166	0.404	0.879**
	(0.246)	(0.128)	(0.371)	(0.412)	(0.468)	(0.229)	(0.151)	(0.398)	(0.486)	(0.526)	(0.227)	(0.112)	(0.253)	(0.289)	(0.406)
6	1.124	0.302	1.440**	1.146***	0.721	-0.814	0.125	-1.132	-1.040**	-0.542	-0.700	-0.411	-1.203***	-0.904***	-0.777**
	(0.803)	(0.969)	(0.699)	(0.385)	(0.525)	(0.839)	(1.051)	(0.730)	(0.417)	(0.551)	(0.581)	(0.570)	(0.458)	(0.242)	(0.340)
7	0.405***	0.223	0.210	0.536***	0.802***	-0.152	-0.132	-0.012	-0.148**	-0.097	0.094	-0.033	-0.053	-0.285*	-0.655***
	(0.110)	(0.137)	(0.143)	(0.157)	(0.184)	(0.109)	(0.084)	(0.077)	(0.066)	(0.144)	(0.284)	(0.117)	(0.136)	(0.168)	(0.204)
8	0.223*	0.080	0.000	0.144	0.070	-0.061	-0.240	-0.253	-0.017	-0.416	-0.170	0.250	0.220	-0.331	-0.022
	(0.115)	(0.082)	(0.108)	(0.120)	(0.144)	(0.252)	(0.219)	(0.284)	(0.335)	(0.284)	(0.146)	(0.229)	(0.276)	(0.308)	(0.286)
10	0.336*	0.451**	0.237	0.252	-0.082	0.659	0.161	0.146	-0.520	-0.538	-0.198	-0.104	0.005	0.165	0.788**
	(0.194)	(0.189)	(0.181)	(0.158)	(0.203)	(0.745)	(0.587)	(0.657)	(0.751)	(0.852)	(0.385)	(0.289)	(0.310)	(0.422)	(0.382)
11	0.334***	0.312***	0.431***	0.381***	0.242***	0.271**	0.207**	0.098	0.257	0.372*	-0.284*	-0.229	-0.364**	-0.484**	-0.298
	(0.069)	(0.075)	(0.071)	(0.069)	(0.086)	(0.113)	(0.083)	(0.125)	(0.182)	(0.195)	(0.169)	(0.145)	(0.150)	(0.226)	(0.195)
12	-0.299	0.028	0.264	0.241	0.042	1.045**	0.838*	0.222	0.220	0.188	-0.396	-0.454	0.142	-0.040	-0.007
	(0.513)	(0.376)	(0.237)	(0.303)	(0.327)	(0.468)	(0.488)	(0.513)	(0.530)	(0.487)	(0.816)	(0.705)	(0.588)	(0.700)	(0.681)
13	0.051	-0.153**	-0.211***	-0.379***	-0.333**	0.075	-1.182**	-1.466***	-1.901***	-0.770	-0.194	0.375*	0.527***	0.821***	0.453
	(0.091)	(0.070)	(0.080)	(0.112)	(0.157)	(0.661)	(0.488)	(0.400)	(0.582)	(0.878)	(0.315)	(0.205)	(0.178)	(0.261)	(0.398)
14	0.162**	0.096	0.310***	0.462***	0.541***	-0.296***	-0.246**	-0.333***	-0.562***	-0.738***	0.209**	0.269***	0.015	-0.067	-0.095
	(0.082)	(0.102)	(0.078)	(0.106)	(0.087)	(0.081)	(0.098)	(0.090)	(0.104)	(0.075)	(0.098)	(0.093)	(0.082)	(0.084)	(0.094)
15	0.152	0.121	0.064	0.065	0.169	0.189	0.125	0.009	-0.055	-0.121	-0.346**	-0.308*	-0.309***	-0.431***	-0.364
	(0.094)	(0.078)	(0.075)	(0.088)	(0.176)	(0.125)	(0.183)	(0.104)	(0.101)	(0.217)	(0.138)	(0.183)	(0.111)	(0.126)	(0.240)

Table A.11 - Continued: Quantile regression (QR) results, by industry - Baseline specification

