Buyer Market Power as Buffer to Exchange Rate Shocks *

Leticia Juarez†
University of Michigan/Inter-American Development Bank

September 4, 2024

Job Market Paper
[Click here for latest version]

Abstract

I study the impact of buyer market power on international price responses to exchange rate changes. In markets with high buyer concentration, larger foreign buyers secure marked-down prices that adjust flexibly to exchange rate shocks. Using a novel dataset of Colombian export transactions, I estimate an open economy oligopsony model with endogenous markdowns, revealing that sellers connected to larger buyers experience milder price changes (1% impact) compared to those connected with smaller buyers (15% impact). These findings highlight a trade-off: while larger buyers reduce seller revenues, they also reduce sellers' exposure to exchange rate volatility, emphasizing the strategic importance of buyer relationships in international markets.

JEL Codes: *D43, E31, F31, F41, F42, L1*
Keywords: *Market power, Exchange rate, Oligopsony, Market structure, Markdown, Exchange-rate pass-through*

*I am extremely grateful to Javier Cravino, John Leahy, Andrei Levchenko and Pablo Ottonello for their invaluable mentorship, support, and advice. I also want to thank Vanessa Alviarez, Kayleigh Barnes, David Berger, Nina Buchmann, Brian Ceballos, Kathryn Dominguez, Jan Eeckhout, Kyle Handley, Ezequiel Garcia Lembergman, Andres Gonzalez Lira, Caitlin Hegarty, Hiau Looi Kee, Patrick Kennedy, Dmitry Mukhin, Emir Murathanoglu, Matthieu Pedemonte, Andrés Rodríguez-Clare, Esteban Rossi-Hansberg, Sebastian Sotelo, Linda Tesar, Carolina Tojal, Lucas Zavala and Roman Zarate for very helpful comments and discussions. I would also like to thank seminar participants at University of Michigan, Carlos III, ITAM, MIT Sloan, UCLA Anderson, Federal Reserve Board, Federal Reserve of New York, Federal Reserve of Boston, LMU Munich, RES Inter-American Development Bank, PUC Chile, Universidad de Chile, Banco Central de Chile, Universidad Adolfo Ibanez, Universidad de los Andes - Chile, EPGV Rio, PUC Rio, YES Yale Conference, RIEF Conference, SED, LACEA, EEA-ESEM, IEA World Congress and WAIFS Conference. All errors are my own.

†The views expressed here are strictly those of the author and do not necessarily reflect the views of the University of Michigan or the Inter-American Development Bank, its Board of Directors or the countries they represent. Email: leticiaj@umich.edu. Website: https://leticiajuarez.github.io/.

1 Introduction

Large firms dominate many sectors of the global economy. It has become increasingly clear that this phenomenon has important macroeconomic consequences (Autor et al., 2020; Gutiérrez and Philippon, 2019; De Loecker, Eeckhout and Unger, 2020). In the context of international markets, a vast group of small exporting firms often sell their goods to just a handful of large, multinational buyers. For example, the top one percent of importers account for 83.5% of U.S. imports (Bernard et al., 2018). This raises the question of how the presence of large buyers affects prices and price dynamics in export markets. In particular, when there is an exchange rate shock, do large firms leverage this buyer market power to increase their profits? What are the consequences for smaller connected firms?

This paper studies buyer market power in international markets and its impact on exchange rate pass-through. Exchange-rate pass-through corresponds to the change in international prices in the seller's currency as a response to a change in the exchange rate. I combine a novel transaction-level dataset covering the universe of Colombian exports with an oligopsony model of buyer market power in international trade. The main conclusion is that buyer market power moderates the response of international prices to exchange rate shocks. The main mechanism behind this effect is that large firms have *more* variable markdowns and can use this as a tool to maintain more stable prices. When the Colombian currency depreciates, U.S. buyers absorb the shock by reducing their markdowns. The result is that the prices Colombian exporters receive respond less. I directly estimate this effect between firms within a market.

I begin by documenting stylized facts on Colombian export markets. This paper uses data on exports from Colombia to the rest of the world from 2007 to 2020. I exploit the granularity of my data, containing identifiers of buyer, seller, product, destination country, and year in each transaction. Export data are matched to data on bilateral exchange rates for each year and destination country. I define a *market* as a product-destination-year combination. I find that (i) sales are concentrated among a few large foreign buyers in each market, (ii) a given seller faces different prices for different buyers of the same products and destination country, and (iii) markets with a higher concentration of sales among buyers display more moderate changes in market average prices after an exchange rate shock (i.e., lower exchange rate pass-through).

Motivated by these stylized facts, I propose an open economy model of oligopsony that accounts for buyer market power in international markets and illuminates its consequences for price determination in international transactions. In my model, sellers are located in the home country and buyers are in foreign countries. On the supply side, buyers face a nested CES supply curve from sellers. The supply curve is microfounded with a discrete-choice problem, where sellers are price takers and choose which product to produce and which buyer to supply. On the demand side, buyers observe the quantities supplied and choose the price they are willing to pay for a product. Given a finite number of buyers, they act strategically, internalizing their influence over prices. In equilibrium, buyers pay sellers a price marked down from the marginal revenue of the product.

The first theoretical result is that markdowns are increasing in the buyer's market share—that is, larger buyers have greater markdowns. Aggregating the firm-level markdowns across all firms in a market, I find market-level average markdowns are increasing in buyer market concentration.

Additionally, markdowns depend on sellers' within-product cross-buyer elasticity of substitution and the cross-product elasticity of substitution. Lower elasticities correspond to greater markdowns. Intuitively, if substitution across buyers and products is costly for sellers, buyers have more market power and higher markdowns.

The second theoretical result is that the price response to exchange rate shocks varies with buyer market share. This is a novel source of exchange rate pass-through dispersion that, to my knowledge, has not been previously studied in the literature. The overall effect is driven by two offsetting mechanisms: a markdown channel and a marginal-revenue channel.

On the one hand, the markdown channel implies that following a change in the exchange rate, buyers adjust their markdowns, keeping prices more stable in the seller's currency. Larger buyers tend to have more variable markdowns and adjust their markdowns more elastically. In response to the stable price, sellers do not substitute away from that buyer.

On the other hand, the marginal-revenue channel implies that, following a change in the exchange rate, a standard price effect induces sellers to change their quantity supplied, which in turn affects marginal revenue. Because sellers have a lower supply elasticity in concentrated markets—intuitively, the costs of finding another buyer are higher for these sellers—larger buyers face smaller changes in marginal revenue. In contrast to the markdown channel, prices in the seller's currency are more volatile.

I then take the model to the data and estimate the exchange rate pass-through elasticity at the firm level. The richness of the transaction-level data allows me to regress buyer-seller-product prices on the exchange rate and on an interaction between the exchange rate and the buyer market share. The measure of buyer market share is based on my model and corresponds to the share of the sales in a market account to a given buyer. In this way, I differentiate the exchange rate pass-through for larger and smaller buyers. I control by a variety of fixed effects including seller time to account for sellers' marginal cost, and year-product-country fixed effects to isolate the differences between markets, comparing across buyers with different market shares.[1]

I find that larger buyers face a lower exchange rate pass-through to prices in the seller's currency, ranging from 1% for the largest buyers to 15% for the smaller ones. Thus, when the currency of the seller's country depreciates, sellers in concentrated markets face attenuated price increases (in the seller's currency) relative to exporters that sell to smaller buyers.

The results thus reveal that the markdown channel is more empirically relevant than the marginal-revenue channel. Intuitively, larger buyers internalize the upward-sloping supply curve and are aware that each additional unit they buy increases the price of every other unit. As a result, buyers strategically purchase fewer units, increasing prices by less than if the seller supply curve were flat. In the event of a depreciation of the seller currency, gains for the large buyer come at the expense of lower prices earned by the seller. This implies large buyers act as an "insurance" for the small connected sellers.

To further ensure the validity of the main results, I conduct a series of robustness tests. First, I address the implications of the currency of invoicing and price stickiness, dedicating an entire

[1]Note that even though this might drop the exchange rate coefficient, the coefficient of interest—the one for the interaction term—does not change.

section to this issue. In this case, I observe that exports are predominantly invoiced in dollars, with 98% of transactions in the Colombian customs data reflecting this. I conduct additional checks, finding that the regression results remain consistent whether considering the entire sample or only dollar-invoiced transactions. This indicates minimal bias from currency invoicing, suggesting that the primary findings are robust to the choice of invoicing currency. Second, I explore alternative definitions of buyer market share to ensure that the results are not sensitive to the specific metrics used. Third, I incorporate import intensity as an additional variable, considering its potential impact on market dynamics. Fourth, I test the robustness of the findings by using alternative samples that vary in terms of the included destinations, firms, and products.

I proceed by quantifying the markdowns for large firms and estimating how they change in response to an exchange rate shock. In the model, two elasticities govern the magnitude of this effect: the cross-product elasticity of supply and the within-product cross-buyer elasticity of supply. I propose an approach that integrates (i) empirical estimates of the exchange rate pass-through elasticities, (ii) moments from the cross-section of prices and (iii) a simulated method of moments to estimate these elasticities by indirect inference. I find the markdowns for the average firms are around 26%.

Finally, I use the model to simulate a counterfactual economy with no buyer market power. In a perfectly competitive economy, sellers' revenues are higher due to a price effect (i.e., the absence of markdowns) as well as a quantity effect (i.e., they adjust quantities in response to higher prices). However, revenues in the seller currency are more elastic in response to international shocks, potentially generating greater volatility.

I illustrate my findings with an example. Starbucks, a large U.S. buyer of Colombian coffee, receives a higher markdown (i.e., a price discount) than smaller U.S. firms buying coffee from Colombia. All else equal, Starbucks is thus able to pay lower prices for coffee. Moreover, prices paid by Starbucks in the seller currency (i.e., the COP, Colombian peso) are less responsive to exchange rate shocks. In the aggregate, if the U.S.–Colombia coffee market is dominated by large buyers like Starbucks, the average market price for coffee is also reduced and less responsive to shocks. In a counterfactual world where Starbucks and other large firms did not have such market power, the sellers in developing countries would increase their revenues because they would sell at a higher price. However, these sellers would charge prices that respond more to shocks which would bring volatility to their revenues.

This paper contributes to three strands of the literature. First, it contributes to the literature on international pricing response to exchange rate changes (Amiti, Itskhoki and Konings, 2014; Auer and Schoenle, 2016; Burstein and Gopinath, 2014; Gopinath et al., 2020). While most of these papers focused on the seller side [2], a theoretical contribution of this paper is to introduce buyer market and a buyer-concentration effect. Empirically, the detailed buyer–seller data I use in this research allows me to quantify the role of buyer–seller relationships in determining the exchange rate pass-through and to quantify the markdown response.

Second, this paper relates to the literature on market power (De Loecker, Eeckhout and Unger, 2020; De Loecker et al., 2016) and imperfect competition in firm-to-firm trade (Atkeson and Burstein, 2008; Alviarez et al., 2023; Morlacco, 2019; Kikkawa, Magerman and Dhyne, 2019). In particular, a

[2]These papers find that seller concentration reduces pass-through into domestic prices. The seller side is explored throughout the papers and further expanded upon in the Appendix.

growing body of work on buyer market power in labor markets uses olipsonony and monopsony models to explain why workers' wages are marked down from their marginal products (Berger, Herkenhoff and Mongey, 2022; Azar, Marinescu and Steinbaum, 2019; Lamadon, Mogstad and Setzler, 2022; Felix, 2022). My theoretical approach most closely resembles Berger, Herkenhoff and Mongey (2022) in labor markets in the U.S. and Zavala (2022) in agricultural value chains in Ecuador. I draw the modeling tools from this literature, but apply them to an international-trade setting with buyers having oligopsony power over the sellers. I contribute to this literature by showing the implications of buyer market power on international prices.

Third, I contribute to a nascent literature on buyer–seller links, global value chains, and shock transmissions (Devereux, Dong and Tomlin, 2017; Huneeus, 2018; Lim, 2018; Hottman and Monarch, 2020; Dhyne et al., 2021). Because of data availability, most of these papers focus on firm-to-firm transactions in the domestic context while my paper and a few others (Adão et al., 2022; Bernard et al., 2019) analyze the international markets. I contribute to this literature by documenting the existence of price dispersion for the same seller, product and destination in the international setting. Additionally, I estimate the cross-buyer elasticity of substitution, a key parameter that had not been previously estimated.

The rest of the paper proceeds as follows. Section 2 presents my data and empirical setting together with some key stylized facts on buyer–seller relationships in Colombia and their consequences for exchange rate pass-through. Section 3 presents the model that links buyer market concentration to export prices, yielding a specification for estimating the effect of buyer market power on exchange rate pass-through. Section 4 presents my empirical strategy and its link to my theoretical model. Section 4 also uses the estimates from the empirical part to calibrate the model and estimate key elasticities to quantify the markdown channel. Section 5 proposes a counterfactual scenario with no buyer market power. Section 6 concludes.

2 Data

This paper combines buyer–seller transaction data for Colombia in international markets with data on bilateral exchange rate shocks. In this section, I describe the data and present summary statistics relevant for the analysis.

2.1 Buyer–Seller Data

One of the challenges of studying buyer market power in international markets is the lack of detailed information on bilateral transactions between buyers and sellers. I use novel data on the universe of cross-border trade transactions between Colombian exporters and foreign firms during 2007–2020.[3] The data come from the Colombian National Directorate of Taxes and Customs (DIAN; Dirección de Impuestos y Aduanas Nacionales de Colombia).[4] For each transaction, DIAN reports the value and quantity shipped (in USD and in COP), the shipment date, the 10-digit Harmonized System

[3] In the appendix, we include robustness checks conducted with data at the transaction level for importing firms.
[4] This dataset was accessed through Datamyne.

(HS10) code of the product traded, the country of destination, the weight, the port through which this transaction occurred and the transportation mode. The key element of the dataset is that I am able to uniquely identify the foreign firm interacting with the Colombian firms and, in this way, I can carry on a buyer–seller analysis.

I combine this administrative microdata with data on bilateral exchange rates from International Financial Statistics of the International Monetary Fund (IMF). In particular, I use the monthly nominal bilateral exchange rate expressed as local currency per USD.

Constructing price and volume indices using customs data presents a significant hurdle, primarily due to the unit value bias. This bias arises because unit values, derived by dividing observed values by quantities, do not reflect actual prices. Even in the absence of price fluctuations, unit values can vary due to shifts in composition. To address this bias, I eliminate 8-digit products with a unit value variance higher than a threshold as those observations are more likely to be biased [5].

2.2 Descriptive Statistics for Colombia

As Colombia is a developing country that hosts thousands of small firms exporting to the rest of the world, it is the ideal setting to study how the characteristics of their buyers affect their prices and how these prices react to shocks. The U.S. is Colombia's largest trading partner, representing about 41% of Colombia's exports. In addition, as the COP has depreciated against the USD and other leading currencies several times over the last decades, my data also presents a perfect setting to study the exchange rate pass-through to international prices.

I have information on the universe of Colombian firms exporting to the rest of the world. My data consists of all exports from 50,869 Colombian firms producing 6,941 different HS10-level goods[6] exported to 54 different countries during 2007–2020.

