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

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Abstract

The paper quantifies buyer power in input trade and evaluates its aggregate effects. We develop an empirical strategy for estimating importers' buyer power from standard trade and production data that does not rely on assumptions about other input markets. Using data on French manufacturing firms, we find an average markdown of 1.49 on imported inputs and of 1.59 on domestically purchased inputs, revealing significant buying power in both markets. We explore the welfare implications of these estimates using an equilibrium model. Like an import tariff, the importers' buyer power forces a trade-off between terms-of-trade gains and losses in consumer surplus.

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1 Introduction

Large buyers play a prominent role in many sectors of modern economies, and their ability to pressure sellers into lowering prices below competitive levels is a growing concern of antitrust authorities.[1] The exercise of buyer power can impact the economy's overall welfare, as it not only alters the division of surplus between buyers and suppliers but also affects consumers through output and price effects.

Buyer power may be particularly relevant in international trade. In this context, high fixed costs of participation result in a concentration of imports and exports among a few large and dominant firms (Antràs, 2020). Importers' buyer power can serve as a countervailing force against exporters' market power, potentially resulting in lower import prices. However, it can also lead to distortions in import quantities and total output, making the outcomes for consumer prices and welfare uncertain. Despite the significant role of input trade in a country's economic performance, our understanding of the size and implications of buyer power in imports remains limited, as the international trade literature often assumes that importers act as price takers.

This paper quantifies buyer power in input trade and evaluates its impact on the aggregate economy. Our approach combines a novel empirical strategy to estimate market power in input markets with a tractable equilibrium model to convert the buyer power estimates into welfare calculations. We apply our methodology using trade and production data for French manufacturing firms, which provide an ideal case study for our analysis, given France's status as a large open economy and one of the world's largest importers.

We define market power in a foreign input market as the gap between the marginal cost of a given variety of the foreign intermediate input and its price, known as the input price markdown. Existing literature on estimating markdowns has primarily concentrated on labor markets, using either detailed input price and quantity data or assuming perfect competition in intermediate input markets.[2] However, since our study focuses on manufacturing firms and intermediate inputs, none of the existing methods are suitable for our analysis.

This paper's first contribution is to develop an empirical strategy to estimate importer-level markdowns in input trade using standard trade and production data. The starting point is a theoretical framework that encompasses various models of input trade under imperfect competition. We demonstrate that the average importer markdown across all input markets in which they participate can be calculated as the ratio between the revenue elasticity of the

[1] See, e.g., *American Antitrust Institute (AAI)'s Report on Competition Policy* (2008, Chapter 3).
[2] We discuss how we relate to the existing literature below.

imported inputs and the inputs' share in the total firm revenues. The revenue elasticities can be estimated using trade and revenue data following existing approaches in the industrial organization (IO) literature; the input revenue shares are directly observed in the data.

Our methodology builds upon the production approach to estimating market power pioneered by Hall (1988), De Loecker and Warzynski (2012), and Dobbelaere and Mairesse (2013), which has primarily focused on market power in product or labor markets. This approach has gained popularity recently due to its minimal data requirements and the growing interest in measuring market power in modern economies. However, it faces two significant challenges. First, the standard "double-ratio estimand" approach to estimating markdowns relies on comparing the first-order conditions of two variable inputs, where one input, typically intermediate inputs, is assumed to be perfectly competitive. Second, it relies on estimates of the output elasticity of variable inputs, which are difficult to obtain without data on output and input prices and quantities. This leads to well-known biases in input and output price estimation in production function estimation.[3]

In contrast, our approach and its application to the international trade context overcome both these challenges. The key insight is that information about an input wedge or markdown can be directly obtained from its revenue elasticity. This has two advantages. Firstly, by only analyzing the first-order condition of a single input, our methodology can accommodate imperfect competition in nearly any input market, including those for intermediate inputs. Secondly, by estimating the revenue elasticity of inputs, we avoid the need to separate output price and quantity, thus bypassing the output price bias. While the point that the gap between revenue elasticities and input shares reveals input markdowns has been previously made (Bond et al., 2021; Hashemi et al., 2022), this study is the first to apply it to the specific context of input trade. Leveraging the unique information on input price and quantity available in customs data helps mitigate the bias associated with input prices.[4]

One disadvantage of our approach, compared to more standard methods, is that estimating the revenue elasticities of inputs requires imposing additional structure on output markets. Specifically, it necessitates introducing a demand system into the standard production function framework (Pozzi and Schivardi, 2016; De Loecker, 2011). To address this, we combine a CES demand system with a gross output specification of technology. This allows us to establish a sales-generating production function that connects firm-level revenues to input

[3]For detailed discussions, see, e.g., De Loecker and Goldberg (2014), De Loecker et al. (2016), Bond et al. (2021), De Ridder et al. (2022).

[4]Studies that use a similar methodology include Pham (2022) and Treuren (2022). The former focuses on labor market power. The latter studies market power in both labor and intermediate input markets. To the best of our knowledge, the focus on the trade setting is unique to this paper.

quantities and unobserved demand and productivity factors.

We use a demand estimation procedure to obtain estimates of firm-level demand shifters. This involves analyzing price and quantity data from export records, combined with an instrumental variable (IV) strategy similar to the approach used by Piveteau and Smagghue (2019). By estimating the demand shifters, we can then utilize data on firm-level sales and input quantities to consistently estimate revenue elasticities, using established methods in the production function estimation literature (Ackerberg et al., 2015).

Using the universe of trade and production data for the French manufacturing sector, we apply our methodology and uncover evidence of significant buyer power in input trade. The average firm-level markdown across all manufacturing industries is estimated at 1.49. This finding implies that importers have substantial pricing power, with import prices, on average, being 67% below competitive levels.

While high markdowns are observed across all industries, we document substantial heterogeneity among firms and industries. For example, buyer power is particularly high in the "Basic Metals" and "Wearing Apparel" industries, with average markdown estimates of 1.80 and 1.85, respectively. Conversely, the "Chemical" and "Rubber" industries appear relatively more competitive, with markdowns around 1.25. Across firms, large and productive firms have relatively larger wedges than smaller, unproductive ones. By leveraging the granularity of our highly detailed import data, we further demonstrate that firm-level markdowns on imported inputs exhibited a negative correlation with the average level of competition faced by firms across import markets. This evidence lends support to the claim that methodology is effective at capturing, through a firm-level markdown on imported inputs, the extent of buyer power exerted by a given firm in various import markets.

Although not our primary focus, we then apply our methodology to demonstrate that even when domestically sourced, markdowns on intermediate inputs appear relatively high, with an average markdown of around 1.60.[5] Overall, our findings suggest that intermediate input markets are far from competitive, contrary to the usual assumption in related literature. Specifically, our results indicate that existing estimates of markups or markdowns, derived under the assumption of no buyer power in material inputs, may be prone to an upward bias. This bias occurs because such estimates may inadvertently capture market power in input markets (Avignon and Guigue, 2022; Treuren, 2022).

In the last part of the paper, we embed the model of firm behavior into a parsimonious

[5] The markdowns we estimate in domestic and foreign input markets lie in the same ballpark as markdowns estimated by Treuren (2022) for Dutch manufacturers buying intermediates and by Avignon and Guigue (2022) for French dairy processors buying raw milk.

macroeconomic framework to quantitatively evaluate the implications of the buyer power of importers for production and welfare in the economy. At the individual firm level, buyer power leads to an inefficient substitution of the inputs in production and an inefficiently small firm size. At the aggregate level, micro-level input distortions lead to lower imports and overall lower output, as compared to a world where all firms behave as price takers in all input markets.

The main theoretical insight from the macro model is that at the aggregate level, the buyer power of importers acts like a tariff on imports: it induces distortions on domestic production and the volume of trade, but it does so while improving the terms of trade. On the one hand, lower output and higher prices reduce consumer surplus. On the other hand, profits increase due to foreign rent shifting, and so does producer surplus. The overall effect of buyer power on domestic welfare depends on which of these two effects is larger, so it is ultimately an empirical question.

The micro-level estimates from the first part of our paper are sufficient statistics to provide a quantitative assessment of these effects. In baseline calibrations, we find that welfare is always higher in the distorted economy as compared to the efficient counterfactual benchmark. A classical result in the theoretical trade literature is that countries that have market power in imports exploit it in setting their trade policy (Broda et al., 2008). Our results show that even in the absence of import tariffs, when importers are large and have buyer power in input trade they could generate similar effects on aggregate variables. Moreover, these effects are sizable, despite originating from the behavior of individual firms.

These findings have important policy implications. Because the buyer power of importers could increase national welfare, nationalistic governments may face weak incentives to restrain the market power of the largest firms. A lenient national anti-trust policy could substitute for beggar-thy-neighbor trade policies, such as optimal import tariffs, while being less exposed to the risk of retaliation. We leave a more detailed investigation of similar policy interdependencies for future research.

Literature Review In addition to the papers discussed earlier, our work is related to several works in international trade and macroeconomics. While buyer power in international trade has drawn increased attention from economists in recent years (Alviarez et al., 2021; Ignatenko, 2021), there have been only a few attempts to quantify its importance and even fewer attempts to model its aggregate consequences in general equilibrium.[6] Raff and Schmitt

[6]The bulk of theoretical and empirical work in this literature has focused on the relationship between exports and competition. Studies in this literature include Harrison, 1994; Chen et al., 2009; De Loecker

(2009) studied the implications of buyer power of retailers/wholesalers on the effects of trade liberalization, while Bernard and Dhingra (2019) analyzed the effects of changes in the microstructure of import markets on the division of gains from trade. This paper provides a micro-foundation for a new empirical framework for estimating buyer power in input trade from standard trade and production data. We show novel evidence that the buyer power of importers is sizable, using both reduced-form and structural methods. Finally, we study and evaluate the aggregate implications of buyer power in general equilibrium.

The findings in this paper also contribute to the empirical literature on the effects of input trade for aggregate productivity and growth (Amiti and Konings, 2007; Goldberg et al., 2010; Topalova and Khandelwal, 2011; Halpern et al., 2015; Blaum et al., 2018). By providing evidence that foreign input markets are relatively more distorted than domestic ones, this paper shows that opening up to input trade can generate allocative inefficiencies, such that the productivity gains from input trade may be lower than expected.

Finally, the results in this paper relate to the ongoing academic debate about the causes and consequences of the rising market power in modern economies by bringing international trade and offshoring into the picture.[7]

2 A Framework for Estimating Input Market Power

This section introduces an empirical strategy for estimating firm-level measures of market power in input markets using standard production and trade data. Although our empirical application focuses on the market for imported intermediate inputs, the methodology discussed here can be applied to any static input for which data on production and (input) quantities are available. While we start by using a model of single-product firms for simplicity, we will discuss the extension to multi-product firms at the end of the section as they are prevalent in the data.

2.1 Theoretical Framework

We consider an economy populated by a mass of firms, each indexed by i, which combine several inputs to produce quantity Q_i of a final good variety according to the following

and Warzynski, 2012; De Loecker et al., 2016; Arkolakis et al., 2018; Dhingra and Morrow, 2019.

[7]For evidence and discussions about the rise of market power in modern economies, see, among others, De Loecker et al., 2019; Eggertsson et al., 2018; Gutiérrez and Philippon, 2017; Syverson, 2019.

gross-output technology:

$$Q_i = Q(\mathbf{K}_i, \mathbf{V}_i; \Theta_i). \tag{1}$$

The vector $\mathbf{K}_i = \{L_i, K_i\}$ represents the dynamic inputs subject to adjustment costs or time-to-build, such as capital and labor.[8] The vector $\mathbf{V}_i = \{Z_i, M_i\}$ includes the variable (or static) inputs, such as the quantity Z_i of domestic intermediate input varieties and the quantity M_i of imported intermediate input varieties. Here, we define an imported intermediate input variety as the combination of a Harmonized System (HS) 8-digit product and source country. We denote foreign input varieties as ν, and the set of all such ν sourced by firm i as Σ_i.[9] We consider well-behaved production technologies and assume that $Q(\cdot)$ is twice continuously differentiable with respect to its arguments.

Assumption 1 *The vector of state variables of the firm is given by:*

$$\Theta_i = (\mathbf{K}_i, e^{\omega_i}, \Sigma_i). \tag{2}$$

The state variables include the dynamic inputs for all products ($\mathbf{K}_i$), a productivity term (e^{ω_i}), assumed log-additive and firm-specific, and the firm *sourcing strategy* for foreign intermediate input varieties (Σ_i).

By including the firm sourcing strategy in the state variable vector, we assume separability between an importer's extensive and intensive margin sourcing decisions. This means that a firm input mix is a dynamic choice determined before the amount of input variety is chosen. This assumption captures the high persistence in firm-to-firm relationships, which arises from the high adjustment costs associated with the extensive margin of trade (Antràs, 2020; Monarch, 2021).

Assumption 2 *Foreign input varieties are aggregated according to a constant return to scale production function $h_i^M(\cdot)$, namely:*

$$M_i = h_i^M\left([M_i(\nu)]_{\nu\in\Sigma_i}\right). \tag{3}$$

Assumption 3 *The input quantity $M_i(\nu)$ $\forall$ ν is chosen flexibly in each period, given the sourcing strategy Σ_i.*

[8] While labor is typically assumed to be a static input in production in related literature (e.g., De Loecker and Warzynski, 2012; Dobbelaere and Mairesse, 2013; Yeh et al., 2022), there is evidence that labor markets are particularly rigid in France, especially for large firms (50+ employees), which are the object of our analysis (Garicano et al., 2016). We thus prefer to remain agnostic about the nature of the labor input.

[9] Because variety-level information on domestic inputs is not available, we approximate the set of domestic varieties sourced by all firms with a unit continuum.

Assumptions 2 and 3 are standard in the trade literature (Gopinath and Neiman, 2014; Blaum et al., 2019). Assumption 2 is important for aggregating imported input choices from the variety level to the firm level, which is necessary for matching the model with the data. Assumption 3 allows us to focus on the optimal choice of input quantities given a sourcing set without taking a stand on how such a set is determined.

Assumption 4 *Firms choose the flexible inputs to maximize short-run profits.*

The assumption of profit-maximizing firms is slightly less general than assuming cost minimization, which is more common (e.g., De Loecker and Warzynski, 2012).[10] In the context of estimating market power in input markets, this assumption is valuable as it avoids imposing additional restrictions on the structure of other input markets, as we discuss below.

2.1.1 Market Power in Imported Input Markets

To account for the market power of importers in this general framework, we depart from the standard assumption that importers act as price-takers and instead allow them to negotiate with foreign exporters over the price of intermediate input varieties. We present a formal model of importer-exporter bargaining in Appendix C, which is based on contemporary work by Alviarez et al. (2021). The model we consider is a flexible extension of more common pricing models in the trade literature, as it encompasses both the competitive benchmark and the monopsony limit as special cases. In this section, we provide a summary of the most important elements of the model.