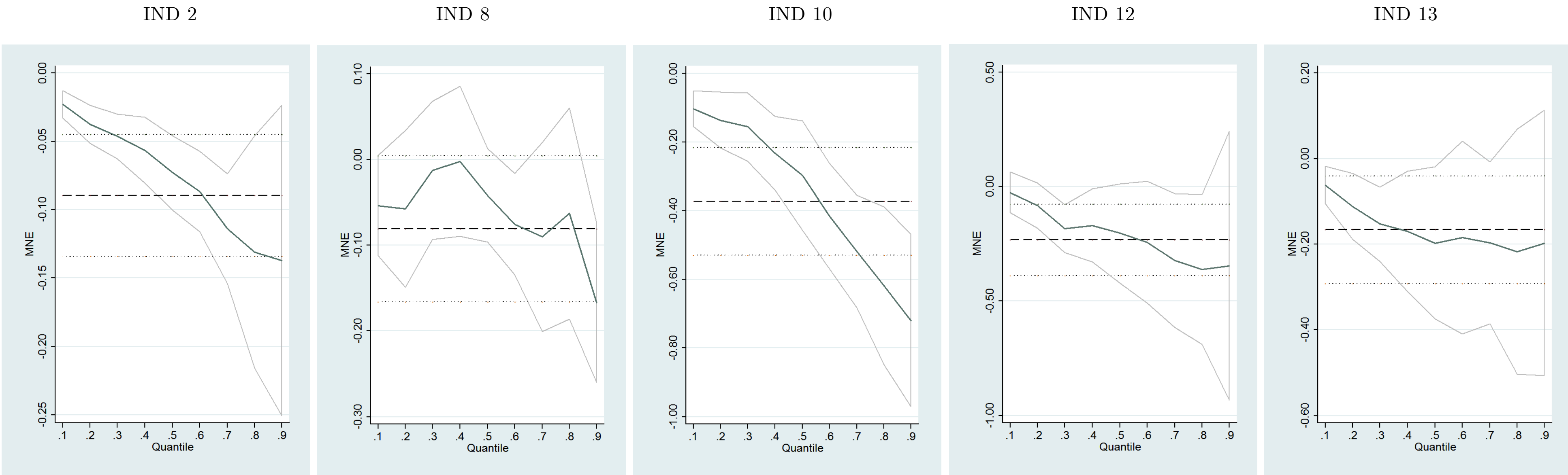
Dep. var: $\ln(\widehat{\varepsilon}_w^N)_{it+1}$	EXP					MNE					EXP×MNE				
Industry	q10	q25	q50	q75	q90	q10	q25	q50	q75	q90	q10	q25	q50	q75	q90
1	1.333***	1.896***	1.377***	1.806***	2.488***	0.100	0.141	0.181	0.521***	0.816***	-0.564***	-0.769***	-0.852***	-0.886***	-1.175***
	(0.411)	(0.510)	(0.350)	(0.403)	(0.578)	(0.134)	(0.168)	(0.118)	(0.137)	(0.146)	(0.175)	(0.230)	(0.179)	(0.233)	(0.197)
2	-0.571*	-0.354	-0.177	-0.440	-0.315	-0.171	0.107	-0.035	-0.169	-0.245*	1.090**	0.553	0.276	0.678*	0.687*
	(0.329)	(0.286)	(0.284)	(0.364)	(0.331)	(0.202)	(0.190)	(0.124)	(0.124)	(0.136)	(0.427)	(0.425)	(0.373)	(0.408)	(0.415)
6	0.371**	0.907***	1.335***	1.378***	1.352***	-0.026	-0.156**	0.123	-0.147	-0.050	-0.011	-0.274***	-0.750***	-0.620***	-0.618***
	(0.155)	(0.129)	(0.124)	(0.274)	(0.289)	(0.093)	(0.073)	(0.103)	(0.095)	(0.133)	(0.131)	(0.090)	(0.131)	(0.150)	(0.201)
8	0.188*	0.201**	0.089	-0.050	-0.082	-0.092	-0.213*	-0.350***	-0.368***	-0.326**	0.051	0.299	0.381*	0.487**	0.631**
	(0.096)	(0.082)	(0.064)	(0.056)	(0.079)	(0.165)	(0.123)	(0.111)	(0.119)	(0.147)	(0.372)	(0.300)	(0.227)	(0.245)	(0.259)
9	0.085*	0.095*	0.235***	0.260***	0.218***	0.137**	0.143***	0.233***	0.176***	0.097**	-0.171**	-0.222***	-0.439***	-0.448***	-0.377***
	(0.049)	(0.050)	(0.063)	(0.044)	(0.065)	(0.053)	(0.051)	(0.051)	(0.042)	(0.045)	(0.070)	(0.059)	(0.069)	(0.068)	(0.086)
11	0.609	0.068	1.617*	0.731	0.484	0.448	0.026	0.831*	0.310	0.135	-0.599	0.132	-1.724*	-0.640	-0.380
	(0.824)	(0.839)	(0.900)	(1.012)	(0.998)	(0.390)	(0.388)	(0.438)	(0.473)	(0.482)	(0.914)	(0.918)	(1.015)	(1.121)	(1.107)
12	0.147***	0.157***	0.147***	0.094***	0.056	-0.127**	-0.076	-0.095**	-0.121***	-0.142	0.123**	0.065	0.056	0.111**	0.140
	(0.023)	(0.022)	(0.019)	(0.033)	(0.049)	(0.053)	(0.073)	(0.043)	(0.047)	(0.089)	(0.057)	(0.081)	(0.051)	(0.048)	(0.095)
14	-3.566	4.815	0.620	2.062	5.374**	0.206	-0.972	-0.323	-0.351	-0.682*	1.746	-1.503	0.230	-0.645	-2.115**
	(5.094)	(4.200)	(2.345)	(2.467)	(2.529)	(0.820)	(0.647)	(0.410)	(0.350)	(0.377)	(1.824)	(1.632)	(0.951)	(1.057)	(1.043)
15	1.814	2.948	2.060	1.647	1.859	14.368	24.913	17.356	13.341	14.239	-14.200	-24.145	-16.685	-12.831	-13.634
	(2.461)	(2.266)	(1.898)	(1.861)	(2.314)	(21.031)	(19.355)	(16.314)	(16.147)	(20.022)	(20.241)	(18.635)	(15.712)	(15.597)	(19.313)

