Market Power in Input Markets:

Theory and Evidence from French Manufacturing*

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Abstract

This paper documents the market power of large importing firms in foreign input markets, and evaluates its effects on the aggregate economy. I develop an empirical methodology to consistently estimate buyer power at the firm level. I apply the methodology to study imperfect competition in the market for foreign intermediate inputs, using longitudinal data on trade and production of French manufacturing firms from 1996-2007. My results show that buyer power is substantial, concentrated in key sectors, and it significantly correlates with the size and productivity of the firm. I then show that, in a simple general equilibrium model of production, buyer power has large distortionary effects, both at the firm and the economy level. This type of distortion could cost around 0.2% of total GDP in France. My analysis suggests that policies that spur import market integration can reduce the scope of buyer power and thus play a key role in stimulating aggregate production.

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1 Introduction

A significant body of theoretical and empirical research has analyzed market power among sellers of goods. By contrast, market power on the *buyers'* side has been largely underexplored. Yet large buyers now figure prominently as a salient feature in many sectors of the economy, and their ability to force sellers to lower prices below competitive levels is raising concerns among competition authorities and policymakers.[1,2] Consider the example of Zara, one of the world's largest fashion manufacturers. Zara has sustained a remarkable growth in profits over the last decade, despite a thick market downstream that results in intense price competition. While there are many possible explanations for Zara's increasing margins, a cost advantage may plausibly be a significant factor. The company largely outsources its production to low-income countries, where it has a dominant buyer position. This position could potentially be used to extract low prices. Such behavior would generate distortions even beyond the input market, because downstream competitors might be unable to rival the dominant buyer's low input prices, and/or because of allocative inefficiencies in production.[3]

This paper takes a step towards filling the existing gap in the literature, and documents the market power of buyers in *foreign input markets*, a setting where this type of distortion is likely to emerge. I lay out a methodology to consistently estimate buyer power at the firm level. Using longitudinal data on firm trade and production, I apply this methodology to measure the extent of buyer power in the market of foreign intermediate inputs in a large economy: France. Based on the empirical findings, I incorporate oligopsony power in a workhorse static general equilibrium model of a production economy and study its effect on the equilibrium (mis)allocation of resources across heterogeneous firms. Finally, I bring together model and empirics to quantify the magnitude of these effects for the French manufacturing sector.

My starting point is a simple theoretical framework where cost minimizing producers choose the optimal quantity of at least two variable inputs free of adjustment costs. My conceptual framework builds on existing work in the literature on markup estimation (Hall, 1988; De Loecker and Warzynski, 2012; De Loecker et al., 2016), generalizing their underlying model

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

[2] Hereafter, I am going to use the terms "buyer power" and "input market power" interchangeably. Noll (2004) defines buyer power as "the circumstance in which demand side of a market is sufficiently concentrated that buyers exercise market power [..] Thus, buyer power arises from monopsony (one buyer) or oligopsony (a few buyers), and is the mirror image of monopoly or oligopoly".

[3] The same line of reasoning is easily applicable to other sectors, such as retail, e.g. Amazon and Walmart, or services, e.g. Uber.
As an economic issue, market power of firms (not necessarily associated to output markets only) has recently received renewed attention in the economic literature, due to its plausible connection to a number of trends common to many rich countries, such as the rising concentration and profit margins of large corporations. See, e.g. Barkai (2016); Blonigen and Pierce (2016); De Loecker and Eeckhout (2017); Zingales (2017).

of firm behavior to account for imperfect competition in input markets. I allow for imperfect buyers competition by allowing input prices to be a flexible function of the demand of the firm. In this framework, the market power of the buyer in a given input market is identified as an input efficiency wedge in her first order condition for that input. I show that this wedge can be expressed as a function of the revenue share of the input, namely the share of expenditure on the input over total firm revenues, its output elasticity, and the firm's markups over marginal costs. By exploiting the first order conditions of *two* variable inputs, I then obtain a system of two equations in three unknowns (one seller markup, and two buyer markups), which can be manipulated to obtain an expression for the buyer markups as a function of only revenue shares and output elasticities. The revenue shares are directly available in most production datasets, whereas the output elasticities can be obtained from standard production function estimation.

I specify the production function of the firm as a function of capital, labor, domestic materials and foreign materials. The material inputs, which I construct as firm-level aggregates, are the two variable inputs of interest. Throughout the empirical analysis, I maintain the assumption that firms are price takers in the market of the *domestic* material input, which enables me to pin down the *level* of buyer power in the *foreign* market, in comparison to this competitive benchmark.

I estimate the output elasticities of the productive inputs using state-of-the-art techniques from the production function estimation literature (e.g. Ackerberg et al., 2015). The lack of data on both physical units and price of inputs and output at the firm level can present an important challenge here. A well-known problem associated with using *nominal* instead of *physical* measures of the production units is the existence of severe biases in the estimates of the production function, due to demand shocks, markups, and input market power (cf. Foster et al., 2008; Katayama et al., 2009; De Loecker and Goldberg, 2014). Existing approaches to these so-called *price biases* involve restrictions on competition in both the input and output markets. In particular, due to data limitations, all input markets are usually assumed perfectly competitive (e.g. De Loecker et al., 2016).

I am able to tackle both these issues by constructing measures of firm-level prices of output and the imported input from the observed firm-product-country export and import unit values. I thus dispense with the need to impose perfect competition in the foreign input market. I first derive, for each product (or product-country) category, the deviation of the firm price from the industry average. I then aggregate these normalized firm-product prices at the firm level, by taking weighted averages, with weights given by the share of each product in total firm imports or exports. The resulting quantity provides a measure of how much the output or imported input price of a firm deviates on average from the industry price, and is thus well-suited to control for unobserved price differences across firms. Finally, I combine these price measures and existing bias correction approaches to address the estimation biases in an internally consistent way.

I use longitudinal data on firm trade and production for the French manufacturing sector over the period 1996-2007, and apply this methodology to study imperfect competition in the market for foreign intermediates. Imported intermediate inputs are an important feature of a country's economic performance. 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, a large body of existing empirical literature documents that trade in intermediates has important implications for firm-level and aggregate-level economic outcomes, such as productivity and welfare (Goldberg et al., 2010; Halpern et al., 2015). The fragmented nature of the global marketplace, where input markets are often specialized or localized in nature due to formal or informal trade barriers, along with the concentration of imports in a small number of large firms (Bernard et al., 2007a), makes the market power of downstream firms a potentially important economic issue in this setting.

My empirical results provide evidence that firms exercise significant buyer power in the foreign input market, both within and across industries. Specifically, the evidence shows that the average firm spends *too little* on the foreign input relatively to the domestic one, given what one would expect in light of their output elasticities. I interpret this finding to suggest that firms curb the demand of the foreign input in order to keep its price low, and hence that buyer power is important. This particular structural interpretation of the input efficiency wedge is supported by several facts, and observations. Across industries, I find that average buyer power is high in sectors where inputs are exchanged in localized and spatially differentiated markets (e.g. livestock, unprocessed food), and are characterized by large transportation or storage factors (e.g. iron ore). These distinctive structural market characteristics have been associated to monopsony power (e.g. Kerkvliet, 1991; Rogers and Sexton, 1994; Bergman and Brännlund, 1995 for the mining, food, and wood sector, respectively). Firm-level evidence further shows that buyer power is positively and significantly correlated with firm size and productivity. To give an example, suppose that the geographic mobility of a given input is restricted, such that the sellers have access to only those buyers who are able to reach the production site in a cost-effective way. Because larger firms have superior sourcing technology, they can easily reach those production sites where this type of friction is relevant, and hence they are more likely to be in the position to take advantage of (constrained) sellers.

In order to investigate the implications of market power of buyers for the aggregate economy, in the second part of the paper I employ the empirical findings and incorporate oligopsony power in a simple static general equilibrium model of a production economy. In the model, I make two important assumptions: first, that there are increasing marginal costs in the production of an horizontally differentiated intermediate input, which implies that the correspondent input supply curve has finite elasticity, and hence that there exist rents in the input market; second, I assume that buyers exercise market power, and seek to transfer rents from the sellers' to the buyers' side of the market. The source of market power of buyers is their positive market share in the market of the foreign intermediate input, which I allow to vary across firms due to the heterogeneity in the size of the demand of their competitors upstream. In order to simplify the exposition, I rule out strategic interactions among buyers.

Buyer power generates equilibrium distortions along several channels. At the individual firm level, firms with higher buyer power: *(i)* buy fewer inputs, *(ii)* have a higher capital-intermediate ratio, and *(iii)* produce less output. From an aggregate standpoint, it is shown that total output decreases with the average degree of buyer power in the sector. This effect is due to the fact that the distorted input is supplied elastically, together with the fact that all firms underproduce relative to the input-competitive equilibrium. By contrast, it is shown that the *dispersion* in buyer power across firms has a *positive* effect on output, due to an *efficient reallocation* of the inelastically-supplied input from more to less distorted firms, that partially offsets the already sub-optimal input mix. This results stands in contrast with a well-known result in the literature of markups of sellers and misallocation, whereby heterogeneous *seller* markups generate an intra-sectoral *misallocation* (Epifani and Gancia, 2011). The asymmetry between input and output market power has to do with the fact that while market power of sellers does not affect the input allocative efficiency of individual firms, market power of buyers alters the relative price of productive inputs, generating a within-firm inefficiency.

I then aim to evaluate how much output is lost due to the existence of buyer power. The model is easy to fit to the data, given that the estimation procedure in the first part of the paper returns direct estimates of almost all the unknown model parameters, together with firm-level estimates of input market power, and productivity. The results show that total manufacturing output would increase by 3% in a counterfactual economy where all firms have the lowest admissible degree of buyer power. A simple back-of-the-envelope calculation reveals that in terms of total French GDP, the estimated cost of this type of distortion is 0.2%. However, the effect of buyer power on the overall welfare of individuals is harder to assess. On the one hand, the output distortion implies that consumers face higher prices, and that the returns to the domestic input are lower. On the other hand, firms in the distorted economy make higher profits, and to the extent that these profits are rebated to consumers in form of dividends, buyer power generates a positive income effect in the economy. An in-depth analysis of the welfare implications of buyer power is beyond the scope of the paper, yet my results suggest that this exercise could constitute a fruitful direction for future research.

A straightforward policy recommendation that emerges from my model is that in order to spur the aggregate production of an economy, trade policy should foster import market integration, so as to make a larger number of buyers available to foreign producers, and thus reduce the scope of buyer power of large importers. In this sense, trade policy could implicitly act as an international antitrust policy.

This paper builds on prevailing related literature. The framework to measure buyer power from production data is based on a generalization of an approach developed by Robert Hall (1986; 1988; 1989) to estimate industry markups.[4] In particular, I build on some recent work by Crépon et al. (2005) and Dobbelaere and Mairesse (2013), who extended the Hall's framework to estimate the degree of imperfect competition in French labor markets. Unlike these authors, I focus on imperfect competition in the market for foreign intermediate inputs; most important, I address several econometric issues in estimation, such as the endogeneity of input choice with respect to unobserved productivity, input and output prices. In this sense, my approach is similar to De Loecker and Warzynski (2012), who first combined the Hall's framework with advanced econometric tools to estimate markups of sellers.

My work also speaks to the literature on production function estimation. To date, empirical studies have ruled out input market power in production function estimation, mostly due to data limitations.[5] By contrast, I allow firms to have market power in the purchase of the imported goods, and still achieve consistency in estimation.

Another literature my paper speaks to is the one on imported intermediate inputs and productivity (Amiti and Konings, 2007; Goldberg et al., 2010; Gopinath and Neiman, 2014; Halpern et al., 2015). This literature finds that firms who use foreign intermediate inputs have higher measured productivity, with positive effects for the aggregate economy (Halpern et al., 2015).[6] 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. These studies use expenditure-based measures of input productivity, and confound the effect of prices and quantity of inputs. My study suggests that buyer power may constitute a significant confounding effect of estimates of productivity of the foreign intermediate inputs.

[4]The idea of conjugating producer theory and econometrics to provide structural estimates of market power has a long tradition in the industrial organization literature (e.g., Iwata, 1974; Appelbaum, 1982; Bresnahan, 1989 together with Hall). Starting in the late eighties, several studies came out that popularized the use of conjectural-elasticity models to test price-taking behavior of firms in *both* input and output markets (Schroeter, 1988; Azzam and Pagoulatos, 1990; Murray, 1995). The majority of these papers specify a structural demand and supply model, and focus on specific industries.

[5]Existing empirical studies assume perfectly competitive input markets, either implicitly, by ignoring any firm-level variations in input prices (e.g. De Loecker and Warzynski, 2012; Ackerberg et al., 2015), or explicitly, in order to narrow down the sources of input price variation (e.g. De Loecker et al., 2016). These approaches are not appropriate in a study of market power, where it is better to avoid such *a priori* restrictions.

[6]Other studies that document a positive welfare effect associated with higher imports of intermediate goods include Amiti and Konings (2007); Goldberg et al. (2010); Gopinath and Neiman (2014); Blaum et al. (forthcoming)

My paper also contributes to the literature on imperfect competition and import trade (e.g. Heise et al., 2016; Krolikowski and McCallum, 2016; Eaton et al., 2016). In the prevailing literature, imperfect competition in import markets arises from search or information frictions. My findings suggest that models of monopsony or oligopsony power of large importers provide an alternative description of the data in a large number of manufacturing sectors.

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

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 a simple framework for estimating input market power at the firm level. I build on existing work in the literature on markup estimation (Hall, 1988; De Loecker and Warzynski, 2012), and generalize their underlying model of firm behavior to account for imperfect competition in input markets. I consider the optimization problem of a firm i, producing output Q_{it} at time t. I assume that the firm uses two variable inputs in production: a *domestic* intermediate input, which I denote by V_{it}^{m}; and a *foreign* intermediate input V_{it}^{x}.[7] I consider domestic and foreign intermediates as firm-level aggregates. As such, I consider them as different *inputs* (e.g. apples vs. oranges), rather than different *varieties* of the same input (e.g. domestic apples vs. foreign apples).[8] I present the conceptual framework and the main results in 2.1; I then describe production function estimation, and how I implement the methodology with the available data in 2.2.

[7]The discussion can be easily generalized to the case where there are $N \geq 2$ variable inputs.

[8]This choice is motivated by the application and data used in this paper, which I describe in section 3. This assumption is validated by a large body of work in the international trade literature showing that imported inputs are different than the domestic ones, both in terms of quality and product characteristics (e.g. Goldberg et al., 2010; Halpern et al., 2015).

