Market Power in Input Markets:
Theory and Evidence from French Manufacturing*

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Abstract

Over the past decades, a rise in market concentration and a boom in outsourcing have made large buyers the dominant players in international markets, raising competitive concerns. In this paper, I document the market power of large buyers in foreign input markets, and evaluate its effect on the aggregate economy. I develop an empirical methodology to consistently estimate buyer power at the firm level, and apply it using longitudinal data on trade and production of French manufacturing firms from 1996-2007. My results show that the buyer power of large French importers is substantial, concentrated in key sectors, and it correlates with the size and productivity of the firm. I then incorporate heterogeneous buyer power in a general equilibrium model of production, and show that it induces large distortionary effects on the aggregate economy, worth about 3% of gross manufacturing output in France. My results suggest that market imperfections are large in international trade, and that models that rely on the assumption of perfectly competitive input markets could overestimate the welfare effect of foreign intermediate inputs on welfare.

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1 Introduction

Large buyers figure prominently as a salient feature in many sectors of modern economies, and their ability to force sellers to lower prices below competitive levels is raising concerns among competition authorities and policymakers.[1] Over the past decades, the rise of powerful buyers has been paralleled by an increasing trend towards globalization and outsourcing, with an unprecedented growth of imports in developed countries and a growing decentralization of production networks, typically in low-cost economies (Feenstra, 1998; Hummels et al., 2001). Large corporations have become major players in such international setting, where they have achieved a dominant buyer position, due to formal and informal trade barriers creating important obstacles to firm entry (Greif, 1992; Bernard et al., 2007a). This position could potentially be used to extract inefficiently low prices, with important implications for trade, and the efficiency of production.

However, neither the empirical size of buyer power in trade nor its implications for the firm-level and aggregate equilibrium are well-understood, as most of the theoretical and empirical literature relies on the assumption of perfectly competitive input markets.

In this paper, I show that buyer power of large importers in foreign input markets is large, and can have a substantial impact on aggregate variables, and welfare. My main contributions are two: (1) I combine modern econometric techniques with rich micro data from France to consistently estimate the buyer power of firms; (2) I incorporate buyer power in a general equilibrium model of a production economy, in order to characterize its effect on the equilibrium (mis)allocation of resources and on the aggregate economy.

I first lay out a methodology to estimate buyer power of firms from micro data. I consider the cost-minimization problem of firms that decide on the optimal demand of at least two static inputs. The conceptual framework builds on existing work in the literature on markup estimation (Hall, 1988; De Loecker and Warzynski, 2012), generalizing the underlying model to allow for imperfect competition in the input markets.[2] In this simple framework, the existence of input market distortions generates an input efficiency wedge in the first order condition of firms. I show that values of the wedge larger than unity are consistent with models of monopsony in input markets. I then show that the wedge can be written as a function of the revenue shares and output elasticities of two static inputs. This is useful for estimation, insofar as the revenue shares can be observed, and the output elasticities can be obtained from production function estimation.

[1] See, e.g. *American Antitrust Institute (AAI)'s Transition Report on Competition Policy* (2008) - Chapter 3).

[2] In so doing, I most closely follow Dobbelaere and Mairesse (2013), and generalize their setting to allow for any underlying model of imperfect input competition.

I specify the production function as a function of capital, labor, domestic and foreign intermediates. The two intermediate inputs are the static inputs of interest. Throughout the analysis, I maintain the assumption that firms are price takers in the domestic market.

I estimate the output elasticities using state-of-the-art techniques from the production function estimation literature (e.g. Ackerberg et al., 2015). The lack of data on physical units of inputs and output can present an important challenge here. A well-known problem associated with using *nominal* instead of *physical* variables is the existence of severe price biases in estimation, due to demand shocks, and/or market power (cf. Foster et al., 2008; Katayama et al., 2009; De Loecker and Goldberg, 2014). To address this issue, I construct firm-level price indices for output and the imported input from observed export and import unit values at the firm-product-country level. In doing so, I dispense with assumptions on the market structure, consistent with the application of the paper.

I use longitudinal data on firm trade and production for the French manufacturing sector for the period 1996-2007, and apply this methodology to study imperfect competition in the market for foreign intermediates. Intermediate inputs account for the majority of world trade (Johnson and Noguera, 2012) and play an increasingly important role in production in many sectors of the economy (Yi, 2003). Moreover, there is large evidence that trade in intermediates has important implications for a country's economic performance (Goldberg et al., 2010; Halpern et al., 2015; Blaum et al., 2018).

My empirical results provide evidence that firms exercise significant buyer power in the foreign input market, even with substantial heterogeneity across firms and industries. I find that on average, firms spend *too little* on foreign intermediate inputs, given what one would expect from the output elasticities. In light of the theoretical framework, I interpret this evidence as suggestive that firms keep the demand and price of the foreign input below competitive levels, thus as evidence of buyer power in foreign input markets.

I support this interpretation of the input efficiency wedge by means of regression analysis, both across sectors, and across firms. At the industry level, I find that input market distortions are big in highly concentrated sectors, in sectors where the share of imports from low-income countries is large, and in sectors characterized by large transportation or storage costs (e.g. food, iron ore). These distinctive structural market characteristics have often been associated with monopsony power (e.g. Kerkvliet, 1991; Rogers and Sexton, 1994; Bergman and Brännlund, 1995). Firm-level analysis further shows that input market distortions are positively and significantly correlated with measures of firm size and productivity. The finding that large and productive firms are relatively more distorted in foreign markets rules out leading alternative explanations of the input wedge based on trade or adjustment costs.

In order to investigate the implications of market power of buyers for the aggregate economy, in the second part of the paper I incorporate buyer power in a static general equilibrium model of a production economy. In the model, I make two important assumptions: first, there are increasing marginal costs in the production of a foreign intermediate input, which implies that there exist rents in foreign input markets; second, buyers exercise market power, and seek to transfer rents from foreign sellers to the domestic economy. Input market power arises due to a positive market share of buyers abroad, which I allow to be heterogeneous across firms.

Buyer power generates equilibrium distortions along several channels. At the individual firm level, firms with high buyer power: (i) buy fewer inputs, (ii) have a higher labor-intermediate ratio, and (iii) produce less output compared to the competitive benchmark. From an aggregate standpoint, I show that total output is inversely related to the *average* degree of buyer power in the economy. However, I also show that an increase in the *dispersion* in buyer power across firms increases aggregate production, by inducing an efficient reallocation of the inelastically-supplied input from more to less distorted firms. This result stands in contrast to a well-known result in the literature of markups and misallocation, whereby only the dispersion in markups, and not its average level, matters for aggregate output (Lerner et al., 1934; Epifani and Gancia, 2011).

I finally aim to quantify the aggregate effect of buyer power on the French economy. The empirical analysis in the first part of the paper provides estimates of almost all the parameters of the model, which is thus structurally identified. Counterfactual analysis shows that total manufacturing output is 3% lower in the calibrated economy as compared to a competitive economy. The increase in total profits in the distorted economy due to rent transfers more than compensate the output losses, and total real income increases by about 0.4%. However, the profit-to-income ratio also increases, suggesting that buyer power might affect income inequality in a country. My analysis suggests that in order to spur aggregate production and contain the threat of increasing inequality, trade policy should foster import market integration, so as to make a larger number of buyers available to foreign sellers, and thus reduce the scope of buyer power. In this sense, trade policy could implicitly act as an international antitrust policy.

This paper builds on prevailing related literature. The issue of market power of large corporations has recently received renewed attention in the economic literature, as it has been related to a number of trends in rich countries, which include a decline in business dynamism and low economic growth overall.[3]

The framework to measure buyer power from production data is based on a general-

[3] See, e.g. Barkai (2016); Blonigen and Pierce (2016); De Loecker and Eeckhout (2017); Zingales (2017).

ization of an approach developed by Crépon et al. (2005) and Dobbelaere and Mairesse (2013), who extended Hall's 1988 framework to estimate the degree of imperfect competition in French labor markets. I depart from existing work by focusing on a different setting - the international market for intermediates - and by addressing several econometric issues in estimation, such as the endogeneity of input choice with respect to unobserved productivity, input and output prices.[4]

My work also speaks to a large literature on imported intermediates and productivity, which finds a positive correlation between a firm reliance on global sourcing and firm and aggregate productivity (Amiti and Konings, 2007; Goldberg et al., 2010; Gopinath and Neiman, 2014; Halpern et al., 2015). Standard channels that have been suggested to explain the foreign intermediates-productivity correlation include higher quality of foreign intermediates and a love-of-variety channel. The findings in this paper suggest that buyer power may be a significant factor determining the profitability, and the measured productivity effect, of foreign intermediate inputs.

Finally, my work relates to an extensive literature on misallocation and firm heterogeneity (Restuccia and Rogerson, 2008; Hsieh and Klenow, 2009), and more important to the literature on market-power induced misallocation (e.g. Epifani and Gancia, 2011; Peters, 2016). This paper is the first to study the effect of buyer market power on the equilibrium misallocation of resources, and points out an important asymmetry between heterogeneous input and output market power.

The remainder of the paper is organized as follows. I introduce the conceptual framework and estimation routine in Section 2. In Section 3 I describe the empirical exercise, the data sources, and main results. In Section 4 I describe the theoretical model, the main theoretical results, and the counterfactual exercise. Section 5 concludes.

2 A Framework to Estimate Input Market Power

This section describes my methodology for estimating input market power at the firm level. I first lay out a conceptual framework and derive an expression for buyer power as a function of data, and output elasticities, building on existing work by Dobbelaere and Mairesse (2013). I then describe my approach to obtain consistent estimates of the output elasticities from production function estimation, which builds on a large literature in production function and markup estimation (Ackerberg et al., 2015; De Loecker et al., 2016). I will pay special focus to describe how, by using price information contained in

[4] In this sense, my approach is similar to De Loecker and Warzynski (2012), who first combined Hall's framework with modern econometric tools to consistently estimate markups of firms.

custom level data, I can allow firms to have market power in input purchase.

2.1 Deriving an Expression for Input Market Power

A firm i produces output in each period according to the following technology:

$$Q_{it} = Q(\mathbf{V}_{it}, \mathbf{K}_{it}; \Theta_{it}), \tag{1}$$

where $\mathbf{V}_{it} = \{V_{it}^m, V_{it}^x\}$ are the variable inputs in production, which the firm can flexibly adjust in each period, and $\mathbf{K}_{it}$ is the vector of "dynamic" inputs, such as capital and labor, which are subject to adjustment costs or time-to-build.[5] I restrict to well-behaved production technologies, and assume that $Q(\cdot)$ is twice continuously differentiable with respect to its arguments.

In each period firms minimize short-run costs taking as given output quantity and state variables. In order to allow for non-competitive buyer behavior, I consider the following mapping between input price and input demand of firm i:

$$W_{it}^j = W\left(V_{it}^j; \mathbf{A}_{it}^j\right) \ \forall\, j = m, x, \tag{2}$$

where W_{it}^j is the input j's unit cost, and $\mathbf{A_{it}}^j$ are other exogenous variables affecting prices, such as location. Equation (2) encompasses models of both perfect and imperfect competition in input markets. When markets are competitive, the firm takes prices as given, and $\frac{\partial W_{it}^j}{\partial V_{it}^j} = 0$. Conversely, under imperfect competition the buyer takes into account the effect that her demand has on input prices, such that $\frac{\partial W_{it}^j}{\partial V_{it}^j} \neq 0$.

The first-order condition for any variable input V_{it}^j with $j = \{m, x\}$ is:

$$\frac{\partial \mathcal{L}}{\partial V_{it}^j} \equiv W_{it}^j + \frac{\partial W_{it}^j}{\partial V_{it}^j} V_{it}^j - \lambda_{it} \frac{\partial Q_{it}(\cdot)}{\partial V_{it}^j} = 0 \tag{3}$$

$$\implies \lambda_{it} \frac{\partial Q_{it}(\cdot)}{\partial V_{it}^j} = W_{it}^j \left(1 + \frac{\partial W_{it}^j}{\partial V_{it}^j} \frac{V_{it}^j}{W_{it}^j}\right). \tag{4}$$

The term $\lambda_{it} = \frac{\partial \mathcal{L}}{\partial Q_{it}}$ is the shadow value of the constraint of the associated Lagrangian

[5] In what follows, I assume that each firm uses exactly two variable inputs in production, namely a *domestic* intermediate input, which I denote by V_{it}^m; and a *foreign* intermediate input, which I denote by V_{it}^x. This choice is driven by the application and data used in this paper, and can be easily generalised to any number of variable inputs.

function, i.e. the marginal cost of output. The left hand side of equation (4) thus represents the shadow value of an additional unit of V_{it}^{j} , or the *effective* marginal cost of the input. Equation (4) says that in this general setting, the marginal cost of the input in equilibrium is equal to the unit price W_{it}^{j}, times a term which differs from one whenever $\frac{\partial W_{it}^{j}}{\partial V_{it}^{j}} \neq 0$, namely whenever the input market is less than competitive. In other words, the existence of input market power generates a *wedge* between the marginal valuation of the input and its equilibrium price, equal to

$$\psi_{it}^{j} \equiv \left(1 + \frac{\partial W_{it}^{j}}{\partial V_{it}^{j}} \frac{V_{it}^{j}}{W_{it}^{j}}\right). \tag{5}$$

The wedge ψ_{it}^{j} represents an *efficiency wedge* in the first order condition of the input, insofar as it captures how much the equilibrium price W_{it}^{j} departs from its efficient counterpart due to market imperfections. I consider ψ_{it}^{j} as the measure of firm i's input market power in the market of $j = \{m, x\}$.

Rearranging terms and multiplying both sides of (4) by $\frac{V_{it}^{j}}{P_{it} Q_{it}}$ gives:

$$\frac{\partial Q_{it}(\cdot)}{\partial V_{it}^{j}} \frac{V_{it}^{j}}{Q_{it}} = \frac{P_{it}}{\lambda_{it}} \cdot \psi_{it}^{j} \cdot \frac{W_{it}^{j} V_{it}^{j}}{P_{it} Q_{it}} \tag{6}$$

Let us now denote the output elasticity of input V_{it}^{j} as $\beta_{it}^{j} \equiv \frac{\partial Q_{it} V_{it}^{j}}{\partial V_{it}^{j} Q_{it}}$, and let $\alpha_{it}^{j} \equiv \frac{W_{it}^{j} V_{it}^{j}}{P_{it} Q_{it}}$ denote the share of expenditure on input V_{it}^{j} for $j = m, x$ over total firm's revenues. Using these definitions, I can conveniently rewrite equation (6) for $j = x, m$ as:

$$\beta_{it}^{x} = \frac{P_{it}}{\lambda_{it}} \cdot \alpha_{it}^{x} \cdot \psi_{it}^{x}, \tag{7}$$

and

$$\beta_{it}^{m} = \frac{P_{it}}{\lambda_{it}} \cdot \alpha_{it}^{m} \cdot \psi_{it}^{m}. \tag{8}$$

We can divide (8) by (7) to write

$$\frac{\psi_{it}^{x}}{\psi_{it}^{m}} = \frac{\beta_{it}^{x} / \alpha_{it}^{x}}{\beta_{it}^{m} / \alpha_{it}^{m}}. \tag{9}$$

Equation (9) shows that the relative input market power of the firm in the two variable input markets can be expressed as a function of two objects: the output elasticities of the inputs, and their revenue shares. This expression is at the core of my methodology to estimate input market power from production data: the output elasticities can be estimated from standard production function estimation, while the revenue shares are directly observed in most production datasets.

