Labor market imperfections, markups and productivity in multinationals and exporters*

Sabien DOBBELAERE† Kozo KIYOTA‡

January, 2017 - PRELIMINARY VERSION

Abstract

This paper examines the links between the internationalization 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) labour market imperfections (workers' bargaining power during worker-firm negotiations or firm's degree of wage setting power) and (iii) revenue productivity. We apply this new framework to analyze whether the pricing behavior of firms in product and labor markets differs across firms that engage in different forms of internationalization. We also distinguish between manufacturing and service firms. We find that exporting firms are more characterized by monopsony and less by efficient bargaining compared to non-exporters. Non-MNEs are very similar to non-exporters in terms of the type of competitiveness in product and labor markets. Compared to exporters, a smaller fraction of MNEs are characterized by efficient bargaining. Once we condition on the type of competition in labor markets, we do no find differences in the degree of labor and product market imperfections across firms that differ in terms of internationalization. We find a positive association between export status and workers' bargaining power in service firms and to a lesser extent in manufacturing firms. We also observe a positive correlation between MNE status and workers' bargaining power in service firms whereas the opposite holds in manufacturing firms. Our results show a positive association between export status and the labor supply elasticity in all firms and in both manufacturing and service firms. We find a negative association between MNE status and labor supply elasticity in manufacturing firms and a positive correlation in service firms.

JEL classification : C23, D24, F14, F16, J50, L13.
Keywords : Rent sharing, monopsony, price-cost mark-ups, productivity, exporting, multinational firms, panel data.

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

*This study is part of the project undertaken at the Research Institute of Economy, Trade, and Industry (RIETI). The study utilizes micro data from the questionnaire in the Basic Survey of Japanese Business Structure and Activities (BSJBSA), which is conducted by the Ministry of Economy, Trade, and Industry (METI).

†Vrije Universiteit Amsterdam, Tinbergen Institute and Institute of Labor Economics (IZA).
‡Keio Economic Observatory, Keio University and RIETI.

variation in firm-specific wages as one of the main drivers of increased wage inequality (see Harrison *et al.*, 2011 for a review). This literature builds upon the seminal contribution of Melitz (2003) by abstaining from the assumption of competitive labor markets and considers rent sharing to be the key mechanism through which trade-induced variation in rents are transmitted to variation in wages.

The Melitz model, characterized by firm heterogeneity in productivity and fixed export costs, generates trade-induced shifts in the productivity distribution of firms through selection of efficient firms into exporting and of inefficient firms into exit. As shown by Egger and Kreickemeier (2009), this standard outcome translates into a positive productivity-wage relationship. The literature has put forward different channels through which employer's ability to pay might affect wages. One set of models postulates that collective bargaining is the main channel through which employer's ability to pay might affect wages (Egger and Etzel, 2012; Montagna and Nocco, 2013).[1]

On the empirical side, microeconometric studies testing some of the predictions of the aforementioned models can be classified in several groups. A first set of papers has provided evidence of the theoretical conjecture that reductions in trade costs lead to a positive correlation between exports and wages.[2] A second set of papers has established empirical support for the positive relationship between a firm's export or MNE status and its productivity level.[3] A third, small set of papers have tested the prediction that exporters will have higher price-cost mark-ups.[4] A fourth set of papers has investigated the impact of openness on labor market imperfections.[5] 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 international activities.

This paper serves the purpose of examining heterogeneity in product and labor market imperfections across multinational enterprises (MNEs), exporters, and domestic firms. Our empirical analysis is

[1] Alternative channels driving the positive performance-pays link are e.g. fair wage concerns (Egger and Kreickemeier, 2009; Amit and Davis, 2012; Egger *et al.*, 2013), efficiency wages (Davis and Harrigan, 2011), search-and-matching frictions with convex adjustment costs (Coşar *et al.*, 2016) and search-and-matching frictions with individual bargaining (Felbermayr *et al.*, 2011; Helpman *et al.*, 2016).

[2] See e.g. Bernard and Jensen (1997, 1999) using plant- or firm-level data, and Munch and Skaksen 2008, Schank *et al.*, 2007, Schank *et al.*, 2010, and Verhoogen, 2008 using matched employer-employee data.

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

[4] This prediction can either be generated by heterogeneity on the supply side (productivity) as Melitz and Ottaviano (2008) or by heterogeneity on the demand side (quality differences). See e.g. Martin (2010), De Loecker and Warzynski, 2012; Kato, 2014 and Guillo and Nesta, 2015 for empirical support based on the former and e.g. Kugler and Verhoogen, 2012 and Hallak and Sivadasan, 2009 for empirical support based on the latter. Forlani *et al.* (2015) explicitly accounts for heterogeneity on both the supply and the demand side.

[5] Relying on a collective bargaining framework, several studies have showed evidence of a relationship between international trade and workers' bargaining power using either firm panel data (e.g. Abraham and Konings, 2009; Ahsan and Mitra, 2014; Brock and Dobbelaere, 2006; Dumont *et al.*, 2006) or matched employer-employee data (e.g. Felbermayr *et al.*, 2014). Relying on a search-and-matching framework, Davidson *et al.* (2014) examine how openness affects the degree of matching between workers and firms using matched employer-employee data.

based on an unbalanced panel of 14,621 manufacturing and service firms covering the period 1994-2012 in Japan. We contribute to the empirical international trade literature and the econometric literature on identifying market imperfections along various dimensions First, using a static cost minimization model, we derive an econometric framework that allows for three-dimensional firm heterogeneity: productivity, product market imperfections (price-cost mark-ups) and labor market imperfections. Rather than imposing a particular imperfectly competitive model of wage determination to the data, our framework let the data determine the type of competition prevailing in product and labor markets. We accomplish this by building on the methodology of 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 model underlying this approach nests two polar extremes of imperfectly competitive models of wage determination in the seminal framework of Hall (1988) for estimating price-cost mark-ups: the 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 monopsony model (Manning, 2003) allocates market power to employers through search frictions or heterogeneous worker preferences for job characteristics which generate upward-sloping labor supply curves to individual firms.

The second contribution is to apply this new framework to analyze the type and the degree of product and labor market imperfections in MNEs, exporters and domestic firms, while accounting for differences in productivity. As such, we are capable of 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 in firms that engage differently in international activities. Indeed, several empirical studies such as Bernard *et al.* (2003) have documented that MNEs and exporters are larger in terms of the employment than domestic firms.[6] Such firms could have considerable monopsony power in the labor market, implying that market power could be consolidated on the labor demand side. However, it could also be that unions could be stronger in larger firms, thereby increasing market power on the labor supply side. By recovering firm-specific estimates of labor market imperfections, we also gain deeper insight into how the three dimensions of heterogeneity correlate with each other. To identify the relationship between the degree of labor market imperfections and export/FDI behavior, we first examine mean differences in product and labor market imperfections and productivity across firms that differ in terms of international activities. We then apply standard quantile regression techniques to investigate how the impact of export/MNE status varies along the conditional distribution of either product or labor market imperfections.

Recent empirical work has provided evidence of resource misallocation being higher in services than

[6] See Kiyota and Urata (2008) for evidence on MNEs in Japan.

in manufacturing (see Dias *et al.*, 2016 for references). Imperfectly competitive product markets with firm heterogeneity in pricing behavior are considered as potential sources of misallocation (see e.g. Peters, 2013; Syverson, 2004a,b). By the same token, the number of service firms engaging in international activities has increased rapidly over the past decades (Roberts, 1999; OECD, 2008). To acknowledging these facts, our third contribution is to investigate the links between the internationalization and pricing behavior in product and labor markets in manufacturing versus service firms.

We find that exporting firms are more characterized by monopsony and less by efficient bargaining compared to non-exporters. Non-MNEs are very similar to non-exporters in terms of the type of competitiveness in product and labor markets. Compared to exporters, a smaller fraction of MNEs are characterized by efficient bargaining. Once we condition on the type of competition in labor markets, we do no find differences in the degree of labor and product market imperfections across firms that differ in terms of internationalization. We find a positive association between export status and workers' bargaining power in service firms and to a lesser extent in manufacturing firms. We also observe a positive correlation between MNE status and workers' bargaining power in service firms whereas the opposite holds in manufacturing firms. Our results show a positive association between export status and the labor supply elasticity in all firms and in both manufacturing and service firms. We find a negative association between MNE status and labor supply elasticity in manufacturing firms and a positive correlation in service firms.

The plan of the article as follows. Section 2 presents the static cost minimization model. Section 3 discusses our econometric model and the estimation procedure. Section 4 presents the Japanese firm panel data. In Section 5 contains the estimation results of three-dimensional heterogeneity: markups, labor market imperfection and productivity parameters by export/MNE status. Section 6 shows the results of identifying the relationship between product/ labor market imperfections and export/MNE status within a regression framework. Section 7 concludes.

2 Static cost minimization model

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

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

with (L_{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 and

(*ii*) producers active in the market are cost minimizing. Therefore, we consider the associated Lagrangian function:

$$\mathcal{L}(L_{it}, M_{it,it}, \lambda_{it}) = w_{it}L_{it} + j_{it}M_{it} + r_{it}K_{it} + \lambda_{it}(Q_{it} - Q_{it}(\cdot)) \tag{2}$$

with w_{it}, j_{it} and r_{it} the firm's input prices for L, M and K, respectively.

Assuming that a firm takes the input price of intermediate inputs as given, the first-order condition for intermediate inputs is given by:

$$\frac{\partial \mathcal{L}}{\partial M_{it}} = j_{it} - \lambda_{it}\frac{\partial Q_{it}(\cdot)}{\partial M_{it}} = 0 \tag{3}$$

where the marginal cost of production at a given level of output is $\frac{\partial \mathcal{L}}{\partial Q_{it}} = \lambda_{it}$.

Rearranging Eq. (3) and multiplying both sides by $\frac{\mathbf{X}_{it}}{Q_{it}}$ yields:

$$\frac{\partial Q_{it}(\cdot)}{\partial M_{it}}\frac{M_{it}}{Q_{it}} = \frac{j_{it}M_{it}}{\lambda_{it}Q_{it}} \tag{4}$$

From Eq. (4), it follows that cost minimization implies that the optimal demand for intermediate inputs is satisfied when a firm equalizes the output elasticity of the variable input M_{it} (denoted θ_{it}^{M}) to $\frac{j_{it}M_{it}}{\lambda_{it}Q_{it}}$.