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; while $\mathbf{K}_{it}$ is the vector of "dynamic" inputs, subject to adjustment costs, or time-to-build.[9] I restrict to well-behaved production technologies, which means that I 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, which include dynamic inputs ($\mathbf{K}_{it}$), exogenous factors such as firm location, and other payoff-relevant 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 $\mathbf{A_{it}}^j$ denotes other exogenous variables affecting prices. Equation (2) encompasses both perfect and imperfect competition in input markets. In particular, 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 equilibrium input price is endogenous to V_{it}^j, which means $\frac{\partial W_{it}^j}{\partial V_{it}^j} \neq 0$. Note that the key element in (2) is that W_{it}^j is allowed to depend on the quantity of input V_{it}^j chosen by the firm.[10]

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

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

where W_{it}^j denotes the price of input V_{it}^j, and where $\lambda_{it} = \frac{\partial \mathcal{L}}{\partial Q_{it}}$ is the shadow value of the constraint of the associated Lagrangian function, i.e. the marginal cost of output. Equation (3) says that the *effective* marginal cost of the input, that is the shadow value of an additional

[9] Although I assume $\mathbf{V_{it}} = \{M_{it}, X_{it}\}$, note that the only requirement that is necessary is that the vector $\mathbf{V_{it}}$ has *at least two* elements.

[10] In particular, equation (2) must not be confused with increasing or decreasing marginal returns in production, which are not incompatible with perfect competition. The important difference is that with decreasing (increasing) marginal returns, input prices increase (decrease) with *total* input demand V_t^j, but in unrelated to firm level actions, i.e. $W_{it}^j = W^j(V_t^j; \mathbf{A_{it}^j})$, with $V_t^j \perp V_{it}^j$.

unit of the input, i.e. $\lambda_{it}\frac{\partial Q_{it}(\cdot)}{\partial V_{it}^j}$, is equal to the unitary price (cost) of employing that *additional* unit, i.e. W_{it}^j, plus an extra term $\frac{\partial W_{it}^j}{\partial V_{it}^j}V_{it}^j$, that reflects the change in the unitary price (cost) of the *infra-marginal* units due to the higher input demand. This last term captures imperfect competition in the market o f input j, and in particular the endogeneity of input prices with respect to individual demand. Rearranging terms and multiplying both sides by $\frac{V_{it}^j}{Q_{it}}$ gives:

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

$$= \frac{1}{\lambda_{it}}\frac{W_{it}^j V_{it}^j}{Q_{it}}\psi_{it}^j \tag{5}$$

Equation (4) looks similar to the one often used in the literature of markup estimation (e.g. De Loecker and Warzynski, 2012). The main difference is the extra term $\psi_{it}^j \equiv \left(1+\frac{\partial W_{it}^j}{\partial V_{it}^j}\frac{V_{it}^j}{W_{it}^j}\right)$ in the right hand side, which in the prevailing literature is always assumed equal to one. By constrast, the term ψ_{it} is now allowed to take values $\psi_{it}^j \neq 1$ when the market of input j is imperfectly competitive.

I consider ψ_{it}^j as the measure of firm's input market power in the market of $j = \{m, x\}$. Note that ψ_{it}^j is identified from the wedge between the effective marginal cost of the input and the supply price of the input, i.e. W_{it}^j. These terms coincide when there is perfect competition in the input market. Therefore, I identify input market power an *input efficiency wedge* in the first order condition of the variable input.

Let $\beta_{it}^j \equiv \frac{\partial Q_{it} V_{it}^j}{\partial V_{it}^j Q_{it}}$ denote the output elasticity of input V_{it}^j, 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 (4) for $j = x, m$ as:

$$\beta_{it}^x = \frac{P_{it}}{\lambda_{it}} \cdot \alpha_{it}^x \cdot \psi_{it}^x, \tag{6}$$

and

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

The term $\frac{P_{it}}{\lambda_{it}}$ is the ratio of firm output price and marginal costs, which measures a firm's markups. Note that this term is common to the two first order conditions, which means that we can divide (7) by (6) to write

$$\frac{\beta_{it}^x/\alpha_{it}^x}{\beta_{it}^m/\alpha_{it}^m} = \frac{\psi_{it}^x}{\psi_{it}^m}. \tag{8}$$

Equation (8) shows that the (relative) input market power of the firm in the two markets can be expressed as a function of two objects: the output elasticities of the inputs, and their revenue shares. This result 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 provides a simple test of the assumption of perfect competition in all input markets, which is maintained in the prevailing literature. In particular, if all markets were perfectly competely we should observe that $\frac{\beta^x_{it}/\alpha^x_{it}}{\beta^m_{it}/\alpha^m_{it}} = 1$. Second, equation (8) suggests that the *level* of input market power can be pinned down by normalizing one of the two buyer markups. In particular, if we fix the value of buyer power in the domestic market as $\psi^m_{it} = 1$, input market power in the market of foreign intermediates can be derived as:

$$\psi^x_{it} = \frac{\beta^x_{it}}{\beta^m_{it}} \cdot \left(\frac{\alpha^x_{it}}{\alpha^m_{it}}\right)^{-1}. \tag{9}$$

Suppose that the foreign intermediate input x were twice as productive as the domestic input m (as measured by the output elasticities). Equation (9) says that if distortions in the foreign input market were absent (i.e. $\psi^x_{it} = 1$), the firm would spend twice as much on the foreign input as it does on the domestic one. Input market power is thus estimated positive (negative), insofar as we observe the firm spending too little (too much) on the foreign intermediate input relatively to the domestic one, in light of the differences in their output elasticities.

How Can ψ be Interpreted? - The conceptual framework set forth in this section encompasses a number of models of imperfect competition in the input markets. The structural interpretation of the input market power parameter ψ^x_{it} varies depending on which specific model is assumed. The buyer power interpretation of ψ_{it} is accurate in models of monopsonistic or oligopsonistic competition in the input market. In these settings, the general mapping in (2) corresponds to the inverse of the input supply function, and ψ_{it} is a function of the input supply elasticity, which is finite in these models. Moreover, ψ_{it} takes values $\psi^x \geq 1$, which imply that the share of expenditure on the foreign input is *lower or equal than* the competitive level.[11] In general, values of $\psi^x < 1$ are also admissible. Dobbelaere and Mairesse (2013) show that in a worhorse model of efficient bargaining of the labor markets, the term $\psi^j \in (0, 1)$ is a function of the relative bargaining power of firms (buyers) and workers (sellers). Therefore, although in this paper I only focus on the buyer power interpretation of ψ , the methodology is portable across a variety of applications.

[11]In the labor literature, the term $\psi^x > 1$ 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.

Output Market Power and Joint Efficiency Wedge - So far, my discussion has abstracted from the markups of the firms as *sellers.* All the results I derived so far hold regardless of how the firm behaves in the output market. Nevertheless, the conceptual framework has many elements in common with existing studies of sellers' markups, where markups are identified as the ratio between the output elasticity and the revenue share of any input free of adjustment costs (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. $\mu_{it} = \frac{P_{it}}{\lambda_{it}}$ (cf. De Loecker and Warzynski, 2012). The first order condition in (6) then becomes:

$$\frac{\beta_{it}^j}{\alpha_{it}^j} = \mu_{it} \cdot \psi_{it}^j \equiv \Xi_{it}^j, \text{ for } j = \{m, x\}. \tag{10}$$

Equation (10) shows that in general setting, the ratio between the output elasticity and revenue share of an input reflects *both* input and output market power of a firm. I define the right hand side of equation (10) as the *joint efficiency wedge* of any variable input $j = \{x, m\}$. Only when input markets are perfectly competitive, such that $\psi_{it}^j = 1$, does the ratio correctly identify markups as

$$\Xi^j = \mu_{it} = \frac{\beta_{it}^j}{\alpha_{it}^j}. \tag{11}$$

However, if buyer power is (mistakenly) overlooked, existing approaches would *overestimate* the true level of markups and output market power. As a final remark, note that under the normalization $\psi^m = 1$, one can identify *both* input and output market power from equations (9), as noted above, and (11), by setting $j = m$.

2.2 Empirical Strategy and Output Elasticities

In this subsection I describe how I obtain estimates of the output elasticities, given the available data. In order to ease exposition, and because this is the functional form I use for estimation, I assume a Cobb-Douglas specification of the production technology, which means that (1) becomes

$$q_{it} = \beta_l l_{it} + \beta_k k_{it} + \beta_m m_{it} + \beta_x x_{it} + \omega_{it} + \varepsilon_{it}, \tag{12}$$

where lower-case letters denote logs: m_{it} and x_{it} are the (log) material inputs, while l_{it} is labor, and k_{it} is physical capital. I denote with ω_{it} the unobserved shock component that 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. All the results I derive in this section are applicable to more general production functions. I specify the state variable vector as follows:

$$\varsigma_{it} = \{\omega_{it,} k_{it}, l_{it}, G_i, \varPhi_{it}\}, \tag{13}$$

where G_i is firm location and $\varPhi_{it}$ is the firm's import sourcing strategy, i.e. a measure of the extensive margin of import. Including the firm's import sourcing strategy Φ_{it} in the state variables means that the imported material input x_{it} is considered flexible only *conditional* on the import extensive margin, i.e. the set of imported products.

Estimation of the production function in (12) requires dealing with three major sources of bias: unobserved productivity ω_{it} , unobserved input prices, and unobserved output prices. Correcting for the price biases is particularly important in this context, because the approach relies on measures of *physical* output elasticities, which can be estimated only when measures of quantity of output and inputs are available. The prevailing literature of production function estimation has developed methods to control for these biases. However, due to data limitations, existing approaches to the *input price bias* crucially rely on the assumption of perfectly competitive input markets (e.g. Decker et al., 2016). This approach is not (entirely) suitable in this case, because I am interested in studying market power in input markets.

In what follows, I discuss each one of these biases and my bias correction approach, with a particular focus on how I control for input price bias while allowing for market power of firms in the imported input market.

2.2.1 Output Price Bias

In most production datasets, distinct measures of physical units and prices of output are not available. Output is typically measured as total firm revenues, which can be then translated into physical units using industry-wide price deflators. Let q_{it} denote (log) physical output, and $r_{it} \equiv q_{it} + p_{it}$ be total firm revenues. Firm-level measures of output can be obtained as $\tilde{q}_{it} = r_{it} - \bar{p}_t = q_{it} - (\bar{p}_t - p_{it})$, where $\tilde{q_{it}}$ is *deflated* nominal output, $\bar{p}_t$ is the industry deflator, that is a measure of average output price within an industry, and p_{it} is the (unobserved) firm-level price. We can use this definition in equation (12) and write (in vector form):

$$\tilde{\mathbf{q}} = \beta_k \mathbf{k} + \beta_l \mathbf{l} + \beta_m \mathbf{m} + \beta_x \mathbf{x} + (\mathbf{p} - \bar{\mathbf{p}}) + \omega + \varepsilon. \tag{14}$$

If differences in firm-level prices exist, i.e. $(\mathbf{p} - \bar{\mathbf{p}}) \neq \mathbf{0}$, and are correlated with input demand, there is an *output price bias*. Output market power is a potential source of such correlation: firms with high markups charge higher prices, sell less and thus buy less inputs.[12]

[12]The output price bias has been discussed extensively in the literature. For an extensive treatment of the issue, see for example Foster et al. (2008); De Loecker (2011); De Loecker and Goldberg (2014)

In order to address output price bias, I exploit unit values information on exports at the firm-product-country level and construct measures of firm-level prices, which I then use to directly control for $(\mathbf{p}-\bar{\mathbf{p}})$ in (14). The key intuition is that disaggregated price data contains information about the *average* cost and markups of the firm, and on the average price $\bar{p_{it}}$ thereof. I provide a detailed description of how I construct such prices in Section A.1 of the Appendix.

2.2.2 Input Price Bias

Separate measures of price and quantity of inputs are usually not available. Physical measures of inputs are usually constructed by deflating input expenditures by industry-wide input price deflators. An *input price bias* arises insofar as the prices the firm faces deviate from these industry means[13]. Let us define (log) expenditure on input V as $v_{it}^{EXP}=v_{it}+w_{it}^{V}$, and let $\bar{w}_{t}^{V}$ denote the industry deflator for input V. A physical measure of V is obtained as $\tilde{v}_{it}=v_{it}^{EXP}-\bar{w}_{i}^{V}=v_{it}+\left(w_{it}^{V}-\bar{w}_{t}^{V}\right)$. We can thus rewrite (14) as:

$$\tilde{\mathbf{q}}=\boldsymbol{\beta}'\tilde{\mathbf{z}}+\beta_{x}\mathbf{x}+(\mathbf{p}-\bar{\mathbf{p}})+B(\mathrm{w},\boldsymbol{\beta})+\omega+\varepsilon, \tag{15}$$

where $\tilde{\mathbf{z}}=(\tilde{\boldsymbol{k}},\tilde{\boldsymbol{m}})$ collects the inputs for which firm-level prices are not available. Inputs l_{it} and x_{it} are excluded from $\tilde{\mathbf{z}}$, since measures of prices of l_{it} and x_{it} are available at the firm level.

The term $B(\mathrm{w},\boldsymbol{\beta})\equiv\beta_{k}\left(w_{it}^{k}-\bar{w}_{t}{}^{k}\right)+\beta_{m}\left(w_{it}^{m}-\bar{w}_{t}{}^{m}\right)$ reflects (unobserved) price variation, and thus input price bias. To control for $B(\mathrm{w},\boldsymbol{\beta})$, I follow the control function approach developed by De Loecker et al. (2016).[14] I thereby impose the following (estimation) assumption:

Assumption E1 *The markets of* k_{it} and m_{it} *are competitive, and firms take their prices as given.*

Under Assumption E1, and assuming that firms are only vertically differentiated in the final output markets, one could write $B(\mathrm{w},\boldsymbol{\beta})$ as a function of only output prices p_{it}, and exogenous factors $\mathbf{G}_{i}$, i.e.

$$B(\mathrm{w},\boldsymbol{\beta})=b(p_{it},\mathbf{G}_{i};\beta), \tag{16}$$

where p_{it} is the measure of price I construct from the trade data.

Measuring the Imported Intermediate Input - The data on trade include information on price and quantity of *imports* at the firm-product-country level. I use this information to construct measures of firm-level price and quantity of the foreign input x_{it}. Specifically, I first construct a measure of firm-level prices for x, similarly to what I did with output prices. I then consider

[13]The input price bias has received relatively little attention in the literature, despite equivalent to its output counterpart. For a more detailed description of the problem, see De Loecker and Goldberg (2014).