Importers and exporters exchange an intermediate input and bargain over its price, to maximize their joint profit or generalized Nash product. The price is determined based on the bargaining power and each party's gains from trade. The quantity of the input exchanged is determined by the demand function at the negotiated price. The buyer market power is due to two factors: the upward-sloping export supply function and the oligopsony power of each importer, which is proportional to their share of the total exporter's input supply.

It can be shown that one can fully summarize the outcome of the bargaining game from the importer's perspective using an inverse supply schedule that maps the importer's demand to a negotiated price. Specifically, this can be written as:

$$W_i^M(\nu) = W_i^M \left(M_i(\nu)\right), \tag{4}$$

[10] Specifically, when firms choose inputs to minimize costs, they condition on an output level that is not necessarily profit-maximizing. Vice-versa, when firms maximize profits, they select both inputs and final output optimally.

where the function $W_i^M(\cdot)$ is specific to each importer-exporter match due to factors such as the exporter's bargaining power and productivity, and bilateral outside options. The inverse supply elasticity $\Psi_i^M(\nu) \equiv \frac{d \ln W_i^M(\nu)}{d \ln M_i(\nu)} \geq 0$ characterizes the mapping in (4), and it is non-negative and increasing in the importer's share of the foreign exporter's output.

The mapping in (4) encompasses perfect competition as a special case. Specifically, when importers are atomistic, their share of the foreign exporter's output is small, and the inverse elasticity approaches zero ($\Psi_i^M(\nu) \to 0$). In this case, importers act as price takers in the foreign input market. Conversely, the elasticity is positive for non-atomistic importers because they internalize their impact on aggregate input supply and price when choosing their optimal input demand. They will distort their input demand to negotiate lower prices.

Equilibrium Let $\mathcal{L}_i = R_i - \int_{\Sigma_i} W_i^M(\nu) M_i(\nu) d\nu \ - E_i^Z$ denote the Lagrangian associated with the firm short-run profit maximization problem, where $W_i^M(\nu)$ is the price of input variety ν paid by firm i and E_i^Z denotes total expenditure on domestic intermediate inputs. The buyer chooses the optimal quantity of input variety ν to maximize $\mathcal{L}_i$ subject to the input price schedule in (4). The first-order condition (FOC) of the problem yields:

$$W_i^M(\nu) = \frac{MR_i^M(\nu)}{\psi_i^M(\nu)}, \tag{5}$$

where $MR_i^M(\nu) \equiv \partial R_i / \partial M_i(\nu)$ is the marginal revenues generated by input variety ν, or the input's shadow value. Thus, the first-order condition states that the input price $W_i^M(\nu)$ can be expressed as a wedge $\psi_i^M(\nu)$ below the input's marginal revenues.

The wedge $\psi_i^M(\nu)$ captures the importer i's input price markdown, a standard measure of input market power. This markdown is defined as $\psi_i^M(\nu) \equiv 1 + \Psi_i^M(\nu) \geq 1$, where $\Psi_i^M(\nu)$ is the input's inverse supply elasticity from equation (4). When importers act as price takers in foreign input markets, i.e., when $\Psi_i^M(\nu) = 0$, $\psi_i^M(\nu) = 1$, which means that the input price equals its marginal revenues. Vice versa, when importers have buyer power in input trade, i.e., when $\Psi_i^M(\nu) > 0$, $\psi_i^M(\nu) > 1$ such that the input price is below marginal revenues.

With a bit of algebra, we can rewrite equation (5) as:

$$\psi_i^M(\nu) = \frac{\theta_i^{M,r}(\nu)}{\alpha_i^M(\nu)}, \tag{6}$$

This equation expresses the markdown of firm i for foreign input variety ν as the ratio between the revenue elasticity of variety ν, denoted by $\theta_i^{M,r}(\nu) \equiv \frac{\partial R_i}{\partial M_i(\nu)} \frac{M_i(\nu)}{R_i}$, and its revenue share, denoted by $\alpha_i^M(\nu) \equiv \frac{W_i^M(\nu) M_i(\nu)}{R_i}$.

Equation (6) is similar to standard markup expressions used in the literature to estimate markups (e.g., De Loecker and Warzynski, 2012), but with two differences. First, the elasticity on the right-hand side of equation (6) is the *revenue* elasticity of the input, instead of the *output* elasticity. Second, the markdown is defined at the firm-variety level, rather than just the firm level. This makes it challenging to obtain data on revenue elasticities of input varieties, as this information is typically only available at the firm level. However, we can use Assumption 2 to overcome this measurement issue.

2.1.2 From Theory to Measurement

Let us denote by $\theta_i^{M,r} \equiv \frac{\partial R_i}{\partial M_i}\frac{M_i}{R_i}$ the elasticity of revenues to the foreign input quantity index M_i, and by $\alpha_i^M \equiv \frac{\int_{\Sigma_i} W_i^M(\nu)M_i(\nu)d\nu}{R_i}$ the revenue share of foreign input expenditures. We derive the following result.

Lemma 1 *The average markdown of firm i in foreign input markets can be written as:*

$$\overline{\psi}_i^M = \frac{\theta_i^{M,r}}{\alpha_i^M}, \tag{7}$$

where $\overline{\psi}_i^M \equiv \int_{\Sigma_i} \gamma_i^M(\nu)\psi_i^M(\nu)d\nu$ is the weighted average of variety-level markdowns $\psi_i^M(\nu)$, with weights equal to the share of variety ν in total firm i's expenditure on imported inputs, i.e. $\gamma_i^M(\nu) \equiv \frac{W_i^M(\nu)M_i(\nu)}{E_i^M}$.

Proof See Appendix B.1.

Lemma 1 demonstrates that one can estimate the average firm-level markdown of firm i across foreign input markets, which is a theory-consistent measure of buyer power at the importer level, given data on the revenue shares of imported inputs (α_i^M) and estimates of the revenue elasticity of foreign intermediate inputs ($\theta_i^{M,r}$).

Given that we can estimate firm-level revenue elasticities from revenue and input quantity data, and revenue shares are directly observed, Lemma 1 implies that we can gain insights into the market power of importers in input trade solely by analyzing standard firm-level data, without requiring further knowledge of the import environment. This can be done starting with a general model of production and input trade that imposes minimal assumptions on output and input markets.

2.1.3 Discussion

Before we discuss how we estimate the revenue elasticities, we establish a connection between our framework and the existing literature on firm-level markdown estimation.

In the empirical labor literature, measures of the employers' markdowns have been estimated using the "double-ratio estimand" approach (Dobbelaere and Mairesse (2013)). This approach shares similarities with the one described above but with two key distinctions. Firstly, it assumes firms behave as cost-minimizers rather than profit-maximizers. Secondly, it assumes the existence of at least one input market where firms act as price takers. Under cost minimization and price-taking buyer behavior in a generic input market X, the average markdown of firm i in market M can be expressed as:

$$\overline{\psi}_i^M = \frac{\theta_i^M}{\alpha_i^M}\left(\frac{\theta_i^X}{\alpha_i^X}\right)^{-1}, \tag{8}$$

Here, $\theta_i^V,\ V = \{M, X\}$ represents the output elasticity of variable input V, defined as $\theta_i^V \equiv \frac{dQ_i}{dV_i}\frac{V_i}{Q_i}$. The variable input X is assumed to be perfectly competitive.

The expression in (8) has been widely used in empirical research to estimate labor markdowns, such as in Dobbelaere and Mairesse (2013), Dobbelaere and Kiyota (2018), and Yeh et al. (2022), among others. However, this standard approach has two limitations. First, it requires knowledge of output elasticities $\theta_{it}^V,\ V = \{M, X\}$. Estimating output elasticities using standard production data, where revenue serves as the measure of output, is notoriously challenging due to well-known biases in input and output prices in production function estimation.[11] A second limitation of the standard approach is its assumption of price-taking behavior by firms in at least one input market, typically the market for intermediate inputs. However, given our focus on market power in intermediate input markets and the absence of a clear candidate for a competitive input market, the "double-ratio estimand" approach may not be suitable for this study.

Although more restrictive than cost minimization, assuming that firms maximize profits enables us to infer an importer's buyer power by analyzing firm behavior in a single input market, without having to impose restrictions on the market structure of other input markets where the firm operates. The key insight is that if firm-level markups are not necessary,

[11] Studies that discuss the so-called *output price bias* in production function estimation include, but are not limited to, Klette and Griliches (1996), De Loecker (2011), De Loecker and Goldberg (2014), De Loecker et al. (2016). More recently, Bond et al. (2021) highlights the issues when proxying output elasticity by revenue elasticity in the production function approach to markup estimation, while Hashemi et al. (2022) shows that using the revenue elasticity for a variable input recovers input wedges, rather than output wedges.

information about an input's wedge or markdown can be directly obtained from its revenue elasticity (Bond et al., 2021; Hashemi et al., 2022).

However, our approach requires estimating revenue elasticities alongside markdowns, with both advantages and disadvantages. The main advantage is that, unlike output elasticities, identifying and estimating revenue elasticities does not require data on the physical units of output, avoiding the issue of output price bias. The main disadvantage is that the revenue function depends on the underlying demand system and market structure, necessitating imposing some structure on the output market that would not be necessary otherwise.

2.2 Estimating the Revenue Elasticities of Inputs

We consider the following functional-form specification of the production function in (1):

$$Q_{it} = e^{(\omega_{it}+\epsilon_{it})} K_{it}^{\beta_k} L_{it}^{\beta_l} X_{it}^{\beta_x} \tag{9}$$

$$X_{it} = \left(M_{it}^{\rho} + Z_{it}^{\rho}\right)^{\frac{1}{\rho}} , \tag{10}$$

where X_i is an intermediate input composite, which is a constant elasticity of substitution (CES) composite of foreign-produced (M_i) and domestically-produced (Z_i) intermediates, with substitution elasticity equal to $1/(1-\rho) > 1$. The coefficients $\beta_j,\ j = \{k, l, x\}$ are the Cobb-Douglas elasticities of capital, labor, and intermediates, respectively. The vector of parameters $\{\boldsymbol{\beta}, \rho\}$ is assumed to be common at the two-digit manufacturing sector level and constant over the sample period, as is standard in the literature. In addition to the various inputs, production depends on a firm-specific productivity shifter (ω_{it}), which captures the productivity component known by the firm, and ϵ_{it}, which captures measurement error and idiosyncratic shocks to production.

Taking logs on both sides of equation (9), and using Taylor's formula for a second-order expansion of equation (10) around $\rho = 0$, one could write the firm's production function as:[12]

$$q_{it} = \beta_k k_{it} + \beta_l l_{it} + \beta_m m_{it} + \beta_z z_{it} + \beta_{mm} m_{it}^2 + \beta_{zz} z_{it}^2 + \beta_{mz} m_{it} z_{it} + \omega_{it} + \epsilon_{it}, \tag{11}$$

[12] Following Kmenta (1967), the second-order Taylor expansion of (10) around $\rho = 0$ reads:

$$\begin{aligned} x_{it} &= m_{it} + z_{it} + \frac{\rho}{2} m_{it}^2 + \frac{\rho}{2} z_{it}^2 + \rho m_{it} z_{it} + \epsilon_{it} \\ &= \gamma_m m_{it} + \gamma_z z_{it} + \gamma_{mm} m_{it}^2 + \gamma_{zz} z_{it}^2 + \gamma_{mz} m_{it} z_{it} + \epsilon_{it}, \end{aligned}$$

which is a Translog function of order 2. The β coefficients in equation (11) are then defined as $\beta_i \equiv \beta_x \gamma_i$ for $i = \{m, z, mm, zz, mz\}$.

where lower-case variables denote the logs of the corresponding upper-case variables.

We define a firm's (log) revenue as $r_{it} = q_{it} + p_{it}$, where p_{it} is the log price of the firm's output. To determine the price p_{it}, we incorporate a demand system for the firm's final good variety into the production framework. Specifically, we follow De Loecker (2011) in adopting a standard CES demand system:

$$q_{it} = -\sigma_s(p_{it} - p_{st}) + q_{st} + \eta_{it}. \tag{12}$$

Here, p_{st} and q_{st} represent the (log) average price and quantity in industry s, and η_{it} is an idiosyncratic demand shifter observed by the firm but unobserved by the econometrician. The parameter σ_s denotes the substitution elasticity across varieties of the final good. In the single-product case, each firm produces a single variety and, in equilibrium, the quantity produced equals the quantity demanded.

Using equations (11) and (12), we obtain an expression for firm-level (log) revenues as:

$$r_{it} = \tilde{\beta}_k k_{it} + \tilde{\beta}_l l_{it} + \tilde{\beta}_m m_{it} + \tilde{\beta}_z z_{it} + \tilde{\beta}_{mm} m_{it}^2 + \tilde{\beta}_{zz} z_{it}^2 + \tilde{\beta}_{mz} m_{it} z_{it} + \delta_{st} + \omega_{it}^* + \eta_{it} + \epsilon_{it}, \tag{13}$$

where $\tilde{\beta}_x = (1 - \sigma_s)\,\beta_x,$ for $x = \{k, l, m, z, mm, zz, mz\}$ are reduced-form parameters that combine technology and demand parameters, and where the term δ_{st} subsumes the market-level demand shifters. Just like the production function coefficients, the unobserved productivity and demand term enters the estimating equation scaled by the relevant demand parameter, e.g., $\omega_{it}^* \equiv (1 - \sigma_s)\,\omega_{it}$. Since we are not interested in separately identifying demand and technology parameter, we ignore this distinction and drop the asterisk notation hereafter.

Given equation (13), the revenue elasticity of foreign inputs can be found as:

$$\theta_{it}^{M,r} = \tilde{\beta}_m + 2\tilde{\beta}_{mm} m_{it} + \tilde{\beta}_{mz} z_{it}, \tag{14}$$

which is a function of data (m_{it}, z_{it}) and parameters $\{\tilde{\beta}_m, \tilde{\beta}_{mm}, \tilde{\beta}_{mz}\}$ and which can be estimated alongside the revenue equation (13).

Obtaining consistent estimates of the parameters of equation (13) requires dealing with several sources of bias. First and foremost, unobserved demand (η_{it}) and productivity shocks (ω_{it}) lead to well-known simultaneity biases (Foster et al., 2008; Ackerberg et al., 2015). An additional issue in estimating equation (13) is that it requires information on firm-level input quantities, which are not directly available for all inputs. In the following three paragraphs, we discuss our approach to dealing with these biases.

2.2.1 Estimating Firm-level Demand Shifters

Our initial objective is to estimate the firms' idiosyncratic demand shifters η_{it} based on equation (12). Estimating these demand shifters relies on demand estimation, which necessitates data on the quantity and price of final goods sold by the firms. However, in our data context, we can only observe information on the price and quantity of goods the firm exports.

In this section, we outline our approach to estimating firm-level export demand shifters using customs data. These demand shifters will serve as a proxy for the average firm-level demand shifters in output markets. To fully utilize the richness of our customs data, we first recover demand shifters at the firm-product-destination-year level and then aggregate them at the firm level.