Notes: Significance level of ***1%, **5%, *10%. Bootstrapped standard errors (50 replications).
Results are based on pooled simultaneous-quantile regressions for $\tau \in \{0.05, 0.10, 0.20, 0.25, 0.30, 0.40, 0.50, 0.60, 0.70, 0.75, 0.80, 0.90, 0.95\}$.
Results for other regressors and other quantiles are available upon request. See Table A.10 for the selection of industries.

Graph A.1: Average and quantile impact of export/MNE status on $\ln \widehat{\mu}_{it+1}$ in selected industries



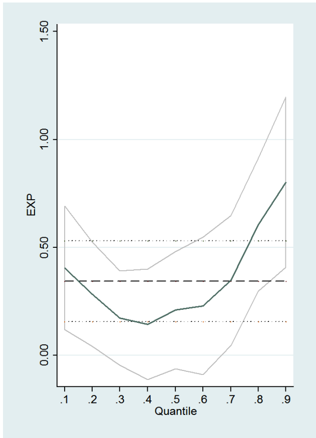
Graph A.1 - Continued: Average and quantile impact of export/MNE status on $\ln \widehat{\mu}_{it+1}$ in selected industries



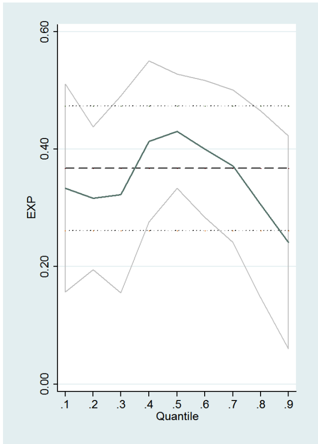
Notes: In industries manufacturing food products and beverages, textiles and wearing apparel, publishing and printing, chemicals, petroleum and coal products, non-metallic mineral products, fabricated metal products, transport equipment, and other manufacturing (industries $J = \{1, 2, 5, 6, 7, 8, 11, 14, 15\}$), we observe positive exporter returns along most quantiles, whereas we observe negative exporter returns in machinery (industry 12). Negative MNE returns are found for firms in industries manufacturing textiles and wearing apparel, non-metallic mineral products, non-ferrous metals, machinery, and electrical machinery (industries $J = \{2, 8, 10, 12, 13\}$).

Graph A.2: Average and quantile impact of export/MNE status on $\ln\left(\frac{\widehat{\phi}_{it+1}}{1-\widehat{\phi}_{it+1}}\right)$ in selected industries