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

the expenditure of each firm on this input, which I deflate using the firm-level input price. This will be my measure of x in equation (2.2.2). Note that, because I use firm-level deflators, the concern of input price bias for input x vanishes.[15]

2.2.3 Simultaneity bias

The last source of bias in equation (12) 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 a static input demand equation, as in Ackerberg et al. (2015).[16] I consider the following (log) demand for the imported input:

$$x_{it} = x_t(\boldsymbol{\varsigma}_{\mathbf{it}}, \mathbf{w}_{\mathbf{it}}, m_{it}, \nu_{it}, \mathbf{G}_i). \tag{17}$$

The demand for x depends on the state vector $\boldsymbol{\varsigma}_{it}$, input price vector $\mathbf{w}_{\mathbf{it}}$, domestic material demand m_{it}, and input quality ν_{it}. I choose to invert the demand for imported rather than (the more conventional) domestic material input because I observe firm-level prices of x_{it}, which means that the *scalar monotonicity* condition is more likely to be satisfied in this case.[17] In section A.2 in the Appendix I show that in a simple model with buyer power, the import demand in (17) is strictly monotonic in productivity conditional on the included variables, which means that it can be inverted to write

$$\omega_{it} = h_t(w_{it}^X, x_{it}, \tilde{k}_{it}, \tilde{l}_{it}, \tilde{m}_{it}, p_{it}, \mathbf{G}_i). \tag{18}$$

I substitute equation (18) in (12) to control for firm's productivity.

2.2.4 Estimation

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

$$\begin{aligned} \tilde{q}_{it} =& \beta_l l_{it} + \beta_k \tilde{k_{it}} + \beta_m \tilde{m}_{it} + \beta_x x_{it} + (p_{it} - \bar{p}_t) + \\ & b(p_{it}, \mathbf{G}_i; \beta) + h_t(w_{it}^X, x_{it}, \tilde{k}_{it}, \tilde{l}_{it}, \tilde{m}_{it}, p_{it}, \mathbf{G}_i) + \epsilon_{it}. \end{aligned} \tag{19}$$

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[15] I describe how I construct measures of price and quantity of x in section **??** of the Appendix.

[16] I refer to the paper for a complete discussion of the proxy control function approach. See also Olley and Pakes (1996); Levinsohn and Petrin (2003)

[17] The *scalar monotonicity* condition is a necessary condition for implementing the proxy approach. It requires that ω_{it} is the *only* unobserved *scalar* entering the input demand in (17) (see, e.g. Olley and Pakes (1996)). Because prices largely affect input demand, they shall be included whenever possible.

To estimate (19), 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 high order polynomial of $(l_{it}, \tilde{k_{it}}, \tilde{m_{it}}, x_{it}, p_{it}, w_{it}^X, G_i)$:

$$\tilde{q}_{it} = \phi_t(l_{it}, \tilde{k_{it}}, \tilde{m_{it}}, x_{it}, p_{it}, w_{it}^X, G_i) + \epsilon_{it}. \tag{20}$$

The goal of this first stage is to identify the term $\hat{\phi_{it}}$, 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:

$$\omega_{it} = g(\omega_{it-1}) + \xi_{it}, \tag{21}$$

where $g(\cdot)$ is a flexible function of its arguments[18]. Using (19) and (20) we can express ω_{it} as

$$\omega_{it}(\beta) = \hat{\phi}_{it} - \left(\beta_l l_{it} + \beta_k \tilde{k_{it}} + \beta_m \tilde{m_{it}} + \beta_x x_{it} + (p_{it} - \bar{p}_t) + b(p_{it}, \mathbf{G}_i; \beta)\right), \tag{22}$$

which we can substitute in (21) to derive an expression for the innovation in the productivity shock $\xi_{it}(\beta)$ as a function of only observables and unknown parameters β.

Given $\xi_{it}(\beta)$, we can write the moments identifying conditions as:

$$\mathbb{E}\left(\xi_{it}(\beta) \begin{pmatrix} l_{it} \\ \tilde{k}_{it} \\ \tilde{m}_{it-1} \\ x_{it-1} \\ p_{it} \end{pmatrix} \right) = 0, \tag{23}$$

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)). The next and final step is to run a GMM procedure given the moment conditions in (23) to finally estimate the βs.

Obtaining Markups and Input Market Power Parameter - Once the output elasticities have been estimated, computing input market power becomes a simple task. As a preliminary step, I follow De Loecker and Warzynski (2012) and compute the revenue share for each of the variable inputs

[18] In the empirical application, I model $g(\cdot)$ as a second order polynomial in lagged productivity.

$j = \{m, x\}$ as:

$$\alpha_{it}^{j} = \frac{W_{it}^{j} V_{it}^{j}}{P_{it} \frac{\tilde{Q_{it}}}{\hat{\epsilon}_{it}}}, \tag{24}$$

where $\hat{\epsilon}_{it}$ is the residual from the first stage of the production function estimation. This correction purges revenue shares from variation unrelated to technology or market power. I thus compute input market power and markups of the firm as

$$\begin{cases} \psi_{it}^{x} = & \frac{\hat{\beta^{x}}}{\hat{\beta^{m}}} \cdot \left(\frac{\tilde{\alpha_{it}}^{x}}{\tilde{\alpha_{it}}^{m}} \right)^{-1} \\ \mu_{it} = & \frac{\hat{\beta^{m}}}{\tilde{\alpha_{it}}^{m}}, \end{cases}, \tag{25}$$

where the $\hat{\beta}$ are constant across firms and over time due to the Cobb-Douglas assumption.

3 Market Power in the Market of Imported Intermediates

In this section, I apply the methodology set forth in Section 2 to study the market power of firms in the purchase of imported intermediate inputs, analyzing how input market power varies across sectors and across firms within a sector. My primary purpose is to determine whether the behavior of firms in this market is consistent with the existence of significant firm buyer power (i.e. $\psi > 1$). The market of foreign intermediates' characteristic features naturally lead to imperfect competition among firms. On the one hand, imports are dominated by large firms (e.g. Bernard et al., 2007a), and large firms plausibly take advantage of sellers, especially in small, localized input markets. On the other hand, substantial search and information frictions in trade (e.g. Allen, 2014; Startz, 2017), can lead to the existence of market power both downstream and upstream. This means that both buyer's monopsonies and bargaining models are arguably good approximations of reality.

Theoretical work in import trade and imperfect competition has recently focused on situations of the latter sort, emphasizing 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), while little attention has gone to analyzing the monopsony or oligopsony power of importing firms. This paper contributes to prevailing literature by providing new evidence of the type and magnitude of input market power of firms.

3.1 Foreign and Domestic Intermediate Inputs

The computation of buyer power relies on the existence of two variable inputs in production. I focus on domestic intermediates, together with foreign intermediates, as my second input of interest. Througho ut the analysis, I maintain the assumption that firms compete in perfect competition in this market.[19] I make this choice for several reasons. First, as I explained in section 2.2.2, this assumption is needed in order to consistently estimate the output elasticities. Specifically, implicit in the control function for unobserved input prices in equation (19) is an assumption that the market for domestic intermediates is competitive. Allowing for a more general market structure of the domestic input market at this point would thus generate an internal inconsistency. Second, this assumption is standard in the literature on production function and markup estimation (cf. Ackerberg et al., 2015; De Loecker and Warzynski, 2012; De Loecker et al., 2016). Third, it is the observed input that most likely satisfies the requirement of short-run flexibility. One leading alternative to domestic materials is the labor input. 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 extent 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. 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.

3.2 Data Description

I employ two main 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.[20] 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. Trade and production data can be easily matched using unique firm identifiers (i.e. SIREN codes).

Sample Selection - I select all *manufacturing* firms that simultaneously import and export markets for at least two consecutive years[21]. These so-called "international firms" are the firms

[19]Later on, I will argue that the evidence on market power distortions for different inputs further validates this assumption.

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

[21]I classify a firm as "manufacturing" if its main reported activity belongs to the NACE2 industry classes 15 to 35. Manufacturing firms account for 30% of the population of French importing firms and 53% of total import value (average across the years in the sample).

TABLE I. SUMMARY STATISTICS (AVERAGE 1996-2007)

Variable	ALL INTERNATIONAL	SUPER INTERNATIONAL*
# Firms	16,346	6,687
(% of total)	15.6%	6.4%
(log) employment premium$^{(a)}$	3.29	6.82
(log) sales premium	2.33	3.07
(log) wage premium	0.3	0.36
(log) TFP premium$^{(b)}$	0.19	0.27
Belongs to a group$^{(c)}$	50.70%	65.08%
# Years in the sample	8.32	7.66
Total (log) imports	13.06	14.36
Import revenue share	14.5%	19.7%
No. Observations	173,953	76,436

Source: Author's calculations. Notes: The average number of *all* the manufacturing firms in a given year is 105,051.$^{(a)}$ 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): 15.3% A firm "belongs to a group" if it is classified as either French private, French public, foreign private (group).

for which input and output prices are available. For my preferred sample, I further select those international firms that source from at least one country outside the EU, so-called "super-international" firms. A necessary condition to identify these market power parameters is that the inputs are flexible, such that their first order condition is given by equation (7) . A concern is that unobserved factors other than adjustment costs, such as capacity constraints, might affect a firm's optimal choice of imports. This might be the case, for example, if shipping and transportation costs become prohibitively high above a certain threshold of imports. 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 these constraints.[22] 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.[23] Super-

[22]The main results are qualitatively not affected by this selection. In the Appendix 5 I show all the main tables and figure obtained when using the full sample.

[23]Note that although the selected sample is *not* representative of the average manufacturing firm in France, large firms are arguably those for which market power is larger.

TABLE II. REVENUE SHARES: DISTRIBUTION QUANTILES

Variable	1996-2007				
	Mean	Std Dev	p10	p50	p90
Labor α_{it}^{L}	.17	.08	.07	.16	.28
Capital α_{it}^{K}	.04	.05	.002	.02	.08
Domestic Materials α_{it}^{M}	.49	.16	.28	.49	.69
Imported Materials α_{it}^{X}	.20	.17	.03	.15	.43

Notes: Super-international firms, pooled sample. Number of observations: 76,436.

international firms constitute 40% of the sample of international firms, and about 6% of all the manufacturing firms. The final sample includes around 6700 firms per year, spread across 17 manufacturing sectors, for a total of 76,436 observations. In the Data Appendix, I discuss the variables and sample construction, along with additional sample statistics.

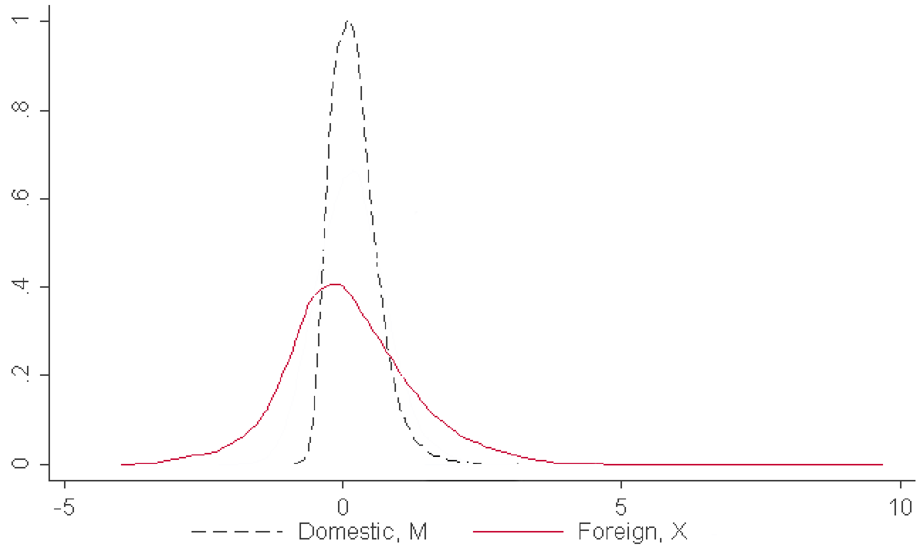
(Data on) Revenue Shares - To construct the input's revenue shares ($\{\alpha_{it}^{j}\}_{j=l,k,m,k}$), I divide the firm nominal expenditure on each of the inputs by the firm nominal value of production. Table 2 reports the means, standard deviations and quartile values of these variables. These shares 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 interquantile ranges. Compared to the full sample of international firms (cf. Table 2B in the Appendix), the super-international firms are less labor intensive, and use a lower share of domestic material input in production and a larger share of foreign material inputs. In particular, the average revenue share of imported intermediate inputs is 5pp higher for the super-international firms than for the average French importer. This is consistent with the disintegration of the production process of global firms across borders (e.g. global value chain), and with a parallel increase in the use of intermediates in production, and in global sourcing (cf. Feenstra and Hanson, 1996; Feenstra, 1998; Hummels et al., 2001; Yi, 2003).

3.3 Results

I estimate the output elasticities for each manufacturing industry using the 2-steps GMM procedure described in section 2.2.[24] Table 3 (in Appendix) gives the estimated output elasticities together with standard errors, which I obtain by block bootstrapping. By and large, the output

[24] 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

Figure 1: Distribution of $\log \Xi^j_{it}$, for $j = m, x$



Notes: Super-international firms, pooled across industries. The mean and interquantile range (i.e. $p90 - p10$) of Ξ^j_{it} are: [1.42;1.38],[2.9;4.41] and [1.47;2.07] for $j = m, x, l$ respectively. Note that the Figure plots $\log \Xi^j$.

elasticities conform to the revenue shares. Consistent with the extensive global sourcing of large international firms, the labor and capital coefficients are typically smaller, and the two material coefficients larger, than what one would find by using a more representative subset of manufacturing firms.[25] The estimated returns-to-scale coefficient is slightly above one for the average manufacturing industry. Let us consider equation (10), and define a measure of overall market distortions for each variable input $j \in \mathbf{V}_{it}$ as:

$$\Xi^j_{it} \equiv \frac{\hat{\beta}^j}{\tilde{\alpha}^j_{it}} = \mu_{it} \cdot \psi^j_{it} \; \forall j \in \mathbf{V}_{it}, \tag{26}$$

The "joint distortion" parameter Ξ^j_{it} reflects imperfect competition in the market of input j (i.e. ψ^j), and in the output market (i.e. μ_{it}). Figure 1 plots the distribution of Ξ^j across firms for the two variable inputs, i.e. foreign and domestic intermediates. Note that if all variable input markets were perfectly competitive, then the joint distortion parameter would only reflect output market power, namely $\Xi^j_{it} = \Xi^{j'}_{it} = \mu_{it}, \forall j, j' \in \mathbf{V_{it}}$, such that it would not vary across inputs. Figure 1 says that the hypothesis of joint perfect competition in all input markets is strongly rejected by the data. In particular, the distributions of Ξ^j for the domestic and foreign intermediate input (i.e. $j = m, x$) look very different. On the one hand, market distortions in the foreign input market are twice as large as distortions in the domestic input market. On

[25]cf. Dobbelaere and Mairesse (2013) for a study of French manufacturing, and Table 3B in the Appendix, for the results on the full sample of international manufacturing firms

the other hand, distortions in the foreign market are also more heterogeneous across firms, as shown by the 300% wider interquantile range.