Considering the multi-product, multi-country nature of the data, we introduce additional notation in the demand system described in equation (12). We use c to represent the destination country and p to denote the product variety sold by firm i in destination c. The price of product p sold by firm i in destination country c, accounting for iceberg trade costs and expressed in local currency, is denoted as p^{ipct}. This price is related to the observed FOB (Free on Board) price in the home currency (p_{ipct}) by the equation $p^{ipct} = p_{ipct} + \ln \tau_{pct} - e_{ct}$, where τ_{pct} represents the iceberg trade cost of shipping good p from France to destination d, and e_{ct} denotes the logarithm of the bilateral exchange rate, indicating the foreign currency price of one unit of domestic currency (euro in our application).

We denote with η_{ipct} the firm-product-country specific demand shifter, which reflects factors such as vertical quality differences among firm-level varieties of an exported good or demand idiosyncrasies across foreign importers that may influence the sale of a product at a given price. We decompose η_{ipct} as $\eta_{ipct} = \eta_{it} + \eta'_{ipct}$, where η_{it} is a firm-level average, and η'_{ipct} is a deviation of the demand shifter of firm i selling product p in c from the firm-level average shifter. We consider η_{it} as a measure of the demand shifter in the revenue function in (20).

We allow the demand function to vary across broad product chapters, denoted by s, as defined in the official in the HS Product Classification, and estimate the following equation for each product p in chapter s:[13]

$$q_{ipct} = -\sigma_s p_{ipct} + \delta_{pct} + \eta_{ipct} \tag{15}$$

[13] Examples of broad product categories in the HS classification include "Animal and Animal Products" (HS2 codes 01-05), "Textiles" (HS2 codes 53-60), and "Machinery and Electrical" (HS2 codes 84-85).

where q_{ipct} is the (log) quantity of the variety sold by i in the destination market, and $\delta_{pct} \equiv -\sigma_s(\ln \tau_{pct} - e_{ct}) + (\sigma_s - 1)\ln P_{pct} + \ln Q_{pct}$ is a product-destination-time term capturing aggregate shifters, including the price index of good p in destination c at year t, the aggregate expenditure, the iceberg trade cost and exchange rate.

Estimating equation (15) is complicated by a well-known simultaneity problem: positive shocks to market appeal lead producers to raise prices, which can result in p_{ipct} and η_{ipct} being positively correlated (Foster et al., 2008). Therefore, estimating demand elasticity using plain ordinary least squares (OLS) would underestimate it. To address this endogeneity problem, we use an instrumental variable (IV) approach and instrument for p_{ipct} using an import-weighted exchange rate at the firm level as a supply-side (cost) shifter. The basic idea is that real exchange rate shocks affecting a firm's imports represent cost shocks that are passed through to final prices and are orthogonal to destination-specific demand shifters. Using this instrumental variable strategy, we obtain consistent estimates of the demand parameters, despite the endogeneity of p_{ipct}.

To obtain estimates of firm-level demand shifters η_{it}, we first obtain the residual $\hat{\eta}_{ipct}$ from the IV estimation of equation (15). We then obtain an estimate of the average firm-level shifter η_{it} as a weighted average of these residuals, where weights are given by the export share of the variety at time t. A similar IV strategy has been used by Piveteau and Smagghue (2019) to obtain quality measures at the firm-product-country-year level. We closely follow their approach when adapting equation (15) to our data, and we refer readers to their study for a more detailed discussion of the instrument's validity in estimating demand using similar data. Appendix D includes the details of the estimation procedure.

2.2.2 Unobserved Productivity

To control for unobserved productivity ω_{it} in the estimation of the revenue function (13), we consider the control function approach in Ackerberg et al. (2015). The idea behind this approach is to write the firms' unobserved productivity as a function of observable variables by inverting the equilibrium demand function for a flexible variable input.

We consider firm-level expenditure on services as the flexible input of interest. In the French data, expenditures on services primarily include subcontracting costs, leasing fees, rents and rental charges, maintenance and repair, insurance premiums, the remuneration of intermediaries and fees, advertising costs, and banking services; it is one of the variables that most strongly correlate with contemporaneous output growth (Wong, 2019), thus satisfying the flexibility condition. We denote as s^e_{it} the (observed) expenditure on services, and with s_{it}

the corresponding (unobserved) physical measure.

Since expenditures on services largely reflect firms' operating expenses not directly related to the production of goods sold, we assume that services do not affect the production of output directly, but only through their impact on productivity. We thus write $\omega_{it} = \omega(s_{it}, \phi_{it})$ where ϕ_{it} is an exogenous idiosyncratic productivity term, known by the firm but unknown to the econometrician. We also assume that $s_{it} = s(s^e_{it}, \phi_{it})$, with $s'_\phi > 0$, which says that the total amount of services available to the firm is an increasing function not only of expenditures but also of productivity ϕ_{it}. In this sense, we can think of ϕ_{it} as capturing the efficiency with which firms deploy services (De Ridder, 2019). Our last assumption is that firms take the price of services as given, such that nominal expenditure measures do not confound unobserved price differences across firms, conditional on a firm's location and industry.

We consider the following optimal service expenditure function:

$$s^e_{it} = h(\phi_{it}, \mathbf{X}_{it}, G_{it}, \eta_{it}), \tag{16}$$

where G_{it} is a vector of variables that can affect firms' service prices, which includes location, sector, and year fixed effects. Equation (16) allows operating expenses to vary with the firm inputs $\mathbf{X}_{it} = (k_{it}, l_{it}, m_{it}, z_{it})$. Finally, we also allow the idiosyncratic demand shocks to affect a firm demand of services.

To obtain a control function for unobserved productivity ϕ_{it}, we invert the function in (16) under the assumption that ϕ_{it} is the only unobserved variable affecting operating expenses.[14] The control function can thus be written as $\phi_{it} = h^{-1}(s^e_{it}, \mathbf{X}_{it}, G_{it}, \eta_{it})$, such that, given $\omega_{it} = \omega(s_{it}, \phi_{it})$ and $s_{it} = s(s^e_{it}, \phi_{it})$, we can write:

$$\omega_{it} = \tilde{h}(s^e_{it}, \mathbf{X}_{it}, G_{it}, \eta_{it}). \tag{17}$$

2.2.3 Input Price Biases

When firm-level inputs are measured as deflated expenditures, standard techniques for estimating equation (13) may lead to an input price bias (De Loecker and Goldberg, 2014).

We alleviate concerns about the foreign input price bias by constructing a physical measure of the imported input relying on a firm-level deflator built from import data. We first use a fixed effect strategy on variety-level import prices to construct a measure $\hat{w}^m_{it}$ of average

[14] Note that, even if demand shocks η_{it} are unobserved, we can control for them using our estimates from demand estimation.

firm deviation from the industry-level price of different imported inputs. We then construct the firm-level import price deflator as

$$\tilde{w}^m_{it} = w^m_{st} + \hat{w}^w_{it}, \tag{18}$$

where w^m_{st} is the observed industry deflator for imported intermediates. Finally, we construct a physical measure of the imported input by deflating total expenditures on the imported inputs by the firm-level deflator in (18). In doing so, differences in imported input prices among firms are accounted for, thus alleviating concerns about the foreign input price bias.

The remaining concern is thus with domestic intermediate inputs, due to the lack of price and quantity data and the possibility of unobserved price differences across firms that are not captured by industry-wide deflators. The presence of a domestic input price bias in our analysis would be problematic for our focus on buyer power in import markets to the extent that it biases the measure z_{it} and the coefficients $\tilde{\beta}_m$, $\tilde{\beta}_{mm}$, and $\tilde{\beta}_{mz}$. De Loecker et al. (2016) propose approaches based on control functions to address input price bias, essentially suggesting to alleviate concerns about unobserved differences in buyer power or quality by controlling for (relevant) market shares or prices. We refer to De Loecker et al. (2016) for a more formal explanation. Our baseline approach includes firm-level average wages per worker (a proxy for labor quality) in the input price bias control function. They are good proxies for other input quality, as they positively correlate with input quality in a large class of theoretical models. Additionally, we include indicators for the firm 4-digit sector and region to control for variation in input prices across sectors and locations.[15]

Formally, it implies the following input price bias control function:

$$b_{it}(\cdot; \tilde{\beta}^b) = b\left(1, X_{it} \times X^b_{it}; \tilde{\beta}^b\right) + \gamma_{it} \tag{19}$$

where inputs contained in X_{it} enter only interacted with the control variables in X^b_{it} (solely featuring the average wage in our baseline estimation) in order not to perturb the production function specification. $\tilde{\beta}^b$ contains the corresponding coefficients and γ_{it} contains 4-digit sector and location fixed effects which enter linearly.

[15] We do not include output (here export) price controls in the baseline as we aim here to estimate a revenue function. We do not include market share controls as we cannot observe relevant market shares for domestic input markets. The market shares we can build, defined at the industry or industry-location level, lack relevance and create a spurious correlation with firm-level domestic input measures. Ignoring convergence issues for some industries, robustness checks including such controls however deliver results similar to baseline results.

2.2.4 Estimation

Putting pieces together, the estimating equation reads:

$$r_{it} = f(\mathbf{X}_{it}; \tilde{\beta}) + \omega_{it} + \eta_{it} + \epsilon_{it}, \tag{20}$$

where $f(\mathbf{X}_{it}; \tilde{\beta}) \equiv \tilde{\beta}_k k_{it} + \tilde{\beta}_l l_{it} + \tilde{\beta}_m m_{it} + \tilde{\beta}_z z_{it} + \tilde{\beta}_{mm} m_{it}^2 + \tilde{\beta}_{zz} z_{it}^2 + \tilde{\beta}_{mz} m_{it} z_{it}$ is the production function, $w_{it} \equiv h(s_{it}^e, \mathbf{X}_{it}, G_{it}, \eta_{it})$ is the TFP shock, and where we subsumed the market-level shifter δ_{st} which will be controlled in the estimation by time fixed effects. To estimate (20), we follow the two-step GMM procedure described in Ackerberg et al. (2015).

In the first stage, we run OLS on a non-parametric function of the dependent variable on all the included terms:

$$r_{it} = \phi_t(s_{it}^e, \mathbf{X}_{it}, G_{it}, \eta_{it}) + \epsilon_{it}, \tag{21}$$

where the function ϕ_t is approximated by a third order polynomial. The goal of this first stage is only to separate anticipated revenue $\hat{r}_{it}$ from a term $\hat{\epsilon}_{it}$ made of unanticipated shocks and/or measurement errors: $r_{it} \equiv \hat{r}_{it} + \hat{\epsilon}_{it}$.

The second stage then identifies the revenue function coefficients from a GMM procedure. The first-order Markov law of motion for productivity is described by:

$$\omega_{it} = g(\omega_{it-1}) + \xi_{it}, \tag{22}$$

where we approximate $g(\omega_{it-1})$ by a second order polynomial in s_{it-1}^e, $\mathbf{X}_{it-1}$, and η_{it-1}, while fixed effects contained in G_{it-1} enter linearly. Using (19), (20) and (21) we express ω_{it} as:

$$\omega_{it}(\cdot, \tilde{\beta}, \tilde{\beta}^b) = \hat{r}_{it} - f(\cdot; \tilde{\beta}) - b_{it}(\cdot; \tilde{\beta}^b) - \eta_{it}. \tag{23}$$

We can now substitute (23) in (22) to derive an expression for the innovation in the productivity shock $\xi_{it}(\tilde{\beta})$ as a function of observables and unknown parameters $\tilde{\beta}$. Given $\xi_{it}(\tilde{\beta})$, we can write the moments identifying conditions as:

$$\mathbb{E}\Big(\; \xi_{it}(\tilde{\beta}) \;\, \mathbf{Z}_{it} \Big) = 0, \tag{24}$$

where $\mathbf{Z}_{it}$ includes terms in $g(\cdot)$, a second-order polynomial in k_{it}, and interactions of k_{it} with all lagged inputs. The identifying restrictions, standard in the production function estimation literature (e.g. Levinsohn and Petrin, 2003; Ackerberg et al., 2015), is that the innovation term ξ_{it} is uncorrelated with current levels of the dynamic inputs (here k_{it}), and lagged level of the static inputs (here l_{it}, m_{it} and z_{it}).[16]

We estimate the revenue function by 2-digit sector over the sample period 1996-2007. We then compute the revenue elasticities of the foreign intermediate input as in equation (14). We then use these elasticities to compute our measures of the input market power of importers using the expression in (7). When doing so, and similarly to Treuren (2022), we use anticipated revenue from the first stage in the input wedge construction. This reflects the fact that firms by definition optimize on planned revenue, not unanticipated revenue. Formally, revenue shares used in equation (7) are thus based on planned revenue as computed from $\hat{R}_{it} = R_{it}/\hat{\epsilon}_{it}$.[17]

3 Data

To conduct the empirical analysis, we employed two longitudinal datasets covering the production and trade activity of all French manufacturing firms from 1996 to 2007.[18] The first dataset contains complete production accounts for each firm, which includes information on the value of output and inputs, such as labor, capital, and materials. We obtained this dataset from the FICUS database of the French Institute of National Statistics (INSEE). Additionally, we used industry-level deflators for output, capital, and material inputs from the STAN Industrial dataset to supplement the production data.

The second dataset is sourced from official records of the French Customs Administration, providing comprehensive information on the import and export flows of French firms. The trade flows are reported at the firm-product-country level, with products defined at the 8-digit (CN8) level of aggregation. One significant advantage of customs data is that they include details on the value and quantity of imports and exports, which makes it possible to calculate import and export prices as unit values. We refer to Bergounhon et al. (2018) for an extensive description of this dataset.

Sample Selection

The methodology involves two steps. Firstly, we estimate demand shifters at the firm level using the demand estimation approach described in Section 2.2.1 and Appendix D. For this exercise, we use import and export data and conduct demand estimation at the firm-product-

[16] Assuming instead that labor, on which we do not want to take a specific stand, is a dynamic input does not affect the results.

[17] While theory-consistent, this adjustment as a limited impact in practice.

[18] For a detailed description of these data sources, we refer to Blaum et al. (2018)

country-year level. Import data are leveraged to build shift-share cost instruments for prices, based on exchange rate movements and the firm import sourcing mix. The estimating sample thus comprises firms that engage in import and export activities during a particular year. Table A.1 presents the relevant summary statistics for this sample, while Appendix E.2 provides more detail on the basic cleanings we implement.

Secondly, we combine firm-level demand shifters from demand estimation with firm-level production and import data to estimate revenue elasticities from equation (20). The estimating sample thus comprises firms engaging in import and export activities during a particular year which are matched with production data. To align with homogeneity requirements implied by the revenue function estimation exercise (done at the 2-digit industry level) and our focus on input trade, we restrict attention to firms whose imports represent more than 5% of their revenues. Table A.2 presents relevant summary statistics for the sample retained for revenue function estimation, while Appendix E.2 provides more detail on the exact selection procedure.

These firms constitute approximately 46% of all manufacturing firms in France and contribute to 80% of total manufacturing value added. The French data confirms a significant size premium for importing and exporting firms, consistent with extensive empirical research on firms and trade. The firms retained for revenue function estimation heavily rely on foreign intermediates for their production, with imported inputs accounting for around 40% of the total material expenditure and 20% of revenues. The final sample comprises approximately 16,000 firms annually, spread across 18 two-digit manufacturing sectors.