This result has two main implications. First, it says that if all markets were perfectly competitive, we should observe $\frac{\beta^x_{it}/\alpha^x_{it}}{\beta^m_{it}/\alpha^m_{it}} = 1$. Therefore, equation (9) provides a simple test of the assumption of perfect competition in all input markets, which is maintained in the prevailing literature. Second, equation (9) suggests that by normalizing the value of ψ^m_{it} in the market for input M, one could pin down the *level* of input market power in market X from standard firm-level data. In particular, in the extreme case where the domestic market is assumed competitive, one could set $\psi^m_{it} = 1$, and write input market power in the market of foreign intermediates as:

$$\psi^x_{it} = \frac{\beta^x_{it}}{\beta^m_{it}} \cdot \left(\frac{\alpha^x_{it}}{\alpha^m_{it}} \right)^{-1}. \tag{10}$$

To show the workings of equation (10), let us suppose that the output elasticity of the foreign input was twice as large as the output elasticity of the domestic input, i.e. $\frac{\beta^x_{it}}{\beta^m_{it}} = 2$. Equation (10) says that absent any distortions in the foreign market (i.e. if $\psi^x_{it} = 1$), the firm would optimally spend twice as much on the foreign input as it does on the domestic one. Input market power is thus estimated positive (negative), when we observe the firm spending a lower(higher)-than-optimal share of revenues on the foreign intermediate input compared to the domestic input, in light of the differences in their output elasticities.

Interpreting the Input Efficiency Wedge The framework set forth in this section encompasses a number of models of imperfect competition in the input markets, and the structural interpretation of the wedge ψ^x_{it} varies depending on which underlying model is assumed.

In models of monopsonistic or oligopsonistic competition, the price function in (2) corresponds to the inverse of the input supply function, and is characterized by a positive elasticity to individual demand, such that $\psi^x_{it} \geq 1$. In those models, the wedge ψ^x_{it} represents the degree of buyer power of firm i in the market for input X, which is higher the more the input price varies with individual demand.[6]

Values of $\psi^x < 1$ are also admissible. Dobbelaere and Mairesse (2013) show that in a model of efficient bargaining in the labor markets, the labor wedge ψ^l_{it} is lower than unity, and is proportional to the bargaining power of buyers. In Section A.1 in the Ap-

[6] In the labor literature, the labor wedge $\psi^l > 1$ is sometimes referred to as the "rate of exploitation" (e.g. Pigou (1932)), since it measures how much buyers (firms) are able to push prices (wages) below the marginal product.

pendix, I consider a model with second degree price discrimination (quantity discounts) and a model with two-part tariff, and show that even in these settings the input efficiency wedge is predicted lower than unity. More generally, this is the case whenever the input price is inversely proportional to the quantity purchased by the firm, and therefore whenever $\frac{\partial W^j_{it}}{\partial V^j_{it}} \frac{V^j_{it}}{W^j_{it}} < 0$.

The strength of the empirical analysis in this paper, is that I am able to estimate values of ψ^x_{it} across industries, and therefore to see which model better fit the data, without taking a stand ex ante on the underlying model of competition in the market of input X. Based on the findings that across sectors, values of ψ^x seem to be consistently greater than one, in the second part of the paper I then build a model of monopsonistic competition in the market of X, and discuss its implications for the aggregate economy.

Firm-level Markups The discussion so far has abstracted from output market considerations, despite having many elements in common with existing studies of markups (e.g. Hall 1988; De Loecker and Warzynski 2012; De Loecker et al. 2016). To see how my approach relates to this literature, let us define markups μ_{it} as output prices over marginal costs, i.e. $\mu_{it} = \frac{P_{it}}{\lambda_{it}}$. The first order condition in (6) can be rewritten as:

$$\frac{\beta^j_{it}}{\alpha^j_{it}} = \mu_{it} \cdot \psi^j_{it}, \text{ for } j = \{m, x\}. \tag{11}$$

Equation (11) shows that in a general setting, the ratio between the output elasticity and revenue share of an input reflects *both* input and output market power of a firm. Only when input markets are perfectly competitive, such that $\psi^j_{it} = 1$, does the ratio correctly identify markups as

$$\mu_{it} = \frac{\beta^j_{it}}{\alpha^j_{it}}. \tag{12}$$

However, if input market power is mistakenly overlooked, existing approaches would over- or under- estimate the true level of markups, depending on whether $\psi^j_{it} \gtrless 1$. Note finally that under the normalization $\psi^m = 1$, one can set $j = m$ in equation (12) and identify *both* input and output market power using both equations (10) and (12).

2.2 Empirical Strategy and Output Elasticities

In this section I describe how one could obtain unbiased estimates of the output elasticities, when input markets are allowed to depart from perfect competition. To ease the exposition, I assume a Cobb-Douglas specification of the production technology, which means that I can write the production function in (1) as

$$q_{it} = \beta_l l_{it} + \beta_k k_{it} + \beta_m m_{it} + \beta_x x_{it} + \omega_{it} + \varepsilon_{it}, \tag{13}$$

where lower-case letters denote logs. Note that all the results I derive in this section are applicable to more general production functions. I let q_{it} denote the log of physical output of firm i at time t, $m_{it} \equiv \log V_{it}^m$ and $x_{it} \equiv \log V_{it}^x$ denote the log of the domestic and foreign material inputs, respectively, l_{it} denotes log labor, and k_{it} is the log of physical capital. I denote by ω_{it} the shock component that is unobserved by the econometrician but is correlated with the inputs, which notably include the (log) productivity of the firm, and I denote with ε_{it} the component of the shock that is orthogonal to inputs, such as idiosyncratic measurement error.

I specify the state variable vector as follows:

$$\varsigma_{it} = \{\omega_{it}, k_{it}, l_{it}, G_i, \Phi_{it}\}, \tag{14}$$

where G_i denotes firms' observable characteristics that might affect material prices such as firm location, and Φ_{it} is the firm's import sourcing strategy, i.e. a measure of the extensive margin of import. Including Φ_{it} in the state variables means that the imported material input x_{it} is considered flexible only *conditional* on the firm sourcing strategy.

Estimation of the production function in (13) requires dealing with three major sources of bias, which are due to unobserved productivity ω_{it}, unobserved physical inputs and unobserved physical output. Correcting for the associated simultaneity and price biases is important in this context, given that the approach relies on measures of *physical* output elasticities. A large body of work in the industrial organization literature has dealt with the simultaneity bias.[7] Similarly, many studies have addressed the output price bias in production function estimation.[8] On the contrary, the input price bias has often been overlooked, and the few studies that deal with it do it by assuming perfect competition in all input markets (De Loecker et al., 2016). Because I allow some input markets to be imperfectly competitive, existing approaches to control for input prices are not entirely suitable in this context. My approach to deal with input and output price bias is to exploit information on import and export prices included in commonly available custom records

[7] See, for example, Olley and Pakes (1996); Blundell and Bond (2000); Levinsohn and Petrin (2003); Ackerberg et al. (2015)

[8] Studies that deal with output price bias in production function estimation include Foster et al. (2008); De Loecker (2011); De Loecker et al. (2016), among others.

to construct a firm-level price deflator for foreign intermediate inputs and output, respectively, which I then use to construct quantity measures of the relevant variables. This approach does not rely on any assumption on the nature of competition in the output or foreign input markets, and is therefore robust to the application of this paper.

In what follows, I first discuss the estimation biases, and my bias-correction approach. I then describe the identification strategy and the moment identifying condition I employ to obtain estimates of the output elasticities of importing firms.

2.2.1 Output Price Bias

Let p_{it} denote the log of the output price, and $\bar{p}_t$ denote an industry-wide price deflator, that is a measure of average output price within the industry where firm i operates. In most production datasets, neither q_{it} nor p_{it} are usually available. Measures of physical output q_{it} are usually obtained by deflating the log of total firm revenues r_{it} by the industry-wide price deflator, namely $\tilde{q}_{it} = r_{it} - \bar{p}_t = q_{it} - (\bar{p}_t - p_{it})$, where $\tilde{q_{it}}$ is *deflated* revenues, and where I used the definition $r_{it} \equiv p_{it} + q_{it}$ to derive the second expression. We can substitute $q_{it} = \tilde{q_{it}} + (\bar{p}_t - p_{it})$ in equation (13) and write:

$$\tilde{q}_{it} = \beta_l l_{it} + \beta_k k_{it} + \beta_m m_{it} + \beta_x x_{it} + (p_{it} - \bar{p}_t) + \omega_{it} + \varepsilon_{it}. \tag{15}$$

If differences in firm-level prices exist, i.e. $\exists \ (i,t)$ s.t. $(p_{it} - \bar{p}_t) \neq 0$, and if they are correlated with input demand, then there is an *output price bias*. Market power is potentially a source of such bias: firms who charge high markups sell less, and thus buy less inputs.

In order to address the output price bias, I exploit export unit values at the firm-product-country level to construct a measure of firm-level output price deflator, which I then use to directly control for $(p_{it} - \bar{p}_t)$ in (15). The key idea is that export data contain information about the price of a firm relative to the industry average within each product-destination country, and therefore can be used to construct a measure of firm average deviation from the industry average price.

2.2.2 Input Price Bias

Let us define the log expenditure of firm i on input V as $v^E_{it} = v_{it} + w^v_{it}$, where $v_{it} = \log V_{it}$ is the log quantity of input V, and w^v_{it} is the log unit price of the input. Let $\bar{w}^v_t$ denote the industry deflator of input V. Due to lack of firm-level data on input prices, physical units of input V are tipically measured as total expenditures deflated by an industry wide deflator, namely $\tilde{v}_{it} = v^{EXP}_{it} - \bar{w}^V_i = v_{it} + \left(w^V_{it} - \bar{w}^V_t\right)$. If differences in input prices exist, i.e. $\exists \ (i,t)$ s.t. $\left(w^V_{it} - \bar{w}^V_t\right) \neq 0$ for $V = K, M, L, X$, and they are correlated with input demand, then there is an *input price bias*. Existing methods to deal with the input price bias try to control for unobserved price deviations with observable variables, but they only work under the assumption that all input markets are perfectly competitive. Because the focus of this paper is to estimate input market power in the market of input X, such approach cannot be used for this particular input.

To deal with this issue, let us assume that firm-level input prices can be constructed, both for the labor input and the foreign intermediate input, i.e. we have information on w^l_{it} and w^x_{it}, while data on w^k_{it} and w^m_{it} are not available. If this was the case, then we can substitute $\tilde{v}_{it}$ in (15) for $V = M, K$, and obtain:

$$\tilde{q}_{it} = \beta_l l_{it} + \beta_k \tilde{k}_{it} + \beta_m \tilde{m}_{it} + \beta_x x_{it} + (p_{it} - \bar{p}_t) + B(\mathrm{w}, \boldsymbol{\beta}) + \omega_{it} + \varepsilon_{it}, \tag{16}$$

where $B(\mathrm{w}, \boldsymbol{\beta}) \equiv \beta_k \left(\bar{w}_t{}^k - w^k_{it}\right) + \beta_m \left(\bar{w}_t{}^m - w^m_{it}\right)$ is the unobserved input price term, which generates an input price bias. To control for $B(\mathrm{w}, \boldsymbol{\beta})$, I follow the control function approach developed by De Loecker et al. (2016).[9] The idea behind their control function approach to input price bias is that, if firms are price takers in the input markets, firm-specific input price deviations from the industry average can arise either because local input prices differ, and/or due to variation in input quality. Because high quality inputs produce high quality output, and because output quality is correlated with output prices and market shares, one could use the latter to control for differences in input prices. I therefore impose the following assumption:

Assumption 1 *The markets of* k_{it} and m_{it} *are competitive, and firms take their prices as given.*

Under Assumption 1, De Loecker et al. (2016) show that one could write unobserved differences in input prices as a function of output prices p_{it}, market share ms_{it} and exogenous factors (such as location) $\mathbf{G}_i$, i.e.

$$B(\mathrm{w}, \boldsymbol{\beta}) = B(p_{it}, ms_{it}, \mathbf{G}_i) \equiv -(\beta_k + \beta_m) b(p_{it}, ms_{it}, \mathbf{G}_i), \tag{17}$$

where measures of firm average market shares, as well as output prices, can be constructed from custom-level data.

2.2.3 Simultaneity bias

The last source of bias in equation (13) is the unobserved productivity term ω_{it}. I deal with the well-known associated simultaneity problem by relying on a control function for productivity based on the demand equations of the static inputs, building on the work by

[9] I refer to the paper for a complete discussion of the approach.

Ackerberg et al. (2015). Because I allow for input market power in foreign input markets, the demand of static inputs are affected by two unobservables, which are firm-level TFP, and input market power. I thus consider the static demand functions for both the imported and domestic input, x_{it} and m_{it}. In Section A.2 in the Appendix I show that given these demand functions, one can derive a system of two equations in two unknowns, which means that one could solve for ω_{it} as a function of observables only:

$$\omega_{it} = h_t(\tilde{k}_{it}, l_{it}, G_i, \Phi_{it}, w^x_{it}, p_{it}, \tilde{m}_{it}, x_{it}). \tag{18}$$

I substitute equation (18) in (13) to control for firm's productivity.

2.2.4 Estimation

I put all the pieces together and write the estimating equation as:

$$\begin{aligned} q_{it} =& \beta_l l_{it} + \beta_k \tilde{k_{it}} + \beta_m \tilde{m}_{it} + \beta_x x_{it} + B(p_{it}, ms_{it}, \mathbf{G}_i; \mathbf{fi}) \\ &+ h_t(\tilde{k}_{it}, l_{it}, G_i, \Phi_{it}, w^x_{it}, p_{it}, \tilde{m}_{it}, x_{it}). + \epsilon_{it}. \end{aligned} \tag{19}$$

To estimate (19), I follow the 2-steps GMM procedure in Ackerberg et al. (2015), which I describe in Section A.3 of the Appendix. For my baseline estimation, I run the GMM procedure on a sample of firms that source their foreign inputs from at least three countries outside the EU. This choice addresses the concern that foreign intermediate choice is affected by adjustment costs. I thus implement a selection correction to address the potential selection bias stemming from the use of large importers in estimation.

I adopt a Cobb-Douglas specification of the technology $f(\cdot)$ because it involves a lower number of parameters to be estimated, and thus it keeps the estimation more tractable. The dimensionality problem associated with choosing a more flexible specification of the production function is a particularly important issue in my case, due to the large number of inputs I consider.[10] The choice of a Cobb-Douglas production function has the disadvantage that the output elasticities are constrained to be the same across years and firms within an industry. While this is a limitation of my approach, it is still the case that I can obtain consistent estimates of the *average* level of input market power within an industry, which is the primary object of interest. In Section 3 I am going to discuss how this choice affects the distribution of market power across firms, and how one

[10] For example, by adopting the more flexible Translog specification of $f(\cdot)$ the GMM procedure would involve a non-linear search over about 20 parameters.

can still learn about correlates of market power even in this context.

3 Market Power in the Market for Imported Intermediates

In this section, I apply the methodology set forth in Section 2 to study the market power of French manufacturing importers in the market for foreign intermediate inputs. My primary goal is to determine whether the behavior of importers in foreign input markets is consistent with the existence of significant market distortions. I then aim to determine whether market distortions are significantly related to sector and firm characteristics.

The market of foreign intermediates has features that may lead to imperfect competition among firms, and thus it represents a good setting for a study of buyer power. On the one hand, imports are dominated by large firms (e.g. Bernard et al., 2007a), and large firms plausibly enjoy a dominant buyer position, especially in small, isolated input markets. On the other hand, substantial search and information costs related to trade (e.g. Allen, 2014; Startz, 2017) can lead to the existence of market power both downstream and upstream. Therefore, both models of monopsonistic competition and search models are potentially good approximations of reality.