Two clarifications are in order. First, all the variation in market power (i.e. in the Ξs) is driven by variation in the "adjusted" revenue shares $\tilde{s}^j_{it}$. This is due to the assumption of constant output elasticities within an industry. Clearly, if output elasticities differ across firms, they would affect these shares, and bias the results. The results seem to suggest that technology is not a main driver of the results.[26] The second observation is that the evidence of market distortions for the domestic material input seems to be consistent with the assumption of perfect competition in this market. In particular, under the null the average value and standard deviation of Ξ^m coincides with the first and second moment of markups in the economy. I find this number to be equal to 1.42, which correspond to an average markup of 42% of international firms. The overall dispersion in the pooled sample is 1.38, which goes down to about 0.4 if we look across firms within an industry. This is consistent with De Loecker and Warzynski (2012) who find, using similar methods for the Slovenian manufacturing sector, an average markup of around 22%, with a standard deviation of about 0.5. The larger average markups in my sample are consistent with French international manufacturers charging higher markups than the average Slovenian manufacturer. Because the competitive assumption on the domestic input markets implies that$\psi^m_{it} = 1,$ I can derive firm-level markups as $\mu_{it} = \Xi^m_{it} \equiv \frac{\hat{\beta^m}}{\tilde{\alpha}^m_{it}}$. Markups at the industry level are reported in Table 4 (in Appendix). The mean and median markups are 1.29 and 1.21, respectively, but there is considerable variation across sectors and across firms within sectors. Some firms report average markups below 1. This result may be due to the fact that part of the variation in revenue shares and markups can be related to technology differences across firms.

3.3.1 Input Market Power across Industries

We now have all the elements to compute input market power in the foreign input market given equation (9), i.e.

$$\psi^x_{it} = \frac{\beta^x_{it}}{\beta^m_{it}} \cdot \left(\frac{\alpha^x_{it}}{\alpha^m_{it}} \right)^{-1}. \tag{27}$$

Following the discussion at the end of section 2.1, I classify industries as "BP", i.e. *buyer power*, if the mean and median ψ in the industry are both greater than one; as "EB', i.e. *efficient bargaining*, if the mean and median ψ are both smaller than one; and as "PC" if both mean and median ψ are close to unity, and thus *perfect competition*. Where the distinction is less clear, I choose

[26] In particular, I observe that larger firms have smaller shares of intermediate inputs on average. If differences in technology among firms are an important driver of the revenue shares, I would expect larger firms to spend more on intermediates, because of higher degrees of vertical specialization and outsourcing.

Table V. Input Market Power, by Sector

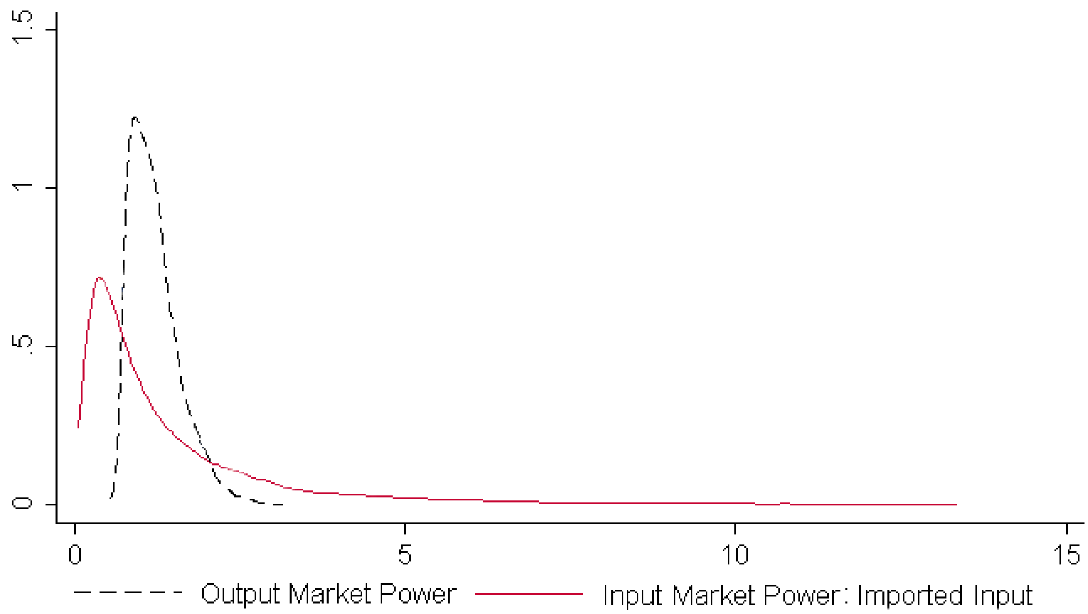
Sector	$\psi^x{}_{it}$ Mean	$\psi^x{}_{it}$ Median	Regime
15 Food Products and Beverages	3.45	1.91	BP
17 Textiles	1.15	0.78	
18 Wearing Apparel, Dressing	1.16	0.66	
19 Leather, and Leather Products	0.97	0.60	
20 Wood and Products of Wood	2.26	1.30	BP
21 Pulp, Paper and Paper Products	1.07	0.71	
22 Printing and Publishing	1.44	0.88	
24 Chemicals and Chemical Products	0.81	0.47	EB
25 Rubber and Plastic Products	2.01	1.31	BP
27 Basic Metals	2.56	1.71	BP
28 Fabricated Metal Products	2.01	1.12	BP
29 Machinery and Equipments	3.23	1.86	BP
31 Electrical machinery and Apparatus	1.04	0.57	
33 Medical, Precision Instruments	0.43	0.24	EB
34 Motor Vehicles, Trailers	0.42	0.27	EB
35 Other Transport Equipment	1.28	0.68	
Average	1.76	1.06	

Notes: The table reports the mean and median input market power by sector for the preferred sample over the period 1996-2007. The average standard deviation across industries is 1.89, with some heterogeneity across sectors. 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 4. The table trims observations with ψ that are above and below the 3^{rd} and 97^{th} percentiles within each sector.

not to take a stand on that particular industry. Table 5 reports input market power at the industry level.[27] The evidence indicates that in a large number of sectors, more than 50% of the firms behave as if they exercised significant buyer power in the imported input market. The mean and median input market power across sectors are 1.76 and 1.06, with an average standard deviation of 1.89. There is considerable variation across sectors and across firms within sectors. On average, in the imported input market, firms pay 76% less than the competitive price (i.e. value of marginal product of the input), which diminishes to 6% less than competitive for the median firm in the pooled sample. Note that, unlike markups (cf. Table 4), there is much more sectoral heterogeneity in input market power. For example, in the food industry, large international firms pay, on average, 250% less than the competitive price; the median value is also high, at 90% below the marginal revenue product. Conversely, firms active in sectors such as motor vehicles and medical instruments seem to engage in a different type of competition in

[27]I report the results on the full sample of importing firms in Table 5B in the Appendix

Figure 2: Market Power in Input and Output Market, Pooled



Note: Sample: super-international firms, pooled across industries and years. The figure plots the distribution of buyer power ψ, and markups μ, in the French manufacturing sector. The parameters ψ and μ are derived according to the system in (24). The moments of the two distribution are $[\mathbb{E}\psi, \text{p50}(\psi), \text{SdDev}(\psi)] = [1.76, 1.06; 1.89]$ and $[\mathbb{E}\mu, \text{p50}(\mu), \text{SdDev}(\mu)] = [1.29; 1.21; 0.35]$Figure 2B in the Appendix

the foreign input markets, where on average they pay more than the competitive price.

In Figure 2, I plot the distribution of markups and import market power in the pooled sample. Input market power is right-skewed, with a few firms apparently holding a large amount of buyer power. Conversely, the distribution of markups in the economy looks more "normal". The result on buyer power is driven by a small number of firms spending too little on the foreign input. More precisely, we observe that some firms are spending a larger share of revenues on domestic intermediate inputs relative to foreign intermediates, although the difference in shares is not entirely justified by differences in input productivity (i.e. output elasticities). Given that, *ceteris paribus*, the behavior of firms in the market of the domestic input is optimal, the result is consistent with firms withholding the demand of their foreign intermediate inputs, so as to keep the price low. Below, I will investigate whether these differences across firms are meaningfully correlated with other measures of firm size and performance. A closer look at the inter-sectoral heterogeneity reveals that buyer power is greatest in the following sectors: food, wood, rubbers, metals (both basic and fabricated) and machinery and equipment. By contrast, the sectors where the buyer power story does not seem to have much hold are the chemical industry, medical and precision instruments, and the motor vehicle industry. Interestingly, buyer power seems to be concentrated in those sectors where the goods that are exchanged are frequently commodities, such as agricultural products (raw food, livestock) and natural resources (wood, pulp, unrefined metals). 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).

Direct Evidence of Buyer Power in Selected Sectors - The evidence of buyer power in sectors such as food and food 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.[28]

To further assess the plausibility of my results, I now examine whether differences in the average degree of buyer power seem to be driven by systematic differences in sector-level performance. In Table 6 in the Appendix I report the average level of output, employment, value added, total imports, measured TFP and number of firms across the two different groups of sectors identified by the average degree of buyer power being above or below one. The evidence shows that firms who operate in "monopsonised" sectors are, on average, larger (i.e. higher output, employment, and imports), more productive, and have a higher share of value added and a higher number of firms. This further shows that, as hypothesized in the prevailing literature of the eighties, firms that operate in sectors with larger average firm size and value added act as if they had monopsony or oligopsony power in the input markets.

3.3.2 Input Market Power across Firms

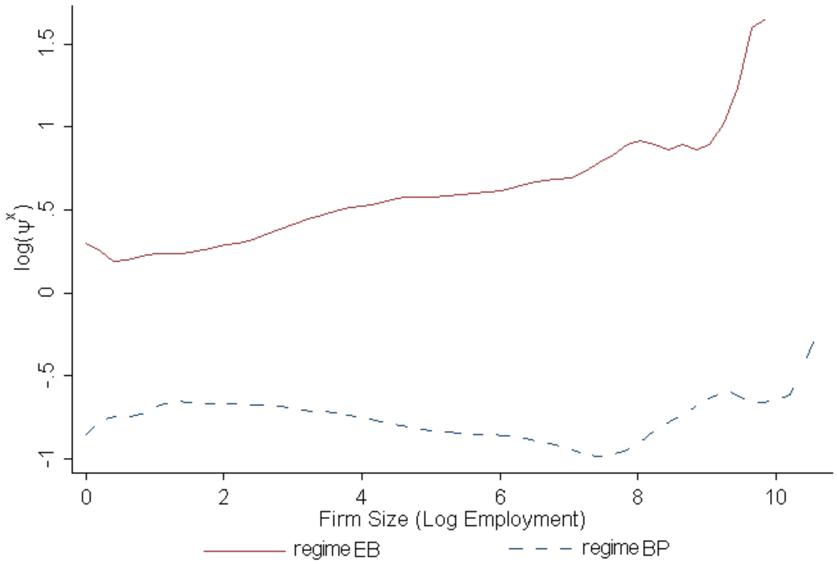
To verify whether market power is systematically correlated with firm-level characteristics, I run non-parametric regressions of the impact of firm size on the firm-level estimate of ψ_{it}, using local polynomial regressions.[29] Figure 3 reports the results for the main sample. The red solid line shows the estimates for the group of firms that operate under monopsony power (i.e. regime "BP"), while the blue dashed line reports the results for firms that operate in the other regime, more consistent with efficient bargaining (i.e. regime "EB"). Beginning with the first group,

[28]cf. 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.

[29]Specifically, I estimate (separately for the two groups of firms as identified by the relevant regime):

$$\log \psi_{it} = m(\log employment_{it}) + \epsilon_{it}$$

Figure 3: Input Market Power and Firm Size, by Regime



Note: Sample: Super-international firms. The Figure reports estimates from kernel-weighted local polynomial regressions of the (log of) input market power parameter ψ on firm size, as measured by log employment l. Estimates are pooled across firms and years. Regime "BP" includes sectors {15, 20, 25, 27, 28, 29}. Regime "EB" includes sectors {19,24,31,33,34}

TABLE VII. BUYER POWER AND FIRM CHARACTERISTICS

Sample	All sectors			"BP" Sectors		
Dep. Var.: $\ln \psi_{it}$	(1)	(2)	(3)	(4)	(5)	(6)
(log) Employment$_{it}$	.025***			0.07***		
	(8.55)			(13.59)		
(log) Value Added$_{it}$		.0013			0.04***	
		(0.48)			(9.10)	
(log) TFP$_{it}$			-.47***			1.76***
			(-15.42)			(21.52)
Adj R^2	0.32	0.31	0.32	0.07	0.07	0.07
No. Observations		59,591			23,342	

Notes: The table reports the estimates of OLS regressions on equation (28) when the dependent variable is $y_{it} = \psi_{it}$, using the sample of super international firms. All regressions include Industry Fixed Effects. Column (4)-(6) focus on those sectors where the average and median estimated buyer power is consistent with monopsony distortions. It includes sectors $BP = \{15, 20, 25, 27, 28, 29\}$. *** denotes significance at the 10% level, ** at the 5% and *** at the 1%.

the estimated degree of buyer power is increasing in firm size, along the whole size distribution, and the effect is stark. The results for the "EB" group show a rather flat relationship between input market power and size, which becomes positive only for the top quartile of firms. Figure 4 in the Appendix depicts the distribution of firm size - normalized by mean firm size in the industry - across different percentiles of buyer power. Figure 4a plots the distribution of firms in the "BP" regime, while Figure 4b looks at firms within the regime "EB". The Figure confirms that in sectors with evidence of monopsony distortions, firms with high estimated buyer power are larger than average. Finally, I run OLS regressions of a firm's market power (in both the input and output market) on different measures of firm size and performance. Specifically, I run

$$\log y_{it} = \beta X_{it} + regime\_BP_{it} + ind_{it} + \epsilon_{it}, \tag{28}$$

where $y_{it} = \{\psi^x_{it}; \mu_{it}\}$ and X_{it} are different measures of size or performance. The variable $regime\_BP_{it}$ is a dummy equal to one when the firm operates in a sector classified as "BP", whereas ind_{it} are sector dummies. The results for $y_{it} = \psi^x_{it}$ are shown in Table 7, whereas Table 7B in the Appendix reports both the results for $y_{it} = \psi_{it}$ (i.e Panel A) and for $y_{it} = \mu_{it}$ (i.e. Panel B). The results show a positive and significant correlation between firm size and input market power. On average, a one standard deviation increase in firm size corresponds to a 2.5% increase in the gap between value of marginal product and marginal cost of the input. This number is about 7% in those sectors with evidence of monopsonistic and oligopsonistic competition. Examining the correlation between value added and input market power yields similar results. The evidence shows an average strong negative correlation between TFP and buyer power. The correlation becomes positive and strong for firms in the group "BP". When I look at estimates of markups of sellers (cf. Panel B of Table 7B), I find a positive and significant correlation between measures of firm size and performance on markups. This is consistent with the findings in De Loecker and Warzynski (2012), for example, who find higher markups for large, successful exporters. We find that that the effect is much weaker in sectors where input distortions are higher.