Table 1 summarizes the main descriptive statistics relevant for my analysis. In each year of data, an average of 13,382 sellers trade with 39,028 buyers each year.[7] Each combination of destination and HS10 product includes, on average, 4.55 buyers, suggesting only a few buyers for a large number of sellers. Each of these buyers buys on average 3.68 products from Colombia.

Table 1: Annual Summary Statistics

Variable	Mean	SD
# Products	6,941	91
# Sellers	13,382	5,479
# Buyers	39,028	2,914
# Buyers by destination $\times$ product	4.6	23
# Products by buyer	3.7	9

Notes: In this table products are at the 10-digit Harmonized System level. Source: Colombian Customs Data.

[5] This approach aligns with the methodology suggested by Boz, Cerutti and Pugacheva (2019)

[6] Each product is identified with a 10-digit code, which corresponds to the Harmonized Commodity Description and Coding System at the highest level of disaggregation. An example for this could be women's or girls' cotton panties versus knitted or crocheted panties.

[7] Note that these buyers correspond to all possible destinations.

2.3 Facts

Small sellers in Colombia sell their products to large firms abroad. In this section, I document three stylized facts on the role of these large buyers in Colombian export markets. Together they suggest the existence of substantial buyer market power. Most importantly, they support the idea that buyer market power is relevant not only for price setting in international markets, but also for price adjustments to exchange rate shocks (exchange rate pass-through).

I find that (i) most Colombian exports are sold to the largest foreign buyers in each market, (ii) sellers price discriminate across buyers in international markets, and (iii) the exchange rate pass-through coefficient is negatively correlated with the concentration of buyers in a market. These facts motivate the oligopsony model in Section 3 where buyer market power determines the degree of exchange rate pass-through into international prices.

Fact I: Most Colombian Exports Are Sold to the Largest Foreign Buyers in Each Market

I explore the well-known dominance by large firms of the markets in my data. I define a market as a destination $\times$ product $\times$ year, where a product is at the HS10 level.

First, I identify the top buyers (top 3, top 5, top 10) of exports in each market and calculate how much they contribute to the total value bought in each market. Figure 1, Panel A shows that the value of the exports bought by the top three buyers along in each market accounts for 78% percent of exports from Colombia, suggesting the high degree of buyer concentration in Colombia's export market. For example, for the coffee market into the U.S. for a certain year, this would mean Starbucks, Peets Coffee and Dunkin Donuts buy most of Colombia's coffee sold to the U.S., by value.

Second, I calculate the degree of concentration of sales by using a standard measure of concentration, the Herfindhal-Hirschman Concentration Index (HHI). Before defining this index, I define S_{bjkt} as Buyer b's share of the nominal value of all exports of Product j to Country k in period t.

$$S_{bjkt} = \frac{p_{bjkt}q_{bjkt}}{\sum_b p_{bjkt}q_{bjkt}}$$

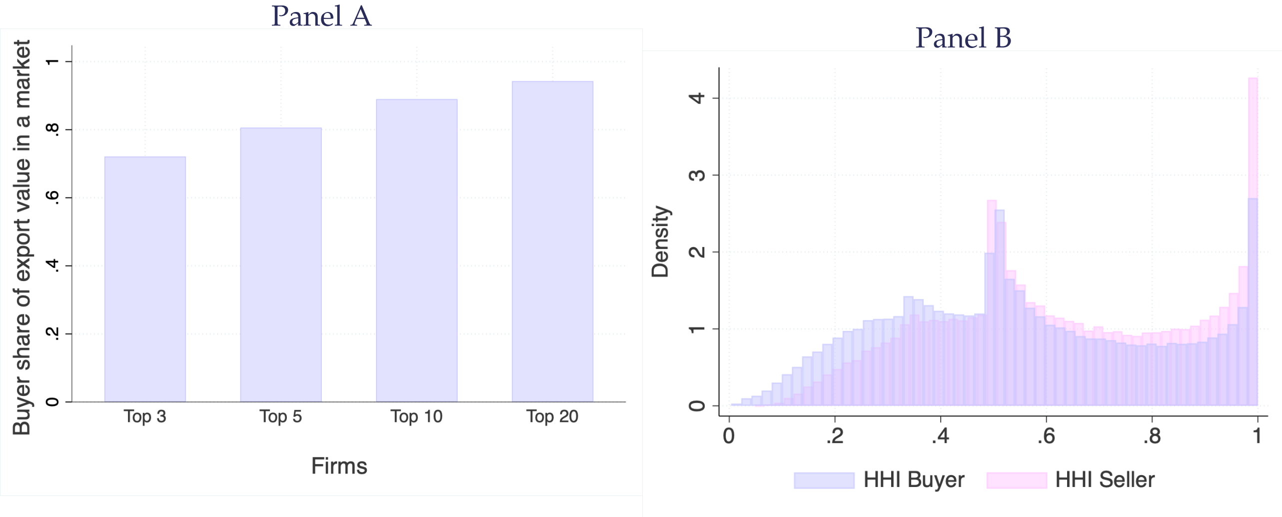
I then define the HHI.

$$HHI_{jkt} = \sum_b S_{bjkt}^2 \tag{2.1}$$

Figure 1, Panel B plots the distribution of the HHI. Note that in a market with only one buyer the HHI would be 1, while in a market with two buyers where each of them accounts for half of the market share, the HHI is 0.5. The figure shows a considerable number of markets with a high HHI, implying a high degree of concentration of sales among buyers.

I benchmark the observed level of concentration against the HHI for sellers comparing the concentration of buyers in Colombian markets with the concentration of sellers. Figure 1, Panel B indicates the concentration of export flows among buyers is as important as the concentration among sellers, and therefore, it could have important economic implications.

Figure 1: Buyer market concentration



Notes: This figure shows the concentration of Colombian exports among foreign buyers. Panel A shows how much of the export value in a market, where the market is defined as destination country $\times$ HS10 product $\times$ year, corresponds to the top buyers. Top buyers are ranked by their purchases in the given market. Panel B shows the distribution of the HHI using equation 2.1 for the buyer market share (blue) and the seller market share (pink). Source: Colombian Customs Data.

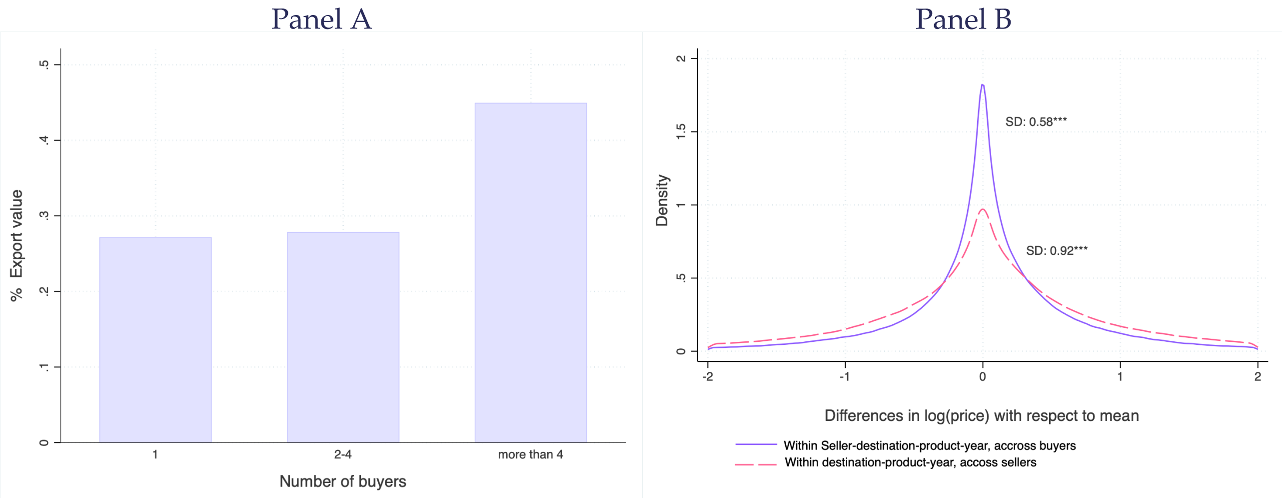
Fact II: Buyers Pay Different Prices for the Same Seller in International Markets

I document the existence of multi-buyer firms in a market and that these firms receive different prices for the same product among their buyers.

Figure 2, Panel A shows many multibuyer firms in Colombian export markets. In my sample, these firms account for roughly 80% of the exports value of the country. To date, no empirical evidence exists on price differences for buyers in international markets. I document this new stylized fact for sellers (exporters) in Colombia. As documented in Figure 2, Panel B, the same firm, exporting the same product to the same destination in the same year, receives different prices from different buyers. This is true even controlling for sector $\times$ destination $\times$ year fixed effects to compare similar destination markets (i.e., controlling for size of the market, as well as growth of a particular sector). The standard deviation from the mean of prices received by one firm for the same product to the same destination across similar buyers is around 0.58%. This suggests specific buyers have characteristics that considerably affect a firm's price. [8]

[8] In Appendix 7.2.3, I explore empirically the relationship between price dispersion and buyer size. Furthermore, my theoretical model in Section 3 explains why this relationship is not straightforward, as it involves distinct price components related to markdowns and the marginal revenue product.

Figure 2: Export value explained by multibuyer sellers and top buyers and price dispersion



Notes: This figure shows characteristics of multibuyer sellers. Panel A highlights that sellers with more than one buyer account for half of the export value on average per market. Panel B illustrates the price dispersion after including product fixed effects, country of destination fixed effects and year fixed effect. The blue line includes also seller fixed effects. That is, for a given seller, product, year and country of destination, prices have a standard deviation of 0.58%. Source: Colombian Customs Data.

Fact III: Markets with High Concentration of Sales Among Buyers Display Low Exchange Rate Pass-through

I now explore how the concentration of buyers relates to the exchange rate pass-through. I define exchange rate pass-through as how export prices, that is the prices in COP, react to a change in the exchange rate. For every market, destination–product, I run the following regression.

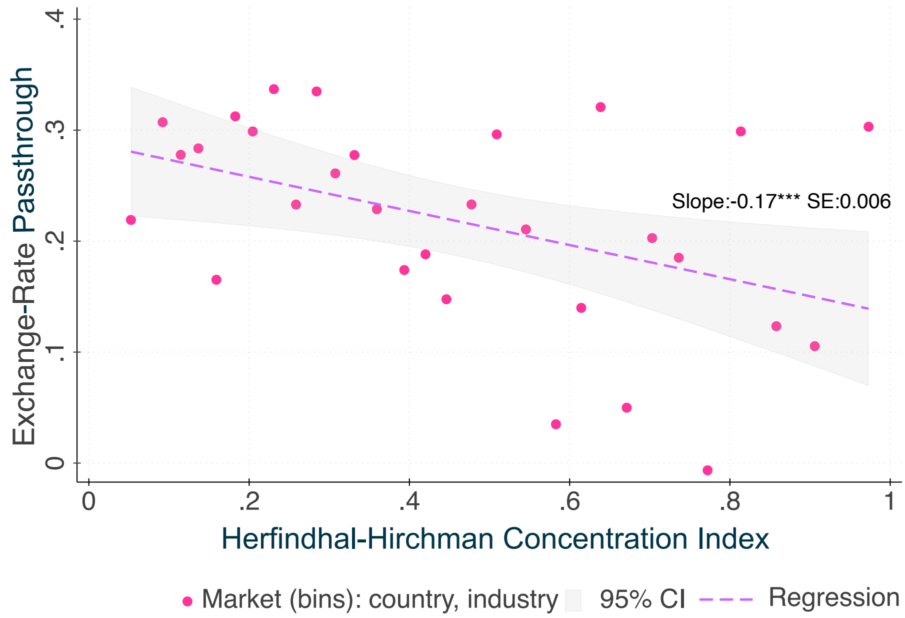
$$\Delta \ln p_t = \underbrace{\psi_{jk}}_{\substack{\text{Exchange rate} \\ \text{pass-through}}} \Delta \ln e_{kt} + \epsilon_t \tag{2.2}$$

where p_t corresponds to the average price in seller currency (COP) and e_k is the nominal bilateral exchange rate (local currency per unit of foreign currency).

Figure 3 presents the coefficients of my regression on a bin scatter plot. It shows there is a negative correlation between the exchange rate pass-through and the concentration of buyers. This means that in the event of an exchange rate shock, markets where buyers are more concentrated have fewer changes in prices, in the sellers' currency. This last fact motivates my model in the following section, exploring buyer market power in international markets as the main channel for this effect. Given that buyers are large and have buyer market power, this affects how prices are adjusted.[9]

[9] I have just shown that this relationship holds in the cross section for the different industries. In Section 7.2.6 of the appendix, I also show this relationship holds in the time series for Colombia.

Figure 3: Exchange Rate Pass-through and the Concentration Index



Notes: This figure shows regression 2.2, which accounts for correlations between the exchange rate pass-through coefficient for a given market and the HHI defined as equation 2.1. Source: Colombian Customs Data.

3 The Model

I develop an oligopsony model in international markets with an infinitely many sellers located in the home country and a few large buyers in each foreign market. This concentration of demand gives the buyers market power and allows them to choose the prices they pay.[10] The concentration of buyers, and hence their market power, differs across and within products. Given these prices, sellers choose which products they produce, and to which buyer they sell. I model the seller's choice of sector and buyer as a discrete-choice problem, which yields a nested CES supply curve.

The equilibrium price is a function of the relative buyer market share.[11] The shape of this function is determined by two key elasticities, the cross-product supply elasticity and within-product cross-buyer supply elasticity, which govern the heterogeneity of costs in the seller's choice problem. Intuitively, more heterogeneous sellers' costs lead to greater consequences of buyers' market power.

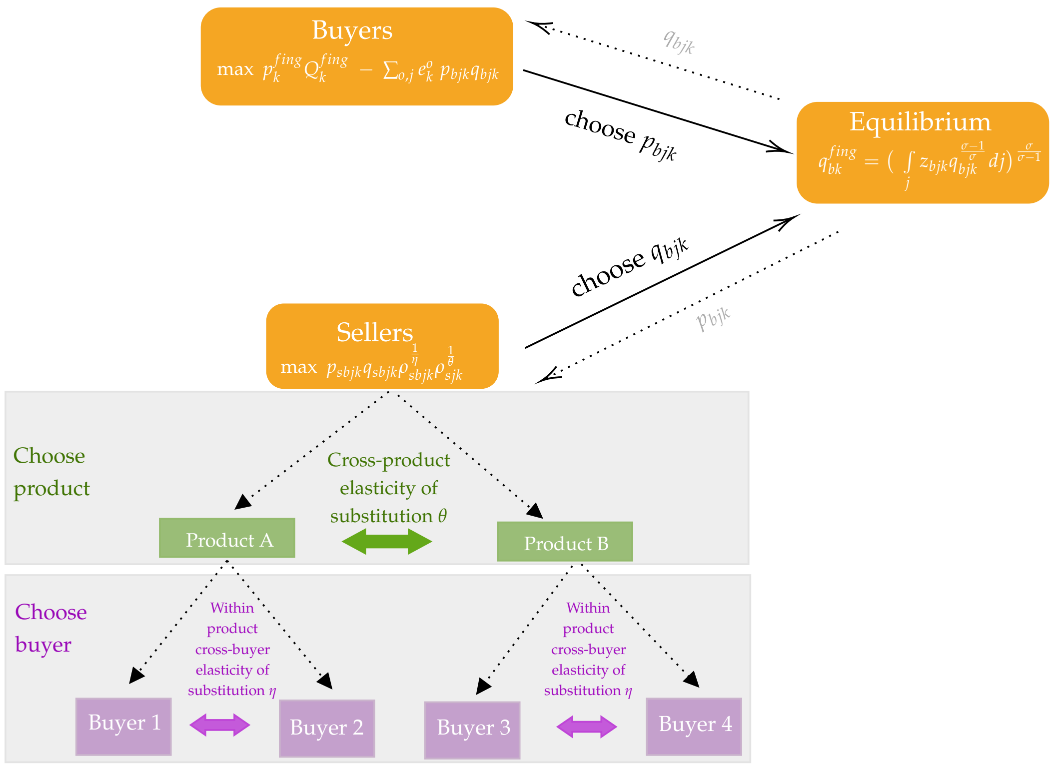
3.1 Timeline and Model Structure

The timeline of the model is as follows: (i) productivity shocks are realized, (ii) buyers choose the price they want to pay for their inputs, and (iii) sellers choose the quantity they are going to supply of each input. I solve this by backward induction, starting with the seller's problem then moving to the buyer's problem. Figure 4 summarizes the model structure with notation explained in the text.