Theoretical work in import trade and imperfect competition has recently focused on situations of the latter sort, motivated by the empirical relevance of micro-level trade relationship and bargaining (e.g. Heise et al., 2016; Monarch and Schmidt-Eisenlohr, 2016; Krolikowski and McCallum, 2016; Eaton et al., 2016). However, far too little attention has been paid to analyzing the monopsony or oligopsony power of large importing firms. This paper contributes to prevailing literature by providing new evidence of the type and magnitude of market distortions in foreign input markets.

3.1 Data Description

I employ two longitudinal datasets covering the activity of the universe of French manufacturing firms during the period 1996 - 2007. The first dataset comes from fiscal files and contains the full company accounts, including nominal measures of output and different inputs in production, such as capital, labor, and intermediate inputs, at the firm level.[11] The second dataset comes from official files of the French custom administration, and includes exhaustive records of export and import flows of French firms. Trade flows are reported at the firm-product-country level, with products defined at the 8-digit (NC8) level of aggregation.

[11] I refer to Blaum et al. (2018) for a more detailed description of the data sources.

Sample Selection Due to the focus of the exercise, I select all manufacturing firms that engage in both import and export activities in a given year.[12] These are the firms for which input and output prices are available, and I will refer to them as "international firms". To address the concern that a firm's optimal choice of foreign intermediates might be affected by significant fixed costs, and thus that foreign intermediates is not a variable input for the firm, for my baseline estimation I run the procedure on a subset of international firms that source their imports from at least three countries outside the EU, which I refer to as "super-international" firms, while implementing a selection correction to address the potential selection bias stemming from the use of large importers in estimation.[13] The idea behind my selection criterion is that firms that are large enough to afford to import from distant sources are less likely to be affected by things like trade costs and/or capacity constraints.

Table 1 provides summary statistics for the selected firms. As expected, both the international and especially the super-international firms have superior performance (cf. Bernard et al., 2007a,b, 2009). These firms are bigger, sell more, and are more productive than the average manufacturing firm in France. International firms are about 8% of the entire population of manufacturing firms in France, and they account for about 59% of total manufacturing value added. Note that both international and super-international firms heavily rely on foreign intermediates for production, with imported intermediates accounting for 29% and 35% of total material expenditure, respectively. The final sample includes around 12 thousands firms per year, spread across 18 two-digit manufacturing sectors. The sample of international firms is *not* representative of the average manufacturing firm in France, and the results presented here only apply for this subset of firms.

Firm-level Prices of Output and Imported Input The consistent estimation of the production function described in Section 2.2 relies on the existence of measures of prices of output and of the foreign input at the firm-level. Because price information are not available at the production-line level, I exploit information on exports and imports at the firm-product-country-year level in order to construct a firm price index for output (p_{it}) and imported input (w^x_{it}).

Prices of output and foreign materials are constructed by running the following re-

[12] I classify a firm as "manufacturing" if its main reported activity belongs to the NACE2 industry classes 15 to 35. Manufacturing firms account for 19% of the population of French importing firms and 36% of total import value (average across the years in the sample).

[13] The choice is due to the fact that the median importers sources from 3 countries outside the EU. Results are not substantially affected by this choice.

gression:

$$\log\left(uv^j{}_{iknt}\right) = \theta^j_{it} + c^j_{knt} + \epsilon_{iknt},$$

where i indexes firms, k indexes NC8 digit products, n indexes destination or source country, and t indexes years. Finally, j is an index for either exports ($j = EX$) or imports ($j = IM$). I define uv^j_{iknt} the unit value that firm i charges (pays) for product k sold in (sourced from) country n in year t, calculated as expenditures divided by units of physical quantity. I regress the log of the unit values on firm-time fixed effects (θ^j_{it}), and product-country-time fixed effects (c^j_{nct}), where ϵ_{inct} is a mean-zero error term. The product-country-time fixed effects (c^j_{nct}) capture the average price of a particular product in a particular market across firms in a given year. Therefore, the firm-year effects θ^j_{it} measure firm-level average prices purged of effects due to the composition of products. I define firm-level average input prices to be equal to these OLS estimates, namely $p_{it} = \hat{\theta}^{EX}_{it}$, and $w^x_{it} = \hat{\theta}^{IM}_{it}$.[14]

Note that in order to use export prices to infer information about average output prices, I am implicitly assuming that the marginal cost of the individual goods does not systematically vary by destination markets. This is an assumption common to many studies of pricing-to-market and pass-through (e.g. Burstein and Gopinath, 2014). I discuss these models in Section B.3.2 in the Appendix. In the Data Appendix, I discuss the construction of all variables, along with additional sample statistics.

Domestic Intermediate Inputs Throughout the analysis, I consider firms as price takers in domestic input markets. As discussed in Section 2.2.2, the lack of data on prices of domestic intermediates forces us to impose restrictions on the nature of competition in the market in order to consistently estimate the production function coefficients. Not only is the assumption of perfect competition the standard one in the literature on markup estimation (cf. De Loecker and Warzynski, 2012; De Loecker et al., 2016), but it also has the advantage that allows me to apply existing control function approaches to correct for input price bias in estimation.

The choice of domestic materials as second input of interest is also dictated by the fact that among all the inputs I observe, domestic intermediates is the one that most likely satisfies the requirement of short-run flexibility. One leading alternative to domestic materials is labor. However, labor markets in France are highly regulated and adjustment costs of labor are high, especially for large firms, which are the focus of my analysis (e.g. Abowd and Kramarz, 2003; Kramarz and Michaud, 2010; Garicano et al., 2016). To the ex-

[14] A similar procedure has been used by Bastos et al. (2018) to construct firm-level intermediate input prices using Portuguese data.

tent that adjustment costs are an important factor in firms' labor decisions, the first-order condition of labor compounds the effects of market power and other unobserved factors, such as the expected stream of future profits, which implies that the methodology cannot be implemented.[15]

(Data on) Revenue Shares To construct the input's revenue shares ($\{\alpha_{it}^{j}\}_{j=l,k,m,k}$), I divide the firm nominal expenditure on each of the inputs by the firm nominal value of production. Table 2 reports the means, standard deviations and quartile values of these variables. These shares are fairly stable over the period 1996–2007. As expected for firm-level data, the dispersion of all these variables across firms is large, as it can be seen from the different interquartile ranges.

3.2 Empirical Results

In this subsection, I present the output elasticities obtained using the procedure described in section 2.2.[16] I then present and discuss my estimates of markups and buyer power in foreign input markets. Finally, I discuss heterogeneity and robustness of the results.

Table 3 gives the estimated output elasticities together with standard errors, which I obtain by block bootstrapping over the entire procedure.

Table 4 repeat the production function estimation without implementing the correction for the unobserved input price variation discussed in Section 2.2.2 (Columns 1-5), and without implementing the correction for sample selection (Columns 6-11). The uncorrected procedure yields quite different estimates of the production function the output elasticities, which shows the importance of input and output price bias in production function estimation. The stability of the coefficient estimates with and without selection correction for the unbalanced panel suggests that the use of the unbalanced panel of large importing firms likely alleviates most of the concerns about the selection bias.

Given the estimates of elasticities and measures of input revenue shares, I derive the overall efficiency wedges for domestic and foreign intermediate inputs. Recall that equation (11) says that one could derive a measure of overall (average) market distortions for each variable input $j = \{x, m\}$ as the ratio of output elasticity and revenue share of the

[15] As a robustness check, I also perform the analysis using the labor input; under these conditions, the main results on buyer power do not vary substantially.

[16] I use the NACE rev.1 industry classification, which is similar to the ISIC industry classification in the US. The level of aggregation is presented in Table A1 in the Data Appendix

input, i.e.

$$\Xi^m \equiv \frac{\hat{\beta}^m}{\bar{\alpha}^m} = \bar{\mu} \cdot \bar{\psi}^m \tag{20}$$

$$\Xi^x \equiv \frac{\hat{\beta}^x}{\bar{\alpha}^x} = \bar{\mu} \cdot \bar{\psi}^x. \tag{21}$$

Because the markup term $\bar{\mu}$ is common to both equations, by looking at the differences between Ξ^m and Ξ^x one can get a sense of the differences in the structure of the two input markets. In particular, if all variable input markets were perfectly competitive, as it is often assumed in economics, we should observe $\Xi^m = \Xi^x$.

Table 5 reports the mean and median value of Ξ^j for $j = m, x$.[17] Across sectors, I observe large differences between Ξ^m and Ξ^x, which means that the level of competition in the domestic and foreign input market differs markedly. In particular, the foreign market seems to be much more "distorted" than the domestic one. Note that under the assumption of perfectly competitive domestic market, the wedge Ξ^m coincides with the average markup of French international firms, which is on average 68%. These numbers are consistent with the results of De Loecker and Warzynski (2012) who find, using similar methods for the Slovenian manufacturing sector, an average markup of around 22%. The larger estimates in my sample can be attributed to French international manufacturers charging higher markups than Slovenian manufacturers. On the contrary, if one was to assume that the foreign input market is competitive, it would set $\bar{\mu} = \Xi^x$ and find an average markup of 340%.

3.2.1 Input Market Power across Industries

I now have all the elements to compute input market power in the foreign input market given equation (10). Table 6 reports mean and median value of ψ^x across sectors. I focus on mean and median values because of the Cobb-Douglas specification of the production function, which yields measures of output elasticities constant within a sector, and over time. The mean and median level of input market power are 3.42 and 2.16, respectively, with considerable variation across sectors.

The evidence indicates that in the vast majority of manufacturing number of sectors, the median input market distortion parameter ψ^x is substantially greater than one, which is consistent with the median French importer having buyer power in the imported in-

[17] Due to the Cobb-Douglas specification of the production function, the output elasticities are constant within sectors and over time so that they represent a measure of "average" elasticity in a sector. I thus compare these elasticities with mean and median value of revenue share of the input to get a sense of average distortions.

put market. In particular, the if we were to attribute all the distortions to input market imperfections, we would conclude that on average, in the imported input market, French importers pay 116% less than the competitive price (i.e. value of marginal product of the input). To verify that the large estimates are not driven by the existence of a large number of small importers, in Table 7 I report the market distortion parameters for only firms in the top 3 quartiles of imported input shares (Column I), and the results for the sample of super international firms only. Table 7 confirms that the average estimated market distortions in international market is large even for different subsamples of large importers, which rules out, or downsizes the importance of alternative explanations of the wedge based on trade frictions or adjustment costs.

A closer look at the inter-sectoral heterogeneity reveals that buyer power is greatest in the following sectors: food, wood, printing, rubbers, and also machinery, radio and medical instruments, and transport equipment and equipment. Buyer power seems to be concentrated either in sectors where the goods that are exchanged are raw products and commodities, such as agricultural products (raw food, livestock) and natural resources (wood, pulp);[18] or in sector where the downstream market is characterised by large economies of scale, which means the downstream market is more concentrated (e.g. motor vehicles). This evidence is consistent with the focus of an extended body of empirical literature that emerged during the eighties and nineties, which aimed to measure the extent of buyer power in those sectors concerned over market monopsonisation due to rising concentration, large economies of scale downstream, and a large number of atomistic sellers upstream.[19]

Having quantified industry differences in foreign input market imperfection, I now aim at assessing the plausibility of the industry estimates. To this end, I relate these estimates to industry observables. I classify the 18 industries according to: (1) concentration, (2) productivity, (3) trade exposure to low-income countries and (4) fraction of commodities in intermediates. I expect each of these observables to be positively correlated with buyer power. In Figure 1, I plot the median estimate of foreign market imperfection in the industry with the average value of each of these observables, across industries. We find

[18]The markets for these products are often localized and spatially differentiated, and characterized by significant transportation or storage factors (Hotelling, 1929; Murray, 1995). This naturally gives rise to many atomistic sellers and few, concentrated buyers, a favorable condition for the insurgence of monopsony or oligopsony power (Rogers and Sexton, 1994).

[19]See Just and Chern (1980); Schroeter (1988); Azzam and Pagoulatos (1990) for studies in in the Food and meatpacking industry; and Murray (1995) and Bergman and Brännlund (1995) for studies of the Wood and Pulp industry. The bulk of (industry-level) findings of these studies do not reject the hypothesis of non-competitive buyer behavior in these sectors, although the magnitude of industry-level buyer power is at most modest. My firm-level evidence suggest that there is substantial heterogeneity within sectors, which means that buyer power can result modest in the aggregate, despite being large at the firm-level.

a strong positive correlation between sectoral market imperfections and industry concentration and productivity, consistent with the interpretation of the wedge as buyer power. We also find that the wedge is substantially higher in sectors which import a large fraction of their intermediates from low-income countries, and a positive, but weak, correlation with the share of commodities in total intermediate imports of sectors.

3.2.2 Input Market Power across Firms

I now investigate how estimates of buyer power relate to firm characteristics. The importance of this exercise is twofold. On the one hand, it gives us a sense of which firms are more distorted in the economy, which is an important determinant how the aggregate effects of buyer power, and welfare. On the other hand, it is important to validate the interpretation of the average input efficiency wedges as measures of buyer power. Note that the wedge ψ^x is estimated high whenever firms spend a lower-than-optimal share of revenues in the foreign input X. One might be concerned that some firms are constrained in the choice of foreign inputs, such that a low input share α^x has to do with trade costs or other constraints, rather than input market distortions.[20] Because smaller firms are more likely to be affected by those constraints, if our estimates were biased due to the existence of substantial trade costs we would observe small firms having very large buyer power. Conversely, if buyer power and firm size were positively related, then our buyer power interpretation of the wedges is more likely to be accurate.

Let us write our measures of buyer power as:

$$\log \psi_{it}^{x} = \log\left(\frac{\beta_x}{\beta_m}\right) + \log\left(\frac{\alpha_{it}^{m}}{\alpha_{it}^{x}}\right).$$

Note that under the Cobb-Douglas specification, the term $\log\left(\frac{\beta_x}{\beta_m}\right)$ is an industry constant, such that all the within industry variation in buyer power is driven by differences in revenue shares across firms. The concern is that differences in buyer power might also be related to unobserved differences in technology across firms, which we rule out for the estimation of the production function coefficients. However, in the regression analysis I can control for other variables that are likely to be correlated by production choices of firms. For example, I can control for the main reported activity of the firm, which is a variable likely to be correlated with the production technology of firms. Similarly, I can control for the extensive margin of imports, as measured by total number of sourc-

[20] Recall that in order to address this concern, I have estimated the elasticities on a sample of large importers, which are less likely to be concerned by trade frictions, while performing a sample selection correction procedure in the estimation of the production function.

ing countries and total number of imported products. Firms that source more inputs are more likely to outsource a large fraction of their production process, and are therefore only comparable with similarly "fragmented" firms.

I therefore run the following regression:

$$\log\left(\frac{\alpha_{it}^{m}}{\alpha_{it}^{x}}\right) = \beta_0 + \beta_1 \log size_{it} + \beta_2 \log\hat{\omega}_{it} + \mathbf{z}_{it} + \gamma_{st} + \varepsilon_{it}, \tag{22}$$

where the dependent variable is the ratio of revenue share of domestic and foreign intermediates, $size_{it}$ is a measure of firm size, such as total sales or employment, $\hat{\omega_{it}}$ is the estimate of firm-level TFP which I can obtain from the estimation of the production function, and $\mathbf{z}_{it}$ includes controls such as the extensive margin of imports, dummies of main reported activity of the firm, and dummies for the business group of the firm, while γ_{st} are industry-time fixed effects. Note that I used $\log\left(\frac{\alpha_{it}^{m}}{\alpha_{it}^{x}}\right)$ rather than $\log\hat{\psi_{it}}$ as the dependent variable because the variation in input market power due to the output elasticities are captured by the industry fixed effects. The coefficient of interest are $\hat{\beta}_i$, with $i = 1, 2$. Table 8 presents the results from estimating (22), where I report the bootstrap standard errors.