4 Results

This section presents the estimation results. We first discuss the results of the demand (shifters) estimation exercise and then those of revenue function estimation.[19]

4.1 Demand Shifters

We estimate demand in the pooled sample of firms and by broad HS chapters. Table 1 presents the demand estimates for the pooled sample. As expected, the coefficient from OLS estimation is biased towards zero compared to the corresponding IV estimate. The IV methodology identifies a price elasticity of around 4, consistent with the results in Piveteau

[19]For now, all standard errors displayed in this section are step-specific standard errors. We will ultimately compute standard errors from bootstrapping the entire procedure.

Table 1: Demand Estimation - Pooled

	OLS	IV	First Stage	Reduced Form
	q_{ipct}	q_{ipct}	p_{ipct}	q_{ipct}
p_{ipct}	-0.869***	-4.076***		
	(0.017)	(1.523)		
$\overline{RER}_{it}^{imp_{t-1}}$			0.266***	-1.086***
			(0.076)	(0.352)
$Entry_{ipct}$	-0.966***	-0.957***	0.003	-0.968***
	(0.015)	(0.017)	(0.003)	(0.015)
$\overline{GDP}_{it}^{imp}$	0.015	0.042**	0.007**	0.0127
	(0.013)	(0.019)	(0.004)	(0.013)
$\overline{GDP}_{it}^{exp}$	0.199***	0.236***	0.012**	0.186***
	(0.027)	(0.040)	(0.005)	(0.027)
Observations	1,199,857	1,199,857	1,199,857	1,199,857
Kleibergen-Paap F-stat		12.45		

Notes: Firm×prod×dest×spell and prod×dest×year fixed effects are included in all regressions. Standard errors in parentheses are clustered at the firm level. *** p<0.01, ** p<0.05, * p<0.1.

and Smagghue (2019) who used similar data on French exports.[20] The first-stage and reduced-form price coefficients in columns (3) and (4) exhibit expected and statistically significant correlation signs. Our instrument, which is interpreted as a positive cost shifter, is found to be significantly and positively (negatively) correlated with output prices (quantities). The validity of the instrument is confirmed by the Kleibergen-Paap F-statistic, which exceeds the rule-of-thumb threshold of 10.

We report the demand estimates by broad product chapters in Table A.3 in the Appendix. Similar to the results from the pooled sample, the IV procedure identifies price elasticities ranging from 2.1 to 5.5 for most industries considered.

Given the demand elasticity estimates from Table A.3, we recover estimates of firm-year level demand shifters (η_{it}) using the methodology described in Section 2.2.1.[21] Table A.5 demonstrates how these firm-level demand shifters positively correlate with export prices, quantities, and values. Furthermore, Table A.6 confirms that such positive correlations persist even when considering firm-level variables, such as employment (l_{it}), wage bill (wl_{it}), and revenue (r_{it}), which are only partially influenced by the firm's exporting activity. The

[20] The main differences between our study and theirs are as follows: (1) we focus solely on manufacturing firms, while their research includes retailers and wholesalers; (2) they examine a slightly longer sample period that extends to 2010.

[21] In a first step, we estimate demand shifters at the firm-product-destination country level. We then purge the residuals from product-country-year (PCY) fixed effects, and Table A.4 shows that prices (p_{ipct}), quantities (q_{ipct}), and exports (exp_{ipct}) significantly and positively correlate with these residuals.

strong correlation with firm-level revenue is reassuring, as we aim to control for these firm-level demand shifters when estimating the revenue function.

4.2 Revenue Elasticities

Table 2 presents the estimates of the revenue elasticity of foreign- and domestically-produced intermediates, calculated using the equation in (14). To ensure clarity, we report only the median estimate of the revenue elasticities across firms within each two-digit industry. The complete table of estimates, including the vector of parameters $\tilde{\beta}$, along with the estimates' standard errors and standard deviations, is available in Table A.7 in the Appendix.

On average, the median revenue elasticity across firms for foreign-produced intermediates is estimated to be around 0.25 in each 2-digit industry, while the median revenue elasticity for domestically-produced intermediates is around 0.40. The revenue elasticity of the labor and capital coefficients are estimated to be 0.05 and 0.30, respectively, as indicated by the respective coefficients in Table A.7. All coefficients are estimated precisely.

Table 2: Revenue Function Estimates

	Sector	$\theta_i^{M,r}$	$\theta_i^{Z,r}$	Obs.
15	Food Products and Beverages	0.233	0.465	6,096
17	Textiles	0.281	0.326	5,238
18	Wearing Apparel	0.332	0.282	3,527
19	Leather	0.298	0.335	1,609
20	Wood	0.181	0.441	2,027
21	Pulp	0.227	0.371	2,694
22	Printing and Publishing	0.272	0.265	1,891
24	Chemicals	0.206	0.399	5,986
25	Rubber	0.195	0.380	5,574
26	Non-metallic mineral Products	0.207	0.307	1,925
27	Basic Metals	0.285	0.356	1,805
28	Fabricated Metal Products	0.209	0.319	7,175
29	Machinery and Equipment	0.210	0.347	6,906
31	Electrical machinery & App.	0.210	0.358	2,447
32	Radio and Communication	0.214	0.342	1,453
33	Medical	0.178	0.301	3,161
34	Motor Vehicles	0.222	0.422	1,838
35	Other Transport Equipment	0.257	0.390	724

Notes: Median θ by industry, θ being defined by equation (14).

4.3 Market Power in Input Markets

Table 3 presents the mean and median estimated markdowns based on the revenue elasticities reported in Table 2 for each two-digit industry. Table A.8 provides additional deciles and more detailed distribution information. Both tables also report estimates for domestically produced inputs. Across all manufacturing industries, the average firm-level markdown in the market for foreign intermediates is 1.50, indicating substantial price-setting power for importers. The average and median markdowns significantly deviate from competitive levels in every manufacturing industry, with variation in heterogeneity across industries and firms. For instance, "Basic Metals" (1.80) and "Wearing Apparel" (1.85) industries show high markdowns, while "Chemical" (1.24) and "Rubber" (1.29) industries appear to be more competitive.

The market for domestically produced intermediates also exhibits high markdowns, with an average estimated markdown of 1.60 across two-digit industries. We find a positive correlation between the average industry markdowns in the two input markets. The distribution of markdowns in the foreign input market is substantially skewed, with firms in the 90th percentile charging a markdown almost three times as high as those in the 10th percentile. In contrast, the distribution is relatively normal in the domestic input market. These findings align with the significant skewness in import behavior documented in Table A.2.

4.4 Validation

The econometric framework used in this study identifies market power in input markets by examining distortions, or "wedges", in the profit-minimizing behavior of industries and firms. In this context, foreign and domestic intermediates are defined as firm aggregates, which allows for the use of production function estimation techniques to obtain consistent estimates of the wedges. However, this level of aggregation may introduce concerns about confounding factors that could affect the results.

The literature on trade and industrial organization offers several potential confounding factors, with the unobserved fixed cost of sourcing and input-augmenting productivity being the most important. For instance, if low-cost country sourcing is more expensive, larger and more productive firms might spend less on shipments of the same size (Antràs et al., 2017), leading the econometric framework to attribute differences in sourcing costs to differences in pricing power across firms. Additionally, if the production technology features input-augmenting productivity, then we could wrongly attribute the wedges to input market

Table 3: Average and Median Markdowns

		ψ_i^M		ψ_i^Z	
	Sector	Mean	Median	Mean	Median
15	Food Products and Beverages	1.63	1.56	1.36	1.24
17	Textiles	1.52	1.40	1.79	1.60
18	Wearing Apparel	1.85	1.60	1.90	1.54
19	Leather	1.54	1.46	1.72	1.57
20	Wood	1.16	1.10	1.63	1.49
21	Pulp	1.19	1.15	1.44	1.38
22	Printing and Publishing	2.30	2.11	1.74	1.27
24	Chemicals	1.24	1.17	1.60	1.42
25	Rubber	1.29	1.22	1.51	1.41
26	Non-metallic mineral Products	1.58	1.46	1.82	1.51
27	Basic Metals	1.80	1.62	1.43	1.31
28	Fabricated Metal Products	1.66	1.55	1.63	1.42
29	Machinery and Equipment	1.46	1.36	1.41	1.27
31	Electrical machinery & App.	1.23	1.14	1.52	1.38
32	Radio and Communication	1.29	1.19	1.67	1.45
33	Medical	1.22	1.12	1.61	1.35
34	Motor Vehicles	1.44	1.26	1.59	1.44
35	Other Transport Equipment	1.52	1.34	1.77	1.57

Notes: The table shows relevant moments of the markdown distribution in each two-digit industry, for the imported and domestic intermediates, respectively. The distribution is trimmed at the 3rd and 97th percentiles.

power (Raval, 2022).

Table 4 provides robust evidence that the size and variation in the wedges are large and economically important, even after sourcing costs and differences in technology are controlled for. Moreover, evidence across firms lends support to the interpretation of the wedges as due to input market power.

First, in all regressions, markdowns are found to be positively correlated with firm size, as measured by firm employment l_{it}.

Second, the validation exercise also aims to leverage the granularity of import data, exploiting differences in competition intensity faced by French firms in their import markets. Regressions in column (1) include, as all columns, industry-year fixed effects, an indicator for the firm multinational status, and the average GDP per Capita ($\overline{GDP}_{it}^{imp}$) in the firm source markets, but does not include sourcing mix controls. As a result, markdowns negatively and significantly correlate with the average number of French importers in the firm sourcing markets, yet with a low magnitude, in Panel (a), but also negatively correlate with the average HHI in the firm sourcing markets, in Panel (b). This is potentially due to spurious correlations driven by firm selection in the different import markets. As the extensive margin of imports is a crucial determinant of input expenditures, it is indeed necessary to hold the sourcing strategy fixed when comparing the estimated wedges across firms.

Columns (2) to (9) thus aim to leverage variation in the average competition faced by firms across import markets, but controlling for the firm selection in a particular sourcing strategy, following Blaum et al. (2019). A sourcing strategy is defined as a given set of import markets (resp. ranked in terms of import values), where the market definition varies across our different specifications. A market is defined as a CN4 category in column (2) (resp. (3)), a CN4 category-country in column (4) (resp. (5)), a CN4 category-year in column (6) (resp. (7)) or a CN4 category-country-year triplet in column (8) (resp. (9)).[22]. The identification thus stems from variations (i) in the *intensive margin* of imports, *i.e* in the weight of each import market in the firm sourcing mix, and (ii) in the *competition* faced by firms across different CN8 products, holding the extensive margin of imports, *i.e* the sourcing strategy, fixed. Columns (2) to (5) leverage such variation both in the cross-section and panel dimensions, while columns (6) to (9) only leverage variation in the cross-section.[23]

With stringent enough sourcing strategy definitions, as in columns (4) to (9), markdowns are found to be negatively correlated with the average competition faced by the firm in its import markets, as measured by the number of competing French importers sourcing the same products from the same markets or the Herfindahl index (HHI). In the last two columns, even though the drastically shrunk sample size suggests caution, the effect of firm size and the average competition faced by a firm on its import markets are of a comparable magnitude.

The results presented in Table 4 thus show the ability of our methodology to capture in a sufficient statistic, namely the firm-level markdown, the overall ability of a given firm to exert buyer power in different import markets.

[22]We rely on a CN4 (instead of a more stringent CN6 or CN8) definition of a product category as the sample size rapidly shrinks when adding sourcing strategy fixed effects.

[23]Columns (2) to (5) (as well as Column (1) thus accordingly rely on the harmonized CN8 nomenclature defined in Bergounhon et al. (2018).

Table 4: Markdowns and Average Competition in Import Markets

Outcome var: ψ_i^M	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Panel (a): Number of French Importers									
$\overline{N}_{it}^{imp}$	-0.015***	-0.007	-0.012	-0.066**	-0.083**	-0.048***	-0.046***	-0.136**	-0.150**
	(0.004)	(0.010)	(0.011)	(0.030)	(0.033)	(0.016)	(0.017)	(0.059)	(0.060)
l_{it}	0.035***	0.095***	0.094***	0.110***	0.105***	0.114***	0.116***	0.204***	0.207***
	(0.003)	(0.011)	(0.012)	(0.027)	(0.030)	(0.018)	(0.019)	(0.043)	(0.045)
Panel (b): Herfindahl Index (HHI)									
$\overline{HHI}_{it}^{imp}$	-0.024***	-0.002	0.001	0.066**	0.076***	0.029	0.028	0.125***	0.130***
	(0.005)	(0.012)	(0.013)	(0.029)	(0.028)	(0.018)	(0.018)	(0.045)	(0.045)
l_{it}	0.035***	0.094***	0.093***	0.110***	0.105***	0.106***	0.106***	0.166***	0.168***
	(0.003)	(0.011)	(0.012)	(0.027)	(0.029)	(0.016)	(0.017)	(0.041)	(0.043)
Sourcing Strat. FE	No	P	P^r	PC	PC^r	PT	P^{r}T	PCT	PC^{r}T
Observations	38,091	6,054	5,046	2,125	1,697	2,001	1,870	257	232

Notes: $\overline{N}_{it}^{imp}$ is a weighted average of the number of French importing firms across import markets of firm i in year t, where a market is defined by a product-country combination. $\overline{HHI}_{it}^{imp}$ is a weighted average of HHI across import markets of firm i in year t, where a market is defined by a product-country combination. All variables are in log. Products are defined based on the harmonized nomenclature for columns (1)-(5), and the CN8 contemporaneous nomenclature for columns (6)-(9). l_{it} is the employment (average number of workers) of firm i in year t. Sourcing strategies are defined in terms of the presence of firms on CN4 product (P), or CN4 product-country (PC) markets, interacted with year (T) for col (6)-(9). Firms sharing the same (ranked, denoted with the subscript r) sourcing strategy have the same set of import markets (ranked similarly in terms of value). All regressions include Industry-Year fixed effects, an MNF indicator, and $\overline{GDP}_{it}^{imp}$ controls. Sample reduced to observations (firm-year) for which products switching nc4 categories over time represent less than 2% of imports. Standard errors in parentheses are clustered at the firm level. *** p<0.01, ** p<0.05, * p<0.1.

5 Buyer Power and the Aggregate Economy

Having established the sizable buyer power of French importers in input trade, we next aim to measure its impact on aggregate variables. We do this by constructing the most straightforward model that enables us to answer this question within the context of French manufacturing.

We consider the standard heterogeneous firms model of production in Melitz (2003) and expand it to incorporate imperfect competition in input trade. To concentrate on this source of aggregate distortions, we assume that domestic input markets are perfectly competitive. Hereafter, we will use capital letters to represent aggregate variables and lowercase letters to denote firm-level variables.

5.1 Environment

The economy consists of two symmetrical countries: the Home country (France) and a Foreign country (Rest of the World). We focus on the equilibrium in the Home country, where a representative consumer consumes differentiated varieties of a final good, supplies a fixed amount of labor L at a fixed unit wage of W^L, and earns profit income from owing claims to the firms' profits.