4 Buyer Power and Aggregate Output

The results in Section 3 highlight significant distortions in the market of the imported input. In a number of sectors, these distortions are largely consistent with market power of buyers. In this section, I aim to investigate what are the consequences of this type of firm behavior for the allocation of productive resources within and across firms, and how buyer power affects the aggregate output and productivity of the domestic economy. I develop a tractable general equilibrium model where firms are heterogeneous in both their efficiency, and market power as buyers. I show how the model relevant parameters can be mapped onto the empirical estimates in Section 3, and how this allows to gauge the importance of the input distortion for the French manufacturing sector. Concretely, I aim to evaluate how much output is lost (or gained) due to firms exercising market power in some of their input markets.

4.1 Environment

The economy is inhabited by a representative firm, which produces a final good Q in a perfectly competitive output market.[30] The inputs in production of the final good are the output Q_s of S manufacturing industries. The representative firm combines industry output according to a Cobb-Douglas technology:

$$Q = \prod_{s=1}^{S} Q_s^{\theta_s}, \text{ where } \sum_{\mathrm{s=1}}^{\mathrm{S}} \theta_{\mathrm{s}} = 1. \tag{29}$$

Cost minimization then implies that the firm spends a constant fraction of total revenues on each sectoral output:

$$P_s Q_s = \theta_s P Q, \tag{30}$$

where P_s is the price of the industry output Q_s, and $P \equiv \prod_{s=1}^{S} (P_s/\theta_s)^{\theta_s}$ represents the price of the final good, which I set as the numeraire. A continuum of measure M_s of monopolistically competitive firms operates in each sector $s \in S$. Each firm i produces a differentiated variety. Individual varieties are combined to produce the industry output, according to the following CES technology:

$$Q_s = \left(\int_{i \in M_s} q_s(i)^{\frac{\sigma_s - 1}{\sigma_s}} di \right)^{\frac{\sigma_s}{\sigma_s - 1}}, \quad \sigma_s > 1. \tag{31}$$

Equation (31) implies that the demand for variety i in sector s is given by:

$$q_s(i) = A_s p_s(i)^{-\sigma_s}, \quad A_s = P_s^{\sigma_s} Q_s, \tag{32}$$

where A_s is a sector market index, determined by the sectoral demand Q_s and the price index. As it is standard, the price index can be derived as

$$P_s = \left(\int_{i \in M_s} p_s(i)^{1-\sigma_s} di \right)^{\frac{1}{1-\sigma_s}}. \tag{33}$$

[30] Hereafter, I make a change in the notation and use capital letters to denote aggregate quantities of any given variable X, and lower-case letters, i.e.x_i, to denote firm-level quantities.

With a continuum of firms, each firm is measure zero in the market, and takes A_s as given.

Technology - Firms in each sector differ in their efficiency level $\omega_i \in \mathbb{R}_+$. In order to ease the exposition, hereafter I drop the sector subscript, implicit in all variables unless stated otherwise. Production requires two variable factors: a domestic input, which might think of as physical capital k, and an intermediate input x. 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 to beef processor, or raw (non-)organic milk to packaged (non-)organic milk producers.[31] Capital is purchased from a competitive market at unit price r, which all firms take as given. The market(s) for the intermediate input x is allowed to depart from the competitive benchmark, as I describe in the next paragraph. I assume a Cobb-Douglas production technology, that means that output is produced as

$$q_i = \omega_i {x_i}^{\phi} {k_i}^{1-\phi}, \tag{34}$$

where ϕ and $(1-\phi)$ represent the output elasticities of inputs x and k, respectively.

4.2 The Market of the Intermediate Input

Firms buy their intermediate input in the global marketplace, where (several) markets exist for each given variety. There are economic rents on the supply side of these markets, such that suppliers receive overall more revenues than they actually need to provide the quantity of goods that is sold. In particular, I assume that economic rents arise from decreasing returns in production. Let $C(X)$ denote total costs, which satisfies standard regularity conditions.[32] Decreasing returns imply that marginal costs $C'(X)$ are increasing in X, i.e. $C'' > 0$. In absence of market power, the price of the input equals the marginal cost of the last unit of the good produced. Since this marginal cost is higher than that of the infra-marginal units, the seller receives a price per unit that is higher than the average cost of production. This gap represents the rents accruing to sellers, often referred to as *Ricardian rents*.[33]

The representative seller in each market has zero market power, and supplies X_i units of the good according to the following (inverse) supply function

$$w_i = X_i^{\eta}, \tag{35}$$

[31] The assumption of horizontally differentiated input varieties is made for simplicity. The same results are obtained by assuming that the input is homogeneous, and firms source from spatially differentiated markets.

[32] In particular, $C(\cdot) : C(X) \in \mathcal{C}^3$, with $C(0) = 0$, and $C(X), C'(X) > 0$ for $X > 0$

[33] Figure 5 in the Appendix provides a convenient graphical representation of this type of rents. Alternative sources of economic rents can arise from quasi-rents, if there are sunk cost in production in the input market, or monopoly rents, that exist if the seller enjoy market power. See Noll (2004) for a discussion.

where the input price w_i also represents the marginal cost to the seller of the X_i^{th} unit of the good. The constant $\eta \in (0,1)$ represents the inverse of the input supply elasticity, which is $finite$ in this setting[34], and is defined as:

$$\eta^{-1} = \varepsilon_X \equiv \frac{\partial X_i}{\partial w_i}\frac{w_i}{X_i} < \infty. \tag{36}$$

Each firm competes with a fringe of foreign buyers, but never with other domestic buyers, such that a downstream firm's demand does not depend on the price paid by another firm. This assumption implies that we can exclude general equilibrium effects of the price paid by i on the demand of other domestic firms. If the demand of the firm is large relative to the total demand of its competitors, which I denote as X_{-i}, the firm exercises buyer power so as to transfer the rents from one side of the market to the other (Noll, 2004). I further assume that X_{-i} can vary by market, and is exogenous to the firm. Total input demand in market i is thus given by $X_i = x_i + X_{-i}$, with $\partial X_i/\partial x_i = 1$. Note that this implies that equation (35) can be rewritten as:

$$w_i = (x_i + X_{-i})^{\eta} = x_i^{\eta} \left(s_i^x\right)^{-\eta}, \tag{37}$$

where $s_i^x \equiv \frac{x_i}{X_i}$ is the input market share of the firm. An important object for the derivation of the equilibrium is the marginal expenditure on input x_i. This is given by

$$\begin{aligned}\frac{\partial w_i x_i}{\partial x_i} = \frac{\partial}{\partial x_i} x_i^{1+\eta}\left(s_i^x\right)^{-\eta} =& w_i\left(1+\eta s_i^x\right)\\ =& w_i \psi_i,\end{aligned} \tag{38}$$

where I defined $\psi_i \equiv (1 + \eta s_i^x)$.[35] It is now instructive to draw a parallel between equation (38), and the right hand side of equation (4). Note that in both cases the term ψ_i describes the gap between the shadow price of an extra unit of input, and the unit price of the input. Therefore, the term ψ_i describes how much the buyer is able to push w_i *below* the competitive level by withholding demand, and hence buyer power. Under the model's assumption, buyer power is a function of two things: the (inverse) supply elasticity η, and the market share of the firm in the input market, s_i^x. A high level of ψ_i, and thus buyer power, occurs in two cases: (1) when the market is sufficiently concentrated (s_i^x high); or when supply is sufficiently inelastic (i.e. ε_X low and η high).[36] This formulation captures heterogeneous buyer power in a tractable way. In

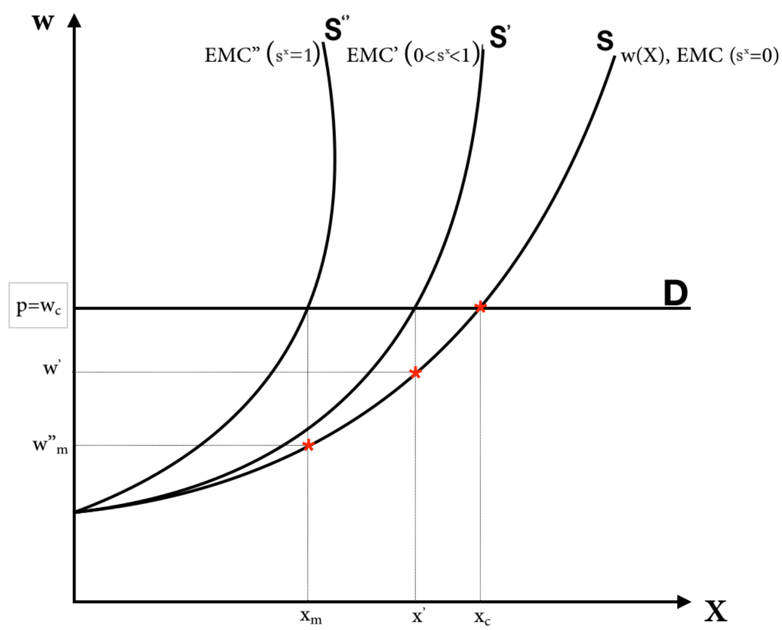
[34] In particular, a finite supply elasticity is implied by increasing marginal costs, given $C" = \eta > 0$.

[35] In its most general form, the term ψ_i is formally defined as $\psi_i = (1 + \eta \frac{\partial X_i}{\partial x_i} s_i^x)$. Here, I am assuming away strategic interactions across buyers, which implies $\frac{\partial X_i}{\partial x_i} = 1$.

[36] Note that in models with perfectly competitive input markets, it is usually assumed that $\varepsilon_X \to \infty$, which

particular, note that if the firm is small relative to aggregate demand, i.e. $s_i^x \to 0$, then $\psi_i = 1$, which corresponds to the competitive case. When the firm is the only buyer in the market, such that $s_i^x = 1$, then $\psi_i = (1+\eta) > 1$. For intermediate cases $0 < s_i^x < 1$, the firm has *some* market power, and $\psi_i \in (1, 1+\eta)$. Note that the supply price w_i will always be lower or equal than the *effective* marginal cost $w_i\psi_i$, which corresponds to the competitive level. In Figure 4 I show the (partial) equilibrium in the market of x_i for different values of s_i^x, in a simple economy where the value of marginal product (curve D), is constant and equal to p.

Figure 4: Equilibrium in the Intermediate Input Market



Given that input supply S is upward sloping, an increase in the total supply X raises the input unit price, which is always pinned down by S. In a competitive setting, firm set marginal revenues, given by the curve D, equal to the marginal cost of the last unit demanded, therefore equal to S. Conversely, firms with buyer power (i.e. $s^x > 0$) chooses optimal demand by setting their marginal revenue curve D to an *effective* cost curve (S' or S'') which is steeper than S, due to the fact that the firm internalizes the increase in the cost of all the infra-marginal units due to the change in the equilibrium price. In equilibrium, firm with high input market shares pay lower prices, and buy lower quantities than in the competitive case.

means that $\psi_i = 1$ regardless of the firm's input market share, and so that buyer power is always ruled out.

4.3 Equilibrium

In this section I describe the static equilibrium allocation within a sector, given a measure M of firms, total capital K, efficiency levels $\{\omega_i\}_{i=1}^{M}$, and buyer power $\{\psi_i\}_{i=1}^{M}$. In principle, the parameter ψ_i is an endogenous variable that depends on x_i. The true underlying exogenous variable is the size of competing buyers in the firm's input market, i.e. X_{-i}. In order to simplify the exposition, and because I can directly estimate it from the data, I write the results in terms of ψ_i, as if it was an exogenous parameter. Each firm solves the following profit maximization problem:

$$\pi_i\left(\omega_i, \psi_i\right) = \max_{\{k_i, x_i\}_{i=1}^{M_s},} p_i q_i - w_i x_i - r k_i, \tag{39}$$

subject to final demand (32), input supply (37), and technology (34), and such that the market for capital clears, i.e.

$$K = \int_{i \in M} k_i di. \tag{40}$$

Since I assume fixed entry, each firm will make positive profits in equilibrium. This consideration is important for when I discuss welfare in this model. In particular, I assume that there is a representative consumer in this economy, who owns both the productive capital K, and the firms, which means that it owns claims to their profits. Total real income of the individual is thus given by

$$I = \Pi + rK, \tag{41}$$

where

$$\Pi = \sum_{s=1}^{S} \left(\int_{i \in M_s} \pi_s(i) di \right). \tag{42}$$

In this simple economy, and given the final price normalization, we can measure welfare as $W = I$. The first order conditions of firm i are given by:

$$1 - \phi = \alpha_i^k \cdot \mu \tag{43}$$

$$\phi = \alpha_i^x \cdot \mu \cdot \psi_i, \tag{44}$$

where $\mu \equiv \frac{\sigma}{\sigma - 1}$ is the constant firm markup, and α_i^j, for $j = x, k$ are the input revenue shares, e.g. $\alpha_i^x \equiv \frac{w_i x_i}{p_i q_i}$. Note that equations (43) and (44) are isomorphic to the cost-minimization conditions in (6). The equilibrium allocations of intermediate input, capital, and output, are given by

$$x_i \propto \omega_i^{\beta(\sigma-1)} \cdot \tilde{\psi}_i^{-\beta(1+(\sigma-1)\phi)}, \tag{45}$$

$$k_i \propto \omega_i^{\beta(1+\eta)(\sigma-1)} \cdot \tilde{\psi}_i^{-\beta(\sigma-1)\phi} \tag{46}$$

$$q_i \propto \omega_i^{\beta(1+\eta)\sigma} \cdot \tilde{\psi}_i^{-\beta\sigma\phi}. \tag{47}$$

where $\beta \equiv [1+\eta(1+\phi(\sigma-1))]^{-1} \in (0,1)$, and $\tilde{\psi}_i \equiv A_i^x \frac{\psi_i}{\phi} = \left(\frac{\psi_1 - 1}{\eta}\right)^{-\eta} \frac{\psi_i}{\phi}$ is a convenient reparametrization of ψ_i. I assume that η is small enough, such that $\tilde{\psi}' > 0 \iff \psi' > 0$. This implies that the minimum value of ψ_i consistent with this economy is $\psi_i = \frac{1}{1-\eta}$. Finally, the capital-intermediate input ratio can be derived as:

$$\frac{k_i}{x_i} \propto \omega_i^{\beta\eta(\sigma-1)} \tilde{\psi}_i^{1+\beta}. \tag{48}$$

In order to illustrate the distortions induced by the existence of buyer power, I will compare equations (45)-(48) to a benchmark equilibrium where all firms have the lowest admissible degree of buyer power, i.e. $\psi_i \to \frac{1}{1-\eta}$. I will refer to the latter as the *input-competitive* benchmark, in spite of firms still having a small degree of market power in this limit. The reason behind this choice is a fundamental asymmetry between the competitive and the distorted economy, which is such that equation (35) do not hold in the limit $s^x \to 0$, and $\psi_i \to 1$.