Constant Elasticity of Substitution Technology I further test the robustness of our results by considering a more general production function where the firm combines an intermediate input bundle Z with primary factors L and K, in a Cobb-Douglas fashion, but where the intermediate input is a Constant Elasticity of Substitution (CES) composite of a domestic variety, with quantity M, and the foreign input bundle X. This is the production technology considered in many studies of foreign intermediates, such as Gopinath and Neiman (2014); Halpern et al. (2015); Blaum et al. (2018). I can write this technology as

$$Y_{it} = L_{it}^{\beta_L} K_{it}^{\beta_K} \left(M_{it}^{\rho} + X_{it}^{\rho}\right)^{\frac{1}{\rho}},$$

where $\frac{1}{1-\rho}$ is the inverse of the elasticity of substitution between foreign and domestic intermediates. Let $\beta_{it}^{j} \equiv \frac{\partial \log Y_{it}}{\partial \log J_{it}}$ denote the output elasticity of intermediate input J, with $J = M, X$. A nice feature of the production technology in XX is that I can write the ratio of output elasticities of foreign and intermediate input as:

$$\frac{\beta_{it}^{x}}{\beta_{it}^{m}} = \left(\frac{X_{it}}{M_{it}}\right)^{\rho},$$

which means that buyer power in a model with CES technology can be written as:

$$\psi_{it}^{x,CES} \equiv \left(\frac{\beta_{it}^{x}}{\beta_{it}^{m}}\right)\left(\frac{\alpha_{it}^{m}}{\alpha_{it}^{x}}\right) = \left(\frac{X_{it}}{M_{it}}\right)^{\rho}\left(\frac{\alpha_{it}^{m}}{\alpha_{it}^{x}}\right). \tag{23}$$

Because I have constructed quantity measures of X_{it} and M_{it}, I can construct $\psi_{it}^{x,CES}$ from available data. As my value of ρ, I choose the estimate in Blaum et al. (2018). Table 9 reports mean and median value of buyer power obtained using the definition in (23). Note that even when I account for potential differences in output elasticities across firms, the estimated buyer power is still consistently positive and high in all industries.

I now run the same regression in (22) while substituting $\log \psi_{it}^{x,CES}$ as the dependent variable. The prior is that if unobserved differences in technology play a role in biasing my estimates of buyer power, then I should obtain different results in the regression analysis when I allow elasticities to vary across firms. Table 10 shows that even with this more flexible production technology, measures of distortions are positively and strongly related to measures of firm size and productivity. Therefore, my results are consistent with larger and more productive firms beingre more distorted in foreign markets, where they seem to enjoy large degree of buyer power.

4 Buyer Power and Aggregate Output

The results in Section 3 highlight that in a number of manufacturing industries, there seem to be substantial distortions in the market of foreign intermediate inputs, consistent with the existence of buyer power. In this Section I aim to investigate the distributional and aggregate consequences of this type of firm behavior. To do so, I develop an heterogeneous firms model as in Melitz (2003) extended to incorporate buyer power in foreign input markets. The model is parsimonious and tractable enough to allow for an analytical characterization of the industry and aggregate equilibrium. In addition, the model parameters can be precisely mapped to the empirical estimates in Section 3, which allows me to gauge the importance of buyer power for the aggregate French economy.

For expositional purposes, in this section I use capital letters to denote aggregate - rather than log - variables, and lower-case letters for firm-level variables.

4.1 Environment

I consider a simplified two-country economy consisting of a Home country (H : France), and a Foreign country (F : Rest of the World). I focus on the equilibrium in the Home country. The Home country is populated by L consumers who inelastically supply one unit of labor, and consume a final good. The domestic consumers earn a wage from their labor supply, and they also own claims to the profits of the domestic firms, which they own in equal shares.

The (competitive) final good is denoted by Q, and is a Cobb-Douglas aggregate of the output of S manufacturing sectors, denoted by Q_s, with $s = 1, .., S$:

$$Q = \prod_{s=1}^{S} Q_s^{\theta_s}, \tag{24}$$

where $\sum_{s=1}^{S} \theta_s = 1$. Cost minimization implies that θ_s is also the fraction of revenues spent on each sectoral output Q_s , i.e. $\frac{P_s Q_s}{PQ} = \theta_s$, $\forall$ s. I assume that the final good is the numeraire, so that $P = 1$.

In each sector there is a continuum of measure M_s of firms, each producing a differentiated product. I assume fixed entry, so that the number of firms in each sector is exogenously given.[21] Individual varieties are combined to produce the industry output, according to a CES technology:

$$Q_s = \left(\int_{i \in M_s} q_s(i)^{\frac{\sigma_s - 1}{\sigma_s}} di \right)^{\frac{\sigma_s}{\sigma_s - 1}}, \quad \sigma_s > 1. \tag{25}$$

Equation (25) implies that the demand for variety i in sector s is given by:

$$q_s(i) = A_s p_s(i)^{-\sigma_s}, \quad A_s = P_s^{\sigma_s} Q_s, \tag{26}$$

where A_s is a market index, determined by the sectoral demand Q_s, and the industry price index P_s, which is defined as :

$$P_s = \left(\int_{i \in M_s} p_s(i)^{1-\sigma_s} di \right)^{\frac{1}{1-\sigma_s}}. \tag{27}$$

With a continuum of firms, each firm is measure zero in the market, and takes A_s as given. In order to ease the exposition, hereafter I drop the sector subscript, implicit in all variables unless stated otherwise.

[21] I focus on the equilibrium with fixed entry because we're mostly interested in understanding the firm-level and distributional consequences of buyer power. Restricted entry may be interpreted as an adequate description of a short-run equilibrium in which entry has not taken place yet and fixed costs are sunk, such that exit is never optimal (e.g. Epifani and Gancia, 2011).

Technology Firms in each sector differ in their efficiency level $\phi \in (0, \infty)$. Production requires two variable factors: domestic labor l, and an intermediate input x.[22] Firms can hire any amount of labor at a given unitary wage W^l.

I assume that each firm uses a horizontally differentiated variety of the input x for the production of its differentiated final variety. For example, different varieties of x in the Food manufacturing sector can be cattle for a beef processor, or raw organic milk for packaged organic milk producers. The production technology is a Constant Returns to Scale Cobb-Douglas function of the inputs, which means that output is produced as

$$q_i = \phi_i {x_i}^{\beta} {l_i}^{1-\beta}, \tag{28}$$

where β and $1-\beta$ represent the output elasticities of inputs x and l, respectively.[23]

4.2 The Market of the Intermediate Input

I assume that each firm i buys its differentiated variety of input x_i from a different seller in the Foreign country. From the point of view of the firms at Home, it is as if each foreign seller were a different market, and markets were horizontally segmented by the product characteristics.

In the foreign input market, each buyer from Home competes with a fringe of competitive buyers from the Foreign country, but never with other buyers from Home, such that a Home firm's input demand does not depend on the price paid by another Home firm. This assumption implies that I can exclude general equilibrium effects of the price paid by i on the demand of other domestic firms. Let us denote total demand by foreign competitors as $X_{-i} \in [0, \infty)$. I assume that X_{-i} varies across firms, and is exogenous, which means that I also rule out strategic interactions across a Home firm i and its Foreign competitors. Total input demand in market i is thus given by $X_i = x_i + X_{-i}$, with $\partial X_i / \partial x_i = 1$.

There exist economic rents on the Foreign markets, which arise owing to decreasing returns in production of the intermediate input varieties.[24] In particular, I assume that

[22] The model is therefore consistent with the general framework in section 2.1, where labor is the variable competitive input and foreign intermediates is the variable input affected by market power. Because the model is static, I abstract from the dynamic inputs in production. One can thus interpret labor as an aggregate of all competitive inputs in production. I do so in the model calibration by considering $\beta_l = 1 - \beta_x$.

[23] The CRS assumption is mostly made for tractability, and none of the theoretical results below depends on it. However, in the empirical section I showed that it well represents the estimated production elasticities for the French manufacturing sector.

[24] Let X denote total demand of an input variety, and $C(X)$ denote total costs of producing it. Decreasing returns imply that marginal costs $C'(X)$ are increasing in X, i.e. $C'' > 0$. In equilibrium, the (unique) price

each seller in the Foreign country supplies X_i units of the good according to the following (inverse) supply function

$$W_i^x = \gamma_i \cdot X_i^{\eta}, \tag{29}$$

where γ_i is a term that reflects market conditions in the Foreign market for input i, and the constant $\eta \equiv \frac{\partial W_i}{\partial X_i}\frac{X_i}{W_i} > 0$ represents the elasticity of intermediate input price to total demand, which I assume constant across firms. The inverse supply elasticity is positive due to the assumption of decreasing returns, and increases with the input price sensitivity to total demand. I consider the following functional form for γ_i:

$$\gamma_i = (a + X_{-i})^{-\eta}, \; a \in \mathbb{R}_+, \tag{30}$$

such that I can rewrite equation (29) as a function of individual demand x_i, and (exogenous) foreign market conditions X_{-i}:

$$W_i^x = \left(\frac{x_i + X_{-i}}{a + X_{-i}}\right)^{\eta}. \tag{31}$$

An important object for the derivation of the firm-level equilibrium is the marginal *expenditure* on input x_i. This is given by

$$\frac{\partial (W_i^x x_i)}{\partial x_i} \equiv W_i^x + \frac{\partial W_i^x}{\partial x_i} x_i = W_i^x \left(1 + \eta s_i^x\right), \tag{32}$$

where s_i^x is defined as $s_i^x \equiv \frac{x_i}{x_i + X_{-i}} \in (0,1)$ and is the input market share of firm i. I can now define buyer power of Home firm i in the Foreign market as the gap between the marginal expenditure and the marginal cost of the input, which is given by:

$$\psi_i \equiv \left(1 + \frac{\partial W_i}{\partial x_i}\frac{x_i}{W_i}\right) = 1 + \eta s_i^x \geq 1. \tag{33}$$

Note that the expression in (33) represents the same object I estimated in Section 3, with the only difference that I now attribute it a structural interpretation. The price elasticity to individual firm demand can be decomposed as $\frac{\partial W_i}{\partial x_i}\frac{x_i}{W_i} = \frac{\partial W_i}{\partial X_i}\frac{X_i}{W_i} \cdot \frac{\partial X_i}{\partial x_i}\frac{x_i}{X_i}$, so that it maps into two model objects: the inverse input supply elasticity η, and the buyer share of firm i in the foreign market. This means that in the model, two conditions must be satisfied for buyer power to emerge: *(i)* the firm must be large compared to its competitors (i.e.

of the intermediate input X_i equal marginal costs, and is higher than the average cost of production. These "excess returns" for the input represent the rents accruing to the seller, and often referred to as *Ricardian rents*.

$s_i^x > 0$); and *(ii)* the (inverse) input supply is sufficiently elastic (i.e. $\eta > 0$).[25]

The model encompasses the cases of monopsony and perfect competition in the foreign input market in a tractable way. When the Home firm is small compared to its competitors in Foreign (i.e. $X_{-i} \to \infty$ and $s_i^x \to 0$), as in the case of perfect competition, then $\psi_i = 1$ and $W_i^x = W^x = 1$. On the contrary, when $X_{-i} \to 0$ and $s_i^x \to 1$ as in the case of monopsony, $\psi_i = 1 + \eta > 1$ and $W_i^x = \left(\frac{x_i}{a}\right)^\eta$, such that the price of the input is a function of individual input demand and parameters.[26]

In Figure 4, I show the (partial) equilibrium in the market of x_i for different values of s_i^x, in the simple case where the marginal revenue product (curve D), is constant and equal to p. Because the input supply S is upward sloping, an increase in the total supply X raises the price, which is always pinned down by S. In a competitive setting, the firm sets marginal revenues (curve D) equal to the marginal cost (curve S). Conversely, firms with buyer power (i.e. $s^x > 0$) set their marginal revenues D equal to an *effective* marginal cost curve (e.g. S' or S'') which is steeper than S, due to the fact that the firm internalizes the fact that the input price changes with quantity. In equilibrium, firms with high input market share pay lower prices, and buy lower quantities relative to the competitive benchmark.

4.3 Equilibrium

In this section I describe the static equilibrium in each sector, for given measure of firms M, labor supply L, and W^l . In 3.3.2 I describe aggregation.

4.3.1 Firm-Level Equilibrium

A firm i with efficiency and input market conditions given by (ϕ_i, X_{-i}) chooses the optimal quantities of inputs l and x to maximize static profits, subject to final demand (26), input supply (31), and technology (28), and taking aggregate variables as given.

[25] This feature of the model is akin to a well-known results in GE models of oligopsonistic competition, where the firm markups increase in both the market share of the firm, and the demand elasticities (e.g. Atkeson and Burstein, 2008).

[26] When solving the model, I set the parameter a to equal firm demand under perfect competition, i.e. $a = x_i^{PC}$. This is to ensure that when $x_i = x_i^{PC}$, the unit price also equals its competitive level, i.e. $W_i^x = \left(\frac{x_{PC_i}}{a}\right)^\eta = 1$.

The equilibrium allocation solves the following first order conditions:

$$\frac{\beta}{\alpha_i^x} = \frac{\psi_i}{\rho} \tag{34}$$

$$\frac{1-\beta}{\alpha_i^l} = \frac{1}{\rho}, \tag{35}$$

where $\alpha_i^x = \frac{W_i^x x_i}{p_i q_i}$, and $\alpha_i^l = \frac{W^l l_i}{p_i q_i}$ are the shares of expenditures on intermediate input and labor over total revenues, and $1/\rho = \sigma/(\sigma-1)$ is the profit maximizing markup, which is constant across firms due to the CES assumption.

In order to analytically characterize the effect of buyer power on the firm equilibrium I compare two firms, i and i', which face different market conditions abroad but are otherwise identical, namely $\phi_i = \phi_{i'} = \phi$ and $X_{-i} \neq X_{-i'}$. In particular, I assume that firm i is a monopsonist abroad, namely $X_{-i} = 0$ and $\psi_i = \psi = 1 + \eta$, while firm i' competes with a large number of foreign competitors, i.e. $X_{-i'} \to \infty$ and $\psi_{i'} = 1$, such that it behaves as a competitive firm both domestically and abroad. I denote variables specific to firm i' with PC, precisely because they correspond to a "competitive benchmark" for firm i.

It is easy to show that the equilibrium demand of foreign intermediate, labor-intermediate ratio, and the equilibrium output are given by

$$\left(\frac{x_i}{x^{PC}}\right) = \psi^{-\kappa_1} < 1, \tag{36}$$

$$\frac{(l_i/x_i)}{(l/x)^{PC}} = \psi^{\kappa_2} > 1, \tag{37}$$

$$\left(\frac{q_i}{q^{PC}}\right) = \psi^{-\kappa_3}, \tag{38}$$

where $\kappa_1 \equiv \frac{1-\rho(1-\beta)}{1-\rho+\eta(1-\rho(1-\beta))} \in (0,1)$, $\kappa_2 \equiv \frac{1-\rho}{1-\rho+\eta(1-\rho(1-\beta))} \in (0,1)$, and $\kappa_3 \equiv \frac{\beta}{1-\rho+\eta(1-\rho(1-\beta))}$ > 0. Together, equations (36) - (38) show that buyer power induces equilibrium distortions along several channels. First, firms buy less intermediates than they would if they were price takers in the foreign market (equation (36)). This happens because when the firm is large relative to aggregate foreign demand, it internalizes the effect of its own demand on the final input price, and it chooses to curb the input demand to capture part of the rents that exist in the foreign market (as in Figure 4). Labor is an imperfect substitute of the foreign input, which means that firms with buyer power also demand lower labor in equilibrium. However, even though the *level* of labor decreases, its share in total firm revenues increases (cf. equation (37)). This happens because labor and intermediates are imperfect substitutes in production, such that the firm partly compensate for the foreign input using relative more labor in production. On the other hand, since the firm uses a lower amount of both inputs in absolute terms, the equilibrium output shrinks compared to the competitive benchmark (cf. equation (36)), such that the final output price is higher for a firm with high buyer power. Therefore, even if firms with buyer power pay a lower price for the foreign intermediate, they do so by distorting output, such that it results in a higher consumer price, and higher profits for the firm. I summarize these results in the following proposition:

Proposition 1: *Compared to the competitive benchmark, firms with buyer power buy less intermediate inputs, have a higher labor-to-intermediate ratio, produce less output, and charge a higher price for their good.*

Proposition 1 describe the *within-firm* inefficiencies induced by the existence of buyer power. In principle, the fact that buyer power is heterogeneous across firms can generate further equilibrium effects, for example by inducing a misallocation of the competitive input *across* firms.[27] In the next section, I are going to show that in presence of buyer power in one input market, the existence of heterogeneity across firms might actually alleviate the equilibrium inefficiencies.