We denote total consumption as Q and write it as:

$$Q = \left(\int_{i \in M} q_i{}^{\rho} di \right)^{\frac{1}{\rho}}, \tag{25}$$

where q_i denotes the quantity consumed of variety i of the final good, and $0 < \rho < 1$ is a preference parameter capturing the substitutability between any two varieties, which can be summarized by an elasticity of $\sigma = \frac{1}{1-\rho} > 1$. We use the final good Q as the numeraire, such that the associated price index is given by $P = \left(\int_{i \in N} p_i{}^{-\frac{\rho}{1-\rho}} di \right)^{-\frac{1-\rho}{\rho}} = 1$.

The consumer problem is to choose $\{q_i\}_{i \in N}$ so as to maximize (25) subject to a budget constraint. Consumer optimization leads to a standard CES demand for variety i, given by:

$$q_i = p_i^{-\frac{1}{1-\rho}} Q. \tag{26}$$

Firms Each of the N differentiated varieties of the final good is produced locally by domestic firms, which combine labor with intermediate inputs sourced from the Foreign country.[24] Hence, international trade is allowed for intermediate inputs but not for final goods, and trade is necessarily unbalanced.[25] We will focus on an equilibrium where entry is restricted, such that the measure N of (firms and) varieties produced in equilibrium remains fixed and exogenous.

We specify the production function of a given firm i as:

$$q_i = \phi_i m_i{}^{\beta} l_i{}^{1-\beta}, \tag{27}$$

where $\phi_i \equiv e^{\omega_i}$ represents the firm-level total factor productivity (TFP), m_i is the quantity of foreign inputs used by firm i in production, and l_i represents the labor input.

[24] Even though we refer to the domestic input (l) as labor, the latter can be thought of as a constant return to scale aggregator of l_v for $v = 1, .., N$ primary factors, including labor, capital, and domestic intermediate inputs.

[25] Importantly, the fact that intermediates are imported in this model implies that aggregate income does not align with total revenues. Instead, aggregate income (and welfare) coincides with domestic value-added, which can be expressed as $Y = \text{VA} \; = Q - \int_{i \in N} W_i^M m_i di$, where the second term in the right-hand side denotes total imports.

Foreign Intermediate Inputs As discussed in Section 2, the firm-level quantity (m_i) and price (W_i^M) of foreign intermediate inputs can be viewed as aggregators of quantities and prices of individual intermediate varieties. Each firm can import a distinct set of varieties, and the price and quantity of individual varieties can be the outcome of a complex negotiation process between the importer and foreign exporters.

Here, we make simplifying assumptions to keep the analysis tractable. Specifically, we consider the foreign intermediates as firm-level inputs, to abstract from variety-level information. We then assume that foreign inputs are horizontally differentiated across firms, and establish a relationship between the quantity and price input aggregators using the following (inverse supply) mapping:

$$W_i^M = \left(\bar{M} - m_i^{\frac{1}{\eta-1}}\right)^{-\frac{1}{\eta-1}}, \quad \eta > 1. \tag{28}$$

where $\bar{M}$ is a normalizing constant ensuring $\bar{M} > m_i^{\frac{1}{\eta-1}}$, and the parameter $\eta > 1$ governs firm i's elasticity of input prices to input demand. The latter is given by $\frac{d \ln W_i^M}{d \ln m_i} = \frac{m_i^{\frac{1}{\eta-1}}}{\bar{M} - m_i^{\frac{1}{\eta-1}}} > 0$, and it is positive due to the assumptions on $\bar{M}$. This specification of the input supply schedule implies a markdown of importer i on imported intermediate inputs that can be expressed as:

$$\psi_i^M = \frac{\bar{M}}{\bar{M} - m_i^{\frac{1}{\eta-1}}} \geq 1. \tag{29}$$

Equation (28) is akin to an inverse input supply function for importer i. The implicit assumption is that foreign input suppliers can supply any quantity of the input to firm i, subject to the constraint given by equation (28). Furthermore, the assumption of horizontal differentiation of inputs makes the supply function in (28) specific to each firm, allowing us to overlook the general equilibrium effects of a firm's behavior on the demand of other domestic firms.

This formulation simplifies the dynamics of the foreign intermediate market significantly while retaining the essential characteristics of a model of input trade with imperfect competition. Specifically, it implies a flexible upward-sloping relationship between the price and quantity of intermediate inputs, resulting in a firm-specific markdown ψ_i^M. Moreover, the specific functional form allows us to express W_i^M as proportional to $(\psi_i^M)^{\eta-1}$, establishing a direct relationship between input prices and markdowns at the firm level. This property of the supply model enables us to analytically analyze the impact of distortions in buyer power on aggregate variables in terms of a single sufficient statistic – the firm-level markdown ψ_i^M – for which we have already obtained estimates in the earlier sections of this paper.

5.2 Market Structure and Firm-Level Equilibrium

We adopt a Cournot model of competition in foreign input markets, where firms determine their quantities based on the inverse input supply curve given by equation (28). We then assume that firms engage in monopolistic competition in the final goods market while they act as price takers in the domestic labor market, hiring labor at a fixed unit wage W^L.

The objective for firm i is to maximize profits by choosing inputs, taking into account final demand, upstream supply, and technology. This objective leads to the following first-order conditions (FOCs) for the two inputs:

$$\beta \frac{p_i q_i}{W_i^M m_i} = \frac{\psi_i^M}{\rho} \tag{30}$$

$$(1-\beta)\frac{p_i q_i}{W^L l_i} = \frac{1}{\rho} \tag{31}$$

Here, ρ^{-1} represents the firm-level markup over the variety of final goods, which remains constant due to the assumptions of monopolistic competition and CES demand; ψ_i^M denotes the firm-level markdown on foreign intermediate inputs defined in (29).

Given the FOCs in (30) and (31), it can be shown that the heterogeneous impact of buyer power in foreign markets on the firm-level equilibrium can be summarized as follows:

$$m_i \propto \phi_i^{\frac{\rho}{1-\rho}} (\psi_i^M)^{-\eta \frac{1-\rho(1-\beta)}{1-\rho}} \tag{32}$$

$$\frac{l_i}{m_i} \propto (\psi_i^M)^{\eta} \tag{33}$$

$$q_i \propto \phi_i^{\frac{1}{1-\rho}} (\psi_i^M)^{-\frac{\beta\eta}{1-\rho}}. \tag{34}$$

This system shows that buyer power in foreign markets generates three sources of inefficiency at the firm level. First, it reduces demand for the foreign input (equation (32)). Second, it leads firms to substitute inefficiently between foreign and domestic inputs (equation (33)). Third, it reduces firm-level output, leading to higher final good prices (equation (34)). Notably, for a given level of productivity ϕ_i, the wedge ψ_i^M summarizes the firm-level distortions resulting from buyer power. It is thus a sufficient statistic for its effect on firm-level variables.

5.3 Aggregation

The simple model allows for an analytical characterization of the aggregate equilibrium. Let $\mu(\phi, \psi)$ denote the joint distribution of firm-level productivity and markdown levels.

Assuming that firm-level productivity and buyer power are i.i.d. distributed across firms, i.e., $\mu(\phi,\psi) = \mu_\phi(\phi)\mu_\psi(\psi)$, aggregate consumption Q can be expressed as:

$$Q = Q^{EFF} \cdot \Psi^{-\frac{\eta\beta}{1-\beta}}, \tag{35}$$

where $\Psi = \left[\int_1^\infty (\psi)^{-\frac{\eta\beta\rho}{1-\rho}} \mu_\psi(\psi) d\psi\right]^{-\frac{1-\rho}{\rho\eta\beta}}$ is a markdown index. The term $Q^{EFF} \equiv \Theta \cdot \Phi^{\frac{1}{1-\beta}} \cdot L$ reflects aggregate output in a counterfactually "efficient" economy where we shut down buyer power in input trade.[26]

Equation (35) clearly shows the impact of buyer power on aggregate output. As the incidence of buyer power increases, the term Ψ increases and aggregate output decreases. The overall effect increases with the output elasticity of foreign intermediates (β) and the scope for input market power in foreign markets, as captured by the parameter η.

The following expressions can be derived for all aggregate variables: aggregate imports of intermediate inputs E^M, aggregate labor income $W^L L$, aggregate profits Π, and welfare, which in this model can be measured as domestic value added: $W = W^L L + \Pi$. We derive the following expressions:[27]

$$\frac{E^M}{E^{M,EFF}} = \tilde{\psi}^{-\frac{\beta(1-\rho)}{(1-\beta)\Phi}} \hat{\hat{\psi}}^{-1} \qquad \frac{W^L L}{(W^L L)^{EFF}} = \tilde{\psi}^{-\frac{\beta(1-\rho)}{(1-\beta)\Phi}}$$

$$\frac{\Pi}{\Pi^{EFF}} = \left[1 + \frac{\beta\rho}{1-\rho}\left(1 - \hat{\hat{\psi}}^{-1}\right)\right] \tilde{\psi}^{-\frac{\beta(1-\rho)}{(1-\beta)\Phi}} \qquad \frac{W}{W^{EFF}} = \frac{1-\beta\rho\hat{\hat{\psi}}^{-1}}{1-\beta\rho} \tilde{\psi}^{-\frac{\beta(1-\rho)}{(1-\beta)\Phi}}. \tag{36}$$

Together with $\tilde{\psi}$, the term $\hat{\hat{\psi}} \equiv \frac{\int_1^\infty \psi^{-\frac{\beta\rho}{\Phi}} \mu_\psi(\psi) d\psi}{\int_1^\infty \psi^{-\frac{\beta\rho+\Phi}{\Phi}} \mu_\psi(\psi) d\psi} > 1$ is a second index of buyer power affecting aggregate variables. While $\tilde{\psi}$ captures the distorting effect of buyer power on output, $\hat{\hat{\psi}}$ captures the distorting effect of buyer power on foreign input markets.

The output distortions lead to lower labor income and consumer surplus, as shown by the top right equation in (36). On the contrary, the effect on profits (bottom left equation) and producer surplus depends both on output and import distortions: the larger the import distortions, i.e., the larger $\hat{\hat{\psi}}$, the larger the profits due to sizable rent transfers from foreign countries; the higher the output distortions, i.e., the larger $\tilde{\psi}$, the lower the profits due to lower demand. The former effect always dominates for profit-maximizing firms, such that

[26] Here, $\Theta \equiv \rho^{\frac{\beta}{1-\beta}} \left(\frac{1}{\beta}\right)^{-\frac{\beta}{1-\beta}}$ is a constant, while $\Phi \equiv \left[\int_0^\infty \phi^{\frac{\rho}{1-\rho}} \mu_\phi(\phi) d\phi\right]^{\frac{1-\rho}{\rho}}$ is a productivity index.

[27] The derivations are to be added in the Appendix.

producer surplus always increases with buyer power.

The contrasting role of buyer power in consumer and producer surplus results in ambiguous welfare consequences. As the bottom right equation shows, welfare increases with $\widehat{\hat{\psi}}$, but decreases with $\tilde{\psi}$. Which of these effects prevails is ultimately an empirical question.

5.4 Calibration

To quantify the aggregate effect of buyer power on the domestic economy, we require estimates of the parameters η, β, and ρ, along with a distribution for ψ.

Inverse Supply Elasticity: The parameter η is the inverse supply elasticity of foreign inputs. Values of $\eta > 0$ indicate that suppliers' marginal costs increase with downstream demand. The value of η can be determined from equation (**??**), which shows that η governs the relationship between firm-level buyer power ψ_i and i's share as a buyer in foreign input market $s_i^M = \frac{m_i}{M_i}$, where $\eta = \frac{\psi_i - 1}{s_i^M}$.

For our baseline result, we choose the value of η that matches the observed ratio between the average median wedge $\bar{\psi^M}$ across sectors and the average buyer share s_i^M observed in French import data.[28] This exercise results in a value of $\eta = 2.61$, which is consistent with the estimates of import supply elasticities by Soderbery (2018).[29]

Demand Elasticity. The parameter ρ governs both the demand elasticity and firm-level markups, which are assumed to be constant in the model. We calibrate this parameter using the estimates of the demand elasticity in Table 1. These estimates imply a value of $\rho = 0.73$.

Output Elasticities and Buyer Power. We calibrate the value of β using the estimates of the revenue elasticities from Table 2 and the demand elasticities from Table 1. The following relationship relates revenue and output elasticities: $\theta^{M,r} = \beta^M/\mu$, where $\mu = \rho^{-1}$ is the firm-level markup. Similarly, the values of ψ_i are set equal to the estimated distribution of firm-level foreign input wedges, i.e., $\psi_i = \psi_i^M$ for all i.

Table 5: Aggregate Effects of Buyer Power in Input Trade

Panel (a): Parameter Estimates (Baseline)			
Parameter	β	ρ	η
Value	0.16	0.73	2.61
Source	Estimated	Calibrated	Calibrated

Panel (b): Changes in Aggregate Variables		
	Lower Bound	Upper Bound
Output ($\Delta\%$)	-2.97	-4.86
Imports ($\Delta\%$)	-35.97	-59.53
Labor Income($\Delta\%$)	-2.97	-4.86
Profits ($\Delta\%$)	11.37	18.91
Welfare ($\Delta\%$)	1.40	2.38

Notes: Panel (a) reports the baseline estimates of the main parameters. See the respective source tables and the main text for more details. Panel (b) shows the changes in the main variables of interest when moving from a counterfactual economy where all buyers are price takers to an economy where firms have buyer power. A negative value should be interpreted as the value is lower in the distorted economy, and vice versa for positive values. Lower bound estimates (first column in panel (b)) are those obtained when we set equal to one the wedge of firms whose raw value is estimated below one in Section 4.3. Upper bound estimates (second column in panel (b)) are obtained when we exclude from the sample all the firms whose estimated ψ_i^M is below one.

5.5 Results

Table 5 summarizes the calibrated parameters and the main results.[30] Losses in aggregate output and labor income range from about 3% to 5%. Buyer power has the largest effect on total imports, which we estimate between 36 and 60% below competitive levels. Profits are higher in the distorted than in the efficient economy. The lower bound estimates yield profits 11% higher in the distorted economy than in the competitive one, while the upper bound estimate is 19%. Finally, welfare always increases in the distorted economy, by about 1.4 to 2.4%. The welfare gains stem from a terms-of-trade effect induced by the largest importers' buyer power: despite lower output and lower volumes of trade, the gain in import prices relative to export prices is such that the economy as a whole is better off in the distorted economy.

5.6 Discussion

The theoretical model offers valuable insights into the role of importers' buyer power in an economy. Like an optimal tariff on imports, the buyer power of importers can benefit a country through terms-of-trade effects that can more than compensate for smaller trade volumes and losses in consumer surplus (Kaldor, 1940). A classical result in the theoretical trade literature suggests that countries with market power in imports exploit it in setting their trade policy (Broda et al., 2008). The results in this Section show that even in the absence of import tariffs, importers with large buyer power in input trade can generate similar effects on aggregate variables. Table 5 provides evidence that these effects are significant, despite being the result of individual firm behavior.