Defining firm i's price-cost mark-up as $\mu_{it} \equiv \frac{P_{it}}{\lambda_{it}}$, it follows that $\lambda_{it} = \frac{P_{it}}{\mu_{it}}$. Inserting in Eq. (4) and rearranging gives:

$$\theta_{it}^{M} = \mu_{it}\alpha_{it}^{M} \tag{5}$$

with $\alpha_{it}^{M} = \frac{j_{it}M_{it}}{P_{it}Q_{it}}$ the share of intermediate input expenditure in total sales.

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), efficient bargaining (EB) and monopsony (MO). Depending on the prevalent LMS, static cost maximization implies the following first-order condition with respect to labor (for details, we refer to Appendix A):

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

$$\frac{\partial \mathcal{L}}{\partial L_{it}} = w_{it} - \lambda_{it}\frac{\partial Q_{it}(\cdot)}{\partial L_{it}} = 0 \tag{6}$$

Substituting λ_{it} by $\frac{P_{it}}{\mu_{it}}$ and rearranging Eq. (6) gives:

$$\theta_{it}^{L} = \mu_{it}\alpha_{it}^{L} \tag{7}$$

with $\alpha_{it}^L = \frac{w_{it}L_{it}}{P_{it}Q_{it}}$ the share of labor expenditure in total sales.

Under EB, firm i and its workers negotiate simultaneously over wages and employment in order to maximize the joint surplus of their economic activity. Static cost maximization implies the following first-order condition with respect to labor (for details, we refer to Appendix A):

$$\theta_{it}^L = \mu_{it}\alpha_{it}^L - \mu_{it}\gamma_{it}(1 - \alpha_{it}^L - \alpha_{it}^M) \tag{8}$$

with $\gamma_{it} = \frac{\phi_{it}}{1-\phi_{it}}$ the relative extent of rent sharing and ϕ_{it} the part of economic rents going to the workers or the degree of workers' bargaining power during worker-firm negotiations.

Under MO, firm i faces a labor supply $L(w)$, which is an increasing function of the wage w. Static cost maximization implies the following first-order condition with respect to labor (for details, we refer again to Appendix A):

$$\theta_{it}^L = \mu_{it}\alpha_{it}^N \left(1 + \frac{1}{(\varepsilon_w^L)_{it}}\right) \tag{9}$$

with $(\varepsilon_w^L)_{it} \in \Re_+$ the wage elasticity of labor supply of firm i, measuring the degree of wage setting power that firm i possesses.

Using the first-order condition for intermediate inputs, we obtain an expression for firm i's price-cost mark-up (μ_{it}) and using the first-order conditions with respect to intermediate inputs and labor, we define firm i's joint market imperfections parameter (ψ_{it}) as follows:

$$\mu_{it} = \frac{\theta_{it}^M}{\alpha_{it}^M} \tag{10}$$

$$\begin{aligned}
\psi_{it} &= \frac{\theta_{it}^M}{\alpha_{it}^M} - \frac{\theta_{it}^L}{\alpha_{it}^L} && (11)\\
&= 0 \quad \text{if LMS=PR} && (12)\\
&= \mu_{it}\gamma_{it}\left[\frac{1 - \alpha_{it}^L - \alpha_{it}^M}{\alpha_{it}^L}\right] > 0 \quad \text{if LMS=EB} && (13)\\
&= -\mu_{it}\frac{1}{(\varepsilon_w^L)_{it}} < 0 \quad \text{if LMS=MO} && (14)
\end{aligned}$$

3 Econometric model

In order to obtain estimates of the output elasticities θ_{it}^L and θ_{it}^M, 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 the set of producers (denoted by the vector $\boldsymbol{\beta}$). These two assumptions imply the following expression for the production function:

$$Q_{it} = F(L_{it}, M_{it}, K_{it}; \boldsymbol{\beta}) \exp(\omega_{it}) \tag{15}$$

In order to obtain consistent estimates of the production function ($\boldsymbol{\beta}$), we need to control for unobserved productivity shocks ω_{it}, which are potentially correlated with the firm's input choices. We apply a variant of the estimation procedure proposed by Ackerberg *et al.* (2006) using the insight that optimal input choices hold information about unobserved productivity.

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, l_{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 or with labor contract being long terms as in e.g. unionized industries.

We assume that productivity (ω_{it}) evolves according to an exogenous first-order Markov process, that is:

$$\omega_{it} = \mathrm{E}[\omega_{it-1}|I_{it-1}] + \xi_{it} = \mathrm{E}[\omega_{it-1}|\omega_{it-1}] \tag{16}$$

with I_{it-1} the firm's information set at $t-1$.

Given these timing assumptions, firm i's intermediate input demand at t depends directly on l_{it} chosen prior to m_{it}, i.e.:

$$m_{it} = m_t(l_{it}, k_{it}, \omega_{it}) \tag{17}$$

Eq. (16) shows that firm i's intermediate input demand decision is a function of the state variables l_{it}, k_{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 $m_t(l_{it}, k_{it}, \omega_{it})$ is strictly increasing in ω_{it} (strict monotonicity assumption), allow to invert ω_{it} as a function of observables:

$$\omega_{it} = m_t^{-1}(m_{it}, l_{it}, k_{it}) \tag{18}$$

Consider the log version of Eq. (15) given that $\theta_{it}^L = \frac{\partial \ln F(\cdot)}{\partial \ln L_{it}}$ and $\theta_{it}^M = \frac{\partial \ln F(\cdot)}{\partial \ln M_{it}}$(by definition independent of a firm's productivity shock) and allow for non-predictable output shocks and *iid* shocks (ε_{it}) including measurement error (due to e.g. the use of revenue deflated by a price index to proxy output):

$$y_{it} = f(l_{it}, m_{it}, k_{it}; \boldsymbol{\beta}) + \omega_{it} + \varepsilon_{it} \tag{19}$$

where $y_{it} = \ln Q_{it} + \varepsilon_{it}$ with ε_{it} assumed to be mean independent of current and past input choices.

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

$$y_{it} = \beta_0 + \beta_l l_{it} + \beta_m m_{it} + \beta_k k_{it} + \beta_{ll} l_{it}^2 + \beta_{mm} m_{it}^2 + \beta_{lm} l_{it} m_{it} + \omega_{it} + \varepsilon_{it} \tag{20}$$

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

Substituting Eq. (18) in Eq. (20) results in a first-stage equation of the form:

$$y_{it} = f_{it} + m_t^{-1}(m_{it}, l_{it}, k_{it}) + \varepsilon_{it} = \varphi_t(l_{it}, k_{it}, m_{it}) + \varepsilon_{it} \tag{21}$$

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

Hence, the first stage involves using Eq. (21) and the moment condition $\mathrm{E}[\epsilon_{it}|I_{it}] = 0$ to obtain an estimate $\widehat{\varphi}_{it}$, of the composite term $\varphi_t(l_{it}, k_{it}, m_{it}) = f_{it} + m_t^{-1}(m_{it}, l_{it}, k_{it})$, which represents output net of ε_{it}. In our application, estimation of Eq. (21) is implemented by regressing output on a second-order polynomial series expansion where all logged inputs, lagged labor and intermediate inputs squared and interaction terms between logged labor and intermediate inputs squared are included. To allow for time variation in φ_t, these polynomial terms are interacted with time.

We can compute (up to a scalar constant) a prediction for ω_{it} for any value of $\boldsymbol{\beta}$ using:

$$\widehat{\omega}_{it}(\boldsymbol{\beta}) = \widehat{m}_t^{-1}(m_{it}, l_{it}, k_{it}) = \widehat{\phi}_{it} - \beta_l l_{it} - \beta_m m_{it} - \beta_k k_{it} - \beta_{ll} l_{it}^2 - \beta_{mm} m_{it}^2 - \beta_{lm} l_{it} m_{it} \tag{22}$$

In order to implement the second stage and identify the production function coefficients, we need to recover the innovation to productivity (ξ_{it}) to form moments on. Using Eq. (22), a consistent approximation to $\mathrm{E}[\omega_{it}|\omega_{it-1}] = 0$ is given by the predicted values from regressing nonparametrically $\widehat{\omega}_{it}(\boldsymbol{\beta})$ on $\widehat{\omega}_{it-1}(\boldsymbol{\beta})$. The residual from this regression provides us with an estimate of ξ_{it}:

$$\xi_{it} = \omega_{it}(\boldsymbol{\beta}) - \mathrm{E}[\omega_{it-1}(\boldsymbol{\beta})|I_{it-1}] \tag{23}$$

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

$$\mathbf{d}_{it} = \left\{ l_{it-1}, m_{it-1}, k_{it}, l_{it-1}^2, m_{it-1}^2, l_{it-1} m_{it-1} \right\} \tag{24}$$

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 level. In particular, we calculate the firm-specific elasticity of output with respect to labor as:

$$\widehat{\theta}_{it}^{L} = \widehat{\beta}_l + 2\widehat{\beta}_{ll} l_{it} + \widehat{\beta}_{lm} m_{it} \tag{25}$$

Similarly, we calculate the firm-specific elasticity of output with respect to material as:[7]

$$\widehat{\theta}_{it}^{M} = \widehat{\beta}_m + 2\widehat{\beta}_{mm} m_{it} + \widehat{\beta}_{ml} l_{it} \tag{26}$$

Using the shares of labor and intermediate input expenditure in total sales (α_{it}^{L} and α_{it}^{M}, respectively) and our estimates of the output elasticities $\widehat{\theta}_{it}^{L}$ and $\widehat{\theta}_{it}^{M}$, we are able to compute $\widehat{\mu}_{it}$ and $\widehat{\psi}_{it}$. Since we only observe $Y_{it} = Q_{it}\exp(\varepsilon_{it})$, we do not observe the correct expenditure shares for L_{it} and M_{it}. We can recover an estimate of ε_{it} from the first stage to adjust the expenditure shares as follows:[8]

$$\widehat{\alpha}_{it}^{L} = \frac{w_{it} L_{it}}{P_{it} \frac{Y_{it}}{\exp(\varepsilon_{it})}} \tag{27}$$

$$\widehat{\alpha}_{it}^{M} = \frac{j_{it} M_{it}}{P_{it} \frac{Y_{it}}{\exp(\varepsilon_{it})}} \tag{28}$$