4.3.2 Heterogenous Buyer Power and Resource Misallocation

To understand the effect of heterogeneous buyer power in equilibrium, it is instructive to look at the following ratio of labor demand of firms i and j:

$$\frac{l_i}{l_j} = \left(\frac{\phi_i}{\phi_j}\right)^{\frac{\rho}{1-\rho}} \left(\frac{\psi_i}{\psi_j}\right)^{-\frac{\beta\rho}{1-\rho+\eta(1-\rho(1-\beta))}} . \tag{39}$$

Equation (39) says that compared to an equilibrium with no heterogeneity in buyer power ($\psi_i = \psi_j = \psi$), labor is reallocated from more to less distorted firms, who produce higher output for a given unit of input (cf. Proposition 1). In order to assess the implications of this result further, I now derive the aggregate equilibrium. For simplicity, I are going to abstract from the sector notation, and consider a one-sector version of the economy described above.

[27] For example, a famous result in the literature of markup-induced misallocations is that market power in the output market only induces equilibrium distortions through misallocation of productive resources across heterogeneous firms (Lerner et al. (1934); Epifani and Gancia (2011)).

I use (39) in the labor market clearing condition to write labor as:

$$l_i = \frac{\phi_i^{\frac{\rho}{1-\rho}} \psi_i^{-\kappa_3}}{\int_0^1 \phi_i^{\frac{\rho}{1-\rho}} \psi_i^{-\kappa_3} \mu(i) di} L, \tag{40}$$

where $\mu(i)$ is the measure of firms with productivity ϕ_i. Using (25) and (40), aggregate output can then be derived as

$$Q = \Gamma \cdot \left(\int_0^1 \phi_i^{\frac{\rho}{1-\rho}} \psi_i^{-\kappa_3} \mu(i) di \right)^{\frac{1-\rho}{\rho}} \cdot L$$

where $\Gamma = \left(\frac{1}{\beta}\right)^{-\beta} \left(\frac{W^l}{1-\beta}\right)^{(1-\beta)}$ denotes aggregate variables. It is easy to show that in a counterfactual economy where all firms are price takers in all input markets, namely $X_{-i} \to \infty$ for all i and $\psi_i = 1$ $\forall i$, aggregate output is given by $Q = \Gamma \cdot \tilde{\Phi} \cdot L$, where $\tilde{\Phi} \equiv \left[\int_0^{M_s} \phi_i^{\frac{\rho}{1-\rho}} \mu(i) di \right]^{\frac{1-\rho}{\rho}}$ is a measure of average efficiency in the economy, as in Melitz (2003). I write the output losses (gains) induced by buyer power as:

$$\log \hat{W} = \log Q / Q_{EFF} = \frac{1-\rho}{\rho} \left[\log \mathbb{E}\left(Y\right) - \log \mathbb{E}\left(\phi_i^{\frac{\rho}{1-\rho}}\right) \right]$$

where $Y = \phi_i^{\frac{\rho}{1-\rho}} \psi_i^{-\kappa_3}$.

I now impose distributional assumptions on ϕ and ψ, which I consider exogenous objects for the sake of exposition. In particular, I assume that: *(i)* productivity ϕ is distributed log Normal, i.e. $\phi \sim \text{logNormal}\left(\mu_z, \sigma_z^2\right)$; *(ii)* buyer power ψ is distributed log Normal, i.e. $\psi \sim \log\text{Normal}\left(\mu_x, \sigma_x^2\right)$; *(iii)* φ and ψ are independently distributed, i.e. $\varphi \perp \psi$. Using the properties of the log-Normal distribution, it is easy to show that

$$\log \hat{W} = -a_1 \mu_x + a_2 \sigma_x^2$$

where $a_1 = \frac{\beta}{1+\eta\left(1+\frac{\rho\beta}{1-\rho}\right)} > 0$, and $a_2 = \frac{\beta^2 \rho}{2\left(1+\eta\left(1+\frac{\rho \text{fi}}{1-\rho}\right)\right)^2} > 0$. I summarize these results in the following proposition:

Proposition 2: *Heterogeneity in buyer power has a positive effect for aggregate output. In particular, a mean-preserving spread in buyer power across firms induces an intersectoral reallocation of resources, whereby more distorted firms underproduce, and less distorted firms overproduce as compared to the economy with no heterogeneity. This* *reduces the aggregate distortions stemming from within-firm allocative inefficiencies, and increase output.*

4.3.3 Aggregation

The wage in the economy is pinned down by the labor market clearing condition

$$L = \sum_{s=1}^{S} \int_{0}^{M_s} l_s(i) di. \tag{41}$$

Since I assume fixed entry, each firm i will make positive profits in equilibrium. Total real income in the economy is thus given by the sum of labor income, and total profits, namely:

$$I = \Pi + W^l L, \tag{42}$$

where

$$\Pi = \sum_{s=1}^{S} \int_{i \in M_s} \pi_s(i) di. \tag{43}$$

In this simple economy, and given the final price normalization, welfare $\tilde{W}$ can be measured as real income, i.e.

$$\tilde{W} = I. \tag{44}$$

4.4 Quantifying the Costs of Input Market Power

This section aims to evaluate the effect of buyer power on aggregate output Q, and welfare W. Calibrating the model to the data is a rather straightforward task, given that the estimation procedure in Section 2 returns estimates of almost all the unknown model parameters. I set the Cobb–Douglas production function parameter ϕ_s equal to the estimated output elasticity of the imported input in each sector, i.e. $\phi_s = \hat{\beta}_{sx,s}$. I choose the elasticity of substitution between varieties σ_s such that the implied markup $\mu_s = \frac{\sigma_s}{\sigma_s - 1}$ is equal to the average markup in each sector (cf. Table A.2). The sector share θ_s are set equal to the shares of each sector in total manufacturing value added, directly observed in the production data. I set the aggregate labor supply equal to 1, which means that labor income $W^L L = W^L$ is equal to the aggregate wage. The parameter I do not directly estimate is η, the elasticity of the inverse input supply. Given equation (33), and given the estimates for buyer power of firms in Section 3 ((cf. Table III)), I set $\eta = 5$, which is such that the highest observable degree of buyer power, namely the degree of buyer power of a monopsonist with $s_i^x = 1$, is $\bar{\psi} = 1 + \eta = 6$.

Finally, I need to determine the parameters of the underlying distributions of productivity ($\omega_i \sim G_\omega(\cdot)$) and foreign competition ($X_{-i} \sim G_{x_-}$). In Section 2, I estimated the entire distribution of both productivity ω and buyer power ψ across firms within each manufacturing sector. The main challenge for the calibration exercise is thus to choose the parameters of the distribution $G_{X_-}(\cdot)$, which is not directly observed in the data. I estimate the moments of $G_{X_-}(\cdot)$ using a Simulated Method of Moments, such that I minimize the distance between the moments of the distribution of buyer power $\hat{\psi}$ which I simulate from the economic model, and the corresponding moments which I computed from the data. In Table 11, I summarize the model parameters, for the different manufacturing sectors. Note that I focus on those sectors for which the evidence on input market power is consistent with the model assumptions. I assume that the remaining sectors are not distorted.

To see how well the model perform compared to the data, in Figure 7, I plot the distribution of domestic share across quantiles of buyer power, both in the calibrated model and in the data. The Figure shows that the model does a good job in replicating the distribution of domestic shares across quantiles of buyer power.[28]

Counterfactual Exercise I now I aim to quantify the effect of buyer power on aggregate variables for the calibrated French economy. In particular, I focus on: *(i)* the *production distortion*, that is the effect on gross manufacturing output; (*ii)* the *import distortion*, namely how much imports decrease due to buyer power; *(iii)* the *transfers* between the foreign countries and France, as measured by the change in total profits in the French economy; and *(iv)* the overall effect on the *welfare* of the representative agent, as measured by total real income, which I defined in equation (42) as the sum of aggregate profits and labor income.

I summarize the results in Table 12. The results show that buyer power has a large negative effect on both total imports and gross manufacturing output in France. Specifically, I find that in the counterfactual scenario where all firms are price takers in both the domestic and foreign input markets (i.e. $\psi_i = 1, \forall\ i$) , total imports would increase by 32%, and gross manufacturing output by 3.2%. Because firms demand more of all inputs when input markets are competitive, in the counterfactual economy total payments to domestic capital also increase, by 3%. By contrast, firms make lower profits, due to lower transfers of rents from foreign input markets. In my calibration, the loss in profits from moving from the distorted to the competitive economy is about 9%. The drop in

[28]The model cannot replicate as well the dispersion in total firm imports across quantiles of buyer power which is observed in the data.

profits more than offsets the 3% increase in labor income, and together they imply a loss in total real income (total GNP in France) by 0.4%. The latter result further highlights an important shift in the aggregate income composition. The profits-to-income ratio in the counterfactual competitive economy is about 31%, and this number goes up to 36% in the distorted economy. This suggests that in a more realistic setting where the capital and the firms are owned by different individuals, the existence of buyer power can benefit firm owners, but can hurt the individual who own the productive inputs, with potentially important implications in terms of aggregate income inequality within a country.

Policy Implications This exercise can be useful to inform trade policy. In particular, it suggests that higher market integration can increase output in both the foreign and the domestic country, by reducing the scope of buyer power of importers in foreign input markets. Policies should therefore encourage import participation, in order to make more buyers accessible to foreign sellers, which could contrast the buyer dominance in foreign input markets.

5 Conclusions

This paper makes two contributions. On the methodological side, I show that the input market power of firms can be consistently estimated from standard production data. On the theoretical side, I show that input market power induces large distortions in the domestic economy, over and above the well-known effects on the equilibrium price and quantity of the inputs. This paper studies buyer power in the context of imports of intermediates, using longitudinal trade and production data on French manufacturing. I document evidence of significant distortions in this market, which are consistent with French firms withholding imported intermediate demand so as to keep the price of imported inputs low. In so doing, I show how disaggregate trade data on firm-product-country level imports and exports can be used along with production data to address well-known price biases in production function estimations, thus contributing an approach to a long-standing problem in the empirical literature. The paper then presents a quantitative general equilibrium framework of a production economy that incorporates (heterogeneous) buyer power of firms in the purchase of one of two inputs in production. The model yields tractable equilibrium equations and provides simple explanations for the documented evidence based on the existence of buyer power. I use the model to study, and then quantify, how much output is lost due to the existence of buyer power of firms in (international) markets. This paper contributes to the literature examining the role of imperfect competition in international markets. While the focus of this literature has been so far on exports and output markets, I suggest that taking the perspective of international markets as input markets offers new and important insights on firm behavior and trade policy. Buyer power will likely be important in other settings as well, and my methodological framework easily translates to a variety of other situations. A fruitful direction for future research would be to examine whether firms exercise significantly higher buyer power for imports from poorer economies.

TABLE I. SUMMARY STATISTICS (2005)

	INTERNATIONAL	**SUPER INTERNATIONAL***
# Firms	11,916	6489
(% of total)	7.7%	4.2%
(% in total value added)	59%	53%
(log) sales premium [(a)]	3.3	3.97
(log) wage premium	0.29	0.31
(log) TFP premium[(b)]	0.20	0.24
Belongs to a group[(c)]	74%	85%
% French imports	36%	34%
Imported share of intermediates	29%	35%

Source: Author's calculations. Notes: The number of *all* the manufacturing firms in 2005 is 166,175.[(a)] The (log) x premium is computed as the percentage difference in the average x in the selected sample (i.e. all international or super-international) relative to the average x in the full sample of manufacturers. [(b)] TFP is computed as real value-added per worker. [(c)] Benchmark (All firms): 13.4% A firm "belongs to a group" if it is classified as either French private, French public, foreign private (group).

TABLE II. REVENUE SHARES: DISTRIBUTION QUANTILES

Variable	1996-2007				
	Mean	Std Dev	p10	p50	p90
Labor α_{it}^{L}	.18	.08	.08	.17	.29
Capital α_{it}^{K}	.03	.04	.003	.02	.08
Domestic Materials α_{it}^{M}	.31	.15	.12	.30	.52
Imported Materials α_{it}^{X}	.06	.07	.003	.03	.15

Notes: The table reports the share of total revenues of different input expenditures, averaged across time and sectors. I consider the full sample of international firms. Number of observations: 125,123. Imported materials is defined as total imports of intermediate goods, according to the BEC classification.

TABLE III. AVERAGE OUTPUT ELASTICITIES, BY SECTOR

	INDUSTRY	NO. OBS.	β_L	β_K	β_M	β_X	RETURN TO SCALE
C15	Food Products and Beverages	4522	0.28	0.07	0.52	0.13	1.01
			(0.04)	(0.02)	(0.02)	(0.01)	
C17	Textiles	4186	0.26	0.02	0.50	0.16	0.95
			(0.04)	(0.03)	(0.02)	(0.02)	
C18	Wearing Apparel, Dressing	2759	0.24	0.17	0.57	0.15	1.13
			(0.04)	(0.03)	(0.02)	(0.02)	
C19	Leather, and Products	768	0.21	0.22	0.53	0.03	1.00
			(0.12)	(0.06)	(0.05)	(0.04)	
C20	Wood, and Products	1037	0.31	0.32	0.45	0.13	1.20
			(0.09)	(0.10)	(0.03)	(0.02)	
C21	Pulp, Paper, & Products	2319	0.21	0.18	0.50	0.11	0.99
			(0.05)	(0.04)	(0.02)	(0.091)	
C22	Printing and Publishing	878	0.80	0.03	0.34	0.15	1.26
			(0.13)	(0.07)	(0.05)	(0.04)	
C24	Chemicals, and Products	5547	0.37	0.07	0.42	0.12	0.98
			(0.03)	(0.03)	(0.02)	(0.01)	
C25	Rubber, Plastics, & Products	4048	0.42	0.12	0.41	0.12	1.08
			(0.05)	(0.05)	(0.01)	(0.01)	
C26	Non-metallic mineral Products	1566	0.44	0.34	0.35	0.12	1.24
			(0.07)	(0.09)	(0.02)	(0.02)	
C27	Basic Metals	1675	0.40	0.06	0.41	0.17	1.04
			(0.09)	(0.06)	(0.02)	(0.02)	
C28	Fabricated Metal Products	4958	0.55	0.12	0.38	0.06	1.11
			(0.04)	(0.03)	(0.01)	(0.02)	
C29	Machinery and Equipments	5625	0.47	0.05	0.38	0.09	0.99
			(0.05)	(0.02)	(0.01)	(0.01)	
C31	Electrical machinery & App.	1805	0.39	0.03	0.45	0.11	0.98
			(0.05)	(0.05)	(0.02)	(0.02)	
C32	Radio and Communication	1653	0.37	0.08	0.46	0.10	1.02
			(0.06)	(0.04)	(0.03)	(0.02)	
C33	Medical, Precision, Optical Instr.	1961	0.51	0.16	0.35	0.09	1.11
			(0.07)	(0.05)	(0.02)	(0.02)	
C34	Motor Vehicles, Trailers	1684	0.45	0.06	0.44	0.11	1.06
			(0.06)	(0.03)	(0.02)	(0.02)	
C35	Other Transport Equipment	691	0.59	0.11	0.28	0.19	0.95
			(0.14)	0.13	(0.06)	(0.03)	

Notes: The table reports the output elasticities from production function estimation. I perform the 2 Steps GMM procedure on a sample of superinternational firms, while implementing a sample selection correction to address the potential selection bias stemming from the use of large importers in estimation. Column 1 reports the number of observations for each production function estimation. Cols 2–4 report the estimated output elasticity with respect to each factor of production. Standard errors, obtained by block-bootstrapping, are reported in brackets. Col. 5 reports the average returns to scale, which is the sum of the preceding 4 columns.