The analysis also shows that while welfare may increase, gains may be unequally distributed across economic agents. In settings where labor is owned by consumers and firms by producers, only the latter benefit, while consumers are unambiguously worse off. This type of firm behavior could have implications for income inequality within a country.

However, the large sensitivity of welfare estimates to key parameters suggests caution in interpreting specific welfare numbers since the model is stylized. A more rigorous quan-

[28] On average, the quantity share of the French buyer i in foreign export markets ν is observed to be 0.15, with a median value of 0.002 and a standard deviation equal to 0.28.

[29] Soderbery (2018) uses UN Comtrade data over the period 1991-2007 to estimate values of the export supply elasticity by HS4 manufacturing product and import country. Their estimates for η range from 0.15 to 5+.

[30] Figures displayed in Table 5 have to be updated in accordance with the input wedge estimates from Section 4. Table 5 is for now based on the wedges estimated in Morlacco (2019).

tification exercise would require including trade costs, asymmetries between the Home and Foreign countries, and more realistic assumptions on the joint distribution of productivity and buyer power. These are straightforward extensions of the current model but have been omitted to ensure transparency of the main results.

Finally, the study has implications for trade policy. The analysis suggests mixed incentives for governments and anti-trust authorities in open economies to restrain the market power of the largest firms. Under most parameter calibrations, buyer power in input trade generates gains in national welfare, at the expense of foreign countries. Therefore, a rationale for lenient anti-trust conduct may be found in beggar-thy-neighbor trade policies, while being less exposed to the risk of retaliation. In similar settings, anti-trust policies would require a globally coordinated policy response to prevent large multinational buyers from accumulating excessive market power.

6 Conclusions

This paper presents micro-level estimates of buyer power in input trade and analyzes its aggregate implications. We develop a methodology to estimate buyer power in input trade using only firm-level data, without requiring knowledge of the import environment. Our methodology starts with a general model of production and input trade that imposes minimal assumptions on output and input markets. Although our empirical analysis focuses on imported intermediate inputs, the methodology can be applied to any static input with available data on production and input quantities.

Applying our methodology to the universe of trade and production data for the French manufacturing sector, we find evidence of substantial buyer power in input trade. The average firm-level markdown in input trade is 1.49, indicating significant price-setting power on the importers' side, with substantial heterogeneity in markdowns across industries and firms. Larger and more productive firms have larger wedges than smaller, unproductive ones. Using our highly disaggregated import data, we validate our buyer power measures by showing that firm-level markdowns on imported inputs positively correlate with the average concentration faced by firms across their import markets.

We develop a macro model with heterogeneous firms to link the micro-level wedges to aggregate variables. We show that buyer power in input trade generates aggregate distortions while producing a terms-of-trade improvement, similar to an import tariff. Thus, our results suggest that even without trade policy instruments, significant terms-of-trade gains for the economy can result from individual importers' behavior in foreign markets.

Our paper enhances our understanding of the role of buyers in modern economies, specifically in the context of international trade. Despite increasing attention to buyer power, there has been limited focus on the global trade context. Our findings have broader implications for the relationship between globalization and market structure in advanced economies. As participation in international trade increases, the market power of large firms can grow, leading to a decline in overall competition in the economy. Additionally, our results suggest that national governments and anti-trust authorities may have no incentive to prevent excessive market power buildup, as it can result in a net increase in domestic welfare.

These observations contribute to the ongoing debate about the causes of the increase in market concentration and the decline in business dynamism in advanced economies, which includes the impact of international trade and offshoring (See, e.g., De Loecker et al. (2019); Van Reenen (2018); Syverson (2019); Eggertsson et al. (2018); Akcigit and Ates (2019)).

A promising area for future research would be to conduct an explicit analysis of the role of globalization in the observed increase in concentration and market power in large economies.

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A Additional Tables and Figures

Table A.1: Descriptive Statistics - Demand Estimation

	Mean	p10	p25	p50	p75	p90
(1) Full sample: N = 4,436,635						
# Source countries by firm	9.53	0	2	7	14	23
# Observations by exporting spell	3.61	2	2	3	4	8
# Varieties by export market	3.16	1	1	1	3	6
(2) Selected Sample: N = 1,322,508						
# Source countries by firm	14.98	1	6	12	21	31
# Observations by exporting spell	8.06	4	6	8	11	11
# Varieties by export market	4.68	2	2	3	5	9
(3) Estimating sample: N = 1,199,857						
# Source countries by firm	16.72	4	8	14	22	33
# Observations by exporting spell	7.58	4	6	8	10	11
# Varieties by export market	4.49	2	2	3	5	8

Notes: An observation is an export flow at the firm, nc8 product, destination, year combination. An exporting spell is a set of consecutive export flows for a firm-destination-nc8 product triplet. An export market is a nc8 product-destination-year triplet, and a variety a firm-nc8 product pair. Sample (1) comprises firms importing and exporting in a given year. Sample (2) restricts Sample (1) to exporting spells shorter than 7 years. Sample (3) restricts Sample (2) to observations which are not firm×prod×dest×spell and prod×dest×year singletons.

Table A.2: Descriptive Statistics - Revenue Function Estimation Sample

	Mean	p10	p25	Median	p75	p90
(1) Full Sample N=139,789						
Revenue Shares of Inputs						
Labor - α^L	0.25	0.10	0.16	0.23	0.32	0.41
Capital - α^K	0.37	0.06	0.13	0.26	0.48	0.76
Imported Materials - α^M	0.15	0.01	0.03	0.09	0.21	0.36
Domestic Materials - α^Z	0.30	0.08	0.16	0.27	0.39	0.52
Extensive and Intensive Margin of Imports						
# Sourcing countries	6.77	1	3	5	9	14
# Sourcing markets	33.59	2	5	15	36	77
Imported Share of Intermediates	0.32	0.02	0.09	0.25	0.51	0.74
(2) Selected Sample N=87,098						
Revenue Shares of Inputs						
Labor - α^L	0.23	0.10	0.15	0.22	0.30	0.37
Capital - α^K	0.36	0.06	0.13	0.27	0.49	0.76
Imported Materials - α^Z	0.19	0.07	0.09	0.16	0.26	0.38
Domestic Materials - α^M	0.27	0.10	0.16	0.25	0.36	0.47
Extensive and Intensive Margin of Imports						
# Sourcing countries	8.26	2	4	7	11	16
# Sourcing markets	44.71	5	10	23	49	97
Imported Share of Intermediates	0.42	0.16	0.24	0.39	0.59	0.75
(3) Estimating sample: N=62,077						
Revenue Shares of Inputs						
Labor - α^L	0.23	0.10	0.15	0.22	0.29	0.36
Capital - α^K	0.37	0.06	0.13	0.28	0.50	0.76
Imported Materials - α^M	0.20	0.07	0.10	0.17	0.27	0.38
Domestic Materials - α^Z	0.27	0.10	0.16	0.25	0.35	0.46
Extensive and Intensive Margin of Imports						
# Sourcing countries	8.89	3	5	7	11	17
# Sourcing markets	49.51	6	12	26	55	107
Imported Share of Intermediates	0.43	0.18	0.26	0.41	0.59	0.74

Notes: Observations are at the firm-year level. Sample (1) is restricted to importers and exporters kept in demand estimation. Sample (2) restricts Sample (1) according to the selection procedure described in Section E.2. Sample (3) restricts Sample (2) to firm-year observations for which a lag for a given firm is present.

Table A.3: Price-elasticity estimates ($-\hat{\sigma_s}$) for different product categories.

	OLS		IV (Single FS)		0bs.
Animal Products	-1.014***	(0.035)	-3.479*	(2.045)	31,097
Vegetable Products	-0.915***	(0.034)	-3.624**	(1.457)	14,555
Foodstuffs	-0.972***	(0.015)	-3.085***	(0.926)	95,686
Mineral Products	-0.961***	(0.047)	-5.526***	(1.078)	8,359
Chemicals & Allied	-0.926***	(0.008)	-4.509***	(0.500)	189,848
Plastics, Rubbers	-0.979***	(0.011)	-4.108***	(0.653)	108,043
Skins, Leather	-0.691***	(0.030)	-3.609***	(0.966)	16,255
Wood, Wood Products	-0.877***	(0.014)	-0.978	(0.726)	68,880
Textiles	-0.732***	(0.010)	-5.032***	(0.287)	246,854
Footwear, Headgear	-0.365***	(0.038)	-9.379***	(1.236)	14,078
Stone, Glass	-0.955***	(0.021)	-2.235*	(1.223)	28,322
Metals	-0.824***	(0.010)	-2.161***	(0.687)	107,337
Machinery, Electrical	-0.929***	(0.007)	-2.375***	(0.476)	179,498
Transportation	-0.956***	(0.019)	-4.353***	(1.278)	36,403
Miscellaneous	-0.813***	(0.014)	-3.135***	(0.724)	54,642

Notes: Estimates in column *OLS* are estimated by OLS separately for each industry. Estimates in column *IV (single FS)* are obtained by estimating a single first stage and a second stage where the price-elasticity is allowed to vary across industries. Controls for weighted average GDP per capita in export and import markets ($\overline{GDP}_{it}^{exp}$, $\overline{GDP}_{it}^{imp}$), for partial-year effect ($Entry_{ipct}$), and firm×prod×dest×spell and prod×dest×year fixed effects are included in all regressions. See D and Piveteau and Smagghue (2019) for more details on the methodology. *** p<0.01, ** p<0.05, * p<0.1.

Table A.4: Firm-Prod-Dest-Year Level Demand Shifters and Export Variables

	p_{ipct}	q_{ipct}	exp_{ipct}	p_{ipct}	q_{ipct}	exp_{ipct}
$\hat{\eta}_{ipct}$	0.179***	-0.046***	0.133***	0.171***	0.285***	0.457***
	(0.001)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)
Fixed Effects	No	No	No	PCY	PCY	PCY
Observations	3,681,030	3,681,030	3,681,030	3,681,030	3,681,030	3,681,030
R2	0.415	0.009	0.108	0.871	0.575	0.653

Notes: Observations are at the firm×prod×dest×year level. Standard errors in parentheses are clustered at the firm-year level. *** p<0.01, ** p<0.05, * p<0.1.

Table A.5: Firm-Level Demand Shifters and Export Variables

	p_{it}	q_{it}	exp_{it}	p_{it}	q_{it}	exp_{it}
$\hat{\eta}_{it}$	0.193***	0.394***	0.587***	0.131***	0.248***	0.379***
	(0.004)	(0.009)	(0.007)	(0.003)	(0.006)	(0.005)
Fixed Effects	No	No	No	IY	IY	IY
Observations	212,726	212,726	212,726	212,726	212,726	212,726
R2	0.043	0.074	0.283	0.900	0.900	0.905

Notes: Observations are at the firm×year level. Standard errors in parentheses are clustered at the firm level. *** p<0.01, ** p<0.05, * p<0.1.

Table A.6: Firm-Level Demand Shifters and Balance Sheet Variables

	l_{it}	wl_{it}	r_{it}	l_{it}	wl_{it}	r_{it}
$\hat{\eta}_{it}$	0.192***	0.218***	0.226***	0.023***	0.025***	0.037***
	(0.003)	(0.004)	(0.004)	(0.001)	(0.001)	(0.001)
Fixed Effects	No	No	No	IY	IY	IY
Observations	212,726	212,726	212,726	212,726	212,726	212,726
R2	0.101	0.113	0.109	0.962	0.962	0.962

Notes: Observations are at the firm×year level. Standard errors in parentheses are clustered at the firm level. *** p<0.01, ** p<0.05, * p<0.1.

Table A.7: Revenue Function Estimates

	Sector	$\tilde{\beta}_k$	$\tilde{\beta}_l$	$\tilde{\beta}_m$	$\tilde{\beta}_z$	$\tilde{\beta}_{mm}$	$\tilde{\beta}_{zz}$	$\tilde{\beta}_{mz}$	$\theta_i^{M,r}$	$\theta_i^{Z,r}$	Obs.
15	Food Products and Beverages	0.033	0.273	0.049	0.320	0.043	0.037	-0.069	0.233	0.465	6,096
		(0.003)	(0.005)	(0.032)	(0.033)	(0.004)	(0.003)	(0.007)	(0.399)	(0.575)	
17	Textiles	0.028	0.333	0.218	0.129	0.041	0.046	-0.077	0.281	0.326	5,238
		(0.003)	(0.006)	(0.052)	(0.05)	(0.005)	(0.005)	(0.009)	(0.452)	(0.482)	
18	Wearing Apparel	0.033	0.330	0.246	0.176	0.020	0.021	-0.033	0.332	0.282	3,527
		(0.005)	(0.008)	(0.053)	(0.055)	(0.005)	(0.006)	(0.01)	(0.422)	(0.36)	
19	Leather	-0.003	0.376	0.027	0.308	0.046	0.037	-0.073	0.298	0.335	1,609
		(0.007)	(0.01)	(0.072)	(0.066)	(0.006)	(0.006)	(0.011)	(0.504)	(0.472)	
20	Wood	0.044	0.305	-0.017	0.339	0.040	0.034	-0.063	0.181	0.441	2,027
		(0.006)	(0.009)	(0.045)	(0.059)	(0.004)	(0.004)	(0.008)	(0.358)	(0.549)	
21	Pulp	0.052	0.334	0.089	0.175	0.056	0.056	-0.101	0.227	0.371	2,694
		(0.005)	(0.007)	(0.044)	(0.05)	(0.004)	(0.004)	(0.008)	(0.448)	(0.546)	
22	Printing and Publishing	0.057	0.429	0.069	0.432	0.023	0.009	-0.031	0.272	0.265	1,891
		(0.007)	(0.012)	(0.085)	(0.073)	(0.009)	(0.01)	(0.019)	(0.36)	(0.319)	
24	Chemicals	0.044	0.328	0.103	0.361	0.046	0.041	-0.083	0.206	0.399	5,986
		(0.003)	(0.006)	(0.03)	(0.031)	(0.003)	(0.003)	(0.006)	(0.397)	(0.539)	
25	Rubber	0.030	0.392	0.179	0.195	0.044	0.047	-0.084	0.195	0.380	5,574
		(0.002)	(0.005)	(0.036)	(0.036)	(0.003)	(0.003)	(0.006)	(0.384)	(0.512)	
26	Non-metallic mineral Products	0.087	0.376	0.224	0.362	0.019	0.017	-0.039	0.207	0.307	1,925
		(0.006)	(0.011)	(0.057)	(0.06)	(0.006)	(0.007)	(0.013)	(0.292)	(0.372)	
27	Basic Metals	0.074	0.273	0.308	0.201	0.048	0.051	-0.094	0.285	0.356	1,805
		(0.007)	(0.01)	(0.052)	(0.048)	(0.006)	(0.006)	(0.011)	(0.495)	(0.521)	
28	Fabricated Metal Products	0.060	0.378	0.205	0.099	0.022	0.029	-0.043	0.209	0.319	7,175
		(0.003)	(0.005)	(0.036)	(0.035)	(0.003)	(0.003)	(0.006)	(0.299)	(0.402)	
29	Machinery and Equipment	0.035	0.393	0.241	0.232	0.034	0.036	-0.067	0.210	0.347	6,906
		(0.003)	(0.006)	(0.028)	(0.031)	(0.003)	(0.003)	(0.006)	(0.359)	(0.457)	
31	Electrical machinery & App.	0.042	0.372	0.126	0.361	0.038	0.033	-0.068	0.210	0.358	2,447
		(0.005)	(0.009)	(0.044)	(0.043)	(0.004)	(0.004)	(0.008)	(0.367)	(0.481)	
32	Radio and Communication	0.074	0.351	0.104	0.413	0.037	0.029	-0.064	0.214	0.342	1,453
		(0.007)	(0.014)	(0.061)	(0.07)	(0.006)	(0.006)	(0.012)	(0.372)	(0.467)	
33	Medical	0.049	0.446	0.144	0.326	0.029	0.024	-0.053	0.178	0.301	3,161
		(0.005)	(0.009)	(0.047)	(0.049)	(0.004)	(0.004)	(0.007)	(0.313)	(0.395)	
34	Motor Vehicles	0.054	0.275	0.272	0.312	0.039	0.042	-0.079	0.222	0.422	1,838
		(0.006)	(0.01)	(0.038)	(0.041)	(0.004)	(0.004)	(0.007)	(0.426)	(0.557)	
35	Other Transport Equipment	0.058	0.323	0.423	0.410	0.026	0.029	-0.062	0.257	0.390	724
		(0.013)	(0.019)	(0.099)	(0.102)	(0.009)	(0.009)	(0.018)	(0.388)	(0.505)	

Notes: $\tilde{\beta}$ coefficients from the revenue function estimation by industry. Associated standard errors are in parentheses. Median θ by industry, θ being defined by equation (14). Associated standard deviations are in parentheses.