Buyer power induces distortions at the firm level along several channels. First, firms buy less intermediate input, as shown in (45). This is the standard partial equilibrium effect of buyer power described in subsection 4.2: in order to keep the input price low, the firm withholds demand. Since capital is an imperfect substitute for the intermediate input, high buyer power firms also decrease the amount of capital used in production, although in a lesser degree (i.e. equation (**??**)). This effect has two main implications. On the one hand, even though the *level* of capital decreases, its share in total revenues increases (i.e. equation (48)). On the other hand, since the firm uses a lower amount of both productive inputs, the equilibrium output also shrinks. Together, these effects imply that the final output price is higher. I summarize these results in the following proposition:

Proposition 1: *Compared to the input-competitive benchmark, firms with high buyer power buy less inputs, have a higher capital-intermediate ratio, and produce less output.*

Since I assumed that firms are heterogeneous in ψ_i, I briefly discuss the equilibrium effect of the heterogeneity in buyer power across firms. To so so, we can look at the following ratio:

$$\left(\frac{k_i}{k_j}\right) = \left(\frac{\omega_i}{\omega_j}\right)^{\beta(1+\eta)(\sigma-1)} \left(\frac{\tilde{\psi}_i}{\tilde{\psi}_j}\right)^{-\beta\phi(\sigma-1)} . \tag{49}$$

Compared to an equilibrium where all firms have the same ψ, in the model with heterogeneity capital is reallocated from more to less distorted firms, namely to firms with $\psi \to \frac{1}{1-\eta}$. In Proposition 1 I argued that the more distorted firms are using too much capital relative to the intermediate input, which implies that the dispersion in buyer power may have an offsetting effect on the existing allocative distortions at the firm level, and thus a positive effect on aggregate output. I discuss the effect of heterogeneity on the aggregate equilibrium in more detail in Section B.2 of the Appendix.

4.4 Quantifying the Costs of Input Market Power

This section aims to evaluate the effect of buyer power on aggregate output Q, and real income I, which I take as my measure of welfare. 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. First, the procedure yields consistent estimates of the distributions of productivity (i.e. ω_i), input market power (i.e. ψ_i) and markups (i.e. μ) across firms in each manufacturing sector. We set the Cobb–Douglas production function parameter ϕ_s equal to the estimated output elasticity of the imported input in each sector, i.e. $\phi_s = \hat{\beta}_{sx,s}$. Then, we 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 4). Finally, the sector share θ_s are set equal to the shares of each sector in total manufacturing value added, which is directly observed in the production data. I set the aggregate capital equal to 1, which means that capital income $rK = r$ is equal to the rental price of capital. The only unknown parameter left is η, the elasticity of the inverse input supply. I set $\eta = 0.2$, which is small enough to guarantee that the equilibrium input demand decreases with buyer power. Table 8 summarizes the estimates of 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.

In Figure 5, to check the (qualitative consistency) of the model with the empirical evidence, I plot the distribution of the share of expenditure on the domestic input over total input expenditure across quantiles of buyer power, and I compare it to the distribution I see in the data. The model underestimates the observed dispersion, but it does a good job in replicating the pattern across quantiles of buyer power. A similar figure is obtained when looking at the distribution

TABLE VIII. MODEL PARAMETERS

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

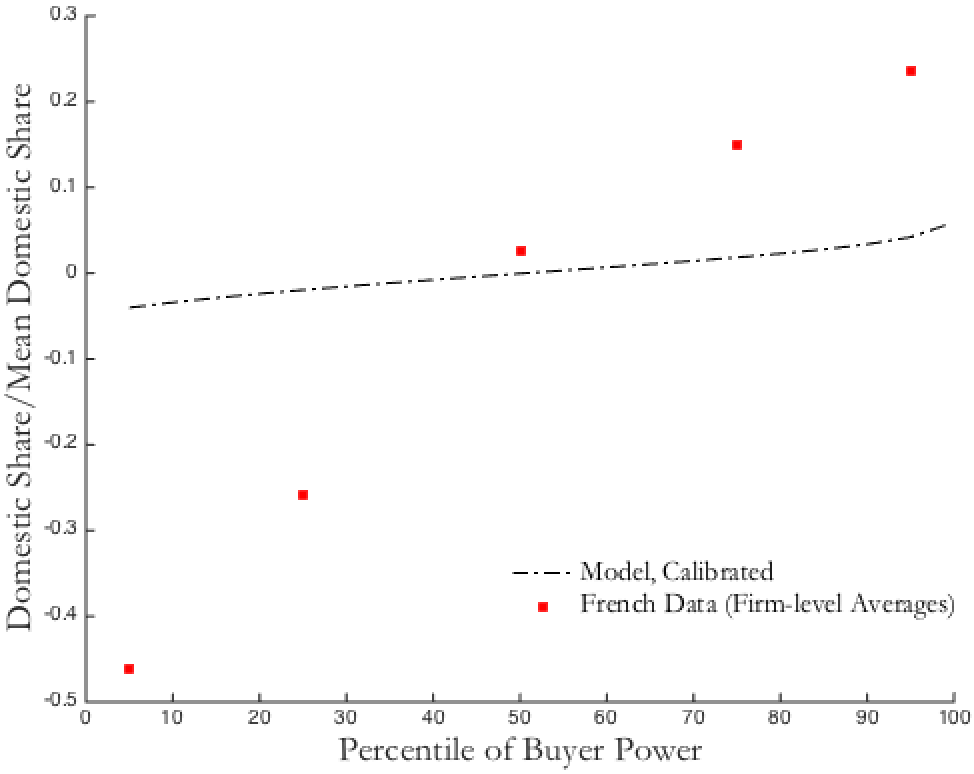
Notes: The table reports the main estimates of the model parameter. I consider only sectors when the mean estimated input market power is above 1, which are the sectors that are consistent with the model assumptions. $^{(a)}$ The estimation procedure yields estimates of mean and standard deviation of $\log \varphi$. 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.

of imports across quantiles of buyer power.

Figure 6 in the Appendix plots the aggregate equilibrium for different average values of ψ. To focus on the effect of buyer power, I set the dispersion to zero in all the equilibria. The input-competitive equilibrium, where firms have the lowest possible level of ψ, is signaled by the blue star. The red star represents the value of the aggregate variables that we would observe in an alternative model where all input markets are perfectly competitive, and the firms take the price w as given. As I discussed above, my model does not admit the competitive benchmark as a limit case because of a fundamental asymmetry in the wage setting mechanism. Finally, the black star corresponds to the average value of buyer power observed in the French manufacturing sector. The input-competitive benchmark converges to the competitive equilibrium, although it underestimates the effect on total output and profits. As the average value of ψ increases, total output and capital income decrease, whereas profits increase. The overall effect on income, and thereby welfare, is positive across the different equilibria, which means that the increase in profits more than compensate the decrease in capital income.

I now compare the aggregate variables in the calibrated French manufacturing sectors to

Figure 5: Buyer Power and Domestic Share of Input Expenditure, Model vs. Data



an economy where all firms are in the input-competitive equilibrium. This means that I both decrease the level of buyer power in the economy, and the dispersion. I do this exercise in three steps. First, I compare the equilibrium variables to a counterfactual equilibrium where I only change the mean of the ψ. Then, I compare the equilibrium to a counterfactual scenario where I keep the mean as observe in the data, but I shut down the dispersion. Finally, I compute the overall effect of mean and variance to see which of these two forces is stronger. I summarize the results in Table 9. The results for the counterfactual economy confirms that buyer power has a negative distortionary effect on aggregate manufacturing output. In an economy where all firms have the lowest possible degree of buyer power (cf. Column (3)), the total manufacturing output is 3% higher. Column (2) remarks that if we keep the mean level of distortions fixed, but eliminate the dispersion in buyer power across firms, then output would decrease. This has to do with the efficient reallocation associated with heterogeneity in buyer power, as discussed at the end of the previous section. These results suggest that the cost of this type of distortion is large. A simple back-of-the-envelope calculation tells us that buyer power of manufacturing firms could decrease total GDP by an estimated value of around 0.2%.[37] Note that the previous

[37]To compute this number, I first scale the 3% effect on manufacturing by the share of the distorted firms in total manufacturing value added, which is 45%. Then, I take into account that, over the period 1996-2007, manufacturing

Counterfactual Equilibrium:	Mean Variance	$\mathbb{E}\psi \to \frac{1}{1-\eta}$ No Change	No Change 0	$\mathbb{E}\psi \to \frac{1}{1-\eta}$ 0
		(1)	(2)	(3)
$\%\Delta Q$		+1%	-1%	+3%
$\%\Delta W$		-32%	-29%	-25%
Recall: $W = \Pi + rK$	% due to $\Delta\Pi$	$\simeq 99\%$	$\simeq 99\%$	$\simeq 99\%$
	% due to ΔrK	$\simeq 1\%$	$\simeq 1\%$	$\simeq 1\%$

Notes: The table reports the changes in aggregate variables between the distorted and the counterfactual economies. I define the change in total manufacturing output as the weightd 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.

numbers only take into account the effect of buyer power on aggregate output. However, buyer power also benefits the economy through a substantial increase in total profits, which are always positive in my static economy where firm entry is restricted. The bottom half of Table 9 reports the results for welfare, as measured by equation (41). I find that the changes in total income are large and negative. Specifically, total income decrease by around 25% in the input competitive economy. The almost entirety of these effects is due to a decrease in profits between the distorted and the competitive economy. Capital income increases in the counterfactual economy, but its effect is tiny compared to the decrease in profits. Understanding the allocative and distributive consequences of the change in profits associated with the exercise of buyer power is beyond the scope of this paper, but constitute a fruitful direction for future research.

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 undoing the existing efficiency distortion at the firm level. Policies should therefore encourage import participation, in order to make more buyers accessible to foreign sellers, and thereby reduce the scope of buyer power abroad. In terms of welfare, the same policies may have a redistributing effect of profits from the buyer to the seller country, therefore lowering total income in the domestic economy. Again, the overall effect of this redistribution of rents is not clear, and requires a more thorough consideration of consumer preferences at home and abroad, as well as of how profits are distributed among heterogeneous agents in an economy. This is beyond the scope of the current paper, and is left to future investigations.

value added accounted for about 14% of total GDP (Source: World Bank National Accounts Data). Therefore, the relative magnitude of the estimated output cost and total GDP is given by $0.03 \times 0.45 \times 0.14 = 0.19\%$

5 Conclusions

This paper had two goals. On the methodological side, I aim to 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 hitherto 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 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	6,177	0.09	0.11	0.55	0.24	0.99
			(0.17)	(0.16)	(0.16)	(0.13)	
C17	Textiles	5,915	0.14	0.08	0.57	0.20	1.00
			(0.12)	(0.10)	(0.12)	(0.07)	
C18	Wearing Apparel, Dressing	5,775	0.13	0.02	0.64	0.29	1.09
			(0.35)	(0.47)	(0.38)	(0.21)	
C19	Leather, and Products	1,842	0.19	0.09	0.54	0.22	1.04
			(0.33)	(0.48)	(0.33)	(0.13)	
C20	Wood, and Products	2,140	0.08	0.09	0.62	0.21	1.00
			(0.28)	(0.30)	(0.27)	(0.10)	
C21	Pulp, Paper, & Products	2,635	0.09	0.09	0.68	0.17	1.02
			(0.23)	(0.22)	(0.21)	(0.09)	
C22	Printing and Publishing	2,438	0.23	0.08	0.57	0.09	0.97
			(0.32)	(0.32)	(0.25)	(0.10)	
C24	Chemicals, and Products	8,266	0.10	0.04	0.81	0.11	1.06
			(0.17)	(0.15)	(0.15)	(0.10)	
C25	Rubber, Plastics, & Products	5,249	0.21	0.08	0.52	0.18	1.00
			(0.21)	(0.19)	(0.18)	(0.08)	
C27	Basic Metals	2,032	0.18	0.07	0.52	0.26	1.03
			(0.33)	(0.29)	(0.21)	(0.10)	
C28	Fabricated Metal Products	8,000	0.20	0.12	0.50	0.14	0.96
			(0.17)	(0.16)	0.17)	(0.10)	
C29	Machinery and Equipments	9,248	0.25	0.12	0.46	0.18	1.01
			(0.24)	(0.00)	0.28)	(0.19)	
C31	Electrical machinery & App.	4,071	0.24	0.03	0.68	0.11	1.06
			(0.24)	(0.27)	(0.23)	(0.10)	
C33	Medical, Precision, Optical Instr.	6,344	0.50	0.03	0.47	0.03	1.02
			(0.25)	(0.24)	(0.26)	(0.09)	
C34	Motor Vehicles, Trailers	2,163	0.09	0.01	0.81	0.08	0.98
			(0.42)	(0.37)	(0.32)	(0.09)	
C35	Other Transport Equipment	1,676	0.14	0.03	0.73	0.13	1.03
			(0.33)	(0.34)	(0.23)	(0.07)	
	Average, Manufacturing	4,496	0.19	0.07	0.59	0.17	1.02

Notes: The table reports the output elasticities from production function 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 are obtained by block-bootstrapping and are reported in brackets. Col. 5 reports the average returns to scale, which is the sum of the preceding 4 columns.

TABLE IV. MARKUPS, BY SECTOR

SECTOR	μ_{it}	
	MEAN	MEDIAN
15 Food Products and Beverages	1.03	0.97
17 Textiles	1.33	1.27
18 Wearing Apparel, Dressing	1.75	1.58
19 Leather, and Leather Products	1.53	1.43
20 Wood and Products of Wood	1.23	1.14
21 Pulp, Paper and Paper Products	1.43	1.36
22 Printing and Publishing	1.15	1.10
24 Chemicals and Chemical Products	1.64	1.56
25 Rubber and Plastic Products	1.07	1.02
27 Basic Metals	1.12	1.03
28 Fabricated Metal Products	1.09	1.04
29 Machinery and Equipments	0.93	0.88
31 Electrical machinery and Apparatus	1.51	1.43
33 Medical, Precision Instruments	1.05	0.99
34 Motor Vehicles, Trailers	1.72	1.58
35 Other Transport Equipment	1.55	1.45
Average	1.29	1.21

Notes: The table reports the mean and median markups by sector for the preferred sample over the period 1996-2007. The average standand deviation across industries is 0.35, with little heterogeneity across sectors. Markups are computed as the "joint distortion wedge" Ξ^m for the domestic material input. The table trims observations with markups that are above and below the 3^{rd} and 97^{th} percentiles within each sector.