Using Eqs. (25), (26), (27) and (28), we compute $\widehat{\mu}_{it}$ and $\widehat{\psi}_{it}$ follows:

$$\widehat{\mu}_{it} = \frac{\widehat{\theta}_{it}^{M}}{\widehat{\alpha}_{it}^{M}} \tag{29}$$

$$\widehat{\psi}_{it} = \frac{\widehat{\theta}_{it}^{M}}{\widehat{\alpha}_{it}^{M}} - \frac{\widehat{\theta}_{it}^{L}}{\widehat{\alpha}_{it}^{L}} \tag{30}$$

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 $R \in \Re = \{PC\text{-}PR, IC\text{-}PR, PC\text{-}EB, IC\text{-}EB, PC\text{-}MO, IC\text{-}MO\}$ at time t as follows:

We first compute the confidence intervals (CI) at the 95% level for each firm-year estimate of μ_{it} and $gap_{it}^{L} = \frac{\theta_{it}^{L}}{\alpha_{it}^{L}}$:

$$95\% \text{ confidence interval for } \mu_{it}^{M}\text{: } \left[\widehat{\mu}_{it}^{M} - 1.96 \times \sigma_{\mu_{it}^{M}}, \widehat{\mu}_{it}^{M} + 1.96 \times \sigma_{\mu_{it}^{M}}\right] = \left[A_{\mu_{it}^{M}}, B_{\mu_{it}^{M}}\right] \tag{31}$$

$$95\% \text{ confidence interval for } gap_{it}^{L}\text{: } \left[\widehat{gap}_{it}^{L} - 1.96 \times \sigma_{\widehat{gap}_{it}^{L}}, \widehat{gap}_{it}^{L} + 1.96 \times \sigma_{\widehat{gap}_{it}^{L}}\right] = \left[A_{gap_{it}^{L}}, B_{gap_{it}^{L}}\right] \tag{32}$$

To determine firm i's LMS at time t, we use the 95% CI for μ_{it}^{M}. If the lower bound of the 95% CI is lower than unity, firm i is characterized to be perfectly competitive (PC) at time t.

To determine firm i's PMS at time t, we compare the CI's for gap_{it}^{L} and μ_{it}^{M}. In particular, firm i

[7] Under a Cobb-Douglas production function $\widehat{\theta}_{it}^{L}$ and $\widehat{\theta}_{it}^{M}$ would be equal to $\widehat{\beta}_l$ and $\widehat{\beta}_m$, respectively.

[8] This correction is important as it eliminates any variation in expenditure shares that comes from variation in output not correlated with $\varphi_t(l_{it}, k_{it}, m_{it})$.

- is characterized by perfect competition/right-to-manage bargaining (PR) at time t if the 95% CI's for gap_{it}^{L} and μ_{it}^{M} overlap which implies that $\widehat{\mu}_{it}^{M}$ is not significantly different from $\widehat{gap}_{it}^{L} \Longrightarrow \widehat{\psi}_{it} = 0$ at the 95% level.
- is characterized by efficient bargaining (EB) at time t if $A_{\mu_{it}^{M}} > B_{gap_{it}^{L}} \Longrightarrow \widehat{\psi}_{it} > 0$ at the 95% level.
- is characterized by monopsony (MO) at time t if $A_{gap_{it}^{L}} > B_{\mu_{it}^{M}} \Longrightarrow \widehat{\psi}_{it} < 0$ at the 95% level.

Once firm i's regime is determined, we are able to quantify market power in product and labor markets. As shown in Section 2, the product and labor market imperfection parameters are derived from the estimated joint market imperfections parameter $\widehat{\psi}_{it}$.

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), 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, cost, profit, employment, assets, and debt. The strengths of this survey are the sample coverage and the reliability of its information. 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 nonmanufacturing industries such as wholesale trade, retail trade, and information and communication industry. In this study, we focus on manufacturing and the wholesale & retail trade industry, because data for these industries are available throughout our sample period.

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

Output (Q) is defined as real gross output measured by nominal sales divided by the industry-level gross output price index. Labor (L) refers to the average number of permanent workers. Material input is defined as intermediate consumption deflated by the industry-level intermediate consumption price index in the three countries. 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.[9] The shares of labor (α^L) and material input (α^M) are constructed by dividing respectively the firm total labor cost (i.e., wage bill) 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 interest rate and depreciation rate minus the changes in the investment goods price.

From the BSJBSA, we obtain variables for export and MNE status. If a firm report positive exports, it is classified as an exporter. One may ask what kind of wholesale & retail trade firms engage in exports and/or imports. A typical example in the wholesale trade is trading companies. Similarly, some large retail trade firms import foreign products by themselves. Note also that firms could engage in both manufacturing and wholesale & retail trade activities. Firms that engage in both manufacturing and wholesale & retail trade activities are classified as wholesale and retail trade firms if their main sales come from wholesale and retail trade activities. In the BSJBSA, 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 percent and with headquarters located outside of Japan. A firm that has at least one foreign affiliate is regarded as the firm engaging in FDI.[10] In addition, we use the following firm-specific control variables: the R&D-sales ratio, the firm age, and the share of nonproduction workers. R&D is measured by the R&D expenditure. The share of nonproduction workers is defined as the ratio of nonproduction workers to total employees at the firm level.[11]

We use the BSJBSA covering the period 1994-2012. We first delete the observations which report cost shares greater than or equal to one and smaller than or equal to zero. We also drop the observations with top and bottom 1 percentiles in cost shares by industry to remove outliers. We select firms that survive at least two consecutive years because lagged inputs are needed for the moment condition in our estimation framework.[12] Our estimation sample consists of 14,621 firms: 7,639 in manufacturing and 6,982 in services (wholesale and retail trade firms). 7.5% of the firms are identified as exporters and 12.5% as MNEs. Table B.1 in Appendix B reports the panel structure of the estimation sample. Table B.2 reports and the number of observations and firms by industry.

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

[10] If the foreign-owned firms also have foreign affiliates outside Japan, they are classified not 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 percent.

[11] To calculate the share of nonproduction workers, we first obtain the number of employees who work in the manufacturing plant or engage in manufacturing activities in the firm headquarters. We then subtract this number from the total number of employees, which implies the number of nonproduction workers. The share of nonproduction workers is defined as the ratio of this number to the total number of employees.

[12] After the estimation of the production function, we exclude the observations with economically meaningless estimates for θ^L_{it}, θ^M_{it}, gap^L_{it} and μ^M_{it}, i.e. $\widehat{\theta}^L_{it} < 0$, $\widehat{\theta}^M_{it} < 0$, $\widehat{gap}^L_{it} \geq 20$, and $\widehat{\mu}^M_{it} \geq 20$.

Table 1 reports the means, standard deviations and quartile values of our main variables for the entire estimation sample, split between manufacturing and services and split according to international activity. Focusing on the manufacturing/service distinction, the average share of labor in nominal output is considerably larger in manufacturing firms (0.197) than in service firms (0.11) while the opposite holds for the share of intermediate inputs (0.592 in manufacturing versus 0.766 in services). 28% of the manufacturing firms and 13% of the service firms are exporters. 24% of manufacturing and 11% of service firms engage in multinational activities. On average, manufacturing firms are more capital-intensive, have a higher share of non-production workers and invest more in R&D than services firms. Focusing on exporters versus non-exporters, exporting firms are larger, slightly older, employ a lower share of non-production workers and invest more in R&D than non-exporters. The same holds when comparing MNEs to non-MNEs.

<Insert Table 1 about here>

5 Three-dimensional firm heterogeneity

In this Section, we present descriptive statistics of our estimates of product market and labor market imperfections and productivity. Based on firm estimates of price-cost mark-up and joint market imperfection parameters, we first examine how the type of competition prevailing in product and labor markets vary across firms. Conditional on the regime of competitiveness, we then investigate how subsets of firms vary across the different dimensions.

Table 2 presents the percentage of firms belonging to each of the 6 regimes of competitiveness. Focusing on the entire estimation sample, 90% of the firms are characterized 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; 34% of the firms) and monopsony (MO; 24% of the firms). As such, the predominant regimes are IC-EB (42% of the firms), IC-PR (33% of the firms) and IC-MO (15% of the firms).

Comparing the prevalence of regimes across firms that differ in terms of international activities leads to the following conclusions. Let us first focus on differences between exporters and non-exporters. A smaller fraction of exporters is characterized by $PMS = IC$. The three labor market settings are evenly distributed among exporters whereas non-exporters are dominantly characterized by $LMS = EB$ and far less so by $LMS = MO$. As such, a larger fraction of non-exporters is characterized by $R = IC\text{-}EB$. The prevalent regimes of non-MNEs are very similar to those of non-exporters. Compared to exporters, less MNEs are characterized by $LMS = EB$.

We do not only observe variation in regimes of competitiveness across firms that differ in terms of export/MNE status, we also find differences between manufacturing and service firms. 18% of

the manufacturing firms are characterized by $PMS = PC$ whereas all service firms operate in imperfectly competitive product markets. The three labor market settings are much more evenly distributed among manufacturing firms than among service firms. The dominant labor market setting among service firms is efficient bargaining (50%), followed by $LMS = PR$ (40%). Only 9% of service firms are characterized by monopsony. Table 3 shows considerable heterogeneity in regimes across and within industries. For example, the fraction of firms characterized by $R = IC\text{-}EB$ is only 2% in Electrical machinery whereas it equals 99% in Non-metallic mineral products.

<Insert Tables 2 & 3 about here>

Table 4 investigates whether the degree of labor market imperfections vary across firms that differ in terms of internationalization and across manufacturing/service firms. In particular, Table 4 reports the median values of our parameters of interest within each regime. We focus the discussion on $R = IC\text{-}EB$ and $R = IC\text{-}MO$. Within $R = IC\text{-}EB$, we do no find differences in labor and product market imperfections across firms that differ in terms of internationalization: the median price-cost mark-up is about 1.50 and the median workers' bargaining power is about 0.28. Exporters and MNEs are found to be less productive than non-exporters and non-MNEs, respectively. Within $R = IC\text{-}MO$, we again detect no differences in price-cost mark-ups across firms that engage differently in international activities: the median price-cost is about 1.18. Only minor differences are found in terms of labor market imperfections: the wage elasticity of labor supply is slightly higher in non-exporters and non-MNEs compared to exporters and MNEs, respectively (1.84 compared to 1.69 and 1.87 compared to 1.55). Exporters appear to be more productive that non-exporters whereas non-MNEs are more productive than MNEs. We do, however, detect differences in market imperfections between manufacturing and service firms. Within $R = IC\text{-}EB$, manufacturing firms are characterized by higher price-cost mark-ups (1.71) than service firms (1.38) whereas the workers' bargaining power is very similar (about 0.29). Service firms appear to be more productive. Within $R = IC\text{-}MO$, the median price-cost of manufacturing firms is again higher than those of service firms but to a lesser extent (1.19 versus 1.16). Service firms are characterized by more elastic labor supply and appear to be less productive than manufacturing firms.