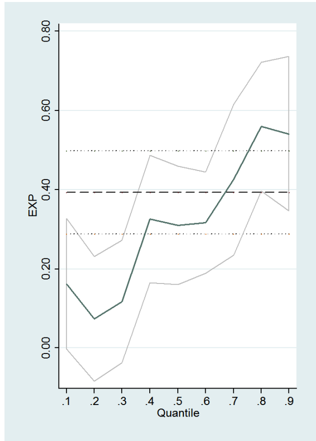
IND 7



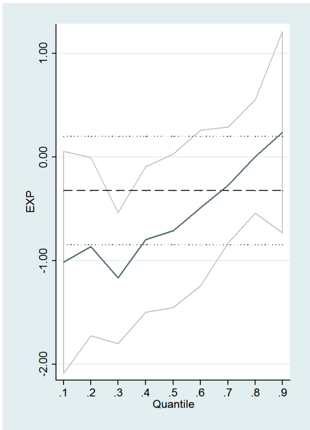
IND 11



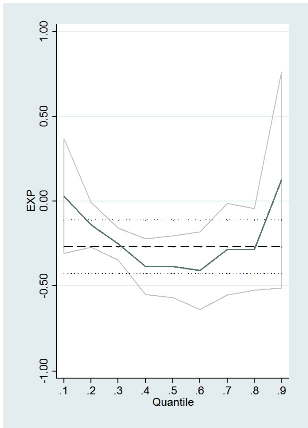
IND 14



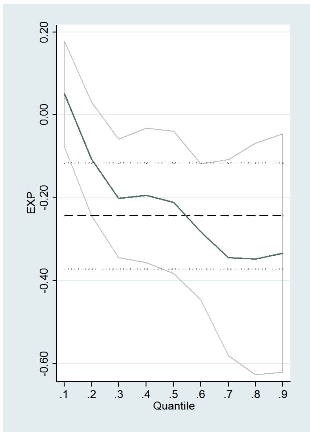
IND 1



IND 2

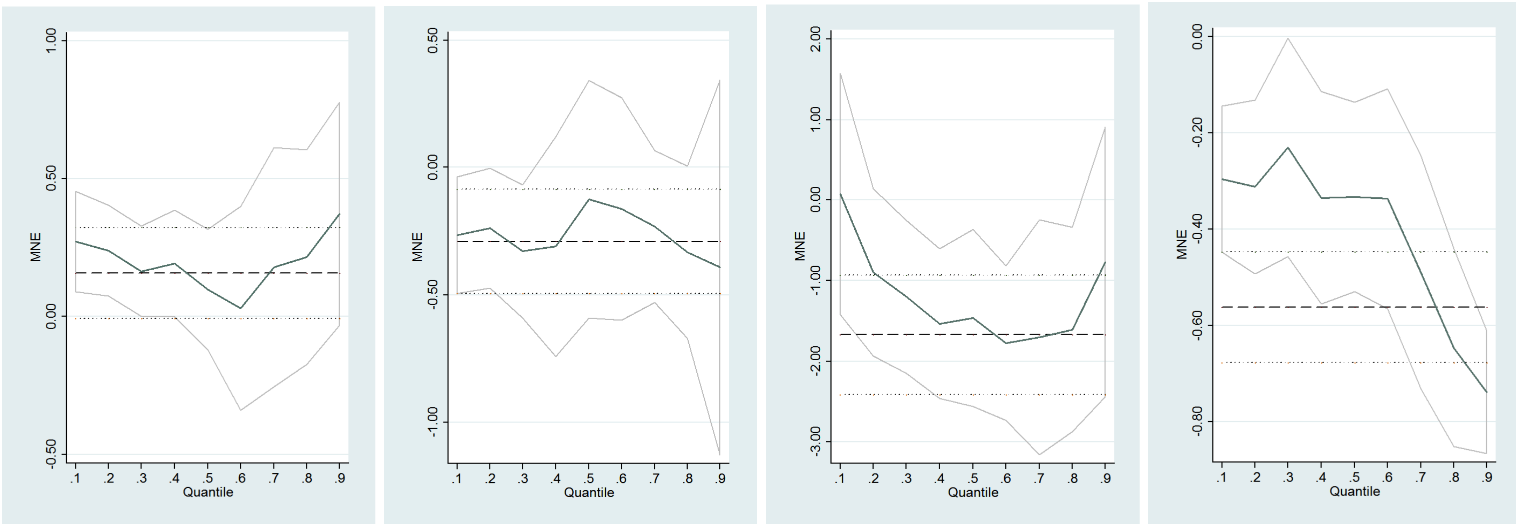


IND 13



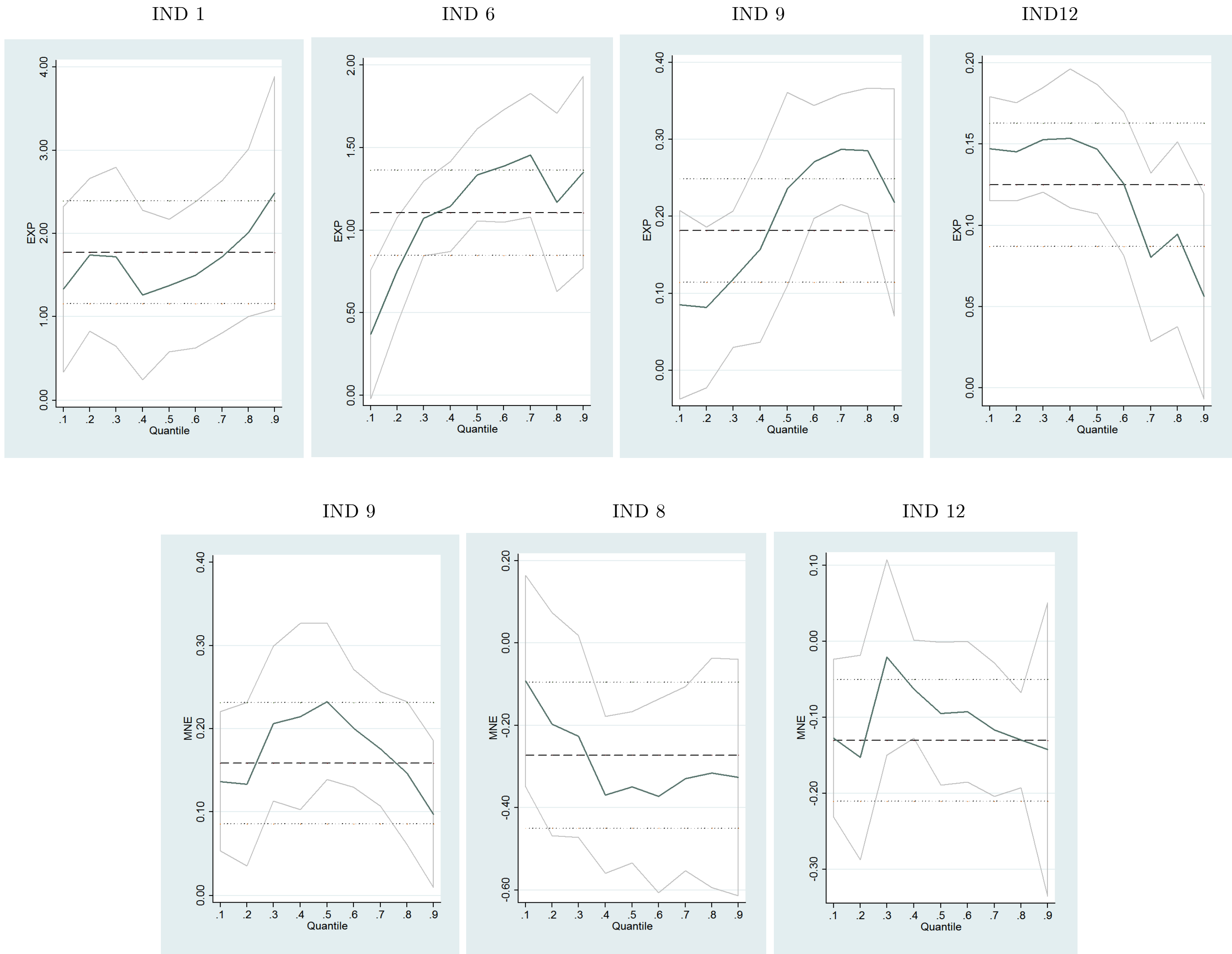
Graph A.2 - Continued: Average and quantile impact of export/MNE status on $\ln\left(\frac{\widehat{\phi}_{it+1}}{1-\widehat{\phi}_{it+1}}\right)$ in selected industries

IND 11 IND 4 IND 13 IND14



Notes: In industries manufacturing petroleum and coal products, non-ferrous metals, and transport equipment (industries $J = \{7, 11, 14\}$), we observe positive exporter returns whereas negative exporter returns are found in industries manufacturing food products and beverages, textiles and wearing apparel, and electrical machinery (industries $J = \{1, 2, 13\}$). Positive MNE returns are found in fabricated metal products (industry 11) whereas firms in industries manufacturing pulp, paper and paper products, electrical machinery, and transport equipment (industries $J = \{4, 13, 14\}$) experience negative MNE returns.

Graph A.3: Average and quantile impact of export/MNE status on $\ln(\widehat{\varepsilon}_w^N)_{it+1}$ in selected industries



Notes: Positive returns along the full conditional distribution are found for firms in industries manufacturing food products and beverages, chemicals, iron and steel, and machinery (industries $J = \{1, 6, 9, 12\}$). Positive MNE returns are observed for firms in iron and steel (industry 9) whereas negative MNE returns are found for firms in industries manufacturing non-metallic mineral products and machinery (industries $J = \{8, 12\}$).