Figure 4a: Input Market Power and Firm Size, Regime “BP”

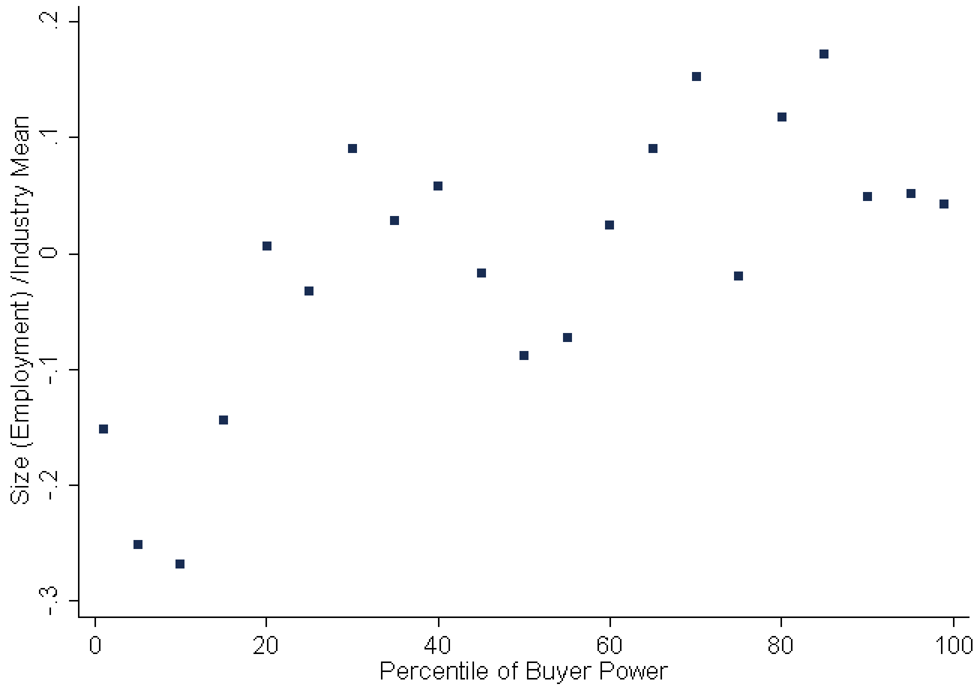
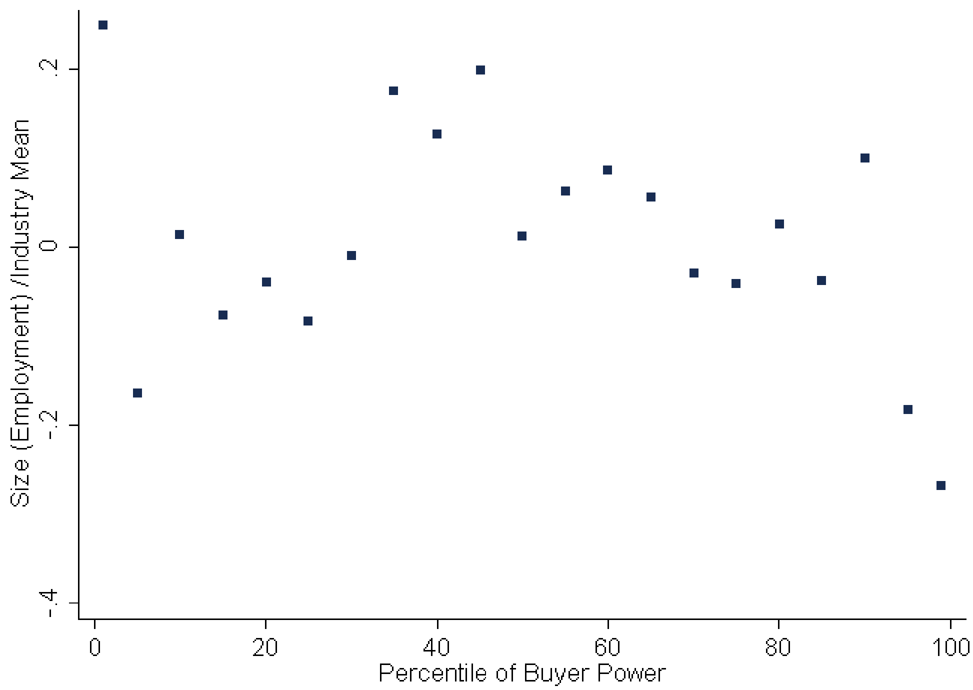


Figure 4b: Input Market Power and Firm Size, Regime “EB”



Note: Preferred sample. The Figure depicts the distribution of average firm size - normalized by the industry mean - across quantiles of buyer power. Figure 4a is constructed for the firms operating in regime “BP”; viceversa Figure 4b are firms operating in regime “EB”. Regime “BP” includes sectors {15, 20, 25, 27, 28, 29}. Regime “EB” includes sectors {19,24,31,33,34}

Table VI. Buyer Power And Correlates, by Regime

Variable	Regime "BP"	Regime "EB"	Difference
(log) Input market power (ψ)	0.54	-.77	1.31
(log) Markups (μ)	.02	.36	-0.34
(log) TFP (ω)	1.13	.73	0.4
(log) Size (output)	16.56	16.34	0.18
(log) Size (employment)	4.52	4.28	0.24
(log) Size (value added)	15.37	15.14	0.23
(log) Size (total imports)	14.69	14.17	0.5
Number of Firms	443.5	382.34	16%

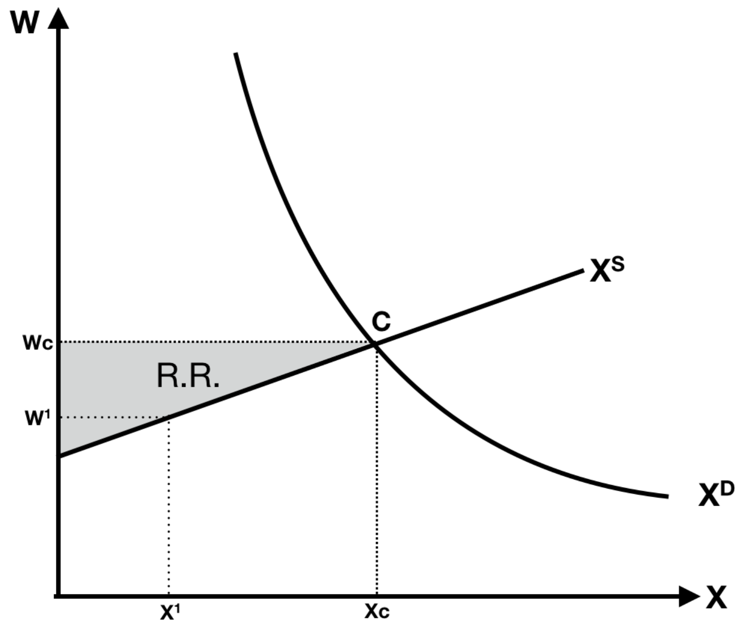
Notes: The table reports the average value of (log) input market power, markups, tfp, output, employment, value added, total imports, measured TFP and the average number of firms for the two groups "BP", and "EB". Groups are classified according to Table 5. Group "BP" includes sectors {15, 20, 25, 27, 28, 29}. Group "EB" includes sectors {19,24,31,33,34}

TABLE VIIB. MARKET POWER AND FIRM CHARACTERISTICS

Panel A. Dependent Variable: Input Market Power $\ln \psi_{it}$						
	(1)	(2)	(3)	(4)	(5)	(6)
(log) Employment$_{it}$	.025***	.014***				
	(8.55)	(4.09)				
(log) Value Added$_{it}$			.0013	-.009**		
			(0.48)	(-2.79)		
(log) TFP$_{it}$					-.47***	-.44***
					(-15.42)	(-47.98)
Regime "BP" (dummy)		1.31***		1.32***		1.49***
		(132.92)		(133.54)		(141.56)
Adj R^2	0.32	0.28	0.32	0.28	0.32	0.31
Panel B. Dependent Variable: Markups $\ln \mu_{it}$						
	(7)	(8)	(9)	(10)	(11)	(12)
(log) Employment$_{it}$	.004***	.01***				
	(5.10)	(8.99)				
(log) Value Added$_{it}$			-0.001	0.004***		
			(-1.35)	(3.86)		
(log) TFP$_{it}$					.28***	.31***
					(23.67)	(4.23)
Regime "BP" (dummy)		-0.39***		-0.39***		-0.39***
		(-137.23)		(-136.6)		(-137.23)
Adj R^2	0.43	0.29	0.43	0.29	.44	.38
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
# Observations			59,591			

Notes: The table reports the estimates of OLS regressions on equation (28). In Panel A, the dependent variable is $y_{it} = \psi_{it}$. In Panel B, the dependent variable is $y_{it} = \mu_{it}$. The results are shown for the sample of super international firms. All regressions include Industry Fixed Effects. Column (2)-(4)-(6) in Panel A and (8)-(10)-(12) in Panel B includes a dummy that is equal to 1 if the firm belongs to those sectors where the average and median estimated buyer power is consistent with monopsony distortions. This group includes sectors $BP = \{15, 20, 25, 27, 28, 29\}$. *** denotes significance at the 10% level, ** at the 5% and *** at the 1%.

Figure 5: Ricardian Rents



The Figure plots a representation of the Ricardian Rents, which are indicated by the grey shaded area. Due to increasing marginal costs, (curve X_s) and because there is a *unique* input price in equilibrium (i.e. price discrimination across input units is ruled out), the inframarginal units, such as point x_1, will be paid in equilibrium a price that is higher than the marginal cost to produce them, that is $w_c > w_1$. The gap $(w_c - w_1)$ represents the Ricardian Rent accrueing to the productive unit x_1.

Figure 6: Aggregate Equilibrium as a function of Buyer Power

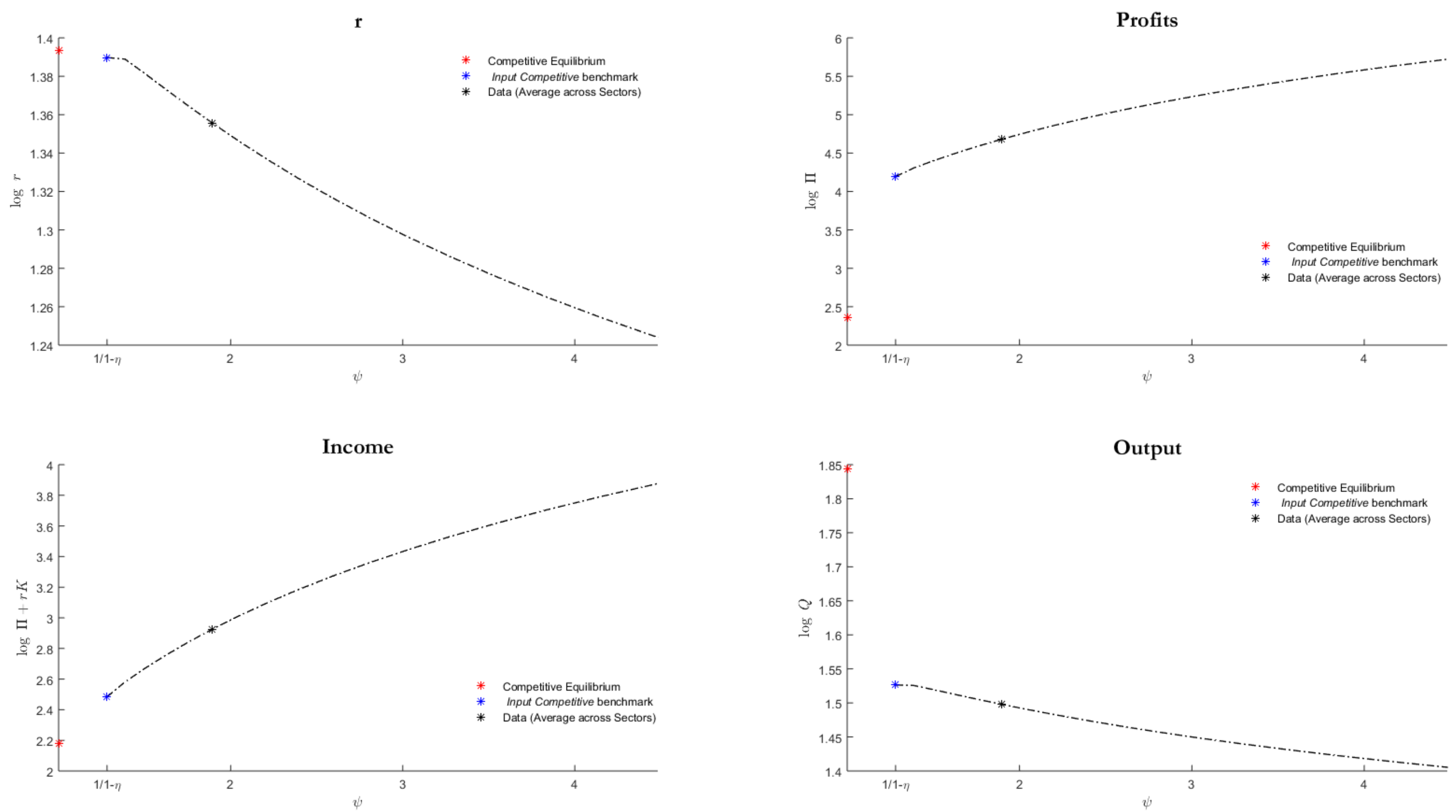


TABLE IIB. REVENUE SHARES: DISTRIBUTION QUANTILES

Variable	1996-2007				
	Mean	Std Dev	p10	p50	p90
Labor s_{it}^{L}	.18	.09	.08	.17	.30
Capital s_{it}^{K}	.03	.05	.001	.02	.08
Domestic Materials s_{it}^{M}	.52	.16	.30	.52	.72
Imported Materials s_{it}^{X}	.15	.17	.02	.10	.37

Notes: Full international sample, pooled. Number of observations: 173,484.