Table A.8: Quantile Distribution of Markdowns

		ψ_i^M						ψ_i^Z					
	Sector	Mean	p10	p25	Median	p75	p90	Mean	p10	p25	Median	p75	p90
15	Food Products and Beverages	1.63	0.93	1.17	1.56	2.02	2.46	1.36	0.86	1.00	1.24	1.60	2.05
17	Textiles	1.52	0.91	1.09	1.40	1.82	2.33	1.79	1.00	1.24	1.60	2.14	2.88
18	Wearing Apparel	1.85	0.87	1.11	1.60	2.32	3.31	1.90	0.77	1.02	1.54	2.36	3.60
19	Leather	1.54	0.89	1.12	1.46	1.88	2.34	1.72	0.98	1.20	1.57	2.09	2.68
20	Wood	1.16	0.70	0.87	1.10	1.38	1.68	1.63	1.03	1.20	1.49	1.88	2.51
21	Pulp	1.19	0.84	0.96	1.15	1.37	1.62	1.44	1.01	1.15	1.38	1.66	1.98
22	Printing and Publishing	2.30	1.06	1.43	2.11	3.04	3.84	1.74	0.76	0.94	1.27	1.98	3.37
24	Chemicals	1.24	0.78	0.94	1.17	1.47	1.82	1.60	0.97	1.14	1.42	1.88	2.55
25	Rubber	1.29	0.81	0.99	1.22	1.53	1.85	1.51	0.96	1.13	1.41	1.78	2.23
26	Non-metallic mineral Products	1.58	0.78	0.99	1.46	2.06	2.61	1.82	0.88	1.10	1.51	2.22	3.26
27	Basic Metals	1.80	0.97	1.20	1.62	2.25	2.89	1.43	0.83	1.01	1.31	1.73	2.16
28	Fabricated Metal Products	1.66	0.81	1.06	1.55	2.17	2.69	1.63	0.91	1.10	1.42	1.93	2.64
29	Machinery and Equipment	1.46	0.79	0.99	1.36	1.82	2.28	1.41	0.86	1.02	1.27	1.65	2.17
31	Electrical machinery & App.	1.23	0.73	0.89	1.14	1.49	1.86	1.52	0.93	1.11	1.38	1.80	2.33
32	Radio and Communication	1.29	0.71	0.89	1.19	1.61	2.02	1.67	0.84	1.08	1.45	2.01	2.88
33	Medical	1.22	0.65	0.81	1.12	1.54	1.95	1.61	0.83	1.02	1.35	1.93	2.76
34	Motor Vehicles	1.44	0.59	0.85	1.26	1.88	2.57	1.59	0.65	0.96	1.44	2.01	2.76
35	Other Transport Equipment	1.52	0.75	0.94	1.34	1.98	2.64	1.77	0.91	1.11	1.57	2.16	2.97
	All	1.49	0.80	1.00	1.34	1.82	2.39	1.59	0.89	1.08	1.39	1.86	2.53

Notes: Mean and distribution quantiles by industry and for the pooled sample (raw "All"), after trimming at the 3rd and 97th percentiles.

B Theory Appendix

B.1 Proof of Lemma 1

From the firm profit-maximization problem (at the individual variety level):

$$W_i^M(\nu)\psi_i^M(\nu) = \frac{\partial R_i}{\partial M_i(\nu)}, \tag{1}$$

where the terms are defined in Section 3. Multiplying both sides of equation (1) by $\frac{M_i(\nu)}{R_i}$ and rearranging, we get:

$$\frac{E_i^M}{R_i} \cdot \frac{W_i^M(\nu)M_i(\nu)}{E_i^M}\psi_i^M(\nu) = \frac{\partial R_i}{\partial M_i}\frac{M_i}{R_i} \cdot \frac{\partial M_i}{\partial M_i(\nu)}\frac{M_i(\nu)}{M_i}, \ \forall \nu \tag{2}$$

$$\alpha_i^M \cdot \int_\nu \gamma_i^M(\nu)\psi_i^M(\nu)d\nu = \theta_i^{M,r} \cdot \int_\nu \frac{\partial M_i}{\partial M_i(\nu)}\frac{M_i(\nu)}{M_i}d\nu, \ \forall \nu, \tag{3}$$

where the last line follows from taking integrals over the set of foreign varieties in both sides of the equation, and where $\alpha_i^M \equiv \frac{E_i^M}{R_i}$ and $\theta_i^{M,r} \equiv \frac{\partial R_i}{\partial M_i}\frac{M_i}{R_i}$ are defined as in the main text. We then note that by Assumption 2, specifically by the fact that the foreign input aggregator is constant returns, we can substitute $\int_\nu \frac{\partial M_i}{\partial M_i(\nu)}\frac{M_i(\nu)}{M_i}d\nu = 1$.

We thus define $\overline{\psi}_i^M \equiv \int_\nu \gamma_i^M(\nu)\psi_i^M(\nu)d\nu$ as the weighted average of input market power of firm i in each individual market, where weights are the total expenditure share of variety ν, namely, $\gamma_i^M(\nu) \equiv \frac{W_i^M(\nu)M_i(\nu)}{E_i^M}$. Substituting in (3), we find:

$$\overline{\psi}_i^M = \frac{\theta_i^{M,r}}{\alpha_i^M},$$

which is the main equation of Lemma 1.

C Price Bargaining in Buyer-Supplier Relationships

This appendix provides a formal economic model that rationalizes the use of a reduced-form input price function in Section 2 to capture bargaining in markets of intermediate inputs. The model builds on the two-sided bargaining framework developed by Alviarez et al. (2021).

We consider a partial equilibrium model of bargaining in firm-to-firm trade. In the model, importers (denoted by i) and exporters (denoted by j) exchange an intermediate input variety and bargain over the terms of trade. To ease exposition, we assume single-product exporters, such that j denotes both the exporter and the traded variety.

We let Σ_i denote the set of foreign varieties sourced by French importer i, or the importer's *sourcing strategy.* Importer i imperfectly substitutes across foreign input varieties. The foreign intermediate input's quantity and price are defined as:

$$M_i = \left(\sum_{j \in \Sigma_i} \varsigma_{ji} M_{ji}^{\frac{\rho-1}{\rho}} \right)^{\frac{\rho}{\rho-1}} \quad \text{and} \quad W_{ji}^M = \left(\sum_{j \in \Sigma_i} \varsigma_{ji}{}^{\rho} \left(W_{ji}^M \right)^{1-\rho} \right)^{\frac{1}{1-\rho}} \tag{4}$$

where $\rho > 1$ is the (constant) elasticity of substitution between varieties sourced by importer i, ς_{ji} is a demand shifter for variety j of the foreign input, and the remaining variables are defined as in the main text.

Firm i produces its final output Q_i combining the foreign intermediate input with other domestic inputs, as in Section 3. We let C_i denote the firm's unit cost, and we denote by $\gamma \in (0, 1]$ the elasticity of firm i's unit cost to the foreign input price:

$$\gamma = \frac{d \ln C_i}{d \ln W_i^M} \in (0, 1]. \tag{5}$$

In the downstream market, firm i competes in monopolistic competition and faces some iso-elastic demand with associated elasticity

$$\nu = -\frac{d \ln Q_i}{d \ln P_i} > 1, \tag{6}$$

where the price P_i is given by the standard formula $P_i = \frac{\nu}{\nu-1} C_i$.[31]

On the exporter side, we write exporter j's total supply of variety j as $M_j = M_{ji} + M_{j(-i)}$, where $M_{j(-i)}$ is total $j's$ demand by downstream importers other than firm i. We let C_j denote exporter $j's$ marginal cost, and let

$$\frac{1-\theta}{\theta} = \frac{d \ln C_j}{d \ln M_j} > 0 \tag{7}$$

denote the marginal cost's elasticity to the total input supply. The parameter $\theta \in (0, 1]$ governs the returns to scale of exporter $i's$ production. When $\theta \in (0, 1)$, the marginal costs

[31] Note that the assumption of CES demand and monopolistic competition is without loss of generality for the purpose of the main result. We discuss below how the main formula of interest would generalize in the case of a more general demand function.

are increasing in total output, which means that upstream production exhibits decreasing returns; conversely, when $\theta = 1$, the exporter's marginal costs are constant, which means that production exhibits constant returns.

Importer i and exporter j engage in bilateral negotiations to determine W^M_{ji}. The outside options of i and j are taken to be the profits when the $i-j$ link is terminated: exporters will make fewer sales, while importers will have higher costs (love-of-variety technology). During negotiations, both the network of firm-to-firm trade and the other nodes' prices are taken as given. We thus leverage the Nash-in-Nash solution concept: the price negotiated between i and j is the pairwise Nash bargaining solution given that all other pairs reach agreement (Horn and Wolinsky, 1988). The negotiated price W^M_{ji} solves:

$$\max_{W^M_{ji}} \left(\pi_j(W^M_{ji}) - \tilde{\pi}_{j(-i)}\right)^{1-\phi_{ij}} \left(\pi_i(W^M_{ji}) - \tilde{\pi}_{i(-j)}\right)^{\phi_{ij}}, \tag{8}$$

where $\pi_j(W^M_{ji})$ and $\pi_i(W^M_{ji})$ are the profits to the exporter j and the importer i if the negotiations succeed, and $\tilde{\pi}_{j(-i)}$ and $\tilde{\pi}_{i(-j)}$ are the disagreement payoffs. The parameter $\phi_{ij} \in (0, 1)$ captures exogenous determinants of the firms' bargaining ability that might influence the outcome of the negotiation process. In our notation, a higher ϕ_{ij} denotes higher relative bargaining power of importer i.

Let $s_{ji} = \frac{W^M_{ji} M_{ji}}{\sum_{j \in \Sigma_i} W^M_{ji} M_{ji}}$ denote the share of exporter j's sales over importer i's total imports, while $x_{ji} = \frac{M_{ji}}{M_j}$ denotes the share of units of good purchased by importer i over the total units supplied by exporter j. Note that neither of these shares maps exactly to the share s^M_{ji} defined in Section 3. Taking the FOC with respect to (8) and rearranging terms, it is possible to write the bilateral price p_{ij} as a markup μ_{ij} over the exporter's marginal cost C_j:

$$W^M_{ji} = \mu_{ji} C_j. \tag{9}$$

The bilateral markup is found to be equal to

$$\mu_{ij} = (1 - \omega_{ij}) \cdot \mu^{oligopoly}_{ji} + \omega_{ij} \cdot \mu^{oligopsony}_{ji}, \tag{10}$$

which is a weighted average between an "oligopoly markup" $\mu^{oligopoly}_{ji} \equiv \frac{\varepsilon_{ji}}{\varepsilon_{ji}-1}$, with $\varepsilon_{ji} = \rho\,(1 - s_{ji}) + \tilde{\nu} s_{ji}$, increasing in the exporter's share s_{ij}, and an oligopsony markdown $\mu^{oligopsony}_{ji} \equiv \theta \left(\frac{1-(1-x_{ji})^{\frac{1}{\theta}}}{x_{ji}} \right)$, decreasing in the importer share of variety j, x_{ji}. The weighting factor ω_{ij} is defined as $\omega_{ij} \equiv \frac{\tilde{\phi}_{ij}\lambda_{ij}}{\tilde{\phi}_{ij}\lambda_{ij}+\varepsilon_{ij}-1} \in (0, 1)$, which is increasing in $\tilde{\phi}_{ij}\lambda_{ij}$ – the product of the relative bargaining parameter $(\tilde{\phi}_{ij})$ and a term, λ_{ij}, which is proportional to the (endogenous) buyer's outside option. The larger $\tilde{\phi}_{ij}\lambda_{ij}$, the larger ω_{ij}, the closer is the bilateral markup μ_{ij} to the oligopsony markup.

We now proceed to characterize the relationship between the bilateral price W_{ji}^M and the quantity purchased by buyer i, M_i. Given equations (9)-(10), it is possible to show that the inverse supply elasticity of the foreign input variety j can be approximated as:

$$\Psi_{ji}^M \equiv \frac{d\ln W_{ji}^M}{d\ln M_{ji}} \simeq \beta_{ji}^1 + \beta_{ji}^2 x_{ji} \tag{11}$$

where β_{ji}^k, $k = 1, 2$ are constants that depends on market conditions upstream and downstream which the buyer takes as given. In particular, $\beta_{ji}^1 \equiv \Gamma_{ij}^s \frac{d\ln s_{ji}}{d\ln M_{ji}} > 0$ and $\beta_{ji}^2 \equiv \left(\theta^2 + \frac{1}{\theta} - 2\right)$, which is positive for values of θ within reasonable ranges. Therefore, we get that the inverse supply elasticity is positive ($\Psi_{ji}^M > 0$), and increasing in the buyer's share x_{ji}.

Given this discussion, it immediately follows that when production upstream features decreasing returns scale (increasing marginal costs), input prices are a (buyer-specific) function of the importer's demand:

$$W_{ji}^M = W_i^M \left(M_{ji}; \mathbf{A}_i\right), \tag{12}$$

where $\mathbf{A}_i$ is a vector capturing demand and technology conditions, which the buyer takes as given.