<Insert Table 4 about here>

6 Market imperfections and export/MNE status

In this Section, we further examine the links between the internationalization of firms and market imperfections within a regression framework. For the total estimation sample and for manufacturing/service firms, we investigate the impact of a firm's export/MNE status on its price-cost mark-up by estimating the following specification:

$$\ln \widehat{\mu}_{it} = \alpha_0 + \alpha_1 E_{it} + \alpha_2 MNE_{it} + \alpha_3 \widehat{\omega}_{it} + \alpha_4 EB_{it} + \alpha_5 MO_{it} + \mathbf{b}'_{it} + \varepsilon_{it} \tag{33}$$

where EB is a dummy equal to 1 if $LMS = EB$ and MO is a dummy equal to 1 if $LMS = MO$, hence taking $LMS = PR$ as the benchmark. We collect all firm-specific controls (such as size, capital intensity, age and the share of non-production workers) in a vector $\mathbf{b}'_{it}$. We also control for industry and time fixed effects.

By the same token, we investigate the impact of a firm's export/MNE status on its absolute extent of rent sharing by estimating the following specification:

$$\ln \widehat{\phi}_{it} = \alpha_0 + \alpha_1 E_{it} + \alpha_2 MNE_{it} + \alpha_3 \widehat{\omega}_{it} + \alpha_4 IC_{it} + \mathbf{b}'_{it} + \varepsilon_{it} \tag{34}$$

where IC is a dummy equal to 1 if $PMS = IC$, hence taking $PMS = PC$ as the benchmark. Again firm-specific controls are included in $\mathbf{b}'_{it}$ and industry and time effects are controlled for.

Likewise, we investigate the impact of a firm's export/MNE status on its labor supply elasticity by estimating the following specification:

$$\ln(\widehat{\varepsilon}^N_w)_{it} = \alpha_0 + \alpha_1 E_{it} + \alpha_2 MNE_{it} + \alpha_3 \widehat{\omega}_{it} + \alpha_4 IC_{it} + \mathbf{b}'_{it} + \varepsilon_{it} \tag{35}$$

Table B.3 in Appendix B presents a correlation matrix of all variables. Table 5 reports the average effects.The left part of Table 5 shows a negative correlation between export/MNE status and price-cost mark-ups for manufacturing firms and a positive correlation for service firms. The productivity of a firm seems to be positively associated with a firm's price-cost markup for all firms but negatively so for manufacturing firms. We find a positive association between efficient bargaining and price-cost mark-ups in service firms whereas a negative association is found between monopsony and price-cost mark-ups in all firms and in both manufacturing and service firms. The middle part of Table 5 reveals positive association between export status and workers' bargaining power in service firms and to a lesser extent in manufacturing firms. We also find a positive correlation between MNE status and workers' bargaining power in service firms whereas the opposite holds in manufacturing firms. The productivity of a firms is negatively associated with the workers' bargaining power in manufacturing firms whereas the opposite is true in service firms. There is a strong association between imperfect competition in the product market and workers' bargaining power in all firms. The right part of Table 5 shows that there is a positive association between export status and the labor supply elasticity in all firms and in both manufacturing and service firms. We find a negative association between MNE status and labor supply elasticity in manufacturing firms and a positive correlation in service firms. Productivity seems to be negative associated with the labor supply elasticity.

<Insert Table 5 about here>

Table 6 reports the results of pooled simultaneous-quantile regressions (QR) for the 10^{th}, 20^{th}, 30^{th}, 50^{th}, 70^{th} and 90^{th} percentiles of the distribution of the respective market imperfections. We

focus the discussion on export/MNE status. We observe heterogeneous effects of export/MNE status on price-cost mark-ups and labor market imperfections. Clearly, OLS estimates – calculating 'the average effect for the average enterprise' – do not accurately describe the relationship between our product and labor market imperfection parameters and export/MNE status. TO BE COMPLETED.

<Insert Table 6 about here>

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 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 threefold. First, based on Dobbelaere and Mairesse (2013), we develop a framework for modelling heterogeneity across firms in terms of (i) product market power (price-cost markups), (ii) labour market imperfections (workers' bargaining power during worker-firm negotiations or firm's degree of wage setting power) and (iii) revenue productivity. Second, we apply this framework and estimate production functions using a recent control function approach in order to examine whether the type and the degree of market power in labor and product markets depends on a firm's international behavior. We consider the 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 in different international activities. Third, unlike most micreconometric studies in the literature on internationalization, we examine the relationship between internationalization and market imperfections for manufacturing and service firms separately. As such, we acknowledge that service firms engaging in foreign markets have increased rapidly over the past decades.

We find that exporting firms are more characterized by monopsony and less by efficient bargaining compared to non-exporters. Non-MNEs are very similar to non-exporters in terms of the type of competitiveness in product and labor markets. Compared to exporters, a smaller fraction of MNEs are characterized by efficient bargaining. Once we condition on the type of competition in labor markets, we do no find differences in the degree of labor and product market imperfections across

firms that differ in terms of internationalization. We find a positive association between export status and workers' bargaining power in service firms and to a lesser extent in manufacturing firms. We also observe a positive correlation between MNE status and workers' bargaining power in service firms whereas the opposite holds in manufacturing firms. Our results show a positive association between export status and the labor supply elasticity in all firms and in both manufacturing and service firms. We find a negative association between MNE status and labor supply elasticity in manufacturing firms and a positive correlation in service firms.

References

[1] Ackerberg, D., K. Caves, and G. Frazer. 2015. 'Identification properties of recent production function estimators', Econometrica, 83(6): 2411–51.

[2] Amiti, M. and J. Konings. 2007. 'Trade liberalization, intermediate inputs, and productivity: evidence from Indonesia', American Economic Review, 97(5): 1611–38.

[3] Ahsan, R.N. and D. Mitra. 2014. 'Trade liberalization and labor's slice of the pie', Journal of Development Economics, 108(C): 1–16.

[4] Bernard, A.B. and J.B. Jensen. 1997. 'Exporters, skill upgrading, and the wage gap', Journal of International Economics, 42(1–2): 3–11.

[5] Bernard, A.B. and J.B. Jensen. 1999. 'Exceptional exporter performance: cause, effect, or both?' Journal of International Economics, 47(1): 1–25.

[6] Bernard, A.B., J.B. Jensen, S.J. Redding, and P.K. Schott, 2007. 'Firms in international trade', Journal of Economic Perspectives, 21(3): 105–130.

[7] Boulhol, H., S. Dobbelaere, and S. Maioli S. 2011. 'Imports as product and labour market discipline', British Journal of Industrial Relations, 49(2): 331–61.

[8] Brock, E. and S. Dobbelaere. 2006. 'Has international trade affected workers' bargaining power?' Review of World Economics, 142(6): 233–66.

[9] Coşar, K., N. Guner and J. Tybout, 2016. 'Firm dynamics, job turnover, and wage distribution in an open economy', American Economic Review, 106(3): 625–63.

[10] Davidson, C., F. Heyman, S. Matusz, F. Sjöholm, and S.C. Zhu. 2014. 'Globalization and imperfect labor market sorting', Journal of International Economics, 94(2): 177–94.

[11] Davis, D.R. and J. Harrigan. 2011. 'Good jobs, bad jobs, and trade liberalization', Journal of International Economics, 84(1): 26–36.

[12] De Loecker, J. and F. Warzynski. 2012. 'Markups and firm-level export status', American Economic Review, 102(6): 2437–71.

[13] Dumont, M., G. Rayp, and P. Willemé. 2006. 'Does internationalization affect union bargaining power? An empirical study for five EU countries', Oxford Economic Papers, 58(1): 77–102.

[14] Egger, H. and D. Etzel. 2012. 'The impact of trade on employment, welfare, and income distribution in unionized general oligopolistic equilibrium', European Economic Review, 56(6): 1119–35.

[15] Egger, H. and U. Kreickemeier. 2009. 'Firm heterogeneity and the labor market effects of trade liberalization', International Economic Review, 50(1): 187–216.

[16] Egger, H., P. Egger, and U. Kreickemeier. 2013. 'Trade, profits, and wages ', European Economic Review, 64(C): 332–50.

[17] Felbermayr, G., J. Prat, and H.-J. Schmerer. 2011. 'Globalization and labor market outcomes: wage bargaining, search frictions, and firm heterogeneity', Journal of Economic Theory, 146(1): 39–73.

[18] Felbermayr, G., A. Hauptman, and H.-J. Schmerer. 2014. 'International trade and collective bargaining outcomes: Evidence from German employer-employee data', Scandinavian Journal of Economics, 116(3): 820–37.

[19] Forlani, E., R. Martin, G. Mion, and M. Muuls. 2015. 'Unraveling firms: Demand, productivity and markups heterogeneity'. CEPR Discussion Papers 11058.

[20] Fukao, K., S. Hamagata, T. Inui, K. Ito, H.U. Kwon, T. Makino, T. Miyagawa, Y. Nakanishi, and J. Tokui. 2007. 'Estimation procedures and TFP analysis of the JIP database 2006 provisional version', RIETI Discussion Paper Series, 07-E-003, Research Institute of Economy, Trade and Industry (RIETI).

[21] Guillou, S. and L. Nesta. 2015. 'Markup heterogeneity, export status and the establishment of the EURO', GREDEG Working Paper Series, No. 2015-04, Group de Recherche en Droit, Economie et Gestion (GREDEG).

[22] Hallak, J.C. and J. Sivadasan. 2009. 'Exporting behavior under quality constraints', National Bureau of Economic Research Working Paper 14928.

[23] Harrison, A., J. McLaren, and M. McMillan. 2011. 'Trade and inequality', Annual Review of Economics, 3: 261–89.

[24] Helpman, E. 2006. 'Trade, FDI, and the organization of firms', Journal of Economic Literature, 44(3): 589–630.

[25] Helpman, E., O. Itskhoki, M.-A. Muendler, and S. Redding. 2012. 'Trade and inequality: from theory to estimation', Review of Economic Studies, 84(1): 357–405.