[10] In my baseline model, buyers compete á la Bertrand. However, in Appendix 7.1.7, I additionally solve for Cournot competition.

[11] In this sense, the model also connects to the work of Alviarez et al. (2022).

Figure 4: Model Structure



Notes: This figure displays a diagram of the structure of the model. The upper part shows how quantities and prices are determined in equilibrium. The lower part illustrates the seller input supply decision according to the discrete choice framework.

3.2 Seller Supply Function

An infinite mass of potential sellers in a home country indexed by $s \in [0, 1]$ sell their products indexed by $j \in [1, ..., M]$ to buyers b in destination countries k. Each seller makes two decisions: (i) which product to produce and (ii) which buyer to supply. This decision will depend on the sellers' initial endowment, some productivity shocks and the prices offered by the buyers.

To begin, each Seller s has an endowment, $q_s \sim \psi$, and can decide to allocate it to the production of any product–buyer combination. As the seller produces more of a product for a buyer, he has less has of this endowment to use for another product and buyer: $sum_{bjk} q_{sbjk} = q_s$. Also, sellers with more of the endowment, q_s, can produce more.

Second, apart from their initial endowment, each Seller s for Product j for Buyer b in Destination k receives an idiosyncratic productivity drawn iid from a nested Frechet distribution: He receives an idiosyncratic shock, ρ_{sjk}, for producing each Product j (product-specific shock) and an idiosyncratic shock, ρ_{sbjk}, for supplying each Buyer b within Product j (within-product buyer-specific shock). Therefore, the idiosyncratic shocks determine the supply. A higher shock for Buyer b and Product j mean the seller can supply more if he chooses that buyer and product. Intuitively, ρ_{sjk} corresponds to the availability of inputs and technology for the seller to produce Product j, and ρ_{sbjk} corresponds to search costs and frictions for the seller to connect with Buyer b of Product j.

Third, the sellers observe the prices offered by the different buyers for the different products in each destination and take these prices into account when maximizing their profits. The seller chooses the buyer and product that yields the highest profits for each Destination k, given the productivity shocks and the prices set by the buyers:[12]

$$\max_{q_{sbjk}} \sum_{bj} p_{sbjk} q_{sbjk} \rho_{sbjk}^{\frac{1}{\eta}} \rho_{sjk}^{\frac{1}{\theta}} \text{ s.t. } \sum_{bjk} q_{sbjk} = q_s,$$

where p_{bjk} is the price of product j at the destination if it is consumed by Buyer b. Note that this price varies by Buyer b since they have market power. As there are no diminishing returns to selling to a given buyer-product in equilibrium each seller will just pick one buyer-product and sell everything to him, if there are no ties.

For intuition, consider the problem of a seller who has an initial endowment of q_s square feet of land to be cultivated. He could use it for either growing coffee or cocoa beans depending on his technology, ρ_{sjk}. For example, he has a machine more suitable for either of those beans. If he produces coffee, he could either sell it to Starbucks or Peet's Coffee depending on the search costs, ρ_{sbjk}. For example, he already sold before to Starbucks' so has some relationship with them, or he matches better with Starbucks packaging preference. Finally, the seller will take into account the price offered by those buyers before deciding to sell to any of them. There could be a trade-off between producing lower quantities and higher prices offered by the buyers.

The probability that Seller s chooses Product j and Buyer b, $\Pr(sbjk)$, is independent of his endowment, q_s. Due to the Frechet distribution of productivity shocks, for a given seller, that is fixing q_s, the probability of choosing Buyer b and Product j is the same as the probability that $(\Pr(revenue_{b',j',k} < revenue_{b,j,k}) \forall b', j' \neq b, j)$. Following Eaton and Kortum (2002), this probability is then equal to how much of the total production of all sellers goes to each buyer and product. Formally, we define λ_{bjk} as the share (of the total of sellers' production) that is sold to Buyer b of Product j in Destination k:[13]

$$\lambda_{bjk} = \underbrace{\frac{P_{jk}^{1+\theta}}{\sum_{jk} P_{jk}^{1+\theta}}}_{\Pr(\text{chooses Product } j)} \underbrace{\frac{p_{bjk}^{1+\eta}}{P_{jk}^{1+\eta}}}_{\Pr(\text{chooses Buyer } b|j)}, \tag{3.1}$$

where $P_{jk} = \left(\sum_{b \in B} p_{bjk}^{1+\eta}\right)^{\frac{1}{1+\eta}}$ and $P_k = \left(\sum_j P_{jk}^{1+\theta}\right)^{\frac{1}{1+\theta}}$. I derive this in Appendix 7.1.3.

Aggregating across sellers yields a nested CES upward-sloping supply curve for Buyer b in Product j, Country k:[14]

$$q_{bjk} = \left(\frac{p_{bjk}^{\eta}}{P_{jk}^{\eta}}\right)\left(\frac{P_{jk}^{\theta}}{P_k^{\theta}}\right) Y_k \tag{3.2}$$

where $Y_k = \sum_{bj} p_{bjk} q_{bjk}$

[12] Note that there are no costs in this maximization given all the sellers have an endowment. One way some types of costs are included is through the different shocks ρ_{sbjk} and ρ_{sjk}, but not input costs.

[13] All destinations here will differ on the exchange rate, and they might also have different elasticities. More details on this in Section 3.2.1.

[14] See Appendix 7.1.4 for derivations and intuitions on how prices relative to the price index relate to quantity. Equation 3.2 is equivalent to $q_{bjk} = \left(\frac{p_{bjk}}{P_{jk}}\right)^{\frac{1}{\eta}} \left(\frac{P_{jk}}{P_k}\right)^{\frac{1}{\theta}} \frac{Y_k}{P_k}$

3.2.1 Interpreting Elasticities

There are intuitive interpretations of the parameters θ and η.[15] First, θ governs the correlation of product-specific shocks. This means that the higher θ, the more correlated are the seller's productivity draws across sectors. This means that, if the idiosyncratic productivity for the different product is more likely to be similar, the prices in the product will be more relevant to determine the quantity choice. Intuitively, θ will be high if the availability of inputs needed for many different sectors and technology is similar so that there is little heterogeneity in productivity. Finally, θ is the elasticity of substitution across products in the CES supply function. If θ is relatively high, then it is easy to substitute products from the point of view of the seller. Higher substitutability would correspond to higher rates of seller switching between products, in a dynamic setting.

Analogously, η governs the correlation of buyer-specific shocks. The higher η, the more correlated are the seller's draws across buyers within a product. Then, since search costs to connect with one buyer or another are similar, the price each buyer offers will be more important. If η is high then sellers are able to actually connect with many buyers, and there will be low heterogeneity in the cost of finding a buyer.

Following the literature on the topic, we expect $\eta > \theta$, which has different interpretations: (i) Idiosyncratic cost shocks are more strongly correlated across buyers than across products, (ii) there is more heterogeneity in the productivity of producing different products than in the costs of connecting with two different buyers,[16] and (iii) sellers are more substitutable within products than across products from the buyer's point of view.

3.3 Buyer's Profit Maximization

There is a finite number of buyers in Foreign Country k. Each buyer purchases her inputs to produce a final good to sell in her home country. A buyer can buy different inputs j from different countries k.[17] Her production function is CES:

$$Q_{b,k}^{finalg} = \left(\int_j z_b q_{bjk}^{\frac{\sigma-1}{\sigma}} dj \right)^{\frac{\sigma}{\sigma-1}}, \tag{3.3}$$

where $z_b \sim O$ is an idiosyncratic productivity term, which is the only source of ex-ante heterogeneity across buyers.

Buyers of Product j exert market power over sellers, which I model as Bertrand competition. When deciding the price to pay, buyers form expectations about how sellers will respond. This means, they internalize the upward-sloping supply curve: each additional unit they purchase increases the price of every other unit. Note that, as I assume that the market structure is oligopsonistic, a buyer can affect the price index P_{jk}, however, there is an infinite mass of products such that the buyer cannot affect the aggregate price index P_k.

Therefore, the problem of Buyer b, located in Country k that buys Product j consists of choosing

[15] The interpretation of elasticities is inspired by Berger, Herkenhoff and Mongey (2022) and Zavala (2022).

[16] Note that, in the empirical analysis, this condition holds for the same destination and in the same period.

[17] Note that he can also buy the *same* input j from different countries k.

the prices they will offer to sellers, p_{bjk}. Buyers maximize the following profit function subject to a production function, Equation 3.3, and the quantity supplied by the seller, Equation 3.2.[18]

$$\max_{p_{bjk}} \ p_k^{finalg} Q_{b,k}^{finalg} - \sum_{origin,j} \frac{1}{e_k^{origin}} p_{bjk} q_{bjk} \quad \text{s.t.} \ \ Q_{b,k}^{finalg} = \left(\int_j z_{bjk} q_{bjk}^{\frac{\sigma-1}{\sigma}} dj \right)^{\frac{\sigma}{\sigma-1}} \ \text{and} \ q_{bjk} = \frac{p_{bjk}{}^{\eta}}{P_{jk}{}^{\eta}} \frac{P_{jk}{}^{\theta}}{P_k{}^{\theta}} Y_k \tag{3.4}$$

The first term of the profit function corresponds to the revenue the buyer obtains after selling quantity Q_k^{finalg} of the final good he produces at price p_k^{finalg}. The domestic price of output is modeled as exogenous.[19] The second term corresponds to the costs paid for the inputs (they buy different products j from different countries k), all the quantities, q_{bjk}, bought at prices, p_{bjk}.

The profit function is expressed in local currency. Buyers sell their final products in the home country so the revenue term is expressed in local currency. As buyers buy these inputs in international markets (costs term), which means they pay for them in the currency of the producer, I introduce the term e_k^{origin} that corresponds to the nominal exchange rate to convert the costs to local currency. The subindex k indicates the country of the buyer, while the superindex *origin* corresponds to the country of the seller.[20] This term is defined as foreign currency per unit of home currency.

The first-order condition (FOC) can be written as

$$p_{bjk} = \underbrace{\frac{1}{\mu_{bjk}}}_{mark\ down: \mu_{bjk}>1} \times \underbrace{MRP_{bjk}}_{marginal\ revenue\ product} \times e_k, \tag{3.5}$$

where markdown $\mu_{bjk} = 1 + \epsilon_{bjk}^{-1}$ with $\epsilon_{bjk} = \frac{\partial \ln q_{bjk}}{\partial \ln p_{bjk}}$ is the supply elasticity faced by Buyer b of Product j in Destination k.

Equation 3.5 shows that the price of the input in the producer's currency (seller's currency) depends on the markdown, the exchange rate and the marginal value of the input, that is the value the input adds to the final product. In other words, the buyers, who are the ones that have market power, will pay for an input an amount equal to how much this input adds to their revenues "reduced" in how much market power they have.[21]

Some relevant intuitions can be derived from equation 3.5. First, MRP_{bjk} is expressed in buyer's currency and the markdown has no unit so, for the price to be in the currency of the seller, I need to multiply by the exchange rate e_k. If all transactions happened in the domestic market (that is, if there is no difference in currency, so $e_k = 1$), then price is equal to the markdown times the MRP. Second, under perfect competition, $\frac{1}{\epsilon_{bjk}} = 0$ and the price is equal to the marginal value of the input. When the buyer has market power, he internalizes the upward-sloping supply of inputs, $\frac{1}{\epsilon_{bjk}} > 0$, and the input price is "marked down" from the perfectly competitive level. The steeper the supply curve faced by

[18] In the baseline specification, I do not include a fixed cost of importing; however, Appendix 7.1.20 addresses this, suggesting some selection into importing, similar to the selection into exporting commonly discussed in the literature.

[19] I relax this assumption in Appendix 7.1.9 and assume these buyers charge markups.

[20] Note that we think about our home country as the *only* origin country for the seller as we move forward, so the superindex "origin" is omitted in the rest of the paper, but e_k refers to the bilateral exchange rate between our home country where the seller is and Country k where the buyer is.

[21] Note that this is equivalent to Berger, Herkenhoff and Mongey (2022) on labor-market power where the wage is equal to the markdown times the marginal productivity of labor. The intuition is the these buyers avoid purchasing the last few units of a good whose value to them is greater than their marginal cost, just to hold down the price paid for prior units.

the buyer (higher $\frac{1}{\epsilon_{bjk}}$), the more market power he has, the higher the markdown, and the lower the price, ceteris paribus. Alternatively, the more value the input adds to the final good (higher MRP), the higher the price.[22]

3.4 Buyer Market Power and Supply Elasticity

The elasticity of supply allows us to better understand how prices are determined. Given Bertrand competition,[23] the elasticity of supply has the following closed form.

$$\epsilon_{bjk} = \eta(1 - S_{bjk}) + \theta S_{bjk}, \tag{3.6}$$

where

$$S_{bjk} = \frac{p_{bjk}q_{bjk}}{\sum_b p_{bjk}q_{bjk}} = \frac{p_{bjk}^{\eta+1}}{\sum_{b\in B} p_{bjk}^{\eta+1}} \tag{3.7}$$

is the relative size of Buyer b and Product j in Destination k. This variable is key given that, together with the elasticities, it determines the buyer's market power.

Focusing on equation 3.6, the supply elasticity, ϵ_{bjk}, is the weighted average of the elasticity of substitution across products, j, and across buyers, b, where the relative size of the buyers governs these weights. Note that the smaller the buyer share, which could relate to a higher level of competition (more buyers per market), the more weight on the substitutability across buyers within a product, η. With many buyers, they exert less influence, and sellers can always switch to other buyers of the same product or input. However, as the number of buyers decreases, the relevance relies on the potential substitution between products, θ.

Finally, I arrive at my first theoretical result. Rearranging equation 3.6, and assuming $\eta > \theta$, I find the elasticity of supply is decreasing in buyer market share, and so the markdown is increasing in buyer market share. Therefore, larger buyers have larger markdowns.