TABLE IV. OUTPUT ELASTICITIES. INPUT PRICE CORRECTION AND SAMPLE SELECTION

		(A) NO INPUT PRICE CORRECTION					(B) NO SAMPLE SELECTION CORRECTION				
		β_L	β_K	β_M	β_X	RETURN TO SCALE	β_L	β_K	β_M	β_X	RETURN TO SCALE
	INDUSTRY										
15	Food Products and Beverages	0.21	0.07	0.56	0.14	0.99	0.29	0.08	0.52	0.10	0.99
17	Textiles	0.18	0.06	0.52	0.26	1.01	0.28	0.02	0.50	0.13	0.93
18	Wearing Apparel. Dressing	0.16	0.07	0.62	0.23	1.08	0.25	0.17	0.58	0.11	1.11
18	Leather. and Products	-0.09	0.25	0.50	0.15	0.81	0.21	0.22	0.54	0.04	1.01
20	Wood. and Products	0.34	0.22	0.51	0.13	1.20	0.32	0.30	0.46	0.11	1.20
21	Pulp. Paper. & Products	0.07	0.30	0.65	0.11	1.12	0.21	0.18	0.50	0.11	0.99
22	Printing and Publishing	1.12	0.00	0.26	0.38	1.76	0.77	-0.03	0.36	0.11	1.22
24	Chemicals. and Products	0.32	0.02	0.47	0.18	0.99	0.37	0.07	0.42	0.11	0.97
25	Rubber. Plastics. & Products	0.14	0.10	0.55	0.23	1.02	0.42	0.12	0.42	0.12	1.08
26	Non-metallic mineral Products	0.38	0.39	0.42	0.18	1.37	0.43	0.35	0.35	0.13	1.25
27	Basic Metals	0.04	0.14	0.40	0.22	0.81	0.41	0.07	0.42	0.15	1.05
28	Fabricated Metal Products	0.27	0.12	0.49	0.25	1.13	0.54	0.12	0.37	0.09	1.12
29	Machinery and Equipments	0.41	0.12	0.40	0.24	1.17	0.47	0.05	0.38	0.08	0.98
30	Electrical machinery & App.	0.13	0.01	0.57	0.30	1.01	0.38	0.04	0.45	0.10	0.98
31	Radio and Communication	-0.01	0.00	0.52	0.33	0.85	0.36	0.08	0.47	0.11	1.02
33	Medical. Precision. Optical Instr.	0.35	0.14	0.39	0.22	1.09	0.51	0.16	0.35	0.10	1.11
34	Motor Vehicles. Trailers	0.39	0.21	0.40	0.21	1.20	0.44	0.06	0.44	0.12	1.06
35	Other Transport Equipment	0.59	-0.09	0.19	0.23	0.93	0.61	-0.10	0.28	0.17	0.97

Notes: The table reports the output elasticities from production function estimation. In Columns (1)-(5), I report the results Of the 2 Steps GMM procedure on a sample of super-international firms, where I don't control for the unobserved price of domestic inputs (material input and capital). These coefficients are thus affected by the input price bias. Columns (6)-(11) reports the results of the procedure without correcting for sample selection. Column 5 and 11 reports the sectoral returns to scale.

TABLE V. INPUT WEDGES, BY SECTOR

SECTOR	DOMESTIC (Ξ^m)		FOREIGN (Ξ^x)	
	MEAN	MEDIAN	MEAN	MEDIAN
15 Food Products and Beverages	1.39	1.22	7.32	5.5
17 Textiles	2.04	1.74	4.21	2.59
18 Wearing Apparel, Dressing	2.45	2.13	4.9	3.1
19 Leather, and Leather Products	1.91	1.66	1.54	1.18
20 Wood and Products of Wood	1.40	1.19	5.31	3.79
21 Pulp, Paper and Paper Products	1.63	1.46	3.71	2.34
22 Printing and Publishing	1.66	1.45	7.97	5.89
24 Chemicals and Chemical Products	1.62	1.39	3.65	2.44
25 Rubber and Plastic Products	1.53	1.37	4.08	2.61
26 Non-metallic mineral Products	2.01	1.62	3.85	2.26
27 Basic Metals	1.71	1.49	4.37	2.6
28 Fabricated Metal Products	1.85	1.55	2.45	1.72
29 Machinery and Equipments	1.46	1.25	3.77	2.69
31 Electrical machinery and Apparatus	1.64	1.41	3.43	2.23
32 Radio and Communication	1.73	1.49	4.47	3.01
33 Medical, Precision Instruments	1.7	1.34	4.46	3.25
34 Motor Vehicles, Trailers	1.29	1.11	3.21	2.03
35 Other Transport Equipment	1.26	1.04	7.75	5.23
Average (Simple)	1.68	1.44	4.47	3.02

Notes: The table reports the mean and median overall input nt wedges Ξ^m and Ξ^x, defined in (20) and (21) respectively.

TABLE VI. INPUT MARKET POWER, BY SECTOR

SECTOR	$\psi^{x}{}_{it}$	
	MEAN	MEDIAN
15 Food Products and Beverages	6.34	4.24
17 Textiles	2.56	1.46
18 Wearing Apparel, Dressing	2.58	1.44
19 Leather, and Leather Products	.96	.69
20 Wood and Products of Wood	4.61	2.91
21 Pulp, Paper and Paper Products	2.77	1.64
22 Printing and Publishing	5.82	3.99
24 Chemicals and Chemical Products	2.68	1.73
25 Rubber and Plastic Products	3.15	1.92
26 Non-metallic mineral Products	2.66	1.37
27 Basic Metals	2.27	1.74
28 Fabricated Metal Products	1.65	1.07
29 Machinery and Equipments	3.18	2.02
31 Electrical machinery and Apparatus	2.6	1.57
32 Radio and Communication	3.26	2.08
33 Medical, Precision Instruments	3.44	2.29
34 Motor Vehicles, Trailers	2.98	1.82
35 Other Transport Equipment	8.11	4.97
Average	3.42	2.16

Notes: The table reports the mean and median input market power by sector for the preferred sample over the period 1996-2007. Input market power is computed as the ratio between the "joint distortion wedge" Ξ^{x} for the foreign intermediate input and the markups, as obtained in Table 5. The table trims observations with ψ that are above and below the 3^{rd} and 97^{th} percentiles within each sector.

TABLE VII . INPUT MARKET POWER. ROBUSTNESS

SECTOR	ψ^x			
	(I)		(II)	
	MEAN	MEDIAN	MEAN	MEDIAN
15 Food Products and Beverages	3.44	2.87	4.13	2.60
17 Textiles	1.23	1.02	1.75	0.98
18 Wearing Apparel. Dressing	1.24	1	1.51	0.86
19 Leather. and Leather Products	.56	.50	1.03	0.74
20 Wood and Products of Wood	2.33	1.90	3.11	1.91
21 Pulp. Paper and Paper Products	1.30	1.02	2.57	1.42
22 Printing and Publishing	3.22	2.74	3.40	2.25
24 Chemicals and Chemical Products	1.42	1.22	2.25	1.48
25 Rubber and Plastic Products	1.59	1.31	2.56	1.53
26 Non-metallic mineral Products	1.18	.92	0.23	1.16
27 Basic Metals	1.47	1.24	2.64	1.40
28 Fabricated Metal Products	.88	.74	2.05	1.28
29 Machinery and Equipments	1.68	1.38	2.52	1.53
31 Electrical machinery and Apparatus	1.28	1.08	2.27	1.33
32 Radio and Communication	1.68	1.42	3.05	1.96
33 Medical, Precision Instruments	1.86	1.58	3.10	2.08
34 Motor Vehicles, Trailers	1.51	1.31	2.83	1.73
35 Other Transport Equipment	3.82	3.04	6.82	0.40
Average	1.76	1.46	2.66	1.48

Notes: The table reports the mean and median input market power by sector over the period 1996-2007. Column (I) reports mean and median estimated input market distortions in the subsample of firms obtained by selecting the top 75% firms in terms of share of imported intermediates over total revenues; Column (II) reports mean and median estimated input market distortions computed for the subsample of "superinternational" firms, i.e. the firms that imports from at least three countries outside the EU. The table trims observations with ψ that are above and below the 3^{rd} and 97^{th} percentiles within each sector.

TABLE VIII. MARKET POWER AND FIRM CHARACTERISTICS

	(1)	(2)	(3)	(4)	(5)	(6)
$\log size_{it}$	-0.032***		0.249***		0.249***	0.31***
	(0.006)		(0.007)		(0.007)	(0.009)
$\log \hat{\omega}_{it}$		0.063**		-0.013	-0.033	-0.073*
		(0.03)		(0.031)	(0.03)	(0.04)
FIXED EFFECTS						
Industry (2 digits) -Time	Yes	Yes				
Industry (3 digits) -Time			Yes	Yes	Yes	Yes
CONTROLS	No	No	Yes	Yes	Yes	Yes
Adj R^2	0.123	0.127	0.240	0.204	0.24	0.264
No. Observations	71824	71824	71824	71824	71824	46459

Notes: The table reports the estimates of OLS regressions on equation (). The dependent variable is $\log \hat{\psi}_{it}$. The results are shown for the sample of all international firms. All regressions include Industry-Time Fixed Effects, where industry is either measured at the 2-digit Isic Rev. 3 level, or 3 digits NACE level. All regressions include controls for the number of source countries in a given year, the number of sourced products, a dummy for which type of business group the firm belongs to, and dummies for the main reported activity of the firm. The regressions exclude outliers in the top and bottom 3rd percent of the markup distribution. All regressions include firm–product fixed effects. The regressions use data from 1989–1997. The standard errors are bootstrapped and are clustered at the firm level. *** denotes significance at the 10% level, ** at the 5% and *** at the 1%.

TABLE IX. INPUT MARKET POWER, CES TECHNOLOGY

SECTOR	$\psi^{x}{}_{it}$		
	MEAN	MEDIAN	STD DEV
15 Food Products and Beverages	4.03	3.56	2.21
17 Textiles	2.31	2	1.22
18 Wearing Apparel, Dressing	2.48	2.09	1.39
19 Leather, and Leather Products	3.11	2.86	1.48
20 Wood and Products of Wood	3.45	3.03	2.4
21 Pulp, Paper and Paper Products	2.88	2.55	1.69
22 Printing and Publishing	3.33	2.90	2.03
24 Chemicals and Chemical Products	2.5	2.19	1.43
25 Rubber and Plastic Products	2.80	2.43	1.57
26 Non-metallic mineral Products	2.41	1.99	1.62
27 Basic Metals	2.42	2.03	1.53
28 Fabricated Metal Products	2.98	2.55	1.95
29 Machinery and Equipments	3.33	2.83	2.16
31 Electrical machinery and Apparatus	2.76	2.38	1.58
32 Radio and Communication	2.85	2.42	1.74
33 Medical, Precision Instruments	2.62	2.23	1.69
34 Motor Vehicles, Trailers	2.86	2.49	1.58
35 Other Transport Equipment	2.36	1.96	1.57
Average	2.86	2.47	1.71

Notes: The table reports the mean and median input market power by sector for the preferred sample over the period 1996-2007, as computed by the CES formula in ()

TABLE X. MARKET POWER AND FIRM CHARACTERISTICS, CES TECHNOLOGY

	(1)	(2)	(3)	(4)	(5)	(6)
$\log size_{it}$	-.038***		0.099***		0.098***	0.123***
	(0.003)		(0.004)		(0.004)	(0.005)
$\log \hat{\omega}_{it}$		0.167***		0.12***	0.112***	0.121***
		(0.036)		(0.034)	(0.03)	(0.03)
FIXED EFFECTS						
Industry (2 digits) -Time	Yes	Yes				
Industry (3 digits) -Time			Yes	Yes	Yes	Yes
CONTROLS	No	No	Yes	Yes	Yes	Yes
Adj R^2	0.114	0.112	0.214	0.194	0.217	0.234
No. Observations	71824	71824	71824	71824	71824	46459

Notes: The table reports the estimates of OLS regressions on equation (). The dependent variable is $\log \hat{\psi}_{it}$. The results are shown for the sample of all international firms. All regressions include Industry-Time Fixed Effects, where industry is either measured at the 2-digit Isic Rev. 3 level, or 3 digits NACE level. All regressions include controls for the number of source countries in a given year, the number of sourced products, a dummy for which type of business group the firm belongs to, and dummies for the main reported activity of the firm. The regressions exclude outliers in the top and bottom 3rd percent of the markup distribution. All regressions include firm–product fixed effects. The regressions use data from 1989–1997. The standard errors are bootstrapped and are clustered at the firm level. *** denotes significance at the 10% level, ** at the 5% and *** at the 1%.

TABLE XI. MODEL PARAMETERS

Variable:	ψ		μ		$\varphi^{(a)}$		ϕ_s	σ_s	θ_s
	MEAN	**STD DEV**	MEAN	STD DEV	MEAN	STD DEV			
Source:	Estimation						Estimation		Data
Food and Beverages	3.45	4.18	1.03	0.25	10.06	2.07	0.24	34.33	0.13
Textiles	1.15	1.04	1.33	0.36	13.20	2.49	0.20	4.03	0.02
Wearing, Apparel	1.16	1.35	1.75	0.71	3.70	1.13	0.29	2.33	0.01
Wood and Products	2.26	2.57	1.23	0.35	7.16	1.60	0.21	5.35	0.02
Rubber and Plastics	2.01	1.96	1.07	0.25	32.20	6.84	0.27	15.29	0.03
Basic Metals	2.56	2.50	1.12	0.34	12.54	3.46	0.26	9.33	0.03
Fabricated Metal Prod	2.01	2.34	1.09	0.27	46.39	9.50	0.14	12.11	0.09
Machinery and Equip	3.23	3.68	0.93	0.22	43.59	13.45	0.18	34.33[b]	0.08
Electrical machinery	1.04	1.27	1.51	0.40	14.36	3.14	0.11	2.96	0.04
Other Transport Equip	1.28	1.57	1.55	0.43	11.04	9.54	0.13	2.82	0.04
Other Manufacturing[c]	1	0	1.29	1.21	16.15	4.29	0.17	4.45	0.51
Average	1.60	1.79	1.34	0.39	48.50	11.58	0.17	8.51	0.05

Notes: The table reports the main estimates of the model parameter. I consider only sectors when the mean estimated input market power is above 1, which are the sectors that are consistent with the model assumptions. [a] The estimation procedure yields estimates of mean and standard deviation of $\log \varphi$. In order to infer mean and variance of φ I assume that $\varphi \sim \log \mathcal{N}(\mu, \sigma^2)$, such that I can use the properties of the log normal to derive $\mathbb{E}\varphi = e^{\mu + \frac{1}{2}\sigma^2}$ and $SD(\varphi) = e^{\mu+\frac{1}{2}\sigma^2}\sqrt{e^{\sigma^2} - 1}$. [b] I set this number arbitrarily high, since the true underlying markup is below one. [c] The category "Other manufacturing" collects all those manufacturing sectors for which the model assumptions seem not to hold. The data are obtained as the average manufacturing value for the variable.