[26] Kato, A. 2014. 'Does export yield productivity and markup premiums? Evidence from the Japanese manufacturing industry', RIETI Discussion Paper Series, 14-E-037, RIETI.

[27] Kiyota, K. and S. Urata. 2008. 'The role of multinational firms in international trade: The case of Japan', Japan and the World Economy, 20(3): 338–52.

[28] Kugler, M. and E. Verhoogen. 2012. 'Plant size, and product quality', Review of Economic Studies, 79(1): 307–39.

[29] Manning, A. 2003. Monopsony in motion: Imperfect competition in labor markets. Princeton University Press: Princeton.

[30] McDonald, I.M. and R.M. Solow. 1981. 'Wage bargaining and employment', American Economic Review, 71(5): 896–908.

[31] Melitz, M.J. and G.I.P. Ottaviano. 2008. 'Market size, trade, and productivity', Review of Economic Studies, 75(1): 295–316.

[32] Montagna, C. and A. Nocco. 2013. 'Unionization, international integration and selection', Canadian Journal of Economics, 46(1): 23–45.

[33] Munch, J. R. and J.R. Skaksen. 2008. 'Human capital and wages in exporting firms', Journal of International Economics, 75(2): 363–72.

[34] OECD. 2008. Staying competitive in the global economy: compendium of studies on global value chains. Paris: OECD.

[35] Peters, M. 2013. Heterogeneous mark-ups, growth and endogenous misallocation. LSE Research Online. London School of Economics.

[36] Roberts, J. 1999. 'The internationalisation of business service firms: A stages approach', The Service Industries Journal, 19(4): 68–88.

[37] Schank, T., C. Schnabel, and J. Wagner. 2007. 'Do exporters really pay higher wages? First evidence from German linked employer–employee data', Journal of International Economics, 72(1): 52–74.

[38] Schank, T., C. Schnabel, and J. Wagner. 2010. 'Higher wages in exporting firms: Self-selection, export effect, or both? First evidence from linked employer–employee data', Review of World Economics, 146(2): 303–22.

[39] Syverson, C. 2004a. 'Market structure and productivity: A concrete example', Journal of Political Economy 112(6): 1181–222.

[40] Syverson, C. 2004b. 'Product substitutability and productivity dispersion', Review of Economics and Statistics, 86(2): 534–50.

[41] Temouri, Y., N.L. Driffield, and D.A. Higon. 2008. 'Analysis of productivity differentials among foreign and domestic firms: Evidence from Germany', Review of World Economics, 144(1): 32–54.

[42] Verhoogen, E. A. 2008. 'Trade, quality upgrading, and wage inequality in the Mexican manufacturing sector', Quarterly Journal of Economics, 123(2): 489–530.

Table 1: Descriptive statistics

All firms	Mean	Sd.	Q_1	Q_2	Q_3	N
Real firm output growth Δq_{it}	-0.005	0.120	-0.065	-0.002	0.057	105474
Labor growth rate Δl_{it}	-0.009	0.082	-0.045	-0.007	0.028	105474
Material growth rate Δm_{it}	-0.008	0.128	-0.073	-0.005	0.058	105474
Capital growth rate Δk_{it}	-0.046	0.135	-0.105	-0.092	-0.059	105474
Labor share in nominal output $\alpha_{L,it}$	0.159	0.092	0.090	0.140	0.209	120288
Material share in nominal output $\alpha_{M,it}$	0.670	0.185	0.560	0.701	0.810	120288
Number of workers L_{it}	456	2186	83	140	295	120288
Age	43	18	32	45	55	120288
Exporter dummy	0.217	0.412	0	0	0	120288
MNE dummy	0.179	0.384	0	0	0	120288
Capital intensity	1.483	0.946	0.984	1.564	2.094	120288
Share of non-production workers	0.611	0.360	0.265	0.596	1.000	120288
R&D expenditure–nominal output ratio	0.011	0.028	0.000	0.000	0.009	45328
Manufacturing	Mean	Sd.	Q_1	Q_2	Q_3	N
Real firm output growth Δq_{it}	-0.004	0.130	-0.070	-0.001	0.064	58808
Labor growth rate Δl_{it}	-0.009	0.080	-0.044	-0.007	0.028	58808
Material growth rate Δm_{it}	-0.011	0.140	-0.083	-0.008	0.063	58808
Capital growth rate Δk_{it}	-0.043	0.134	-0.105	-0.089	-0.052	58808
Labor share in nominal output $\alpha_{L,it}$	0.197	0.091	0.132	0.183	0.247	66578
Material share in nominal output $\alpha_{M,it}$	0.592	0.176	0.487	0.618	0.721	66578
Number of workers L_{it}	542	2566	85	146	320	66578
Age	45	18	33	46	56	66578
Exporter dummy	0.284	0.451	0	0	1	66578
MNE dummy	0.236	0.424	0	0	0	66578
Capital intensity	1.601	0.873	1.114	1.645	2.155	66578
Share of non-production workers	0.350	0.242	0.165	0.299	0.483	66578
R&D expenditure–nominal output ratio	0.016	0.034	0.000	0.003	0.019	28287
Services	Mean	Sd.	Q_1	Q_2	Q_3	N
Real firm output growth Δq_{it}	-0.007	0.105	-0.059	-0.004	0.049	46666
Labor growth rate Δl_{it}	-0.008	0.084	-0.046	-0.008	0.029	46666
Material growth rate Δm_{it}	-0.005	0.111	-0.062	-0.002	0.054	46666
Capital growth rate Δk_{it}	-0.051	0.137	-0.103	-0.094	-0.070	46666
Labor share in nominal output $\alpha_{L,it}$	0.111	0.069	0.066	0.096	0.137	53710
Material share in nominal output $\alpha_{M,it}$	0.766	0.146	0.702	0.797	0.871	53710
Number of workers L_{it}	351	1588	80	133	272	53710
Age	42	17	30	44	53	53710
Exporter dummy	0.134	0.341	0	0	0	53710
MNE dummy	0.109	0.312	0	0	0	53710
Capital intensity	1.337	1.010	0.793	1.450	2.003	53710
Share of non-production workers	0.935	0.170	1.000	1.000	1.000	53710
R&D expenditure–nominal output ratio	0.002	0.009	0.000	0.000	0.000	17041

Notes: Labor and material shares are corrected shares.

Table 1 (continued): Descriptive statistics

Exporters	Mean	Sd.	Q_1	Q_2	Q_3	N
Real firm output growth Δq_{it}	-0.001	0.134	-0.069	0.002	0.069	24963
Labor growth rate Δl_{it}	-0.007	0.077	-0.039	-0.005	0.028	24963
Material growth rate Δm_{it}	-0.008	0.140	-0.079	-0.004	0.067	24963
Capital growth rate Δk_{it}	-0.043	0.134	-0.104	-0.092	-0.054	24963
Labor share in nominal output $\alpha_{L,it}$	0.168	0.091	0.100	0.156	0.223	26142
Material share in nominal output $\alpha_{M,it}$	0.666	0.178	0.561	0.684	0.797	26142
Number of workers L_{it}	956	3776	111	223	578	26142
Age	49	19	39	51	60	26142
MNE dummy	0.552	0.497	0	1	1	26142
Capital intensity	1.600	0.893	1.097	1.665	2.197	26142
Share of non-production workers	0.539	0.313	0.274	0.481	0.848	26142
R&D expenditure–nominal output ratio	0.028	0.037	0.001	0.014	0.041	10047
Non-exporters	Mean	Sd.	Q_1	Q_2	Q_3	N
Real firm output growth Δq_{it}	-0.006	0.115	-0.063	-0.003	0.053	80511
Labor growth rate Δl_{it}	-0.010	0.083	-0.047	-0.009	0.028	80511
Material growth rate Δm_{it}	-0.009	0.124	-0.071	-0.005	0.056	80511
Capital growth rate Δk_{it}	-0.047	0.136	-0.105	-0.092	-0.061	80511
Labor share in nominal output $\alpha_{L,it}$	0.156	0.092	0.088	0.135	0.204	94146
Material share in nominal output $\alpha_{M,it}$	0.671	0.187	0.560	0.706	0.813	94146
Number of workers L_{it}	318	1434	79	127	250	94146
Age	42	17	31	44	53	94146
MNE dummy	0.076	0.265	0	0	0	94146
Capital intensity	1.451	0.958	0.952	1.535	2.064	94146
Share of non-production workers	0.631	0.370	0.261	0.686	1.000	94146
R&D expenditure–nominal output ratio	0.006	0.023	0.000	0.000	0.003	35281
MNEs	Mean	Sd.	Q_1	Q_2	Q_3	N
Real firm output growth Δq_{it}	0.002	0.129	-0.060	0.007	0.070	19680
Labor growth rate Δl_{it}	-0.006	0.079	-0.039	-0.004	0.028	19680
Material growth rate Δm_{it}	-0.004	0.135	-0.070	0.001	0.068	19680
Capital growth rate Δk_{it}	-0.043	0.131	-0.103	-0.090	-0.050	19680
Labor share in nominal output $\alpha_{L,it}$	0.157	0.083	0.096	0.146	0.205	21561
Material share in nominal output $\alpha_{M,it}$	0.673	0.169	0.572	0.693	0.794	21561
Number of workers L_{it}	1458	4923	148	353	906	21561
Age	51	18	41	52	61	21561
Exporter dummy	0.669	0.470	0	1	1	21561
Capital intensity	1.715	0.874	1.204	1.763	2.276	21561
Share of non-production workers	0.537	0.316	0.269	0.475	0.857	21561
R&D expenditure–nominal output ratio	0.027	0.038	0.001	0.013	0.040	9600
Non-MNEs	Mean	Sd.	Q_1	Q_2	Q_3	N
Real firm output growth Δq_{it}	-0.007	0.118	-0.066	-0.004	0.054	85794
Labor growth rate Δl_{it}	-0.010	0.082	-0.046	-0.008	0.028	85794
Material growth rate Δm_{it}	-0.010	0.126	-0.074	-0.007	0.056	85794
Capital growth rate Δk_{it}	-0.047	0.136	-0.105	-0.093	-0.062	85794
Labor share in nominal output $\alpha_{L,it}$	0.159	0.094	0.089	0.138	0.210	98727
Material share in nominal output $\alpha_{M,it}$	0.669	0.188	0.557	0.704	0.813	98727
Number of workers L_{it}	238	513	78	124	234	98727
Age	42	17	31	44	53	98727
Exporter dummy	0.119	0.323	0	0	0	98727
Capital intensity	1.433	0.954	0.932	1.521	2.047	98727
Share of non-production workers	0.627	0.367	0.264	0.660	1.000	98727
R&D expenditure–nominal output ratio	0.006	0.023	0.000	0.000	0.003	35728

Notes: Labor and material shares are corrected shares.