Proposition 1 1. *The markdown of Buyer b for Product j in Destination k is increasing in that buyer's market share in the market:*

$$\mu_{bjk} = \frac{1 + \eta\left(1 - \frac{p_{bjk}^{\eta+1}}{\sum_{b\in B} p_{bjk}^{\eta+1}}\right) + \theta\left(\frac{p_{bjk}^{\eta+1}}{\sum_{b\in B} p_{bjk}^{\eta+1}}\right)}{\eta\left(1 - \frac{p_{bjk}^{\eta+1}}{\sum_{b\in B} p_{bjk}^{\eta+1}}\right) + \theta\left(\frac{p_{bjk}^{\eta+1}}{\sum_{b\in B} p_{bjk}^{\eta+1}}\right)}; \quad \Gamma_{bjk} = -\frac{\partial \mu_{bjk}}{\partial S_{bjk}} < 0.$$

2. *The marginal revenue of a product, MRP_{bjk}, of a Buyer b in Product j is increasing in that buyer's market share in the market:*

$$MRP_{bjk} = \frac{\partial revenue}{\partial q_{bjk}} = z_{bjk}\left(\frac{q_{bjk}}{Q_{b,k}^{finalg}}\right)^{-\frac{1}{\sigma}}; \quad \Theta_{bjk} = \frac{\partial MRP_{bjk}}{\partial S_{bjk}} > 0.$$

[22] I am not assuming constant returns to scale in the marginal revenue of the product. Doing so would be expecting that each additional unit of different inputs would increase the marginal revenue in the same amount. If there were constant returns to scale in the production function, then $\frac{\partial MRP_{bjk}}{\partial q_{bjk}}$ would be 0. This would mean the MRP_{bjk} is not affected by a change in quantities and so also not affected by a change in prices (or exchange rate).

[23] I focus on Bertrand competition and present results under Cournot competition in the appendix.

Proof *See Appendix 7.1.6.*

3.5 Concentration

In this section, I aggregate my previous results at the market level. Aggregating the right-hand side of equation 3.7 across all firms in a local market, weighting each firm by its buyer market share, gives the key relationship between the degree of buyer market power in the inputs market and its concentration level.

Proposition 2 *Suppose inputs supply follows a nested CES, and buyers compete for sellers à la Bertrand, the average price markdown in market jk is given by*

$$\mu_{jk} = \frac{\overline{MRP}_{jk}}{\bar{p}_{jk} e_k} = 1 + \epsilon_{jk}^{-1} = 1 + [\eta HHI_{jk} + \theta(1 - HHI_{jk})]^{-1} \tag{3.8}$$

where $\overline{MRP}_{jk}$ and $\bar{p}_{jk}$ are Market jk's (revenue-weighted) average marginal revenue of product of the input and average price, respectively, ϵ_{jk}^{-1} is the (revenue weighted) average market supply elasticity, and $HHI_{jk} = \sum_{b \in \Theta_{jk}} S_{bjk}^2$ is the market's HHI.

Proof *See Appendix 7.1.10.*

After obtaining an equilibrium price equation and showing how it depends on the markdown,[24] I can now finally investigate the relationship of the markdowns to price adjustments caused by exchange rate shocks.

3.6 Exchange Rate Pass-through

In this section, I investigate the role of buyer market power in determining the export price response to exchange rate shocks (exchange rate pass-through elasticity). I consider a generic exchange rate shock at the country-pair level, Δe_k, our home country and destination Country k.

By definition, a bilateral exchange rate shock affects the prices and quantities for all exports in the home country. This means that, after an exchange rate shock, when Buyer b chooses the new price, full efficiency would require considering how the shock affects the prices chosen by all the other buyers of Seller s.[25] Consistent with my assumption in the buyer profit-maximization problem, I assume that when Buyer b chooses the new bilateral price, she takes as given both prices and quantities of all other pairs. In other words, this means focusing on the direct effect of the shock on the price, p_{bjk}.[26]

[24] In Appendix 7.2.3, I show the relationship between size and price level.

[25] Intuitively, by affecting the price and quantities for other buyer–seller pairs, a given shock may affect the price. p_{bjk}, through changes in buyer market share. Section 7.1.12 considers how the pass-through formula would change once these indirect effects are considered. The more general pass-through formula can be derived by solving a complex system of equations for each Seller s.

[26] I validate this assumption in the next section, where I show that the effect of the country-pair-level shock to the bilateral price is unchanged regardless of whether or not the quantities or prices of other buyers in the same Product j and Destination k are controlled for in the estimation.

Log-differentiating equation 3.5, and using the result in Proposition 1, I rewrite the log change in price, $\mathrm{dln}p_{bjk}$, as[27]

$$\mathrm{dln}p_{bjk} = -\,\mathrm{dln}\mu_{bjk} + \mathrm{dln}MRP_{bjk} + \mathrm{dln}e_k. \tag{3.9}$$

3.6.1 Direct Effect

In the event of a bilateral exchange rate shock, the resulting change in price implied by expression 3.9 can be decomposed into a direct effect at fixed aggregate prices and quantities in product j country k (i.e. $\mathrm{dln}P_{jk} = \mathrm{dln}q_{jk} = 0$) and an indirect effect induced by changes in aggregate prices and quantities. In this section, I focus on the direct effect.

The direct effect can be thought of as the overall effect when seller s is very small relative to country k and product j industry in that changes in the bilateral exchange rate do not affect aggregate outcomes.

If $\mathrm{dln}P_{jk} = \mathrm{dln}q_{jk} = 0$ and solving for each term, I derive

$$\mathrm{dln}\mu_{bjk} = \frac{\mathrm{dln}\mu_{bjk}}{\mathrm{dln}S_{bjk}}\frac{\mathrm{dln}S_{bjk}}{\mathrm{dln}p_{bjk}}\,\mathrm{dln}p_{bjk} \tag{3.10}$$

$$= -\Upsilon_{sbjk}(\eta+1)(1-S_{bjk})\,\mathrm{dln}p_{bjk} \tag{3.11}$$

$$= -\Gamma_{bjk}\,\mathrm{dln}p_{bjk}, \tag{3.12}$$

where I have defined $\Upsilon_{bjk} = -\frac{\partial \ln \mu_{bjk}}{\partial S_{bjk}} > 0$ as the partial elasticity of bilateral markdowns with respect to the buyer share S_{bjk} and $\Gamma_{bjk} = -\frac{\mathrm{dln}\mu_{bjk}}{\mathrm{dln}p_{bjk}} < 0$. In the case of constant markdowns, $\Gamma_{bjk} = 0$.

$$\mathrm{dln}MRP_{bjk} = \frac{\mathrm{dln}MRP_{bjk}}{\mathrm{dln}p_{bjk}}\,\mathrm{dln}p_{bjk} \tag{3.13}$$

$$= \frac{-1}{\sigma}(1-x_{bjk})\epsilon_{bjk}\,\mathrm{dln}p_{bjk} \tag{3.14}$$

$$= \Phi_{bjk}\,\mathrm{dln}p_{bjk}, \tag{3.15}$$

where σ is the elasticity of substitution of the CES production function, x_{bjk} is the expenditure share of Buyer b from Destination k on Product j and ϵ_{bjk} is the elasticity of substitution as in equation 3.6. When the production tecnology for the buyers has constant returns to scale then $\mathrm{dln}MRP_{bjk} = 0$

Substituting equations 3.10–3.13 into 3.9, it is possible to write the log change in the price, p_{bjk}, for each Buyer b in Product j and Destination k as a function of the buyer's market share, S_{sbjk}, and fundamentals.

$$\mathrm{dln}p_{bjk} = \Gamma_{bjk}\,\mathrm{dln}p_{bjk} + \Phi_{bjk}\,\mathrm{dln}p_{bjk} + \mathrm{dln}e_k \tag{3.16}$$

Proposition 3 characterizes the direct component of the pass-through of an exchange rate shock into the price, p_{bjk}.

[27] Note that I am dropping the subindex s, I will assume sellers are homogeneous in the prices they receive from the buyers so I can isolate the buyer effects. In my empirical part, I control for differences in two different sellers connected with the same buyer.

Proposition 3 *The pass-through of a bilateral exchange rate shock to the price p_{bjk} when $dlnp_{bjk} = 0, \forall i \neq k$. is given by:*

$$\frac{dp_{bjk}}{de_k} = \frac{1}{1 - \underbrace{\Gamma_{bjk}(\eta, \theta, S_{bjk})}_{Mark\ down\ channel(+)} - \underbrace{\Phi_{bj}(\varphi_j, S_{bjk})}_{Marginal\ Revenue\ Channel(-)}} \tag{3.17}$$

where $\Gamma_{bjk} = \Upsilon_{bjk}(\eta + 1)(1 - S_{bjk})$ and $\Phi_{bjk} = \varphi_j \epsilon_{bjk}$, with $\varphi_{bjk} = \frac{-1}{\sigma}(1 - x_{bjk})$

Proof *See Appendix 7.1.11.*

Equation 3.17 indicates that the pass-through elasticity into prices in a model with buyer market power can be written as a function of the buyer share in the market and the parameter vector $\nu = \{\eta, \theta, \sigma\}$.

3.6.2 Indirect Effect

Log-differentiating, we have that the log change in price, $\triangle p_{bjk}$, can be approximated as [28]

$$\triangle p_{bjk} = -\triangle \mu_{bjk} + \triangle MRP_{bjk} + \triangle e_k \tag{3.18}$$

I assume that the mark-down depends on the price charged by the seller from country k relative to the (log) aggregate industry price level in the destination country k, P_{jk} That is, I define μ_{bjk} as a function as follows: $\ln \mu_{bjk} = f(\ln p_{bjk} - \ln p_{jk})$

Then we get the expression:

$$\triangle p_{bjk} = \zeta_{bjk}(\triangle p_{bjk} - \triangle p_{jk}) + MRP_q \triangle q_{bjk} + \triangle e_k \tag{3.19}$$

where $\zeta_{bjk} = -\frac{\partial \ln \mu_{bjk}}{\partial(\ln p_{bjk} - \ln p_{jk})} = -\frac{\partial f(\cdot)}{\partial(\ln p_{bjk} - \ln p_{jk})}$ is the elasticity of the markdown with respect to the relative price (constant markdowns, this = 0), $MRP_q = \frac{\partial \ln MRP(\cdot)}{\partial \ln q_{bjk}}$ is the elasticity of the marginal revenue with respect to output (assumed common across firms).

Proposition 3 displays the direct effect on prices resulting from a change in the bilateral exchange rate when aggregate industry prices and quantities remain unchanged to this exchange rate movement (i.e. $\triangle p_{jk} = \triangle q_{jk} = 0$)). In practice, however, changes in the bilateral exchange rate may be associated with changes in aggregate prices and quantities, which give rise to additional indirect effects from exchange rate changes on prices.

Starting from 3.19, log demand is given by $\ln q_{bjk} = g(\ln p_{bjk} - \ln p_{jk}) + \mathrm{dln}q_{jk}$[29] where $\ln q_{bjk}$ denotes the log of the aggregate quantities/demand in country n. Log-differentiating,

[28] I define $d \ln A$ as ΔA

[29] I assume that $\ln q_{bjk}$ can be expressed as a function of the difference between $\ln p_{bjk}$, and $\ln p_{jk}$ such that $\Phi_{bjk} = MRP_q \Psi_{bjk}$

$$\Delta q_{bjk} = \Psi_{bjk}\left(\Delta p_{bjk} - \Delta P_{jk}\right) + \Delta q_{jk}$$

where $\Psi_{bjk} \equiv \frac{\partial g(\cdot)}{\partial\left(\ln p_{bjk} - \ln p_{jk}\right)} > 0$ is the price elasticity of supply.

The direct and indirect effect are characterized by: [30]

$$\Delta p_{bjk} = \Delta p_{bjk}\left(\zeta_{bjk} - \Phi_{bjk}\right) - \Delta p_{jk}\left(\zeta_{bjk} - \Phi_{bjk}\right) + MRP_q \Delta q_{jk} + \Delta e_k \tag{3.20}$$

Proposition 4 summarizes both components of the pass-through of an exchange rate shock into the price, p_{bjk}.

Proposition 4 *The pass-through of a bilateral exchange rate shock to the price p_{bjk} including the direct and indirect effect is given by:*

$$\frac{\Delta(p_{bjk})}{\Delta(e_k)} = \frac{1}{1-\left(\Gamma_{bjk} + \Phi_{bjk}\right)} - \frac{\Gamma_{bjk} + \Phi_{bjk}}{1-\left(\Gamma_{bjk} + \Phi_{bjk}\right)} \frac{\Delta(p_{jk})}{\Delta(e_k)} + \frac{MRP_q}{1-\left(\Gamma_{bjk} + \Phi_{bjk}\right)} \frac{\Delta(q_{jk})}{\Delta(e_k)} \tag{3.21}$$

Proof *See Appendix 7.1.12.*

3.6.3 Aggregate Level

In this section, I derive the aggregate level exchange rate pass-through. Using the proposition 4, I calculate the average exchange rate pass-through by sector and destination, in terms of the HHI.

Proposition 5 *The average exchange rate pass-through is given by:*

$$\psi_{jk} = \frac{dp_{bjk}}{de_k} = \frac{1}{1-\tilde{\Gamma}_{jk}(\eta,\theta,HHI_{jk}) - \tilde{\Phi}_{jk}(\varphi_j, HHI_{jk})} + \frac{\tilde{\Gamma_{bjk}} + \tilde{\Phi}_{jk}(\varphi_j, HHI_{jk})}{1-\tilde{\Gamma}_{jk}(\eta,\theta,HHI_{jk}) - \Phi_{bjk}} \frac{\Delta p_{jk}}{\Delta e_k} + \frac{M\tilde{R}P_q}{1-\tilde{\Gamma}_{jk}(\eta,\theta,HHI_{jk}) - \tilde{\Phi}_{jk}(\varphi_j, HHI_{jk})} \frac{\Delta q_{jk}}{\Delta e_k} \tag{3.22}$$

where $\widetilde{\Gamma}_{jk} = \frac{dln\mu_{jk}}{dlne_k}$ *and* $\tilde{\Phi}_{bjk} = \frac{\Delta MVP_{bjk}}{\Delta e_k}$

Proof *See Appendix 7.1.13.*

3.7 Channels

In this section, I decompose the overall exchange rate pass-through effect into markdown and marginal-revenue channels. From my theoretical model, I derive an expression to quantify each of these channels in the empirical part in Section 4.5.

[30] I assume that $\ln\mu_{bjk}$ can be expressed as function of the difference between $\ln p_{bjk}$, and $\ln p_{jk}$ as in $f(\cdot)$ so $\zeta_{bjk} = \Gamma_{bjk}$

3.7.1 Markdown Channel

The markdown channel is driven by the endogenous response of the buyer's market share to the shock. Following a positive exchange rate shock ($\uparrow e_k$, a devaluation of the home country), the buyer reduces her markdown and increases the price in the buyer currency (compensating for the shock and keeping the price more stable in the seller currency) such that the seller does not substitute away from that buyer. In other words, she internalizes the upward-sloping supply curve in equation 3.2: Each additional unit she purchases increases the price of every other unit.