TABLE XII. MODEL ANALYSIS. CHANGES IN AGGREGATE VARIABLES

Variable:	$\%\Delta x \equiv \frac{x^{PC}-x^{DIS}}{x^{DIS}}$	
Manufacturing Output ($\%\Delta Q$)	+3.2%	
French Imports ($\%\Delta W^x X$)	+32.2%	
Profits ($\%\Delta\Pi$)	-8.9%	
Capital Income ($\%\Delta RK$)	+3.2%	
Welfare ($\%\Delta I \equiv \%\Delta(\Pi + RK)$)	-0.4%	
	due to $\Delta\Pi$	-2.3%
	due to ΔRK	+1.9%

Notes: The table reports the changes in aggregate output between the distorted and the counterfactual economies. I define the change in total manufacturing output as the weighted average of the change in the sectoral output between the calibrated and the counterfactual economy, i.e. $\%\Delta Q = \sum_{s=1}^{S} \theta_s \%\Delta Q_s$. I consider only sectors when the mean estimated input market power is above 1, which are the sectors that are consistent with the model assumptions.

Figure 1: Buyer Power Across Sectors

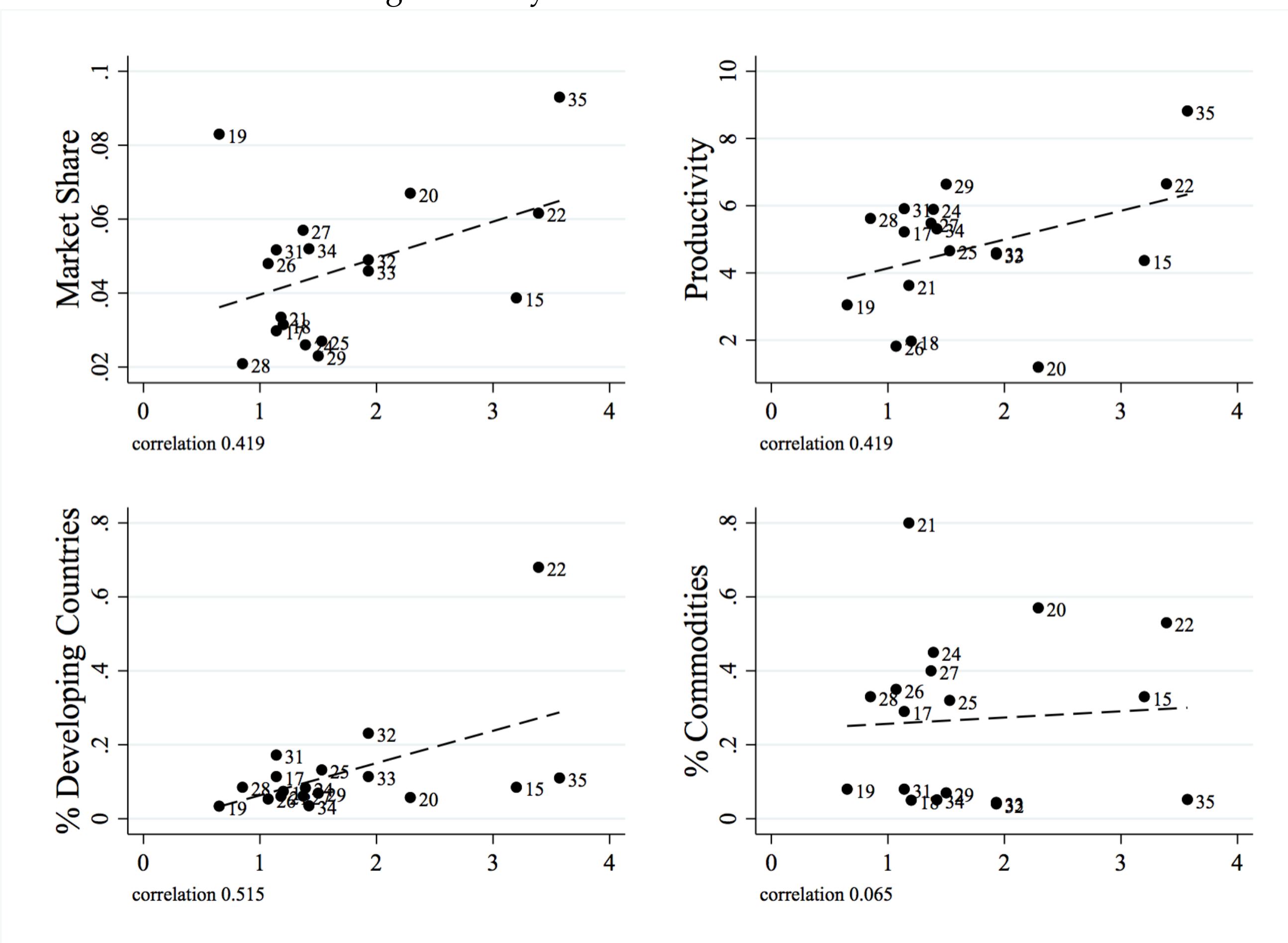


Figure 2: Equilibrium in the Intermediate Input Market

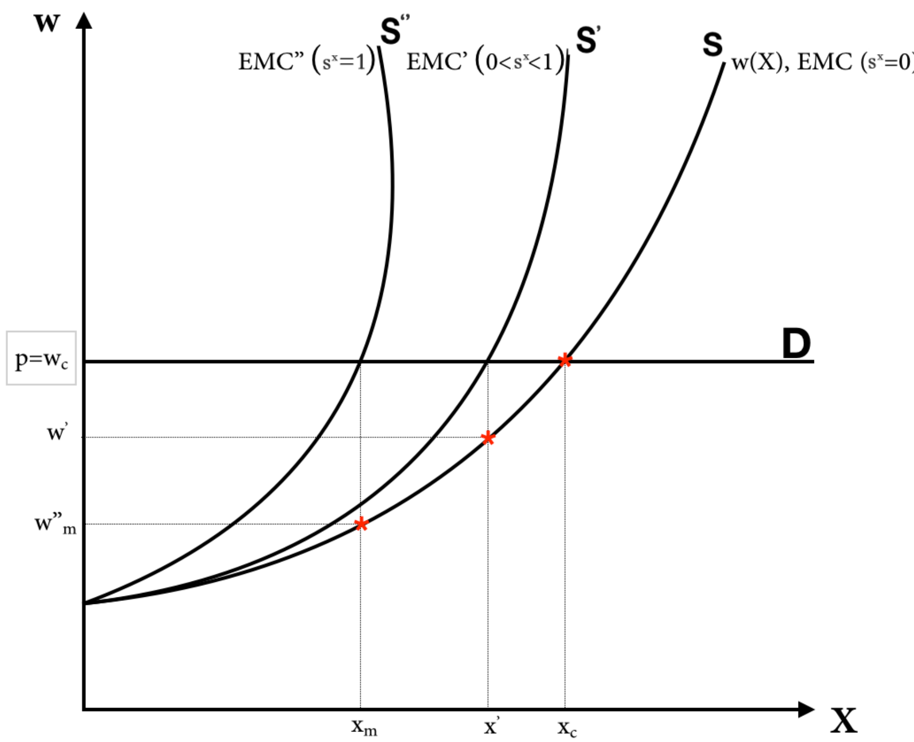
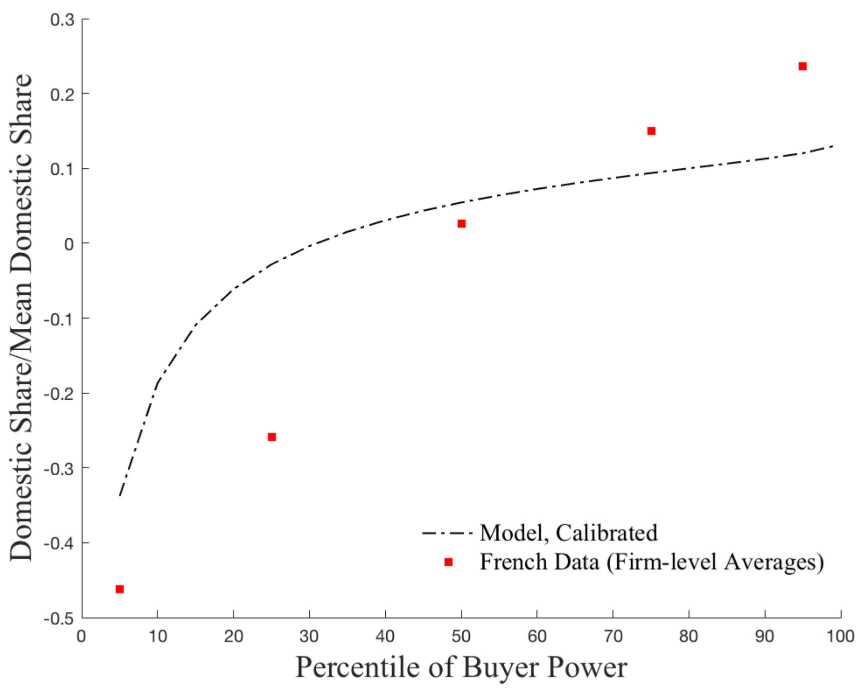


Figure 3: Model Fit



A Appendix

A.1 Models of Imperfect Competition in the Input Markets

In this Section, I consider two particular models of price discrimination in the input markets, and discuss their implications for the input efficiency wage ψ_{it}^{x}. I first consider a model of second degree price discrimination with quantity discounts, and then a model with two-part pricing. The choice of these particular models is based on their saliency in the literature of international trade and industrial organization. The more extensive theoretical literature on price discrimination shows how suppliers may use nonlinear price schedules to price discriminate among different buyers, such that different buyers pay different prices for their inputs, consistent with the general equation (2). It is shown that both these models yield predictions for $\psi_{it}^{x} < 1$, and therefore are not compatible with the evidence for the French economy shown in Section 3.

A.1.1 A Model with Quantity Discounts

Let us consider the following price (cost) schedule for the firm demand of input j. For orders less than 500 units, the supplier charges a price W_{it}^{j} equal to a_1 per unit, for orders of 500 or more but fewer than 1000 units, it charges a_2 per unit, and for orders of 1000 or more, it charges a_3 per unit, with $a_1 > a_2 > a_3$. The discount schedule is applied to all units purchased, so that there is a unique price per order. The unit cost function can thus be described as:

$$W(V_{it}^{j}) = \begin{cases} a_1 & \text{for } 0 < V_{it}^{j} < 500 \\ a_2 & \text{for } 500 < V_{it}^{j} < 1000 \\ a_3 & \text{for } V_{it}^{j} \geq 1000 \end{cases} .$$

Note that the function $W(\cdot)$ can be rewritten as:

$$W(V_{it}^{j}) = a(V_{it}^{j})V_{it}^{j},$$

where $a(V_{it}^{j}) = a_1 1\left(V_{it}^{j} \in [0, 500)\right) V_{it}^{j} + a_2 1\left(V_{it}^{j} \in [500, 1000)\right) V_{it}^{j} + a_3 1\left(V_{it}^{j} \in [1000, \infty)\right) V_{it}^{j}$.

In the limit case where the function $a(\cdot)$ is continuous, I have $a' < 0$, and $\epsilon_{it}^{j} \equiv \underbrace{\frac{\partial W_{it}^{j}}{\partial V_{it}^{j}}}_{-} \underbrace{\frac{V_{it}^{j}}{W_{it}^{j}}}_{+} < 0$, which would imply $\psi_{it}^{j} \equiv 1 + \epsilon_{it}^{j} < 1$.

A.1.2 Non-linear pricing - Two-part Tariff

Let us now consider the case where the firm has to pay a "fee" to buy imports (such as an import license for entry), after which it can buy intermediates at a fixed unit cost a. The total price of V_{it}^j units of the inputs is

$$C(V_{it}^j) \equiv W(V_{it}^j)V_{it}^j = F + aV_{it}^j$$

If the firm takes the fee into account (the fee is not sunk from the firm's point of view), then

$$W(V_{it}^j) = \frac{F + aV_{it}^j}{V_{it}^j},$$

which implies that $\frac{\partial W_{it}^j}{\partial V_{it}^j} = -\frac{F}{V_{it}^{j2}} < 0$,and therefore $\psi_{it}^j \leq 1$. Otherwise, if fee is considered a sunk cost, $W(V_{it}^j) = a$ and the firm behaves as a price taker in the input market, such that $\psi_{it}^j = 1$.

A.2 Proxy Control Function for Unobserved Productivity

Let us consider a setting where heterogeneous firms produce output using two variable inputs: domestic intermediates m_i, and foreign intermediates x_i. The market for domestic material is competitive, such that firms take price w_i^m as given. The price w_i^m is allowed to vary by firms due to quality differences across firms. The market for x_i is not perfectly competitive, and I let ψ_i denote the degree of firms buyer power in the market for foreign intermediates. This environment is similar to the one I consider for the theoretical model in section 4, and the reader should refer to that section for the derivation of the main equations. In particular, it can be shown that the demand for the two productive inputs (conditional on state variables) is given by

$$x_i = f(\omega_i, \psi_i, w_i^x, w_i^m | \varsigma_i) \tag{45}$$

$$m_i = g(\omega_i, \psi_i, w_i^x, w_i^m | \varsigma_i), \tag{46}$$

where ω_i is unobserved firm productivity, w_i^v with $v = x, m$ are the variable input prices, and **&** is the vector of state variables. Since the competitive input m_i is monotonically decreasing in ψ_i, the second expression can be inverted to write:

$$\psi_i = \tilde{g}(\omega_i, w_i^x, w_i^m, m_i). \tag{47}$$

I can now write $m_i = \tilde{m}_i - (w_i^m - \bar{w}^m)$, where $\bar{w}^m$ is the material deflator in the relevant industry, and I can further write, as argued in the main text, $(w_i^m - \bar{w}^m) = w(p_i, G_i)$, given the assumption that the domestic market is perfectly competitive. Putting all pieces together, the demand for intermediate can be written as:

$$x_i = x(\omega_i, m_i, w_i^x, w_i^m | \varsigma_i) \tag{48}$$

$$= x(\omega_i, \tilde{m}_i, w_i^x, p_i, G_i | \varsigma_i), \tag{49}$$

such that productivity ω_i is the only unobserved *scalar* entering the input demand. Since imported input demand is monotonically increasing in firm TFP, I can invert (49) to get

$$\omega_i = h\left(x_i, \tilde{m}_i, w_i^x, p_i, G_i | \varsigma_i\right), \tag{50}$$

which is equation (18) in the main text.