Table 2: Percentage of firms in each regime

	# obs	PC-PR	PC-EB	PC-MO	IC-PR	IC-EB	IC-MO
Total	120288	1.6	0.1	8.8	32.7	42.1	14.7
Manufacturing	66578	3.0	0.1	16.0	26.3	35.2	19.5
Services	53710	0.0	0.0	0.0	40.7	50.5	8.7
Exporters	26142	2.3	0.0	14.7	33.6	32.5	16.9
Non-exporters	94146	1.5	0.1	7.2	32.5	44.7	14.0
MNEs	21561	3.4	0.0	16.3	35.2	28.4	16.8
Non-MNEs	98727	1.3	0.1	7.2	32.2	45.0	14.2

Notes: Product market regime − labor market regime. PC = perfect competition; IC = imperfect competition; PR = perfect competition or right to manage; EB = efficient bargaining; MO = monopsony.

Table 3: Percentage of firms in each regime by industry

	# obs	PC-PR	PC-EB	PC-MO	IC-PR	IC-EB	IC-MO
Total	120288	1.6	0.1	8.8	32.7	42.1	14.7
Food products and beverages	8935	2.8	0.0	5.0	39.4	44.4	8.4
Textiles and wearing apparel	3442	6.7	2.1	4.9	8.9	73.7	3.7
Wood, wooden products, and furniture	1801	0.2	0.0	0.0	33.6	66.2	0.0
Pulp, paper and paper products	2886	0.0	0.0	1.4	29.3	63.8	5.4
Publishing and printing	4081	5.5	0.0	0.0	28.5	65.8	0.1
Rubber products	764	71.1	0.0	0.0	19.4	9.6	0.0
Chemicals	6067	0.0	0.0	0.4	18.1	31.6	50.0
Petroleum and coal products	4102	10.7	0.0	0.0	54.4	34.9	0.0
Non-metallic mineral products	1062	0.1	0.0	0.0	1.0	98.9	0.0
Iron and steel	2273	0.0	0.0	30.4	6.0	9.6	54.0
Non-ferrous metals	1583	0.3	0.0	95.9	1.0	0.0	2.8
Fabricated metal products	5305	1.5	0.0	2.2	51.2	40.4	4.7
Machinery	7194	0.8	0.0	8.6	49.2	24.6	16.8
Electrical machinery	7591	0.1	0.0	68.6	4.0	2.2	25.1
Transport equipment	6608	0.0	0.0	23.7	2.3	12.9	61.2
Other manufacturing	2884	4.5	0.0	8.0	24.7	55.8	7.0
Wholesale and retail trade	53710	0.0	0.0	0.0	40.7	50.5	8.7

Notes: Product market regime − labor market regime. PC = perfect competition; IC = imperfect competition; PR = perfect competition or right to manage; EB = efficient bargaining; MO = monopsony.

Table 4: Three-dimensional firm heterogeneity (markups, labor market imperfections and productivity)

PC-PR	μ	ψ	ω			IC-PR	μ	ψ	ω		
All firms	1.033	-0.127	-0.499			All firms	1.202	0.044	-0.746		
Manufacturing	1.032	-0.140	-0.518			Manufacturing	1.251	0.053	-0.486		
Services						Services	1.181	0.047	-0.833		
PC-EB	μ	ψ	ω	γ	ϕ	IC-EB	μ	ψ	ω	γ	ϕ
All firms	0.987	0.208	0.218	1.229	0.551	All firms	1.492	0.624	0.350	0.402	0.287
Manufacturing	0.989	0.210	0.261	1.196	0.545	Manufacturing	1.714	0.806	0.135	0.419	0.295
Services						Services	1.380	0.522	0.463	0.393	0.283
PC-MO	μ	ψ	ω	β	ε_w^L	IC-MO	μ	ψ	ω	β	ε_w^L
All firms	0.951	-2.782	0.274	0.256	0.344	All firms	1.176	-0.657	-0.045	0.648	1.839
Manufacturing	0.940	-3.122	0.143	0.231	0.301	Manufacturing	1.195	-0.809	0.106	0.605	1.530
Services	1.022	-1.956	0.086	0.341	0.517	Services	1.158	-0.488	-0.289	0.708	2.424
PC-PR	μ	ψ	ω			ICPR	μ	ψ	ω		
Exporters	1.031	-0.178	-0.555			Exporters	1.196	0.069	-0.631		
Non-exporters	1.033	-0.127	-0.499			Non-exporters	1.202	0.044	-0.746		
MNEs	1.032	-0.163	-0.569			MNEs	1.211	0.050	-0.665		
Non-MNEs	1.033	-0.133	-0.490			Non-MNEs	1.199	0.049	-0.743		
PC-EB	μ	ψ	ω	γ	ϕ	IC-EB	μ	ψ	ω	γ	ϕ
Exporters	1.004	0.236	0.806	0.760	0.432	Exporters	1.522	0.640	0.211	0.435	0.303
Non-exporters	0.987	0.208	0.218	1.229	0.551	Non-exporters	1.492	0.624	0.350	0.402	0.287
MNEs	1.006	0.204	0.885	0.577	0.366	MNEs	1.531	0.642	-0.079	0.379	0.275
Non-MNEs	0.987	0.213	0.218	1.233	0.552	Non-MNEs	1.491	0.624	0.369	0.411	0.292
PC-MO	μ	ψ	ω	β	ε_w^L	IC-MO	μ	ψ	ω	β	ε_w^L
Exporters	0.921	-3.730	-0.130	0.200	0.250	Exporters	1.181	-0.728	0.035	0.628	1.687
Non-exporters	0.951	-2.782	0.274	0.256	0.344	Non-exporters	1.176	-0.657	-0.045	0.648	1.839
MNEs	0.918	-3.851	-0.273	0.193	0.239	MNEs	1.180	-0.788	-0.167	0.608	1.551
Non-MNEs	0.951	-2.840	0.298	0.252	0.337	Non-MNEs	1.177	-0.651	0.011	0.652	1.871

Notes: Product market regime − labor market regime. PC = perfect competition; IC = imperfect competition; PR = perfect competition or right to manage; EB = efficient bargaining; MO = monopsony.

Table 5: Mean regression (OLS) results

	MU			PHI			LSUPELAS		
	TOTAL	MANU	SERV	TOTAL	MANU	SERV	TOTAL	MANU	SERV
Exporter dummy	-0.024***	-0.010***	0.028**	0.088*	0.049**	0.118*	0.050***	0.047***	0.130***
	(0.004)	(0.006)	(0.005)	(0.012)	(0.015)	(0.018)	(0.021)	(0.021)	(0.064)
MNE dummy	-0.047***	-0.035***	0.016***	0.043**	-0.038***	0.115*	-0.042***	-0.041***	0.010***
	(0.005)	(0.006)	(0.005)	(0.014)	(0.017)	(0.021)	(0.023)	(0.024)	(0.058)
TFP	0.015***	-0.012***	0.177	0.001***	-0.020***	0.032***	-0.059***	-0.076***	0.453
	(0.003)	(0.004)	(0.005)	(0.007)	(0.009)	(0.013)	(0.017)	(0.020)	(0.035)
Efficient bargaining dummy	0.272	0.353	0.090*						
	(0.004)	(0.006)	(0.003)						
Monopsony dummy	-0.149***	-0.213***	-0.063***						
	(0.005)	(0.007)	(0.003)						
Imperfect competition dummy				0.156***	0.115***	n.a.	1.076	1.124	0.920
				(0.088)	(0.077)	n.a.	(0.019)	(0.019)	(0.306)
Capital intensity	0.116	0.156	0.114	-0.491***	-0.451***	-0.507***	-0.201***	-0.269***	0.111*
	(0.002)	(0.003)	(0.003)	(0.005)	(0.007)	(0.006)	(0.012)	(0.016)	(0.018)
Number of workers	0.004***	-0.042***	0.156	-0.028***	-0.005***	-0.032***	-0.117***	-0.107***	0.282
	(0.003)	(0.004)	(0.004)	(0.007)	(0.010)	(0.013)	(0.013)	(0.015)	(0.031)
Age	-0.001***	-0.001***	-0.001***	0.001***	0.002***	0.001***	0.004***	0.004***	0.003***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)
Share of non-production workers	-0.085***	-0.096***	-0.011***	0.031***	0.101*	-0.036***	-0.084***	-0.101***	0.217**
	(0.008)	(0.010)	(0.012)	(0.019)	(0.022)	(0.031)	(0.037)	(0.039)	(0.089)
Time dummies	yes	yes	yes	yes	yes	yes	yes	yes	yes
Industry dummies	yes	yes	no	yes	yes	no	yes	yes	no
RMSE	0.245	0.268	0.160	0.389	0.373	0.395	0.621	0.627	0.504
R^2	0.490	0.571	0.529	0.632	0.590	0.670	0.723	0.718	0.167
N	120288	66578	53710	50314	23799	26515	28473	23183	5290