The key theoretical result of my model is that, at the firm level, the markdown channel, Γ_{bjk}, is an increasing function of the buyer market share.[31] Therefore, the markdown channel operates differently for buyers with different market shares: Higher market share leads to more variable markdowns. Intuitively, buyers with higher market share, have higher markdowns. They pay a price way below the marginal-revenue product. Given this, they have more *scope* to adjust their markdowns as desired.

To identify the magnitude of this effect, and formally analyze each component present in this channel, I focus on a direct implication of Proposition 2.

Corollary 1

$$markdown\,channel = \frac{\partial \ln \mu_{bjk}}{\partial \ln p_{bjk}} = \frac{\mathrm{dln}\mu_{bjk}}{\mathrm{dln}S_{bjk}}\frac{\mathrm{dln}S_{bjk}}{\mathrm{dln}p_{bjk}} = \frac{-(\eta+1)(1-S_{bjk})S_{bjk}}{\left(\frac{\eta}{\theta-\eta}\right)(\eta+(\theta-\eta)S_{bjk}+1)}$$

If the cross-product elasticity of substitution is lower than the within-product cross-buyer elasticity, $\eta > \theta > 1$, then firms with higher S_{bjk} have more-variable markdowns.

$$\frac{dmarkdown\,channel}{dS_{bjk}} > 0$$

Proof *Differentiate equation 3.8 with respect to S_{bjk}. See Appendix 7.1.17 for details.*

To understand the intuition behind the Corollary 1, suppose that the exogenous shock is a positive bilateral exchange rate shock whose variation I introduce in the empirical section. Two conditions must hold for a positive exchange rate shock to increase the markdown of Buyer b in Product j, and Country k, and thereby reduce price paid via buyer market power. First, a positive exchange rate shock (a depreciation) must increase buyer market share. The reason for this is that buyer market share is the only endogenous component of that buyer's markdown. The other two components, η and θ, are supply parameters, which by assumption do not change. The source of market power in the international market is sellers production heterogeneity for products and buyers. Buyers can "exploit" this heterogeneity to pay marked-down prices. The bigger a buyer is relative to her competitors, the more she can mark prices down without sellers easily leaving because there are fewer buyer options nearby and sellers tend to prefer switching in the same product across buyers before switching markets completely. Therefore, the degree of market power in each market, Product–Destination jk, can only meaningfully change if the relative size of the buyer meaningfully changes.

[31] Equation 3.10 shows Γ_{bjk} depends on S_{bjk}, and Appendix 3.7.1 shows the relationship is increasing.

Second, there must be a difference between sellers' key inverse elasticities of substitution (i.e., $\theta - \eta$). If there is no difference in elasticities, sellers substitute equally between buyers and product. In this scenario, the effect of the exchange rate on buyer market share would be irrelevant for changes in the buyer market power. Such is the case under two of the model's limiting cases: monopsonistic competition (i.e., no gap to induce effects on market power, but because $\theta - \eta < 0$, there is still some level of market power), and perfect competition (i.e., no gap to induce effects, and because $\theta = \eta = 0$ no level of market power either).[32]

3.7.2 Marginal-Revenue Channel

The marginal-revenue channel captures the price response due to changes in the buyer's average revenue. When the bilateral price increases due to a positive exchange rate shock, a standard supply effect leads the seller to supply more of that variety. Higher supply decreases the average revenue, decreasing the price.

Rearranging equation 3.13, I get the following expression for the marginal-revenue channel.

$$\frac{\mathrm{dln}MRP_{bjk}}{\mathrm{dln}p_{bjk}} = \frac{-1}{\sigma}(1 - x_{bjk})\epsilon_{bjk}$$

It can be seen that the marginal-revenue channel depends on (i) σ, the parameter for elasticity of substitution in the buyer's CES production function, (ii) x_{bjk}, the share of input j in the buyer's production costs, and (iii) the elasticity of supply.[33] I interpret how each parameter contributes to this channel.

First, the higher the σ, the more substitutability between products in the production function and the less relevant the marginal-revenue channel. In the extreme, if $\sigma \to \infty$, then every input has a close substitute either from another seller in that same country or in another country and there is no differential marginal-revenue effect for larger buyers, because there is no marginal-revenue effect at all.[34]

Second, a higher x_{bjk} yields a more-relevant product for the buyers' production. If $x_{bjk} = 1$, input j is the only input and the marginal revenue will be constant, where increasing one unit of the input will increase the marginal revenue the same amount. If that were the case, then the buyer's market share would be irrelevant for this channel because, again, this channel would be shut down.

Third, a higher elasticity of supply yields a bigger marginal-revenue channel. Note that this is the only term in the marginal-revenue channel that depends on the buyer market share. This effect differs by buyer market share. As the elasticity of supply is smaller for bigger buyers, the bigger the buyer, the less substantial the revenue (and price) decrease.

[32] For this section, I borrow some labor-market intuitions from Berger, Herkenhoff and Mongey (2022); Felix (2022).

[33] As shown in equation 3.13, the marginal-revenue channel depends on the buyer's production function because it is related to how the product bought is used for production. In my baseline model, I propose a CES production function, but I solve for alternative specification in Appendix 7.1.16.

[34] If the production function were Cobb Douglas, then $\sigma = 1$. This case is explored in the Appendix 7.1.16.

4 Estimation

In this section, I use the data on Colombian exporters to test the theoretical model of the effect of exchange rate shocks on international prices. The results confirm the mechanisms proposed by the theory and show the markdown channel dominates. Then, I use indirect inference to estimate the parameters that account for the markdown channel and quantify the effect. Robustness checks for this section are in Appendix 7.2.8.

4.1 Exchange Rate Pass-through

Consider a sudden change in the bilateral exchange rate between the home country and Destination k. Below, I analyze the degree to which the exchange rate shock is passed on to international prices depending on buyer market power.

The theoretical pass-through regression equation 3.17 cannot be directly estimated since pass-through ψ_{sbjk} is not observed in the data. I can, nonetheless, identify the theoretical coefficients in the relationship between pass-through and buyer market share. Therefore, I step back to the decomposition of the log price change in equation 3.9.

4.1.1 Linearization

To estimate the effect of an exchange rate shock on prices for buyers with different market shares, after linearizing on the buyer market share, S_{bjk}, I calculate a first-order approximation, replace the differential d with a time difference Δ and rearrange to derive Proposition 6.

Proposition 6 1. *The first-order approximation to the exchange rate pass-through elasticity into prices in seller currency for Buyer b in Product j and Destination k is given by*

$$\psi *_{bjk} \approx \mathbb{E}\left[\frac{\Delta p_{bjk}}{\Delta e_k}\right] = \alpha_{jk} + \beta_{jk} S_{bjk}. \tag{4.1}$$

2. *The first-order approximation to the exchange rate pass-through elasticity into producer currency export prices for Product j and Destination k is given by*

$$\psi *_{jk} \approx \mathbb{E}\left[\frac{\Delta p_{jk}}{\Delta e_k}\right] = \alpha_{jk} + \beta_{jk} HHI_{jk}, \tag{4.2}$$

where HHI_{jk} corresponds to the concentration of that sector in that destination.

Proof *See Appendix 7.1.18*

The pass-through elasticity, $\psi *_{bjk}$, measures the buyer-product-destination price's equilibrium log change relative to the log change in the bilateral exchange rate, averaged across all possible states of the world and economic shocks. Proposition 6 relates firm-level pass-through to buyer market share, which forms a sufficient statistic for cross-sectional variation in pass-through within the product-destination universe. The values of the coefficients in this relationship (α_{jk} and β_{jk}) can be estimated in the data. Furthermore, Proposition 6 provides closed-form expressions for coefficients α_{jk} and β_{jk}.

Starting from Proposition 6, I arrive at my main empirical specification, where I regress the annual change in the log export price on the change in the log exchange rate, interacted with the buyer market share. Formally, the exchange rate pass-through into seller currency prices to Buyer b, in Product j and Destination k is

$$\Delta p_{s,b,j,k,t} = \underbrace{[\alpha + \beta S_{b,j,k,t-1}]}_{Exchange\ rate\ pass\ through} \Delta e_{kt} + \underbrace{\tau_{s,j,k} + \tau_{s,t}}_{Fixed\ Effects} + \epsilon_{s,b,j,k,t} \tag{4.3}$$

where $\Delta p_{s,b,j,k,t}$ is the log change in price of Good j from Seller s to Buyer b in Country k at Time t, $\Delta e_{k,t}$ is the log bilateral exchange rate change (COP seller currency per 1 unit buyer currency—Destination k). That is, an increase in e_k corresponds to the bilateral depreciation of seller currency, COP, relative to the Destination k buyer currency. $\tau_{s,j,k}$, $\tau_{s,t}$ are destination-product-seller fixed effect, year-seller fixed effect.[35]

I estimate parameters α and β with values averaged across seller, product, destination, and period. The regression equation 4.3 is a structural relationship that emerges from the theoretical model, and $S_{b,j,k,t-1}$ corresponds to my measure of buyer market share defined in equation 7.1.3.[36] Note that $\alpha + \beta S_{b,j,k,t-1}$ corresponds to the exchange rate pass-through coefficient. That is, if this term is zero, a shock to the exchange rate produces no change in the seller-currency prices (COP), and a proportional change (to the change in the exchange rate) in the buyer currency (rest of the world currency).[37]

The main empirical contribution of this paper corresponds to the coefficient β, which determines how the market share of the buyer affects the exchange rate pass-through. If this coefficient is negative, larger buyers experience a lower change in price in the seller currency in response to exchange rate changes. For example, if Colombia depreciates its currency by 1%, this translates to a $\alpha + \beta$% change for the cases where a buyer is the only buyer in that destination for that product in a given year. However, when there is more than one buyer, the effect of the exchange rate shock is $\alpha + \beta S_{bjk}$%. I summarize the distribution of this variable in my data in the appendix.

I propose different specifications including the fixed effects indicated by parameters in the theoretical model. First, I include a year-HS-country fixed effect. This fixed effect is meant to isolate the differences between markets and compare across buyers with different market shares. Note that the inclusion of this fixed effect, controlling for market level outcomes, is also consistent with the assumption made in Section 3, in which I state that both the quantities that exporters sell to other Buyers b, and the prices that other sellers charge to Firm b, do not change.[38] Second, I include several fixed effects accounting for the seller dimension, such as a year-seller fixed effect to control for shocks to the marginal cost, quality and characteristics of the buyer–seller relationship such as tenure,

[35] In the data, I test directly for nonlinearity in this relationship and find no statistically significant evidence.

[36] In the appendix, I discuss the assumption that $\Delta e_{k,t}$ is uncorrelated with $S_{b,j,k,t-1}$ and so the OLS estimates of α and β from this regression are the theoretical coefficients in the pass-through relationship.

[37] This would correspond to a complete exchange rate pass-through as defined throughout the literature (Amiti, Itskhoki and Konings, 2014; Gopinath et al., 2020).

[38] In particular, for less-saturated versions of the same regression, I also construct specific market-level controls in the data and include them in the regression (e.g., market price index, inflation, GDP).

different products, etc. More robustness checks on this can be found in Appendix 7.2.8.

4.2 Buyer-Seller Level Main Empirical Findings

In Table 2, I present the results for my benchmark empirical specification, equation 4.3. To explore the underlying mechanisms behind the equilibrium relationship between pass-through and buyer market share, I begin with a simpler specification and build up my benchmark empirical specification, equation 4.3. As the equation includes different sets of fixed effects, we go from the least-saturated regression to the more-demanding fixed effects.

Table 2 reports the results. First, in Column (1), I find that, at the annual horizon, the unweighted average exchange rate pass-through elasticity into seller prices in the sample is 0.13, or, equivalently, 0.87 ($= 1 - 0.13$) into destination prices. I include product–destination-specific effects (where industry is defined at the HS 8-digit level) to be consistent with the theory, and year effects to control for common marginal-cost variation. In Column (2), I include an interaction between exchange rates and buyer market share. I show that the simple average coefficient reported in Column (1) masks a considerable amount of heterogeneity, as buyers (for the same seller) with different market share have very different pass-through rates. Buyers with a high market share exhibit a lower exchange rate pass-through into seller-currency export prices. The median buyer in the sample has 13% market share and a pass-through of 16% in the currency of the seller. As the market share increases, the pass-through declines. For example, the pass-through of a buyer with almost no market power (around zero market share) is 14.8% and a buyer with a 50% market share has only a 6% pass-through.

Table 2: Effect of Buyer's Market Share on Exchange Rate Pass-through

	(1)	(2)	(3)	(4)
	$\triangle$ Log(Price)	$\triangle$ Log(Price)	$\triangle$ Log(Price)	$\triangle$ Log(Price)
$\ln(\triangle ER)$	0.132***	0.148***	0.0692*	
	(0.0509)	(0.0547)	(0.0355)	
S_{t-1}		-0.0481***	-0.0565***	-0.0185***
		(0.00684)	(0.00778)	(0.00659)
$\ln(\triangle ER) \times S_{t-1}$		-0.164**	-0.117**	-0.155***
		(0.0789)	(0.0494)	(0.0445)
Period-Seller FE	✓	✓		
Period-HS FE			✓	
Country-HS-Seller FE	✓	✓	✓	
Country-Period-HS FE				✓
N	517100	517100	512577	460477

Notes: Results from equation 4.3. The dependent variable corresponds to the log change of prices. ΔER and S_{t-1} are the bilateral exchange rate and the buyer market share, respectively. Products are defined at the HS10 level. Standard errors are clustered at the country-time level and are shown in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

To better understand the results from my regression, Table 3 shows the number of firms with different levels of exchange rate pass-through and buyer share. The largest buyers have on average between 0% and 5% pass-through while the smallest buyers have an exchange rate pass-through of around 15%.

Table 3: Firms with Different Levels of Exchange Rate Pass-through

EPRT	Number of firms	Mean S
$0 < \alpha + \beta S_t < 0.05$	68,548	0.91
$0.05 < \alpha + \beta S_t < 0.10$	57,011	0.66
$0.10 < \alpha + \beta S_t < 0.15$	82,935	0.44
$0.15 < \alpha + \beta S_t < 0.20$	169,764	0.21
$0.20 < \alpha + \beta S_t$	1,144,500	0.02

Notes: The table shows the number of firms and the mean value for buyer market share S_t for the different categories of exchange rate pass-through coefficients. α and β correspond to the estimates from Table 2.

These results reflect that the dominant mechanism is the markdown channel: Larger firms have lower exchange rate pass-through. That is, given larger buyers have market power, they internalize the upward-sloping supply curve for inputs, which implies that each additional unit they buy raises the price of every other unit.[39] As a result, they increase prices by less than if the supply curve they face were flat. For a given buyer, the higher the market power, the steeper the supply curve faced, and so the lower the pass-through of an exchange rate shock to the seller's price. The intuition behind this is that larger buyers have more market power, which allows them to adjust the markdowns after the exchange rate shock without affecting the price.