A.3 2 Steps GMM Estimation of the Production Function

In the main text, I derived the main estimating equation as:

$$\begin{aligned} q_{it} =& \beta_l l_{it} + \beta_k \tilde{k_{it}} + \beta_m \tilde{m}_{it} + \beta_x x_{it} + B(p_{it}, ms_{it}, \mathbf{G}_i; \mathbf{fi}) \\ &+ h_t(\tilde{k}_{it}, l_{it}, G_i, \Phi_{it}, w_{it}^x, p_{it}, \tilde{m}_{it}, x_{it}). + \epsilon_{it}. \end{aligned} \tag{51}$$

To estimate (51), I follow the 2-steps GMM procedure in Ackerberg et al. (2015). First, I run OLS on a non-parametric function of the dependent variable on all the included terms. Specifically, I run OLS of $\tilde{q_{it}}$ on a third order polynomial of $(l_{it}, \tilde{k_{it}}, \tilde{m}_{it}, x_{it}, p_{it}, w_{it}^X, G_i)$:

$$q_{it} = \phi_t(l_{it}, \tilde{k_{it}}, \tilde{m}_{it}, x_{it}, p_{it}, w_{it}^X, G_i) + \epsilon_{it}. \tag{52}$$

The goal of this first stage is to identify the term $\hat{\phi_{it}} \equiv \hat{q_{it}} - \hat{\epsilon}_{it}$, which is output net of unanticipated shocks and/or measurement error. The second stage identifies the production function coefficients from a GMM procedure. Let the law of motion for productivity be described by:

$$\omega_{it} = g(\omega_{it-1}) + \xi_{it}, \tag{53}$$

where I approximate $g(\cdot)$ as a second order polynomial in all its arguments. Using (51) and (52) I can express ω_{it} as

$$\omega_{it}(\mathbf{fi}) = \hat{\phi}_{it} - \left(\beta_l l_{it} + \beta_k \tilde{k_{it}} + \beta_m \tilde{m}_{it} + \beta_x x_{it} - (\beta_k + \beta_m) b(p_{it}, ms_{it}, \mathbf{G}_i)\right), \tag{54}$$

which I can substitute in (53) to derive an expression for the innovation in the productivity shock $\xi_{it}(\mathbf{fi})$ as a function of only observables and unknown parameters β. Given $\xi_{it}(\mathbf{fi})$, I can write the moments identifying conditions as:

$$\mathbb{E}\left(\xi_{it}(\beta) \ \mathbf{Y}_{it}\right) = 0, \tag{55}$$

where $\mathbf{Y}_{it}$ contain lagged domestic and foreign materials, current capital and labor, lagged output prices, market shares, and their higher order and interaction terms. The identifying restrictions are that the TFP innovations are not correlated with current labor and capital, which are thus assumed to be dynamic inputs in production, and with last period domestic and imported materials, and prices. These moment conditions are fully standard in the production function estimation literature (e.g. Levinsohn and Petrin (2003); Ackerberg et al. (2015)). I run the GMM procedure on a sample of firms that simultaneously import and export for two consecutive years. In particular, I follow the procedure suggested in Wooldridge (2009) that forms moments on the joint error term $(\xi_{it} + \epsilon_{it})$. Finally, the standard errors on the coefficients are obtained using blockbootstrapping, where I draw an entire firm time series.

B Theoretical Model

B.1 Proof of Proposition 2

To ease exposition, I consider a world where firms are not heterogeneous in productivity, namely $\phi_i = \phi_j = \phi$ for any firm pair (i, j). I first derive the aggregate equilibrium in a world with no heterogeneity in market power, i.e. $\psi_i = \psi_j = \psi$, where $\psi = e^{\mu_x}$ is the average level of buyer power in the economy. I then consider an economy where buyer power is heterogeneous across firms, and in particular I consider a mean preserving spread of the distribution of ψ across firms. In the second economy, ψ is randomly distributed across firms according to a log-Normal distribution $\psi \sim \text{Lognormal}(\mu_x, \sigma_x^2)$.

Economy with homogeneous firms Let $\psi_i = \psi_j = \psi$. From market clearing condition for labor in the one sector economy, I can derive:

$$l_i = L, \tag{56}$$

where L is the inelastic labor supply. It is easy to show that in equilibrium firm-level output q is given by

$$q = \phi \left(\frac{1}{\beta}\right)^{-\mathbf{fi}} \left(\frac{W^l}{1-\beta}\right)^{\mathbf{fi}} \tilde{\psi}^{-\beta\kappa_2} L.$$

Because each firm is a representative firm, aggregate output can be written as

$$Q = \Gamma \cdot \psi^{-\beta\kappa_2} \cdot \phi \cdot L,$$

where $\Gamma \equiv \left(\frac{1}{\beta}\right)^{-\mathbf{fi}} \left(\frac{W^l}{1-\beta}\right)^{(1-\mathbf{fi})}$ denotes aggregate prices.

In the counterfactual world where the representative firm has no buyer power, aggregate output is given by $Q^{EFF} = \Gamma \cdot \phi \cdot L$, so that

$$\log \hat{Q} \equiv \log Q / Q_{EFF} = a_1 \mu_x,$$

where $a_1 = -\frac{\beta}{1+\eta\left(1+\frac{\rho\mathbf{fi}}{1-\rho}\right)} < 0$.

Heterogeneous buyer power across firms I now consider a world where firms are heterogeneous in buyer power. I now have

$$\frac{l_i}{l_j} = \left(\frac{\psi_i}{\psi_j}\right)^{-\kappa_3}$$

such that, using labor market clearing,

$$l_i = \frac{\psi_i^{-\kappa_3}}{\int_0^{M_s} \psi_i^{-\kappa_3} \mu(i) di} L, \tag{57}$$

where $\mu(i)$ is the mass of firms with buyer power ψ_i. I can write aggregate output as:

$$
\begin{aligned}
Q^\rho &= \int_{i\in M} q_i^\rho \mu(i)di \\
&= \left(\frac{1}{\beta}\right)^{-\mathbf{fi}\text{æ}} \left(\frac{W^l}{1-\beta}\right)^{(1-\mathbf{fi})\rho} \phi^\rho \int_0^1 \left(\psi_i^{-\beta\rho\kappa_2} l_i^\rho\right) \mu(i)di \\
&= \left(\frac{1}{\beta}\right)^{-\mathbf{fi}\text{æ}} \left(\frac{W^l}{1-\beta}\right)^{(1-\mathbf{fi})\rho} \phi^\rho \left(\int_0^1 \psi_i^{-\kappa_3}\mu(i)di\right)^{1-\rho} L^\rho \\
Q &= \Gamma \cdot \phi \cdot \left(\int_0^1 \psi_i^{-\kappa_3}\mu(i)di\right)^{\frac{1-\rho}{\rho}} \cdot L
\end{aligned}
$$

where I used $-\beta\rho\kappa_2 - \rho\kappa_3 = \frac{-\beta\rho}{1-\rho+\eta(1-\rho(1-\mathbf{fi}))} = -\kappa_3$. In the counterfactual world where all firms have zero buyer power, aggregate output is again given by $Q^{EFF} = \Gamma \cdot \phi \cdot L$, so that

$$
Q/Q_{EFF} = \left(\int_0^1 \psi_i^{-\kappa_3}\mu(i)di\right)^{\frac{1-\rho}{\rho}}.
$$

I now impose distributional assumptions on ψ, which I consider exogenous objects. In particular, I assume that buyer power ψ is distributed log Normal, i.e. $\psi \sim \log \text{Normal}\left(\mu_x, \sigma_x^2\right)$,such that I can write

$$
\log Q/Q_{EFF} = \log \left(\int_0^1 \psi_i^{-\kappa_3}\mu(i)di\right)^{\frac{1-\rho}{\rho}} = \frac{1-\rho}{\rho} \log \mathbb{E}\left(\psi^{-\kappa_3}\right)
$$

Using the properties of the log-Normal distribution, it is easy to show that[29]

$$
\log \hat{Q} = a_1\mu_x + a_2\sigma_x^2
$$

where $a_1 = -\frac{\beta}{1+\eta\left(1+\frac{\rho\mathbf{fi}}{1-\rho}\right)} > 0$, and $a_2 = \frac{\beta^2\rho}{2\left(1+\eta\left(1+\frac{\rho\mathbf{fi}}{1-\rho}\right)\right)^2} > 0$.

B.2 Discussion

Efficiency of the Equilibrium with Buyer Power I showed in the main text that buyer power generates important distortions in both the firm-level and the aggregate-level equilibrium. These distortions are derived as compared to a benchmark where all firms are

[29] In particular, if $X \sim \text{Lognormal}(\mu, \sigma^2)$ then $X^a \sim \text{Lognormal}(a\mu,\ a^2\sigma^2)$ for $a \neq 0$, and such that $\log \mathbb{E}(X^a) = a\mu + \frac{1}{2}a^2\sigma^2$.

competitive buyers in input markets. Note that the existence of this type of distortions does not necessary imply that the equilibrium is inefficient. In fact, firms make positive profits in the distorted equilibrium, which I assume are rebated to consumers in form of dividends. This means that consumers might actually gain from buyer power. In order to see this, consider the equation for total income of individuals in (42). On the one hand, income increases due to higher profits. On the other hand, the price of capital, and capital income thereof, decreases in the distorted equilibrium. This means that the overall effect on welfare is unclear, and depends on which one of these forces is stronger. Clearly, if I considered a setting with heterogenous agents, where profits are concentrated in a small number of individuals, buyer power will generate winners and losers, because only a few individuals will enjoy the positive income effect due to higher profits, while all consumers will face higher prices in equilibrium. I quantify these effects in the Section 5.

Heterogeneous Markups and Buyer Power In the model, I assumed a CES demand for firm varieties, which is widely known to imply constant markups across firms. However, I showed the results for the distribution of markups in the economy which highlighted that markups are far from being constant across firms. One might thus wonder what are the implications of having variable markups in the model. In Section (**??**) of the appendix, I describe a version of the model where firms can charge different markups for their final products. Although the equilibrium impact of variable markups is well-known in the literature of markups and misallocation (e.g. Epifani and Gancia, 2011; Peters, 2016), the results in the appendix point out one main difference between input and output market power, that is that while the former generates inefficiencies at the firm-level by distorting the relative input price, and hence the optimal input mix, output market power does not. This has important implications in terms of the aggregate equilibrium: while dispersion is good in the case of buyer power, because it generates an *efficient reallocation* of productive inputs from less to more competitive firms (low ψ) which partially offset the sub-optimal input mix (i.e. Proposition 2), dispersion in markups is bad, because it generate a *intra-sectoral misallocation*, whereby less competitive firms (high μ) attract a sub-optimally low amount of inputs (cf. Epifani and Gancia, 2011).

B.3 Data Appendix

B.3.1 Variable Construction

Output is measured as total firm sales in a given year, deflated by the STAN industry output deflator. Labor is measured as the total number of "full-time equivalent" employees in a given year. The FICUS Dataset also includes a measure of firm-level cost of salaries, which I use to derive firm-level wages by dividing total cost of labor by total firm employment. I derive (and try) two different measures of the capital input. For the first "rough" measure, I take the book value of capital reported at the historical value, infer a date of purchase from the installment quota given a proxy lifetime duration of equipments, and then use deflators[30]. The second and preferred measure of capital is constructed using a perpetual inventory method, i.e. $K_t = (1 - \delta_s)K_{t-1} + I_t$. I consider the book value of capital on the first year of activity of the firm as the initial level, and take the values for the depreciation rate δ_s, where s indicates that i might vary by sector, from Olley and Pakes (1996).

I construct the foreign intermediate input using information on all firm imports of intermediate inputs. In order to identify which imported product is used in production by the firm, I use the Broad Economic Classification (BEC) to identify NC8 digit products as intermediates, and restrict the attention to imports of intermediates only. My results are robust to using alternative definitions of foreign intermediates. I obtain my measure of physical units of the foreign intermediate input x_{it} by deflating total firm expenditure on imported intermediates by the firm-level input price w^x_{it}, i.e. $x_{it} = e^x_{it} - w^x_{it}$. The domestic intermediate input m_{it} is then constructed by first subtracting total expenditure on foreign intermediates from the total expenditure on wares and inputs reported in the fiscal files (Blaum et al. (2018)), and then deflating by an industry-wide price of material input.

B.3.2 Firm-Level Output Prices

The average "international" firm exports multiple products in different destinations. For this firm, the concept of "firm-level" price is inherently an average across firm-product prices. Let p_{ipct} the price that firm i charges for product p in destination market c. I let firm-product markup vary across different destinations, so I write (log) markup in destination c as:

$$\mu_{ipct} = \bar{\mu}_{ipt} + \hat{\mu}_{ipct}, \tag{58}$$

[30] I thank Claire Lelarge for this suggestion

where $\hat{\mu}_{ipct}$ is the deviation in country c from average firm-product markup $\bar{\mu}_{ipt}$. I can now write the (log) price p_{ipct} as (log) markup plus marginal costs, i.e.:

$$p_{ipct} = mc_{ipt} + \mu_{ipct} = p_{ipt} + \hat{\mu}_{ipct}, \tag{59}$$

where $p_{ipt} \equiv mc_{ipt} + \bar{\mu}_{ipt}$ is the sum of the log marginal cost of the product and the average (log) product markup, and therefore represents a measure of the average product price across destinations. The important assumption here is that marginal cost of the product does not vary across destinations, a standard assumption in the literature of pricing to market (e.g. Burstein and Gopinath (2014)).[31]

Equation (59) suggests that I can run fixed effects OLS on

$$\log uv_{ipct} = \theta_{it} + \gamma_{pct} + \varepsilon_{fint}, \tag{60}$$

where θ_{it} are firm-time fixed effects and the γ_{ipt} are firm-product-time fixed effects. I define uv_{ipct} the unit value that firm i charges for product p in country c in year t, calculated as total sales divided by units of physical quantity. The product-country-time fixed effects (γ_{pct}) capture the average price of a particular product sold in a given market-year by French firms. Therefore, the firm-year effects θ_{it} measure firm-level average output (export) prices purged of effects due to the composition of products and demand. I define firm-level average output prices to be equal to these OLS estimates, namely $p_{it} = \hat{\theta}_{it}$.

B.3.3 Classification of Industries

I consider 17 manufacturing industries, based on the ISIC (International Standard Industrial Classification) Rev. 3. Sectors 15-35 of the ISIC 3 are classified as manufacturing sectors. Among those, I drop sectors 16 ("Tobacco Products"), 23 ("Coke, Refined Petroleum Products") and 30 ("Office, Accounting and Computing Machinery") for insufficient number of observations in the selected sample. I also drop sector 32 ("Radio, Television and Communication Equipment and Apparatus") for lack of precision in the production function estimation. Table A1 presents the industry classification and the number of firms and observations for each industry $s \in \{1, .., 17\}$.

[31] In a recent paper, Bastos et al. (2018) find evidence that firms actually adjust the quality (and therefore the marginal cost) of their goods across different destinations. Even if this was the case, and therefore marginal costs of exported goods systematically varied across destinations, the price index I compute can still be valid if firms adjust their markups and marginal costs proportionally in each destinations, i.e. in a way that differences in prices across firms within product-country still reflect differences in quality and markups.

TABLE A.VIII MANUFACTURING SECTORS, AND SAMPLE SIZE

	INDUSTRY	NO OF OBS. [a]	NO FIRMS	% SUPER INTL FIRMS
C15	Food Products and Beverages	17,917	1506	0.66
C17	Textiles	11,620	989	0.49
C18	Wearing Apparel, Dressing and Dyeing Fur	10,046	860	0.43
C19	Leather, and Leather Products	3,741	321	0.51
C20	Wood and Products of Wood and Cork	6,727	573	0.68
C21	Pulp, Paper and Paper Products	6,053	508	0.56
C22	Printing and Publishing	8,236	693	0.70
C24	Chemicals and Chemical Products	13,656	1141	0.39
C25	Rubber and Plastic Products	14,632	1230	0.64
C26	Other non-metallic Mineral Products	6,200	520	0.60
C27	Basic Metals	4,359	364	0.53
C28	Fabricated Metal Products	25,479	2140	0.69
C29	Machinery and Equipments	21,092	1769	0.56
C31	Electrical machinery and Apparatus	6,634	555	0.39
C33	Medical, Precision and Optical Instruments	10,267	858	0.38
C34	Motor Vehicles, Trailers & Semi-Trailers	4,558	382	0.53
C35	Other Transport Equipment	2,736	229	0.39

Notes: The table reports the list of manufacturing sectors, the total number of observations and the total number of firms in each sector (average over 1996-2007). [a] The number of observation refers to the sample of ALL international firms.

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