D Demand Estimation

D.1 Instrument Choice

We consider a CES demand system at the product category-destination level, where a product category is denoted by k and broadly corresponds to a two-digit industry. The demand function of firm i selling product p (in category k) in country c is:

$$q_{ipct} = -\sigma_k p_{ipct} + \sigma_k p_{pct} + q_{qct} + \eta_{ipct}, \tag{13}$$

where p_{ipct} is the price charged by firm i, expressed in foreign currency units, and p_{pct} and q_{pct} are the market-level price and demand, respectively.

It is well-known that estimation of (versions of) equation (13) is complicated by a classic simultaneity problem: positive shocks to market appeal lead producers to raise prices, making

p_{ipct} and η_{ipct} positively correlated (Foster, Haltiwanger, and Syverson, 2008). In the presence of such endogeneity concerns, the identification of demand can be obtained through cost shifters that are excluded from equation (13) and that are orthogonal to η_{ipct}.

We consider a supply-side model to think about these cost shifters. We let the price of the firm be a markup over marginal cost, i.e., $P_{ipct} = MC_{ipt} \cdot \mu_{ipct} \cdot E_{ct}^{-1}$, where MC_{ipt} is the euro-denominated marginal cost of firm i producing product p, μ_{ipct} is a markup, and E_{ct}^{-1} is the bilateral exchange rate between country c and France, measured as a unit of producer currency for one unit of foreign currency. In our data, we only observe free-on-board prices, which we can write as:

$$P^*_{ipct} = MC_{ipt} \cdot \mu_{ipct}. \tag{14}$$

We consider the same production technology as in equations (9)-(10). The only difference is that here we consider prices in nominal terms: we let W_i^Z denote the euro price of domestically-produced inputs, while $W_i^M E_m$ is the euro price of foreign-produced inputs, where E_m is the exchange rate measured as a unit of producer currency for one unit of foreign currency.[32] It can be shown that the total variable cost function associated with this production structure is given by:

$$TVC_{ip}(Q_{ip}|\Sigma_i) = \underbrace{\frac{C_i^*}{\Phi_{ip}^{\beta_x} \exp(\omega_{ip})}}_{MC_{ip}} Q_{ip}, \tag{15}$$

where $C_i^* \equiv \left(\frac{W^L}{\beta_l}\right)^{\beta_l} \left(\frac{R}{\beta_k}\right)^{\beta_k} \left(\frac{W_i^Z \psi_i^Z}{\beta_x}\right)^{\beta_x}$ is the cost index for a non-importing firm, and $\Phi_{ip} = \left[1 + \left(E_m \frac{W_i^M}{W_i^Z} \cdot \frac{\psi_{ip}^M}{\psi_{ip}^Z}\right)^{\frac{\rho}{\rho-1}}\right]^{\frac{1-\rho}{\rho}}$ is the cost-reducing effect of importing intermediate goods, where $\frac{\psi_i^M}{\psi_i^Z}$ is the relative buyer power of firms in the foreign input market. With this cost structure, the marginal cost is $MC_{ip} = \frac{C_i^*}{\Phi_{ip}^{\beta_x} \exp(\omega_{ip})}$. We let φ_{ip} denote the fraction of total variable cost for producing p spent on imported intermediate inputs. It can be now shown that the partial elasticity of this marginal cost with respect to the exchange rate E_m equals the expenditure share of the firm on imported intermediate inputs, i.e.:

$$\frac{d \ln MC_{ip}}{d \ln E_m} = \varphi_{ip}. \tag{16}$$

[32] We denote by m a generic source of imported intermediates, and hence E_m can be thought of as an import-weighted exchange rate faced by the firms. The generalization of the model to multiple import source countries is straightforward; in the data, we measure E_m as an import-weighted exchange rate at the firm level, as well as split imports by source countries (Amiti et al., 2014)

We consider the import-weighted exchange rate as an instrument for the price P_{ipct} in estimating the demand function in (13). equation (13) shows that this exchange rate has explanatory power over prices, especially for large importers. Further, changes in the (import-weighted) exchange rate are unlikely to be correlated with any short-run firm-specific demand shocks embodied in η_{ipct}. Hence they appear quite suitable as instruments for export prices.

D.2 Implementation

We bring (13) to the data closely following the methodology of Piveteau and Smagghue (2019), who use similar data. q_{ipct} and p_{ipct} are observed, while σ_k and η_{ipct} have to be estimated. q_{pct} will be wiped out by including destination-product-year fixed effects in the regression.

To deal with price endogeneity, merely coming from simultaneity, we instrument prices with a variable consisting of the interaction between firm import shares by country and real exchange rates. As pointed out by Piveteau and Smagghue (2019), this instrumental strategy leverages two sources of variations at the firm level: the set of countries a firm imports from and the share of these imports in the production cost of the firm. More formally, the import-weighted log real exchange rates are defined as:

$$\overline{rer}_{it}^{imp_{t-1}} = \sum_c \omega_{cft-1}^{imp} \times e_{ct}$$

where ω_{cft-1} is the import share of firm f from source country c, and e_{ct} is the log of the real exchange rate from France to country c at time t. The import weights are defined in year $t-1$ to keep us safe from endogeneity issues.[33]

The final instrument is obtained by interacting the import-weighted exchange rate with the share of these imports in the firm operating costs of the firm at time $t-1$:

$$\overline{RER}_{it}^{imp_{t-1}} = \overline{rer}_{it}^{imp_{t-1}} \times \frac{m_{ft-1}}{OC_{ft-1}}$$

where m_{ft-1} and OC_{ft-1} respectively are the total imports and the operating costs of firm f

[33] We here depart from Piveteau and Smagghue (2019) in a few ways. First, we do not deviate real exchange rates from their trends, which blurs the expected relationship between prices and the instrument. Second, we build our import weights including all goods imported by the firm and not only differentiated goods (based on Rauch (1999)), to have a well-defined instrument taking into account shocks to all imported products, even more substitutable ones. Finally, we define weights at year $t-1$ instead of relying on weights at the initial period at which the importing spells started, so that the weights used are closer to current weights. Our results are robust to these alternative definitions.

at date $t-1$. This adjustment accounts for the firm-level exposure to RER shocks depending on the importance of imports in firm's f input mix.

D.3 Identification Discussion

We quickly summarize threats to exogeneity and identification and how to address them, as detailed by Piveteau and Smagghue (2019), to whom we refer for a more exhaustive argumentation. First, the instrument is built from import shares, that are potentially endogenous to demand shifters, which Piveteau and Smagghue (2019) label as quality (Bas and Strauss-Kahn, 2015; Bastos et al., 2018). Spell fixed effects are introduced to capture time-invariant differences across firms so that the identification ultimately is in the time series. We define a spell as a sequence of consecutive years during which a firm-product-destination triplet is exported. Moreover, we use lagged import weights when defining our instrument. Another potential threat to identification comes from the dual impact of exchange rate variations on firm performance for firms that are both importing and exporting in a similar market. We introduce destination-product-year fixed effects to eliminate such a concern. Furthermore, exchange rate variations can *directly* (and not through the firm import mix) imply quality adjustments. We wipe out such potential effects by adding two control variables to the estimation, namely the import- and export-weighted average GDP per capita of the firm, defined as:

$$\overline{GDP}_{it}^{exp} = \sum_{c} \omega_{cft}^{exp} \log(gdp_{ct})$$

$$\overline{GDP}_{it}^{imp} = \sum_{c} \omega_{cft}^{imp} \log(gdp_{ct})$$

Another threat to identification results from endogenous selection in trade activities. As firms can adjust through the extensive margin when they face an adverse shock, $i.e$ stop exporting, the estimation procedure can underestimate intensive margin adjustments to exchange rate movements. We account for this selection bias by limiting our sample to long exporting spells (more than 6 years) to keep in the sample firms that are away from exit thresholds, following Fitzgerald and Haller (2018); Fontagné et al. (2018). Finally, we add a dummy variable, $entry_{ipct}$, equal to one in the first year of an export spell, to account for the well-documented partial-year effect that could contaminate our results (Berthou and Vicard, 2015; Bernard et al., 2017).

D.4 Specification

Again following Piveteau and Smagghue (2019), our specification proceeds in two steps. In the first step, we regress the exported price of the firm on the instrument, the fixed effects mentioned above, and the GDP per Capita controls. This writes:

$$p_{ipct} = \beta_0 \overline{RER}_{it}^{imp_{t-1}} + \beta_1 entry_{ipct} + \beta_2 \overline{GDP}_{it}^{exp} + \beta_3 \overline{GDP}_{it}^{imp} + \delta_{ipcs} + \delta_{pct} + u_{ipct}$$

where s characterizes a spell number for a firm f, destination c, and product p triplet.

Using predicted values of exporting prices $\hat{p}_{ipct}$ from this first stage, we then estimate equation (13) in the second stage:

$$q_{ipct} = -\sigma_k \hat{p}_{ipct} + \alpha_1 entry_{ipct} + \alpha_2 \overline{GDP}_{it}^{exp} + \alpha_3 \overline{GDP}_{it}^{imp} + \gamma_{ipcs} + \gamma_{pct} + \epsilon_{ipct}$$

in which γ_{ipcs} and γ_{pct} are firm-product-country-spell and product-country-year fixed effects. This last equation is identical to the structural demand defined in (13) except that we now impose the demand shifters η_{ipct} to take the following form:

$$\eta_{ipct} = \hat{\alpha}_1 entry_{ipct} + \hat{\alpha}_2 \overline{GDP}_{it}^{exp} + \hat{\alpha}_3 \overline{GDP}_{it}^{imp} + \hat{\gamma}_{ipcs} + \hat{\epsilon}_{ipct}$$

The firm-level demand shifter is then obtained as the firm-level weighted average of the estimated η_{ipct} where weights are given by the firm export share by market:

$$\eta_{it} = \sum_{p,c} \omega_{ipct}^{exp} \eta_{ipct}.$$

E Data Appendix

E.1 Data Preparation

E.1.1 Export Data

We follow Piveteau and Smagghue (2019) in cleaning the export data before demand estimation, and this section fully reproduces for the sake of practicality Appendix A in their paper.

We perform two main operations to prepare the final sample. First, we harmonize the product codes to obtain consistent categories across time. Then, we clean the dataset to take into account the existence of measurement errors in trade data.

Harmonization of product codes The product classification used by custom authorities is regularly updated to follow changes in product characteristics. We need to account for these changes to maintain a coherent set of product categories across time. To achieve this, we follow the procedure from Van Beveren et al. (2012) who apply the methodology from Pierce and Schott (2009) to European statistics. This allows us to obtain consistent product categories from 1997 to 2007.

Choice of units for quantity information Data on quantities are known to be subject to measurement errors, which could lead to spurious relationships between quantities and prices (computed by dividing values with quantities). Moreover, the customs statistics from France allow exporters to declare the quantities in two different units: the weight or a supplementary unit that is product-specific and more relevant to describe the quantities of certain types of goods. Therefore, we use the supplementary unit when at least 80% of the firms in the category are providing this unit. Otherwise, we use the weight of the good as quantity.

Data Cleaning After harmonizing quantities within product categories, we can compute prices as the export value divided by quantity. Then, because of the potential measurement errors in prices, we drop prices that display large variations from one year to another. In particular, given our identification strategy, we perform the following procedure:

- We declare a price p_{ipct} as abnormal when $\log p_{ipct} - \log p_{ipct-1}$ is larger than one or lower than minus one.
- We declare a price p_{ipct} as missing when the quantity for that observation is missing.
- We drop from the sample the entirety of an exporting spell that contains at least one abnormal or missing price.

By performing this cleaning procedure, we ensure that each exporting spell contained in our sample displays reasonable price changes across the years.

E.1.2 Import Data

As we use import values, and not quantities, for the instrument construction in demand estimation, we do not perform any particular cleaning on import data besides the basic ones recommended by Bergounhon et al. (2018). Product harmonization on the import side is not needed for demand or revenue function estimation. It is however required for post-estimation analyses presented in Section 4.4, where the identification in Columns (4) and (5) of Table 4 for instance partly comes from variation in competition intensity within a product market over time. We use the harmonizing algorithm of Bergounhon et al. (2018).

E.2 Sample Selection

E.2.1 Demand Estimation

The demand estimation exercise mechanically reduces the sample to firms that are observed both importing and exporting in the data As described in Section D, we keep exporting spells longer than 6 years for demand estimation, following Piveteau and Smagghue (2019). Demand shifters are then extrapolated on the entire (cleaned) sample.

E.2.2 Revenue Function Estimation

The revenue function estimation exercise requires a more severe sample selection. To comply with a revenue function estimation at the industry level and our focus on input trade, we restrict attention to firms that are homogeneous in terms of their input mix and heavily rely on imported inputs. To that end, we drop firms with labor and domestic input shares in revenues below 1% or above 99%. To deal with the large skewness of the import-to-revenue share distribution, especially on the left side, we implement more severe trimming regarding import shares. We first drop firms whose imported-input-to-domestically-purchased-input ratio is below the 3% or above the 97% percentiles of the corresponding distribution for a given industry-year cell. Finally, we drop firms with an import-to-revenue share below 5%, restricting attention to firms for which the importing activity represents a significant part of their input mix.

Table A.9: Number of Observations and Firms - Revenue Function Estimation Sample

	Sector	*(1) Full Sample* # obs.	# firms	*(2) Selected Sample* # obs.	# firms	*(3) Estimating sample* # obs.	# firms
15	Food Products and Beverages	16,093	2,600	8,471	1,691	6,096	1,306
17	Textiles	9,204	1,501	7,110	1,279	5,238	1,041
18	Wearing Apparel	7,378	1,524	5,329	1,231	3,527	922
19	Leather	2,728	495	2,208	424	1,609	346
20	Wood	5,202	968	3,000	677	2,028	490
21	Pulp	4,721	718	3,545	602	2,694	505
22	Printing and Publishing	6,242	1,320	2,965	758	1,891	498
24	Chemicals	11,441	1,716	7,940	1,378	5,986	1,136
25	Rubber	11,514	1,826	7,672	1,434	5,574	1,161
26	Non-metallic mineral Products	4,381	775	2,679	529	1,925	431
27	Basic Metals	3,524	515	2,426	426	1,805	357
28	Fabricated Metal Products	19,244	3,583	10,462	22,238	7,175	1,61
29	Machinery and Equipment	16,523	2,708	9,729	1,913	6,906	1,436
31	Electrical machinery & App.	4,967	801	3,307	605	2,447	503
32	Radio and Communication	3,396	625	2,124	454	1,453	356
33	Medical	7,95	1,385	4,596	951	3,161	726
34	Motor Vehicles	3,388	539	2,449	437	1,838	370
35	Other Transport Equipment	1,893	379	1,086	249	724	183
	All	139,789	23,978	87,098	17,276	62,077	13,387

Notes: Observations are at the firm-year level. Sample (1) is restricted to importers and exporters kept in demand estimation. Sample (2) restricts Sample (1) according to the selection procedure described in Section E.2. Sample (3) restricts Sample (2) to firm-year observations for which a lag for a given firm is present.