4.3 Aggregation at the Market Level

In this section, I explore the market level exchange rate pass-through. I start from the theoretical equation 4.2, and obtain the following regression at the market level.

$$\Delta p_{s,k,t} = [\alpha + \beta HHI_{s,k,t}]\Delta e_{kt} + FE_j + \epsilon_{s,k,t}, \tag{4.4}$$

where $\Delta p_{s,k,t}$ is the log change of the average price in a market, destination, year; $HHI_{s,k,t}$ is the HHI.[40]

While calculating the exchange rate pass-through at the market level, I can no longer include seller fixed effects to control for specific seller characteristics, such as the seller market share. Thus, the coefficient of this regression could be reflecting either buyer or seller market power. To address this potential issue, I aggregate the information I have at the seller level, and calculate the concentration index also for the sellers. This allows me to disentangle the effects, and I can account accurately for the effect of buyer market concentration. Results for this regression are shown in Table 4. When exports are more concentrated among a few buyers, the exchange rate pass-through for the average market price is lower.

Column (1) shows that, even without controlling for seller HHI, buyer concentration has a significant relationship with exchange rate pass-through. Columns (2), (3), and (4) include information of the distribution of sellers' market share while controlling for period, HS-country and HS-period fixed effects. My preferred specification is Column (4) because it contains the most restrictive fixed effects. It shows that the concentration of the buyers strongly influences the exchange rate pass-through.

[39] This is analogous to a monopoly case where the only seller internalizes the downward-slopping demand curve.
[40] We summarize the distribution of the HHI and the exchange rate pass-through at the market level in the appendix.

Table 4: Effect of Market Concentration on Average Exchange Rate Pass-through

	(1) $\triangle$ Ln(Price$_{jk}$)	(2) $\triangle$ Ln(Price$_{jk}$)	(3) $\triangle$ Ln(Price$_{jk}$)	(4) $\triangle$ Ln(Price$_{jk}$)
$ln(\triangle ER)$	0.0657***		0.0289	
	(0.0243)		(0.0302)	
HHIbuyer	-0.00909*	-0.000965	-0.00878*	-0.000303
	(0.00519)	(0.00479)	(0.00515)	(0.00475)
$ln(\triangle ER)$ × HHIbuyer	-0.166***	-0.187***	-0.159***	-0.176***
	(0.0420)	(0.0395)	(0.0412)	(0.0392)
HHIseller			0.00295	0.00538**
			(0.00319)	(0.00234)
$ln(\triangle ER)$ × HHIseller			0.0580**	0.0735***
			(0.0256)	(0.0191)
HS FE		✓		✓
Period-HS FE	✓		✓	
Country-HS FE	✓		✓	
Country-Period FE		✓		✓
N	334468	376582	334468	376582

Notes: The table shows results for equation 4.4. HHIbuyer and HHIseller correspond to the HHI for sales concentrations among buyers and sellers, respectively. They are calculated by using equation 2.1 with the market share of the buyers and sellers. Standard errors are clustered at the country-time level and are shown in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

4.4 Robustness

In this section, I consider four sets of robustness tests: discussing price stickiness and currency of invoicing, considering alternative definitions of buyer market share, including import intensity, and using alternative samples in terms of included destinations, firms, and products. We conclude the section by a discussion of the possible selection and measurement issues.

Currency of invocing and sticky prices In my model, there are flexible prices and strategic complementarities in pricing. I now briefly comment on the interpretation of our results in an environment with sticky prices, where exporters choose to fix their prices temporarily either in local or in producer currency. I will specifically provide some evidence for the cases where the US dollar can act as the dominant currency - firms set export prices in dollars and change them infrequently, as in Gopinath et al. (2020).[41]

In this setting, the results in this paper would confound together the change in the desired markdown with the mechanical changes in markdown induced by the exchange rate movements when prices are sticky in a given currency. To give some insight on this, I run my main regressions with three alternative specifications: (i) transactions only to the US, (ii) transactions only invoiced in US dollars, (iii) including the ER of the Colombian peso and the US dollar.

[41] In Appendix 7.2.12, I include some specifications to compare with the aggregate results in Gopinath et al. (2020).

Table 5: Sticky Prices and Dominant Currency

	(1)	(2)	(3)	(4)	(5)
	△ Ln(Price)	△ Ln(Price)	△ Ln(Price)	△ Ln(Price)	△ Ln(Price)
$\ln(\triangle ER)$	0.143***		0.128**	0.145**	
	(0.0225)		(0.0591)	(0.0590)	
S_{t-1}	-0.141***	-0.0836***	-0.0635***	-0.0624***	-0.0570***
	(0.0255)	(0.0141)	(0.00870)	(0.00856)	(0.00836)
$\ln(\triangle ER) \times S_{t-1}$	-0.683***	-0.487***	-0.182**	-0.186**	
	(0.128)	(0.104)	(0.0878)	(0.0871)	
$\ln(\triangle ER_{US-COP}) \times S_{t-1}$					-0.216***
					(0.0796)
Buyer FE	✓				
HS-Seller FE	✓	✓			
Period-Seller FE		✓	✓	✓	✓
Country-HS-Seller FE			✓	✓	✓
N	122648	127531	466688	471536	517100

Notes:The table shows results for equation 4.3 but including controls for the sticky prices and the dominant currency paradigm hyphotesis. Standard errors are clustered at the country-time level and are shown in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

First, I explore regression only for the cases where the destination country is the United States. This allows a scenario where the bilateral exchange rate is equal to the dollar exchange rate, such that the apparent dominance of the dollar cannot be an artifact of special conditions that may apply in times when the dollar appreciates or depreciates against all other currencies (e.g. a global recession, changes in assets' markets safety, etc.). In Table 5, Columns (1) and (2) I show these results which are two sets of fixed effects. I find higher buyer market power implies lower exchange rate pass-through, and the magnitude of the effect is even stronger than in the baseline specification.

In Columns (3) and (4), I compare the main specification for the whole sample and only for transactions that have been invoiced in US dollars. It is relevant to note that in Colombian customs data, 98% of the transactions are invoiced in US dollars (Column (3)). Results are very similar in both cases (slightly bigger in magnitude for the sample not accounting for the currency of invoicing) which implies invoicing might not be a threat for biasing my results. Finally, in Column (5) of Table 5, I run a regression that includes the dollar exchange rate and find results that are consistent with Gopinath et al. (2020)[42].

Nonetheless, it is important to consider that my findings indicate that buyer market power, specifically in terms of buyer market share, plays a role in either the incomplete transmission of flexible prices or the probability of local currency pricing. These factors ultimately result in low pass-through rates before price adjustments occur. In practical terms, both these influences are likely contributors to incomplete pass-through in our dataset. However, this paper does not delve into the detailed breakdown of these factors, as it falls outside the scope of the study.[43]

[42]Note that both exchange rates cannot be included due to collinearity.

[43]Gopinath, Itskhoki and Rigobon (2010) show that the sticky price determinants of incomplete pass-through are largely shaped by the same underlying primitives as the flexible price determinants, and they reinforce each other in the cross-section of firms.

Alternative Definitions of Buyer Market Share In this section, I explore alternative definitions of buyer market share to ensure that the results are not sensitive to our definition of it. In table 11, I include two new definitions of buyer market power. First, in columns 1-2, I define a market as a Product HS - year combination. In this case, the buyer market share corresponds to the share of the exports in a Product HS-year combination bought by a given buyer. Second, I define the buyer market share as the share of a given seller s exports in a Product HS - year that corresponds to a given buyer b. In other words, how relevant is a specific buyer in the exports of a seller in a market, independently of how big is the buyer as a whole in that market. In all cases, the signs of my results are essentially unchanged. The magnitude of the effect fluctuates from a smaller effect when only looking at the within-seller size measure to a bigger effect when considering buyers in all destinations. These results are not surprising since the average buyer shares are much lower as we drop a large share of exports from the denominator in the measure.

As a final exercise, I explore the relationship between these alternative definitions and the seller side. To do this, in the last two Columns of Table 9 in Appendix 7.2.8 I include an interaction of the bilateral exchange rate with the seller market share for alternative measures of buyer market share. Results remain significant and with the same sign. It is worth noticing that once I expand the market into product-year level, the seller size, or market share, becomes relevant for the pass-through.

Import Intensity Since it has been documented that more import-intensive exporters have significantly lower exchange rate pass-through, as a face of offsetting exchange rate effects on their marginal cost (Amiti, Itskhoki and Konings, 2014), I discuss this topic in this subsection. For import intensity to create a bias in the estimates, it has to be the case that there is a selection of larger buyers into exporters that, in turn, source their intermediate inputs internationally. Specifically these exporters should import more than other exporters.

To account for this potential effect, I include a measure of import intensity of the exporter, defined as the ratio between the total value of imports for the seller s at time t and the total trade of that seller at time t. Appendix 7.2.9 shows the results of this alternative specification. First, in column 1, I verify my results are unchanged when using the contemporaneous import intensity measure. Next, in column 2 I include the lagged time-varying import intensity and arrive to the same result.

Alternative Samples I further check the robustness of my results within alternative subsamples of the dataset, both in the coverage of export destinations and in the types of products and firms. It reveals the same qualitative and quantitative patterns found in the benchmark sample.

Columns 1–2 of Table 14 in Appendix 7.2.13 report the results for an alternative set of export destinations— OECD countries [44]. It is noteworthy that for the OECD subsample I estimate both a higher baseline pass-through (for firms with zero buyer market share) and a stronger effect of buyer market share on pass-through, than for other countries.

The remaining columns in Table 14 consider different sets of products and firms. I follow the ISIC Rev. 3.1 classification to define which products are commodities. As a robustness check I also use the subsample of differentiated products only, referenced products only and homogeneous products

[44] Note the United States only case is showed in Table 7.2.9

only (instead of the full set of products presented) constructed using the classification of goods by Rauch (1999). This is available in Appendix 7.2.13.

Finally, the sample has included all of the firm's manufacturing exports rather than restricting it only to HS major products. In column 7, I include only the firm's major export products, based on its largest HS code, in order to address the issue of multiproduct firms, identifying a firm's major products, using the HS 10-digit category. I show that the results are not sensitive to this choice of products.

4.5 Estimation of the Markdown Channel

In the model, two key elasticities govern market power and so, the magnitude of the markdown channel: the elasticity of substitution across products, θ, and the elasticity of substitution within product, across buyers, η. In this section, I describe an approach which integrates (i) new empirical estimates using bilateral exchange rate shocks (see Section 4.2) and (ii) new moments from the cross-section, into (iii) a simulated method of moments routine in which all unknown parameters are estimated jointly.

4.5.1 Challenges for Estimation

Equation 3.17 shows that the pass-through term, $\frac{dp_{bjk}}{de_k}$ is a function of three parameters—η, θ, σ—and S_{bjk}. Once we linearize on buyer market shares, S_{bjk}, I have two coefficients (equation 4.1) which I obtain from running the regression in the data. The sizes of the coefficients β and α are informative on the magnitudes of the elasticities θ and η. However, I cannot disentangle them from the effect of the marginal revenue, φ. This is a well-known issue in the markup literature (De Loecker and Warzynski, 2012), which is usually addressed by estimating the production function and backing out market power.[45] Instead, I combine the elasticities from the empirical part with moments from the cross section and use the structure of the model to estimate η and θ directly, along with other parameters.

4.5.2 Indirect Inference

I recover the parameters of the model through indirect inference implemented as simulated method of moments (SMM). I estimate all parameters jointly, but outline the estimation procedure separately for each group of parameters. Appendix 7.3 provides further details.[46]

Estimates for η and θ To estimate η and θ, I proceed in three steps: (1) Estimate equation 4.1 in the actual data. (2) Simulate equation 4.1 in the model. (3) Pick η and θ so that the coefficients α and β from the model match their counterparts in the data.

[45] Another typical problem for the estimation of the elasticity of supply (and so the markdown) is that, when firms behave strategically, the structural elasticity cannot be measured using how prices respond to a well-identified shock. The structural elasticity is a partial equilibrium concept answering the counterfactual: How much firms change supply, holding their competitors' q_{sbjk} constant. The reduced-form elasticity includes all other firms' responses.

[46] I follow a top-down approach related to Berger, Herkenhoff and Mongey (2022) and Zavala (2022).

I estimate equation 4.1 in the actual data already in section 4.2 and obtain $\hat{\alpha}$ and $\hat{\beta}$. To simulate equation 4.1, I use the following procedure. First, I draw the productivity of each buyer from an exogenous distribution.[47] For each guess of η and θ, I solve the model. Next, I shock the prices by drawing from the distribution of bilateral exchange rate shocks. I solve the model again to create a simulated panel, treating the outcomes across these two model economies as panel data. The resulting exchange rate pass-through coefficients, denoted $\beta(\eta, \theta)$ and $\alpha(\eta, \theta)$, are functions of η and θ.

I pick η and θ so that the pass-through coefficients estimated from the simulated data match the coefficients I estimated from the actual data (coefficients from Table 2) such that

$$(\hat{\eta}, \hat{\theta}) = \text{argmin}_{\eta,\theta} \left\{ \|\hat{\alpha} - \alpha(\eta, \theta)\| + \|\hat{\beta} - \beta(\eta, \theta)\| \right\}.$$

Estimate for σ I take advantage of the data available for Colombia and use cross-sectional moments to estimate parameters that govern the marginal revenue product. Holding η and θ fixed, I use the ratio between prices of different products from the same buyer to derive an expression that can be estimated through regression using the available data, and its coefficient becomes a function of σ, specifically $\frac{1}{\sigma}$.[48]

$$\frac{p_{bjk}}{p_{bj'k}} = \frac{\varepsilon_{bjk}\left(1+\varepsilon_{bj'k}\right)}{\left(1+\varepsilon_{bjk}\right)\varepsilon_{bj'k}} \frac{z_{bjk}}{z_{bj'k}} \left(\frac{q_{bj'k}}{q_{bjk}}\right)^{\frac{1}{\sigma}}$$

$$\ln\left(\frac{p_{bjk}}{p_{bj'k}}\right) = \underbrace{\ln\left(\frac{\varepsilon_{bjk}\left(1+\varepsilon_{bj'k}\right)}{\left(1+\varepsilon_{bjk}\right)\varepsilon_{bj'k}}\right) + \ln\left(\frac{z_{bjk}}{z_{bj'k}}\right)}_{\omega_0} + \underbrace{\frac{1}{\sigma}}_{\omega_1} \ln\left(\frac{q_{bj'k}}{q_{bjk}}\right)$$

External Parameters: ϵ_k, z_b and Others I assume that (log) buyers productivity, $log\, z_b$ and log changes in exchange rate shocks, Δe_k, follow normal distributions.

$$log\, z \sim N(\mu_z, \sigma_z^2) \;\; and \;\; \ln \Delta e_k \sim N(\mu_e, \sigma_e^2)$$

For buyer productivity, I choose (μ_z, σ_z^2) to match the distribution of buyers' market shares. For bilateral exchange rate shocks, I choose (μ_e, σ_e^2) to match the distribution of log changes in the bilateral exchange rate in the data. For buyer productivity, I choose (μ_z, σ_z^2) equal to (0,1). Finally, the numbers of products and buyers are also chosen to match the data from Colombia.

[47] This is needed to have nonsymmetric buyer market shares.
[48] In Appendix 7.3.1, I explain the detailed procedure for this.