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

Table 6: Standard quantile regression (QR) results

		MU			PHI			LSUPELAS		
	Quantile	TOTAL	MANU	SERV	TOTAL	MANU	SERV	TOTAL	MANU	SERV
Exporter dummy	q10	-0.008***	0.004**	0.003***	0.078***	0.020**	0.109***	0.052***	0.038*	0.096
		(0.002)	(0.002)	(0.001)	(0.008)	(0.010)	(0.020)	(0.018)	(0.020)	(0.079)
	q30	-0.011***	0.001	0.008***	0.085***	0.046***	0.126***	0.065***	0.044***	0.256***
		(0.001)	(0.001)	(0.001)	(0.007)	(0.011)	(0.011)	(0.013)	(0.011)	(0.068)
	q50	-0.013***	-0.001	0.013***	0.079***	0.047***	0.115***	0.060***	0.042***	0.177***
		(0.001)	(0.002)	(0.001)	(0.007)	(0.008)	(0.010)	(0.010)	(0.011)	(0.051)
	q70	-0.020***	-0.007***	0.020***	0.078***	0.044***	0.112***	0.051***	0.052***	0.090**
		(0.002)	(0.003)	(0.002)	(0.006)	(0.008)	(0.010)	(0.010)	(0.012)	(0.040)
	q90	-0.026***	-0.013***	0.021***	0.073***	0.027***	0.104***	0.033***	0.034	0.023
		(0.003)	(0.004)	(0.004)	(0.006)	(0.008)	(0.010)	(0.012)	(0.021)	(0.051)
MNE dummy	q10	-0.012***	-0.004**	0.002**	0.045***	-0.007	0.068***	-0.013	0.008	0.087*
		(0.001)	(0.002)	(0.001)	(0.013)	(0.017)	(0.019)	(0.017)	(0.020)	(0.049)
	q30	-0.021***	-0.015***	0.004***	0.036***	-0.019*	0.092***	-0.036*	-0.028**	-0.019
		(0.001)	(0.001)	(0.001)	(0.006)	(0.010)	(0.014)	(0.019)	(0.013)	(0.052)
	q50	-0.030***	-0.025***	0.007***	0.030***	-0.037***	0.100***	-0.062***	-0.059***	-0.035
		(0.001)	(0.002)	(0.001)	(0.005)	(0.010)	(0.013)	(0.012)	(0.009)	(0.040)
	q70	-0.035***	-0.030***	0.017***	0.023***	-0.057***	0.119***	-0.070***	-0.070***	-0.001
		(0.002)	(0.002)	(0.002)	(0.006)	(0.008)	(0.012)	(0.015)	(0.011)	(0.039)
	q90	-0.046***	-0.039***	0.016***	0.051***	-0.069***	0.160***	-0.103***	-0.090***	0.041
		(0.003)	(0.004)	(0.004)	(0.005)	(0.010)	(0.014)	(0.022)	(0.017)	(0.074)
TFP	q10	0.007***	-0.010***	0.099***	-0.045***	-0.032***	-0.077***	-0.051***	-0.069***	0.476***
		(0.001)	(0.001)	(0.001)	(0.007)	(0.010)	(0.015)	(0.008)	(0.010)	(0.036)
	q30	0.012***	-0.012***	0.102***	-0.004	-0.019***	0.028***	-0.064***	-0.086***	0.483***
		(0.001)	(0.001)	(0.001)	(0.004)	(0.006)	(0.008)	(0.009)	(0.011)	(0.024)
	q50	0.018***	-0.012***	0.105***	0.007**	-0.018***	0.064***	-0.063***	-0.091***	0.456***
		(0.001)	(0.002)	(0.001)	(0.003)	(0.005)	(0.007)	(0.008)	(0.012)	(0.017)
	q70	0.023***	-0.013***	0.114***	0.009***	-0.020***	0.077***	-0.069***	-0.098***	0.461***
		(0.001)	(0.002)	(0.001)	(0.002)	(0.007)	(0.006)	(0.009)	(0.014)	(0.023)
	q90	0.022***	-0.008***	0.122***	0.005**	-0.019***	0.052***	-0.067***	-0.109***	0.450***
		(0.002)	(0.002)	(0.003)	(0.002)	(0.004)	(0.006)	(0.011)	(0.012)	(0.024)
Efficient bargaining dummy	q10	0.106***	0.160***	0.039***						
		(0.001)	(0.002)	(0.000)						
	q30	0.137***	0.208***	0.056***						
		(0.001)	(0.002)	(0.001)						
	q50	0.180***	0.268***	0.081***						
		(0.002)	(0.002)	(0.001)						
	q70	0.270***	0.371***	0.123***						
		(0.003)	(0.004)	(0.001)						
	q90	0.534***	0.683***	0.271***						
		(0.006)	(0.007)	(0.007)						

Table 6 (Continued): Standard quantile regression (QR) results

		MU			PHI			LSUPELAS		
	Quantile	TOTAL	MANU	SERV	TOTAL	MANU	SERV	TOTAL	MANU	SERV
Monopsony dummy	q10	-0.085***	-0.134***	-0.035***						
		(0.002)	(0.003)	(0.001)						
	q30	-0.089***	-0.127***	-0.035***						
		(0.002)	(0.002)	(0.000)						
	q50	-0.083***	-0.133***	-0.040***						
		(0.002)	(0.002)	(0.001)						
	q70	-0.078***	-0.148***	-0.052***						
		(0.002)	(0.002)	(0.001)						
	q90	-0.093***	-0.178***	-0.079***						
		(0.002)	(0.004)	(0.004)						
Imperfect competition dummy	q10				0.072	0.058	n.a.	1.026***	1.066***	0.991***
					(0.070)	(0.093)	n.a.	(0.013)	(0.019)	(0.167)
	q30				0.188***	0.126**	n.a.	1.002***	1.042***	1.094***
					(0.041)	(0.056)	n.a.	(0.012)	(0.016)	(0.391)
	q50				0.208***	0.165***	n.a.	1.008***	1.047***	1.255**
					(0.032)	(0.042)	n.a.	(0.013)	(0.013)	(0.512)
	q70				0.185***	0.134**	n.a.	1.047***	1.091***	0.636
					(0.055)	(0.059)	n.a.	(0.011)	(0.011)	(0.401)
	q90				0.057	0.045	n.a.	1.191***	1.251***	0.810***
					(0.038)	(0.041)	n.a.	(0.015)	(0.016)	(0.289)
Capital intensity	q10	0.054***	0.074***	0.080***	-0.549***	-0.506***	-0.572***	-0.217***	-0.267***	0.141***
		(0.001)	(0.001)	(0.001)	(0.004)	(0.007)	(0.004)	(0.008)	(0.007)	(0.016)
	q30	0.067***	0.098***	0.079***	-0.504***	-0.467***	-0.520***	-0.212***	-0.277***	0.129***
		(0.001)	(0.001)	(0.001)	(0.003)	(0.004)	(0.004)	(0.008)	(0.008)	(0.015)
	q50	0.079***	0.116***	0.079***	-0.475***	-0.436***	-0.488***	-0.212***	-0.281***	0.126***
		(0.001)	(0.001)	(0.001)	(0.002)	(0.005)	(0.003)	(0.009)	(0.007)	(0.011)
	q70	0.089***	0.133***	0.079***	-0.447***	-0.416***	-0.458***	-0.205***	-0.284***	0.109***
		(0.001)	(0.001)	(0.001)	(0.002)	(0.004)	(0.002)	(0.009)	(0.007)	(0.012)
	q90	0.098***	0.150***	0.080***	-0.414***	-0.383***	-0.424***	-0.199***	-0.280***	0.081***
		(0.001)	(0.002)	(0.001)	(0.003)	(0.004)	(0.004)	(0.006)	(0.011)	(0.013)
Number of workers	q10	-0.005***	-0.034***	0.091***	-0.091***	-0.007	-0.167***	-0.123***	-0.127***	0.314***
		(0.001)	(0.001)	(0.001)	(0.006)	(0.012)	(0.011)	(0.009)	(0.010)	(0.033)
	q30	0.004***	-0.038***	0.095***	-0.034***	-0.004	-0.043***	-0.127***	-0.118***	0.317***
		(0.001)	(0.001)	(0.001)	(0.004)	(0.006)	(0.006)	(0.009)	(0.011)	(0.019)
	q50	0.015***	-0.035***	0.098***	-0.022***	-0.008	0.002	-0.119***	-0.111***	0.280***
		(0.001)	(0.001)	(0.001)	(0.004)	(0.005)	(0.005)	(0.008)	(0.011)	(0.017)
	q70	0.027***	-0.032***	0.106***	-0.013***	-0.005	0.026***	-0.116***	-0.105***	0.275***
		(0.001)	(0.001)	(0.001)	(0.003)	(0.006)	(0.005)	(0.007)	(0.010)	(0.023)
	q90	0.031***	-0.024***	0.111***	-0.013***	0.005	0.003	-0.110***	-0.104***	0.237***
		(0.002)	(0.002)	(0.002)	(0.004)	(0.004)	(0.005)	(0.011)	(0.012)	(0.031)

Table 6 (Continued): Standard quantile regression (QR) results

		MU			PHI			LSUPELAS		
	Quantile	TOTAL	MANU	SERV	TOTAL	MANU	SERV	TOTAL	MANU	SERV
Age	q10	0.000***	0.000***	0.000***	0.002***	0.003***	0.001***	0.004***	0.004***	0.004***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)
	q30	0.000***	0.000	0.000***	0.002***	0.002***	0.001***	0.004***	0.004***	0.004***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)
	q50	-0.001***	0.000***	0.000***	0.001***	0.002***	0.001***	0.004***	0.004***	0.003***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)
	q70	-0.001***	-0.001***	0.000***	0.001***	0.002***	0.000	0.003***	0.003***	0.003***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
	q90	-0.001***	-0.001***	-0.001***	0.000***	0.001***	0.000*	0.002***	0.002***	0.002***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Share of non-production workers	q10	-0.026***	-0.047***	0.002***	0.028	0.073***	-0.068**	-0.116***	-0.137***	0.211***
		(0.001)	(0.002)	(0.001)	(0.017)	(0.023)	(0.029)	(0.027)	(0.034)	(0.070)
	q30	-0.045***	-0.066***	0.000	0.039***	0.116***	-0.034*	-0.072**	-0.075***	0.322***
		(0.002)	(0.003)	(0.001)	(0.011)	(0.015)	(0.019)	(0.029)	(0.025)	(0.060)
	q50	-0.062***	-0.082***	-0.002	0.063***	0.136***	0.006	-0.081***	-0.104***	0.332***
		(0.003)	(0.004)	(0.002)	(0.008)	(0.015)	(0.016)	(0.023)	(0.024)	(0.064)
	q70	-0.072***	-0.082***	-0.012**	0.037***	0.112***	-0.029**	-0.069**	-0.084***	0.212***
		(0.003)	(0.006)	(0.005)	(0.009)	(0.009)	(0.013)	(0.029)	(0.030)	(0.082)
	q90	-0.090***	-0.070***	-0.024**	0.027**	0.068***	-0.023*	-0.032	-0.050*	0.111*
		(0.006)	(0.008)	(0.012)	(0.011)	(0.015)	(0.014)	(0.032)	(0.029)	(0.060)

Theoretical appendix A

In this Appendix, we derive the first-order condition with respect to labor under each labor market setting (perfect competition or right-to-manage bargaining (PR), efficient bargaining (EB) and monopsony (MO)). To simplify notation, we do not use firm and time indices.