Table IIIB. Average Output Elasticities, By Sector, *Full Sample*

Industry	No. Obs.	β_L	β_K	β_M	β_X	Return to Scale
C15 Food and beverages	17,917	0.11	0.05	0.63	0.19	0.99
C17 Textiles	11,620	0.18	0.05	0.54	0.19	0.97
C18 Wearing, Apparel	10,046	0.20	0.05	0.56	0.23	1.04
C19 Leather, and Products	3,741	0.22	0.01	0.58	0.23	1.04
C20 Wood and Products	6,727	0.12	0.08	0.55	0.22	0.97
C21 Pulp, paper and products	6,053	0.15	0.07	0.61	0.19	1.02
C22 Printing and Publishing	8,236	0.26	0.04	0.54	0.15	0.98
C24 Chemicals, and Products	13,656	0.13	0.05	0.74	0.14	1.06
C25 Rubber, Plastics, & Products	14,632	0.21	0.10	0.52	0.17	1.00
C27 Basic Metals	4,359	0.16	0.11	0.51	0.22	0.99
C28 Fabricated Metal Products	25,479	0.18	0.11	0.53	0.14	0.96
C29 Machinery and Equip.	21,092	0.15	0.09	0.59	0.15	0.98
C31 Electrical Machinery	6,634	0.16	0.12	0.60	0.14	1.02
C33 Medical Instruments	10,267	0.18	0.09	0.70	0.14	1.11
C34 Motor Vehicles, Trailers	4,558	0.08	0.13	0.61	0.14	0.95
C35 Other Transport Equip	2,736	0.38	0.14	0.25	0.01	0.79
Average, Manufacturing	173,953	0.18	0.08	0.56	0.17	0.99

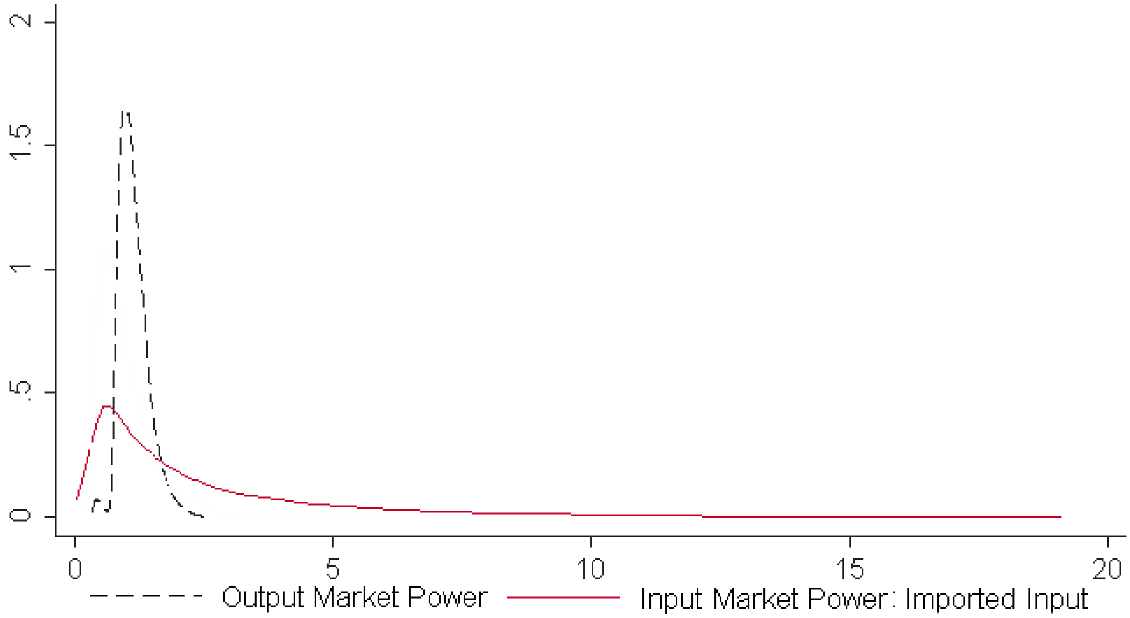
Notes: The table reports the output elasticities from production function estimation. The sample include all manufacturing French firms that simultaneously import and export. Column 1 reports the number of observations for each production function estimation. Cols 2–4 report the estimated output elasticity with respect to each factor of production. Standard errors are obtained by block-bootstrapping and are reported in brackets. Col. 5 reports the average returns to scale, which is the sum of the preceding 4 columns.

Table 5B. Estimates of Markups and Input Market Power, by Industry. **Full Sample**

Industry		μ_{it}			ψ_{it}^X			Regime[(a)]
		Mean	Median	Std Dev	Mean	Median	Std Dev	
C15	Food Products and Beverages	1.02	0.96	0.23	5.14	2.73	5.87	BP
C17	Textiles	1.22	1.15	0.34	2.06	1.16	2.45	BP
C18	Wearing Apparel, Dressing	1.39	1.27	0.57	2.15	0.96	3.03	BP
C19	Leather, and Leather Products	1.51	1.41	0.48	1.61	0.89	1.85	-
C20	Wood and Products of Wood	1.05	0.97	0.29	5.25	2.68	6.25	BP
C21	Pulp, Paper and Paper Products	1.25	1.18	0.30	2.11	1.14	2.54	BP
C22	Printing and Publishing	1.04	0.99	0.22	3.90	2.26	4.23	BP
C24	Chemicals and Chemical Products	1.45	1.38	0.34	1.69	0.94	1.99	-
C25	Rubber and Plastic Products	1.04	0.99	0.24	3.18	1.78	3.62	BP
C26	Other non-metallic Mineral Products	1.14	1.09	0.26	3.59	1.96	4.14	BP
C27	Basic Metals	1.01	0.95	0.27	3.86	2.32	4.40	BP
C28	Fabricated Metal Products	1.12	1.06	0.27	3.33	1.85	3.76	BP
C29	Machinery and Equipments	1.17	1.10	0.28	3.24	1.85	3.67	BP
C31	Electrical machinery and Apparatus	1.31	1.22	0.35	2.14	1.05	2.69	BP
C33	Medical, Precision Instruments	1.56	1.45	0.44	2.35	1.18	2.86	BP
C34	Motor Vehicles, Trailers	1.21	1.09	0.37	2.05	1.15	2.45	BP
C35	Other Transport Equipment	0.52	0.48	0.14	0.66	0.31	0.87	EB

Notes: The table reports the estimates of markups and input market power across industries for the full sample of International firms. Markups are computed as the wedge in the FOC of domestic material, whereas input market power as the residual wedge in the FOC of imported materials, once taken markups into account. [(a)] The last column reports the input market regime for each industry. I classify the industry as consistent with the existence of significant buyer power (BP) if both the median and the mean input market power are above 1. Conversely, the industry is consistent with Efficient Bargaining (EB) if both the median and mean input market power are below 1. The industries which are - denote mixed evidence

Figure 2B: Market Power in Input and Output Market, FULL SAMPLE



Note: Full sample, average across industries and years.

A Appendix

A.1 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 assume that firm-product markup can vary across different destinations, and I write (log) markup in destination c as:

$$\mu_{ipct} = \bar{\mu}_{ipt} + \hat{\mu}_{ipct}, \tag{50}$$

where $\hat{\mu}_{ipct}$ is the deviation in country c from average firm-product markup $\bar{\mu}_{ipt}$. I write (log) price p_{ipct} as

$$p_{ipct} = mc_{ipt} + \mu_{ipct} = p_{ipt} + \hat{\mu}_{ipct}, \tag{51}$$

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 is common across destinations, a standard assumption in the literature of pricing to market (e.g. Burstein and Gopinath (2014)).

Equation (51) suggests that I can run fixed effects OLS on

$$p_{ipct} = \gamma_{pit} + \varepsilon_{fint}, \tag{52}$$

and get an estimate of the average firm-product price as $\hat{p}_{ipt} = \hat{\gamma}_{ipt}$, where the γ_{ipt} are firm-product-time fixed effects.

The following step involves the aggregation of a number of firm-product prices $\hat{p}_{ipt}$ into a single firm-level price. Because different firms export different product bundles, consistent aggregation requires us to take this product heterogeneity into account. For example, consider two firms in the dairy production sector, one selling regular and organic milk at a unit price of 1 and 5 Euros, respectively, and the second one selling organic milk and cheese at 5 and 20 Euros, respectively. A simple average of these product prices would imply that the two firms charge on average 3 and 12.5 Euros, which imply a price differential of 400%, although the two firms charge the same price for organic milk. This difference has nothing to do with firm level prices and markups, but only reflects a combination of different product bundles. In order to deal with this product heterogeneity, a preliminary step which seems sensible to do is to normalize each price by the average price in France for that product. We normalize each price as:

$$\tilde{p}_{ipt} = p_{ipt} - N^{-1} \sum_{i=1}^{N_p} p_{ipt}, \tag{53}$$

where $N_p \geq 3$ is the number of French firms exporting product p[38]; and I compute firm-level prices as a weighted average of the normalized firm-product prices, i.e.

$$p_{it} = \sum_{i \in N_{it}} \omega_{ipt} \cdot \tilde{p}_{ipt}, \tag{54}$$

over the N_{it} products sold by firm i in a given year, with the weights given by the shares of each product in total firm exports $\omega_{ipt} \equiv \left[\frac{Tot.Revenues\ from\ p}{Tot.Revenues}\right]_{ipt}$. In our example above, suppose that we find that the average price for regular milk, organic milk, and organic cheese in France are 2, 5, and 10 Euros respectively. This means that the first firm charges 100% less than average for the first product, and the average price for the second product. The mean normalized price is thus -0.5. The mean normalized price for the second firm is instead 0.5, which is consistent with the firm charging the average price for organic milk, but twice as much as average for the organic cheese. The normalized average prices thus reflect markup differences more appropriately.

[38] In computing prices, I drop all the products which are exported by less than 3 firms in France, so as to have a meaningful "average" price for each product.

A.2 Proxy Control Function for Unobserved Productivity

Let us consider a setting where heterogeneous firms produce output using two inputs: capital k_i and intermediate input x_i. The market for capital is competitive, such that firms take its price r_i as given. The price r_i is allowed to vary by firms because firms might use inputs of different quality. The market for x_i is not perfectly competitive. I let ψ_i denote the degree of firms buyer power. This environment is similar to the one I consider for the theoretical model in section 4, and the reader should refer to that for the derivation of the main equations. It can be shown that the demand for the two productive inputs is given by

$$\begin{aligned} x_i &= f(\omega_i, \psi_i, w_i^x, r_i) \\ k_i &= g(\omega_i, \psi_i, w_i^x, r_i), \end{aligned}$$

where ω_i is unobserved firm productiviity, and w_i^x is the price of the intermediate input. Since capital is monotonically decreasing in ψ_i, the second expression can be inverted to write:

$$\psi_i = \tilde{g}(\omega_i, w_i^x, r_i, k_i).$$

Moreover, since the market for capital is perfectly competitive, we argued that it is possible to write the firm-level input price as a function of output prices ap_i, market share in the output market ms_i; and exogenous factors G_i, all of which are observable. Therefore,we can write

$$r = r(p_i, ms_i, G_i).$$

Putting all pieces together, the demand for intermediate can be written as:

$$x_i = h(\omega_i, w_i^x, p_i, ms_i, G_i),$$

such that productivity ω_i is the only unobserved *scalar* entering the input demand.

B Theoretical Model

B.1 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 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 fot toal income of individuals in (41). 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 we 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 *intrasectoral misallocation*, whereby less competitive firms (high μ) attract a sub-optimally low amount of inputs (cf. Epifani and Gancia (2011)).

B.2 Buyer Power and Aggregate Equilibrium

In order to assess what are the implications of this reallocation of productive resources across heterogeneous it is instructive to characterize the aggregate equilibrium. I restore sector notation, and use (49) and the market clearing equation (40) to write

$$K_s = \int_0^{M_s} k_s(i)di = \int_0^{M_s} \left(\frac{\omega_i}{\omega_j}\right)_s^{\beta_s(1+\eta)(\sigma_s-1)} \left(\frac{\tilde{\psi}_i}{\tilde{\psi}_j}\right)_s^{-\beta_s\phi_s(\sigma_s-1)} k_s(j)di, \tag{55}$$

which implies that

$$k_s(i) = \frac{\omega_s(i)^{\beta_s(1+\eta)(\sigma_s-1)}\tilde{\psi}_s(i)^{-\beta_s\phi_s(\sigma_s-1)}}{\int_{i\in M_s}\omega_s(j)^{\beta_s(1+\eta)(\sigma_s-1)}\tilde{\psi}_s(j)^{-\beta_s\phi_s(\sigma_s-1)}dj}K_s, \tag{56}$$

where K_s is the total (inelastic) supply of capital input in sector s. Given (56), it can be shown that sectoral output is given by:

$$Q_s \propto \left[\int_{i\in M_s}\omega_s(i)^{\beta_s(\eta\phi_s+\sigma_s)(\sigma_s-1)}\tilde{\psi}_s(i)^{-\beta_s\phi_s\sigma_s(\sigma_s-1)}di\right]^{\frac{1}{\sigma_s-1}}K_s. \tag{57}$$

Two things shall be noticed. First, the aggregate output depends on the average degree of buyer power in the economy. By doubling the amount of buyer power of all firms in the economy aggregate output decreases proportionally. Second, note that the output loss in (57) is a concave function of buyer power ψ. This suggests that an increase in the dispersion of ψ can actually increase outout. The first effect is due to the fact that all firms are underproducing, relative to the input-competitive benchmark. The second effect is due to the fact that heterogeneity in buyer power implies that capital is reallocated from more to less distorted firms, as discussed above. I summarize this finding in the following proposition:

Proposition 2: *Compared to the input-competitive benchmark, buyer power has a negative effect on sectoral output. Heterogeneity in buyer power across firms in a sector has instead a positive effect on output, due to reallocation of the inelastically-supplied input from more to less distorted firms. The overall effect depends on which of these two forces is stronger.*

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[39]. 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

[39] I thank Claire Lelarge for this suggestion

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).

The procedure to construct domestic and imported intermediate input is more elaborated. In the fiscal files, I observe total expenditures on intermediates. In the custom files, I observe total expenditure on imports. The domestic material input is then constructed by subtracting total import expenditures from total expenditures in intermediates, as in Blaum et al. (forthcoming). Note that the imported intermediate input in my preferred specification is defined as total import expenditure of the firm. Clearly, it is possible that the firm imports final products along with intermediate inputs in production, which means that total imports overstate the actual intermediate expenditure. As a robustness check, in other specifications I consider only the imports of those products classified as "intermediates" in the Broad Economic Categories (BEC) classification. In yet other specifications, I instead build sectoral shares of intermediate imports from the IO linkages tables for France, and use those shares to scale down total imports. I prefer to use total imports for consistency with the total value. Total expenditure on intermediates is the sum of expenditures on final goods, material goods and other categories. I believe that using both total expenditures and total imports gives a more accurate measure of the two inputs.

B.3.2 Sample Construction, and Sample Statistics

I start by considering the full FICUS (production) dataset for the universe of the French manufacturing firms. I merge this sample with the trade variables, and keep only those firms for which I have a non-empty entry for both output and input price. These are the so-called "international firms". Then, to go from international to "super-international" firms, I keep only those firms that import from more than one country outside the EU.

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 $s \in \{1, .., 17\}$.

Table A.1 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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