4.5.3 Parameter Estimates

Table 6: Summary of parameters

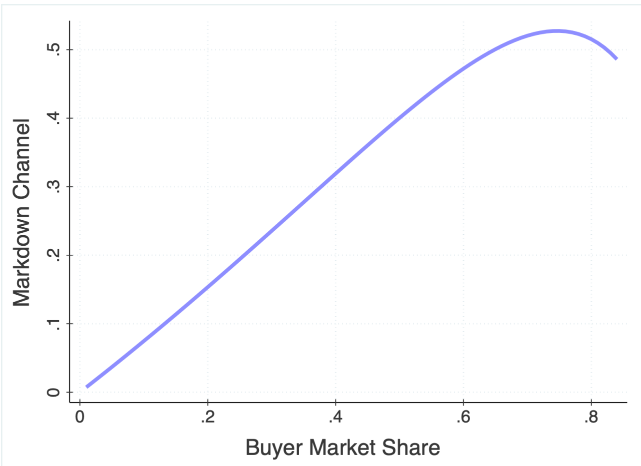
Parameter	Description	Value	Moment	Model	Data
A. Assigned					
N	Number of products	6,983			
M_j	Number of buyers per product	17			
μ_{e_k}	Mean of ln ER changes	0.03			
$\sigma^2_{e_k}$	SD of ln ER changes	0.1			
B. Estimates					
θ	Across-product substitutability	5.14	Baseline pass-through $\hat{\alpha}$	0.181	0.175
η	Across-buyer substitutability	7.17	Interaction buyer share $\hat{\beta}$	-0.243	-0.241
σ	Input substitutability	0.3	Relative price level	0.012	0.013
z	Productivity shifter	0.05	Average firm size	0.21	0.23

In Appendix 7.3, I include the procedure for calculating the standard errors, sensitivity analysis, and proof of uniqueness.

4.5.4 Quantifying the Markdown Channel

After obtaining the estimates for η and θ and using the corresponding S_{bjk} in my data, I calculate the implied markdowns Colombian exporters face. I find the average markdown to be 16%. Then, using the structural equation from the model, I quantify the markdown channel. Figure 5 shows the markdown channel is bigger for buyers with larger market shares once I plug in the estimates for the elasticities.

Figure 5: Markdown Channel and ERPT varies with size



Notes: Figure plots buyer market share on the x-axis and changes in the markdowns (or the markdown channel) on the y-axis. Buyer market share is defined as the share of the market, defined as destination country x product x year, purchased by a given buyer.

5 Counterfactual: Eliminating Buyer Market Power

To explore the aggregate implications of buyer market power for the sellers in Colombia, I propose a counterfactual where I eliminate buyer market power. Moving from an oligopsony structure to perfect competition with no strategic interactions implies not only changes in the level of revenues but also in the volatility of these revenues.

5.1 Level Effect

I simulate an alternative model in which buyers lack market power. Under perfect competition, buyers still face upward-sloping supply curves, whose shapes are determined by the cross-product elasticities of substitution (η) and within-product cross-buyer elasticity of substitution (θ). However, they do not internalize their influence over the price. Rather, they perceive a perfectly elastic supply curve ($\epsilon_{bjk} = \infty$). Input prices are no longer marked down from their marginal-revenue product.

By comparing the sellers' revenues in both versions of the economy, I aim to estimate the welfare losses caused by buyers' markdowns. The total impact of buyer market power is the log difference in sellers' revenues between the two scenarios:[49]

$$\text{Total Effect} = \log \sum_{sbjk} p^C_{sbjk} q^C_{sbjk} - \log \sum_{sbjk} p^M_{sbjk} q^M_{sbjk} \tag{5.1}$$

To perform the welfare analysis, I first aggregate the economy's revenues with and without market power. Then, I calculate the percentage change by dividing the change in aggregated revenues by the revenues with market power. To estimate prices without market power, I re-scale the simulated prices by the markdown, obtaining hypothetical prices in the absence of monopsony, such that, $p^C_{bjk} = p^M_{bjk}\mu_{bjk}$. Using these prices, I determine the corresponding quantities to calculate the revenues. The welfare effect is thus described by the following equations and results:

$$TotalEffect = \frac{\sum_{b,j,k} p^C_{bjk} q^C_{bjk} - \sum_{b,j,k} p^M_{bjk} q^M_{bjk}}{\sum_{b,j,k} p^M_{bjk} q^M_{bjk}} \tag{5.2}$$

The change in the sellers' revenues can be decomposed into a quantity effect and a price effect [50]. I first simulate the model with and without market power to quantify these effects. To differentiate the total effect between the price and quantity effects, I utilize the following expression:

$$\underbrace{\log\left(\sum_{bjk} p^{PerfComp}_{bjk} \hat{q}^{Olig}_{bjk}\right) - \log\left(\sum_{bjk} p^{Olig}_{bjk} \hat{q}^{Olig}_{bjk}\right)}_{\text{Price effect}} + \underbrace{\log\left(\sum_{bjk} p^{PerfComp}_{bjk} \hat{q}^{PerfComp}_{bjk}\right) - \log\left(\sum_{bjk} p^{PerfComp}_{bjk} \hat{q}^{Olig}_{bjk}\right)}_{\text{Quantity effect}} \tag{5.3}$$

[49]The model simulation's approach to scaling quantities by dividing them by Q_k limits my ability to estimate the effects as previously described fully. Consequently, all revenues are adjusted by Q_k, where Q_k represents the equilibrium quantity for total import payments P_k in economy k for an additional unit of aggregate import price. I use $\hat{q}_{bjk} \equiv \frac{q_{bjk}}{Q_k}$.

[50]My analysis shares the spirit of Edmond, Midrigan and Xu (2023), which accounts for the costs of markups.

5.1.1 Price Effect

The price effect corresponds to the increase in price when removing markdowns; sellers earn higher revenues for supplying the same product to the same buyer. This effect can be thought of as a redistribution from buyers to sellers. To measure this effect, I calculate sellers' revenue using quantities from the oligopsony model-baseline and prices from the perfect-competition counterfactual.
The price component after scaling by Q_k is the following:

$$PriceEffect = \frac{\sum_{b,j,k} p^C_{bjk} q^C_{bjk} - \sum_{b,j,k} p^M_{bjk} q^C_{bjk}}{\sum_{b,j,k} p^M_{bjk} q^M_{bjk}} \tag{5.4}$$

5.1.2 Quantity Effect

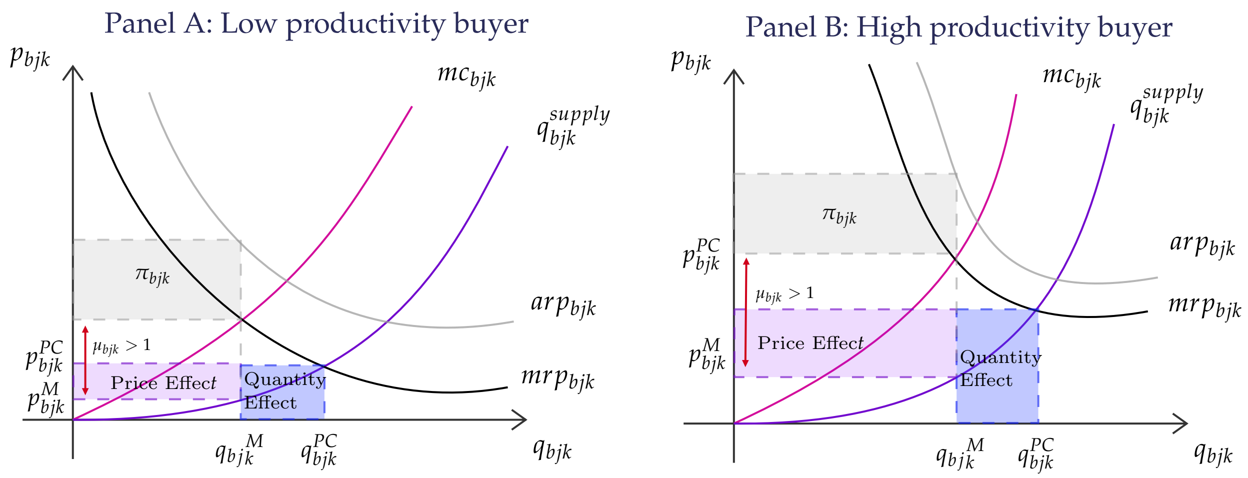
The quantity effect corresponds to efficiency gains. In the model, sellers trade off the price of a given buyer and a given product with their idiosyncratic shock for producing that product and supplying that buyer. This leads to misallocation: Some sellers do not produce the product in which they are most productive simply because its price index is very low. Conditional on a product, some sellers do not supply the buyers with lower information frictions to connect with them, simply because their prices are too low. Once buyer market power is removed, the tradeoff lessens and allows sellers to produce the product they are most productive on and supply their buyer with lower search costs/frictions. I calculate sellers' revenue using prices from the oligopsony-model baseline and quantities from the perfect competition counterfactual to measure this effect.

$$QuantityEffect = \frac{\sum_{b,j,k} p^M_{bjk} q^C_{bjk} - \sum_{b,j,k} p^M_{bjk} q^M_{bjk}}{\sum_{b,j,k} p^M_{bjk} q^M_{bjk}} \tag{5.5}$$

5.1.3 Quantifying the Total Effect, Price Effect and Quantity Effect

The magnitude of the quantity effect and price effect varies by the market shares of the buyer. Figure 6 shows graphically both the price and quantity effect for a large buyer relative to a small one.

Figure 6: Price and Quantity Effect



Notes: This figure shows the price and the quantity effect from comparing with a case of perfect competition depending on the productivity of the buyer, which in turns, determined the buyer market share.

I find that sellers' revenues would be 0.2% higher in the absence of market power. Redistribution from buyers to sellers increases income by 0% and efficiency gains would increase sellers' revenues by 0.199%.[51] Therefore, the markdowns isn't stopping sellers from picking the efficient product-seller combination but they still lose a share of their revenues as a result of the lower prices they face. It is important, however, to remember that these revenues are weighted they represent the value of the buyer's share in the aggregated Q increase given an increase in the aggregated price. Since productivity is the main driver of shares' differences, they remain more or less constant with or without market power which explains why the effect comes from the price and not so much from the quantities.

5.2 Effect on Δ in Revenues with Exchange Rate Shocks

In the rest of this section, I quantify the welfare effects of buyer market power by comparing the volatility of the revenues faced by the sellers in an oligopsony structure to those in perfect competition.

To this end, consider a single consumer, a seller in the home country, whose income is equal to the revenues y_t obtained from exporting their products. Revenues from exports are the only source of income such that $c_t = y_t$. At the same time, revenues in each period follow a random walk:

$$Y_t = Y_{t-1} e^{\mu} e^{-1/2\sigma^2} \epsilon_t,$$

where $\ln(\epsilon_t)$ is a normally distributed random variable with mean 0 and variance σ^2. Under these assumptions $E(e^{-(1/2)\sigma^2} \epsilon_t) = 1$. Preferences over such consumption paths are assumed to be

$$\mathbb{E}\left[\sum_{t=0}^{\infty} \beta^t \frac{((1+\lambda)C_t^{PerfComp})^{1-\gamma}}{1-\gamma}\right], \tag{5.6}$$

where β is a subjective discount rate, γ is the coefficient of risk aversion, and the expectation is taken with respect to the distribution of shocks ϵ_t.

I compare the utility difference for a seller in an oligopsony structure with one in perfect competition. An extremely risk-averse consumer would prefer the case in oligopsonistic competition. I quantify this utility difference by multiplying the perfect competition path by a constant factor $1+\lambda$ in all dates and states, choosing λ so the seller is indifferent between the oligopsony and the compensated perfect-competition path. Therefore, λ is chosen to solve

$$\mathbb{E}\left[\sum_{t=0} \beta^t \frac{((1+\lambda)C_t^{PerfComp})^{(1-\gamma)}}{1-\gamma}\right] = \mathbb{E}[\sum_{t=0} \frac{\beta^t}{1-\gamma} {C_t^{Olig}}^{(1-\gamma)}] \tag{5.7}$$

Canceling, takings logs and collecting terms gives

$$\lambda \approx \frac{1}{2}\gamma(\sigma^2_{PerfComp} - \sigma^2_{Oligop}) \tag{5.8}$$

Note that the compensation parameter λ—the welfare gain from eliminating volatility from buyer market power—depends of three terms: the risk-aversion parameter γ, the amount of risk present in each case $\sigma^2_{PerfComp}$, and $\sigma^2_{PerfComp}$. The last two terms correspond to variance of the ϵ_t for each case.

To estimate λ, estimates of these parameters are needed. As both scenarios have a different variance for their change in revenues, I use the results from the empirical section to estimate this where the variance of the

[51] While all sellers benefit from perfect competition, the gains are not distributed equally: Markets with higher baseline levels of buyer market concentration experience greater increases.

income is

$$\text{var}[\Delta Y_t] = (\hat{\alpha} + \hat{\beta} S_{bjkt})^2 \, \text{var}[\Delta e_{kt}] \tag{5.9}$$

I plug in $S_{bjkt} = 0$ for the perfect competition case, and I assign $S_{bjkt} = 1$ to the oligopsony case, obtaining 0.0008 and 0.000003, respectively. Seeing this agent as a representative seller in a developing country, I use estimates of the coefficient of risk aversion, γ. In macroeconomics and finance, this coefficient ranges from 1 (lowest risk aversion) to 5 (highest risk aversion). I pick a coefficient of 1 and calculate λ:

$$\lambda \approx 0.0004$$

From the literature, these welfare losses of a monetary-policy regime are low, but they are on the order of magnitude of Lucas (2003). Comparing this lambda with Lucas (2003) (0.0005), I can conclude buyer market power accounts for 80% of the costs of welfare related to eliminating the whole business cycle in the U.S. when evaluating the volatility of the sellers' income in Colombia.

Taking into account both effects, the level effect for the price and the effect related to the volatility of the revenues, we can explain why the mentioned parameters (i.e., the elasticities, risk premium, utility function, etc.) matter in understanding how sellers are affected by buyer market power in international markets.

6 Conclusion

This paper studies buyer market power in international markets and its impact on the exchange rate pass-through. I combine a novel transaction-level dataset covering the universe of Colombian exports that crucially contains information on the identity of the foreign buyer for the period 2007–2020 with an oligopsony model of buyer market power in international trade. The main conclusion is that buyer market power is relevant in determining the exchange rate pass-through.

Theoretically, buyer market power has implications for price determination and for how these prices react to exchange rates. First, buyers with higher market share have a higher markdown, and so a lower price, all else equal. Second, buyer market power has consequences for the exchange rate pass-through. The overall effect is driven by two offsetting mechanisms: a markdown channel and a marginal-revenue channel.

My empirical strategy focuses on estimating the Colombian exports' pass-through elasticity to the rest of the world. At the firm level, my findings suggest that bigger buyers pay lower prices, and have a lower exchange rate pass-through to sellers' currency, ranging from 1% for the largest to 15% for the smaller buyers. The mechanism behind this is that large buyers' greater market power leads to *more* variable markdowns. At the market level, in markets where buyers are more concentrated, prices have higher markdowns and exchange rate pass-through in seller currency is lower.