A.1 Output elasticity of labor under PR

In a *perfectly competitive labor market* model, a firm takes the exogenously-determined market wage w as given. Assuming that material input and labor are static inputs in production, free of adjustment costs, the short-run profit function of a representative firm that operates under imperfect competition in the product market is given by: $\pi = R - wL - jM$, with R total revenue, L labor, M material input, and w and j the prices of labor and material input, respectively. Short-run profit maximization with respect to labor implies: $\theta^L = \mu\alpha^L$ [Eq. (7) in the main text].

In the *right-to-manage bargaining model*, labor is also unilaterally determined by the firm from short-run profit maximization, which implies the same static first-order condition with respect to labor as in the perfectly competitive labor market model.

A.2 Output elasticity of labor under EB

The *efficient bargaining model* assumes that the risk-neutral workers and risk-neutral firm negotiate simultaneously over wages and employment in order to maximize the joint surplus of their economic activity. The generalized Nash product is written as:

$$\Omega_{EB} = \left\{Lw + \left(\overline{L} - L\right)\overline{w} - \overline{L}\overline{w}\right\}^{\phi} \left\{R - wL - jM\right\}^{1-\phi} \tag{A.1}$$

with $\overline{L}$ the competitive employment level ($0 < L \leq \overline{L}$), $\overline{w}$ the worker's alternative market wage in the event of a breakdown in bargaining and ϕ the degree of workers' bargaining power during work-firm negotiations or the absolute extent of rent sharing.

Maximization of Eq. (A.1) with respect to the wage rate gives the following first-order condition:

$$w = \overline{w} + \gamma \left[\frac{R - wL - jL}{L}\right] \tag{A.2}$$

with $\gamma = \frac{\phi}{1-\phi}$ the relative extent of rent sharing.

Maximization of Eq. (A.1) with respect to labor gives the following first-order condition:

$$w = R_L + \phi \left[\frac{R - R_L L - jM}{L}\right] \tag{A.3}$$

with R_N the marginal revenue of labor.

Solving simultaneously the first-order conditions with respect to the wage rate and labor leads to the following expression for the contract curve:

$$R_L = \overline{w} \tag{A.4}$$

Eq. (A.4) shows that under risk neutrality, the firm's decision about employment equals the one of a (non-bargaining) neoclassical firm that maximizes its short-run profit at the alternative wage. Put differently, the firm hires workers until the marginal revenue of labor is equal to the wage a worker would receive if fired, i.e. the employment level does not depend on the bargained wage.

Let us denote the marginal revenue by R_Q and the marginal product of labor by Q_L. Given that $\mu = \frac{P}{R_Q}$ in equilibrium (where P is the output price), the marginal revenue of labor can be expressed as follows: $R_N = R_Q \times Q_L = R_Q \times \theta^L \times \frac{Q}{L} = \frac{PQ_L}{\mu}$. Using this expression together with Eq. (A.4), the elasticity of output with respect to labor can be written as:

$$\theta^L = \mu \overline{\alpha}^L \tag{A.4}$$

with $\overline{\alpha}^L = \frac{\overline{w}L}{PQ}$ the labor share evaluated at the reservation wage. Given that we can rewrite Eq. (A.2) as $\alpha^L = \overline{\alpha}^L + \gamma(1 - \alpha^L - \alpha^M)$, we obtain the following expression for the output elasticity with respect to labor:

$$\theta^L = \mu\alpha^L - \mu\gamma(1 - \alpha^L - \alpha^M) \tag{A.5}$$

Eq. (A.5) is equivalent to Eq. (8) in the main text.

A.3 Output elasticity of labor under MO

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, the *monopsony model* postulates that there are a number of reasons why labor supply might be less than perfectly elastic, creating rents to jobs. Paramount among these are the absence of perfect information on alternative possible jobs, moving costs and heterogeneous worker preferences for job characteristics on the supply side, and efficiency wages with diseconomies of scale in monitoring and entry costs on the part of competing firms on the demand side. All these factors give employers non-negligible market power over their workers.

Let us consider a firm that operates under imperfect competition in the product market and faces a labor supply $L(w)$, which is an increasing function of the wage w. Both $L(w)$ and the inverse of this relationship $w(L)$ are referred to as the labor supply curve of this monopsonist firm. The firm's objective is to maximize its short-run profit function, taking the labor supply curve as given:

$$\max_{L,\,M} \pi = R - w(L)\,L - jM \tag{A.6}$$

Maximization with respect to labor gives the following first-order condition:

$$w = \beta R_L \tag{A.7}$$

where $\beta = \frac{\varepsilon_w^L}{1+\varepsilon_w^L}$ and $\varepsilon_w^L \in \Re_+$ represents the wage elasticity of the labor supply. Rewriting Eq. (A.7) and using that $R_L = \frac{PQ_L}{\mu}$ gives the following expression for the elasticity of output with respect to labor:

$$\theta^L = \mu\alpha^N \left(1 + \frac{1}{\varepsilon_w^L}\right) \tag{A.8}$$

Eq. (A.8) is equivalent to Eq. (9) in the main text.

Statistical appendix B

Table B.1: Panel structure: number of participations

# of participation	# obs	%	# firms	%
1	2128	1.8	2115	14.5
2	3761	3.1	1858	12.7
3	3436	2.9	1137	7.8
4	4595	3.8	1141	7.8
5	4102	3.4	816	5.6
6	3892	3.2	646	4.4
7	4203	3.5	596	4.1
8	4125	3.4	510	3.5
9	3105	2.6	336	2.3
10	3491	2.9	345	2.4
11	3671	3.1	332	2.3
12	3224	2.7	267	1.8
13	3890	3.2	298	2.0
14	4070	3.4	290	2.0
15	5314	4.4	354	2.4
16	5378	4.5	336	2.3
17	8313	6.9	489	3.3
18	49590	41.2	2755	18.8
Total	120288	100.0	14621	100.0

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

	# obs	%	# firms	%
Total	120288	100.0	14621	100.0
Food products and beverages	8935	7.4	978	6.7
Textiles and wearing apparel	3442	2.9	516	3.5
Wood, wooden products, and furniture	1801	1.5	248	1.7
Pulp, paper and paper products	2886	2.4	292	2.0
Publishing and printing	4081	3.4	439	3.0
Rubber products	764	0.6	76	0.5
Chemicals	6067	5.0	571	3.9
Petroleum and coal products	4102	3.4	468	3.2
Non-metallic mineral products	1062	0.9	200	1.4
Iron and steel	2273	1.9	246	1.7
Non-ferrous metals	1583	1.3	177	1.2
Fabricated metal products	5305	4.4	625	4.3
Machinery	7194	6.0	802	5.5
Electrical machinery	7591	6.3	949	6.5
Transport equipment	6608	5.5	694	4.7
Other manufacturing	2884	2.4	358	2.4
Wholesale and retail trade	53710	44.7	6982	47.8
Exporters	26142	21.7	1099	7.5
Non-exporters	94146	78.3	13522	92.5
MNEs	21561	17.9	1826	12.5
Non-MNEs	98727	82.1	12795	87.5

Table B.3: Correlation matrix of baseline variables for all firms, manufacturing and services

All firms	TFP	EXP	MNE	EB	MO	IC	KL	SIZE	Age	NONP
TFP	1									
Exporter dummy (EXP)	-0.1011*	1								
MNE dummy (MNE)	-0.2228*	0.5122*	1							
EB dummy (EB)	0.1933*	-0.1050*	-0.1273*	1						
MO dummy (MO)	-0.0445*	0.1075*	0.1132*	-0.4722*	1					
IC dummy (IC)	-0.0072*	-0.1314*	-0.1521*	0.2873*	-0.4798*	1				
Capital intensity (KL)	-0.1054*	0.0651*	0.1144*	0.0447*	-0.0251*	0.1140*	1			
Number of workers (SIZE)	-0.6624*	0.2443*	0.3946*	-0.1496*	0.1758*	-0.1512*	0.1057*	1		
Age	-0.1272*	0.1761*	0.1889*	-0.0440*	-0.0042	-0.0115*	0.1707*	0.2067*	1	
Share of non-production workers (NONP)	-0.0440*	-0.1055*	-0.0964*	0.0924*	-0.2627*	0.2594*	-0.1313*	-0.0070*	-0.0256*	1
Manufacturing	TFP	EXP	MNE	EB	MO	IC	KL	SIZE	Age	NONP
TFP	1									
Exporter dummy (EXP)	-0.0643*	1								
MNE dummy (MNE)	-0.1958*	0.5038*	1							
EB dummy (EB)	0.0515*	-0.1292*	-0.1588*	1						
MO dummy (MO)	-0.0012	0.1110*	0.1144*	-0.5452*	1					
IC dummy (IC)	-0.0083*	-0.0978*	-0.1298*	0.3560*	-0.4907*	1				
Capital intensity (KL)	-0.0804*	0.0650*	0.1305*	0.0817*	-0.0434*	0.2390*	1			
Number of workers (SIZE)	-0.5840*	0.3330*	0.4812*	-0.1883*	0.1462*	-0.1746*	0.1861*	1		
Age	-0.0870*	0.1817*	0.2173*	0.0054	-0.0269*	0.0162*	0.1378*	0.2759*	1	
Share of non-production workers (NONP)	-0.0463*	0.1435*	0.1197*	0.0091*	-0.0732*	0.0211*	-0.0031	0.0962*	0.1301*	1
Services	TFP	EXP	MNE	EB	MO	IC	KL	SIZE	Age	NONP
TFP	1									
Exporter dummy (EXP)	-0.1707*	1								
MNE dummy (MNE)	-0.2851*	0.4835*	1							
EB dummy (EB)	0.3678*	-0.0111*	-0.0280*	1						
MO dummy (MO)	-0.1439*	-0.0798*	-0.0514*	-0.3264*	1					
IC dummy (IC)	0.0015	0.0051	0.0045	0.0128*	-0.0392*	1				
Capital intensity (KL)	-0.1364*	0.0091*	0.0461*	0.0480*	-0.1221*	0.0445*	1			
Number of workers (SIZE)	-0.7807*	0.0582*	0.2182*	-0.0806*	0.2092*	-0.0163*	-0.0084	1		
Age	-0.1814*	0.1407*	0.1161*	-0.0832*	-0.0309*	0.0138*	0.1912*	0.0946*	1	
Share of non-production workers (NONP)	-0.1107*	-0.1029*	-0.0793*	-0.1017*	0.0237*	0.0090*	-0.0804*	0.0522*	-0.0665*	1