Finally, I calibrate the model and obtain key elasticities that allow me to simulate a counterfactual scenario where buyers have no market power. Under this scenario, sellers receive higher prices but their revenues are more responsive to exchange rate shocks. In this setting, seller currency devaluations are much common than appreciations. On balance, sellers are less likely to benefit from reduced volatility than to be disadvantaged by attenuated revenue gains during depreciation episodes.

This paper has important policy implications for sellers from developing countries who sell their products to large firms. Even though when selling to a large firm they might receive marked down prices, these prices are more stable during exchange rate shocks. Countries in Latin America frequently have devaluations, so this mechanism prevents them from suffering a harsher consequence of the shock. On the other hand, multinationals abroad might find it less appealing to connect with small sellers.

In the last decades, concentration of sales in large, multinational firms has been increasing, raising many questions for future research. At the firm level, future work could focus on exploring which kinds of buyers are the best investment for small sellers in developing countries in the long run. At the same time, which markets contribute more to the growth of these small firms. Relevant policy questions at the market level remain unanswered: How does the market structure in terms of concentration of two different countries affect when they engage in trade? How does that market structure affect the propagation of shocks.

7 Appendix

7.1 Appendix: Theoretical Model

7.1.1 Notation

- $s \in [0,1]$: Sellers, $j \in [0,1]$: Product, b : Buyer, k : Country
- $\rho_{s,j,k}$: s' idiosyncratic shock for producing j
- $\rho_{b,s,j,k}$: s' idiosyncratic shock for supplying b with j
- z_b: Idiosyncratic productivity term specific to b
- q_s : Seller's endowment
- $q_{s,b,j}$: Seller s' production of good j for buyer b
- Q_{finalg} : Buyer's production of final good
- $p_{s,b,j,k}$: input j's price at destination k if it is bought by b from s
- $p_{b,j,k}$: input j's aggregate price for b in k
- $P_{j,k}$: input j's price index in destination k
- $\overline{P_{j,k}}$: Market j's average price in destination k
- P_j: input j's aggregate price index
- P_k: aggregate price index in destination k
- p_{finalg}: final good's price
- $\lambda_{s,b,j,k}$: share of seller s' total production corresponding to her sales of input j to buyer b in destination k
- $s_{b,j,k}$: Relative size of buyer b in input j's market in destination k
- $\chi_{b,j,k}$: j's share of b's expenditure in k
- $MRP_{b,j,k}$: marginal revenue of input j in buyer b's production
- $\overline{MRP_{j,k}}$: market of input j's markdown in destination k
- $\mu_{s,b,j,k}$: buyer b's markdown buying input j from seller s in destination k
- $\mu_{b,j,k}$: buyer b's markdown in input j's market in destination k
- $\mu_{j,k}$: markdown of input j in destination k
- $HHI_{j,k}$: market j's concentration index in destination k
- θ: Elasticity of substitution across products in the seller's CES supply function
- η: Elasticity of substitution across buyers within a product
- $\varepsilon_{b,j,k}$: Supply elasticity faced by buyer b of input j in destination k
- $\varepsilon_{j,k}$: Market j's average elasticity
- $\Upsilon_{b,j,k}$: $\mu_{b,j,k}$'s partial elasticity with respect to $s_{b,j,k}$
- $\Gamma_{b,j,k}$: $\mu_{b,j,k}$'s partial elasticity with respect to $p_{b,j,k}$
- $\phi_{b,j,k}$: $MRP_{b,j,k}$'s elasticity with respect to $p_{b,j,k}$

- σ: Elasticity of substitution in the final good's CES
- e_k^{origin}: Nominal exchange rate $\left(\frac{origin\ currency}{destination\ k\ currency}\right)$
- Δe_k^{origin}: Exchange rate shock at the country-pair level
- $\Psi_{b,j,k}$: Exchange rate pass-through to $p_{b,j,k}$
- $\Psi_{j,k}$: Exchange rate pass-through to $P_{j,k}$
- α: Estimated pass through independent of $s_{b,j,k}$
- β: Estimated pass through that depends on $s_{b,j,k}$

7.1.2 Supply Side: Frechet Shocks

We assume that the shock is drawn from a nested Frechet distribution. Then,

$$H(\vec{\rho}) = \exp\left[-\sum_j B_{jk}\left(\sum_b B_{bjk}\rho_{bjk}^{-(1+\eta)}\right)^{\frac{1+\theta}{1+\eta}}\right], \text{ with } \theta < \eta,$$

The seller chooses the buyer that it is going to yield the maximum profits. I will do this for buyer b in product j. The density function of choosing buyer b and product j is:

$$H_{bjk}(\vec{\rho}) = -(1+\theta)\tilde{P}_j^{(1+\theta)-(1+\eta)} B_{jk}\rho_{bk}^{-(1+\eta)-1}\exp\left(-\left(\sum_{j'k}\tilde{P}_{j'k}^{1+\theta}\right)\right) d\rho_{bjk}$$

where $\tilde{P}_{j'k} = B_{j'k}\left(\sum_{b\in B} B_{b'j'}\rho_{b'j'}^{-(1+\eta)}\right)^{\frac{1}{1+\eta}}$.

7.1.3 Supply Side: Share

We need to integrate two things, first the probability of choosing Buyer b and Product j, and second the total quantities. For a given seller, that is fixing q_s, the probability of choosing buyer b and Product j is the same as the probability that $\rho_{b'j'} \leq \frac{p_{bj}}{p_{b'j'}}\rho_{bj} = \frac{p_{bj}}{p_{b'j'}}\rho$.[52] Then[53]

[52]This means that the revenue is higher in Buyer b and Product j. In this demonstration, the subindex k will be eliminated for simplicity, but results remain equivalent while including it.

[53]This is the probability that the shock is higher than any other shock. Specifically by looking at the equations we can see it is the probability that e_{sb} is higher that another shock (cdf of e on point $\frac{p_{sb}}{p_{b'j'}}\rho$) throughout the whole distribution of shocks e (integral part). Also, $\lambda = \int_0^\infty H_{sb}(\rho, \frac{p_{sb}}{p_{b'j'}}\rho, ...)$.

$$
\begin{aligned}
\lambda_{bjk} &= P(\rho_{b'j'k} \leq \frac{p_{bj}}{p_{b'j'k}}\rho_{bjk}) \\
&= \int_0^\infty \underbrace{\exp\left(-\left(\sum_{j'} B_{j'}\left(\sum_{b'\in J'} B_{b'j'}\left(\frac{p_{bj}}{p_{b'j'}}\right)^{-(1+\eta)}\rho^{-(1+\eta)}\right)^{\frac{1+\theta}{1+\eta}}\right)\right)}_{\Pr(\rho_{b'j'}\leq\frac{p_{bj}}{p_{b'j'}})} \underbrace{dH_{bjk}(\rho)}_{density\ \ of\ \ \rho_{bjk}} \\
&= \int_0^\infty \rho^{-\eta-1}\theta B_j B_{bj}\left(\sum_{b'\in S} B_{b'j'}\left(\frac{p_{bjk}}{p_{b'j'k}}\right)^{-(1+\eta)}\rho^{-(1+\eta)}\right)^{\frac{\theta-\eta}{(1+\eta)}} \exp\left(-\left(\sum_{s'} B_{s'}\left(\sum_{a'\in J'} B_{b'j'}\left(\frac{p_{bjk}}{p_{b'j'k}}\right)^{-(1+\eta)}\rho^{-(1+\eta)}\right)^{\frac{1+\theta}{1+\eta}}\right)\right) d\rho \\
&= \int_0^\infty \rho^{-(1+\eta)-1}(1+\theta)B_j B_{bj} p_{bjk}^{\eta-\theta}\left(\sum_{b'\in M} B_{b'j'} p_{b'j'k}^{1+\eta}\rho^{-(1+\eta)}\right)^{\frac{\theta-\eta}{1+\eta}} \exp\left(-\rho^{-\theta} p_{bjk}^{-(1+\theta)}\left(\sum_{j'} B_{j'}\left(\sum_{b'\in j'} B_{b'j'} p_{b'j'k}^{1+\eta}\right)^{\frac{1+\theta}{1+\eta}}\right)\right) d\rho \\
&= \int_0^\infty (1+\theta)P_{jk}^{\theta-\eta} B_{bj} p_{bjk}^{\eta-\theta}\rho^{-(1+\theta)-1}\exp\left(-\rho^{-(1+\theta)} p_{bjk}^{-(1+\theta)}\left(\sum_{j'} P_{j'k}^{1+\theta}\right)\right) d\rho \\
&= \underbrace{\frac{P_{jk}^{1+\theta}}{\sum_{j'} P_{j'k}^{1+\theta}}}_{\Pr(f\ \ chooses\ \ product\ \ j)} \underbrace{\frac{B_{bj} p_{bjk}^{1+\eta}}{P_{jk}^{1+\eta}}}_{\Pr(seller\ \ chooses\ \ buyer\ \ b|j)} \underbrace{\int_0^\infty -\exp(-u)du}_{=1}
\end{aligned}
$$

This expression has an intuitive interpretation: conditional on choosing Product j, the probability of choosing Buyer b, $\Pr(b|j)$ depends on how large the price of Buyer b (numerator) is relative to the price index of Product j (denominator), which is a CES aggregate of prices across buyers within a sector. The unconditional probability of choosing Product j, $\Pr(j)$, then depends on how large the price index of Sector s (numerator) is relative to the overall price index (denominator), which is a CES aggregate of price indexes across sectors. As the elasticities increase, the price becomes more important in determining whether a seller chooses Buyer b, conditional on choosing Product j. This means, the easiest is to switch from product to product, the more relevant the price ratio is.

Therefore, the share of seller's s production that is consumed by Buyer b and Product j is:

$$
\lambda_{bj} = \frac{P_j^{1+\theta}}{\sum_{j'} P_{j'}^{1+\theta}} \frac{B_{bj} p_{bj}^{1+\eta}}{P_j^{1+\eta}} \tag{A7.1}
$$

where $P_j = B_j\left(\sum_{b'\in B} B_{b'j} p_{b'j}^{1+\eta}\right)^{\frac{1}{1+\eta}}$.

In the rest of the paper, I will simplify B_{bj} and B_j to 1.

7.1.4 Supply Curve: Choice of Quantity

Aggregating across sellers yields a nested CES supply curve for Buyer b in Product j. We know that

$$
p_{bjk} q_{bjk} = \lambda_{bjk} P_k Q_k
$$

The expected quantity supplied by Seller s to Buyer b in Product j is

$$q_{sbjk} = q_s \times \Pr(sbjk)$$

Integrating over sellers yields the total quantity in Product j supplied to Buyer b:

$$\begin{aligned} q_{bjk} &= \int_0^1 \Pr(sbjk) q_{sk} dR \\ &= \int_0^1 \frac{p_{bjk}^{1+\eta}}{\sum_b P_{bjk}^{1+\eta}} \frac{(\sum_b p_{bjk}^{1+\eta})^{\frac{1+\theta}{1+\eta}}}{\sum_{j'} (\sum P_{j'k}^{\eta})^{\frac{1+\theta}{1+\eta}}} q_{sk} dR \\ &= \frac{p_{bjk}^{\eta}}{\sum_a P_{bjk}^{\eta}} \frac{\sum_s (p_{bjk}^{\eta})^{\frac{\theta}{\eta}}}{\sum_{s'} (\sum P_{b'jk}^{\eta})^{\frac{\theta}{\eta}}} \underbrace{\int_0^1 p_{bjk} q_{sk} dR}_{Y_k} \end{aligned}$$

Multiplying both sides by p_{sbk} and summing across products and buyers, we have $Y_k = \sum_{bj} p_{bjk} q_{bjk}$, so that Y_k is total spending by buyers on products. So, the quantity supplied to Buyer b of Product j, destination k is:

$$q_{bjk} = \left(\frac{p_{bjk}^{\eta}}{P_{jk}^{\eta}}\right) \left(\frac{P_{jk}^{\theta}}{P_k^{\theta}}\right) Y_k \tag{A7.2}$$

where $P_k = (\sum_j P_{jk}^{1+\theta})^{\frac{1}{1+\theta}}$.

7.1.5 Supply Side: Seller Production Function Instead of Endowment

The quantity a seller with productivity q_s and idiosyncratic shocks ρ_{sjk}, ρ_{sbjk} could sell[54] of Product j to Buyer b, is then determined by their productivity and the idiosyncratic shocks:

$$q_{sbjk} = \rho_{sbjk}^{\frac{1}{\eta}} \rho_{sjk}^{\frac{1}{\theta}} q_s \tag{A7.3}$$

where q_s is a function of labor and does not depend of b. This would mean the seller uses labor to produce and wages adjust where is no longer profitable to keep on producing. Therefore, the production is bounded. An example could be $q_s = L_{sjk}$ and bringing profits for the seller: $p_{sjk} L_{sjk} - w L_{bjk}$ and (perfect competition $w = p$). q_s is seller specific as can be shown in Appendix 7.1.3, if the production function is seller specific then, for a given seller the probability of choosing Firm b and Product j does not depend on the production function. Therefore, the quantity supplied in equilibrium relative to other buyers and products would be the same as in the baseline model.

7.1.6 Firm-level elasticity of Supply

To solve for the value of ϵ_{bj}, I start from the quantity supplied and solve:

$$\varepsilon_{b,j,k} = \frac{\partial q_{b,j,k}}{\partial p_{b,j,k}} \frac{p_{b,j,k}}{q_{b,j,k}}$$

[54]Note that this is not the actual quantity sold, but that quantity that a seller could sell at most to a Buyer b in Product j, if they choose to supply Buyer b in Product j.

$$\frac{\partial q_{b,j,k}}{\partial p_{b,j,k}}\frac{p_{b,j,k}}{q_{b,j,k}} = \left[\eta\frac{1}{p_{b,j,k}}\frac{p^{\eta}_{b,j,k}}{P^{\theta}_{k}}P^{\theta-\eta}_{j,k}Y_k + (\theta - \ \eta)\frac{1}{P_{j,k}}\frac{p^{\eta}_{b,j,k}}{P^{\theta}_{k}}P^{\theta-\eta}_{j,k}Y_k\left(\frac{1}{\eta}\frac{P_{j,k}}{\sum_b p^{\eta}_{b,j,k}}\eta p^{\eta-1}_{b,j,k}\right)\right]\frac{p_{b,j,k}}{q_{b,j,k}}$$

$$\frac{\partial q_{b,j,k}}{\partial p_{b,j,k}}\frac{p_{b,j,k}}{q_{b,j,k}} = \left[\eta\frac{q_{b,j,k}}{p_{b,j,k}} + (\theta-\eta)q_{b,j,k}\frac{p^{\eta}_{b,j,k}}{P^{\eta}_{j,k}}\frac{1}{p_{b,j,k}}\right]\frac{p_{b,j,k}}{q_{b,j,k}}$$

$$\varepsilon_{b,j,k} = \frac{\partial q_{b,j,k}}{\partial p_{b,j,k}}\frac{p_{b,j,k}}{q_{b,j,k}} = \eta(1-S_{b,j,k}) + \theta S_{b,j,k}$$

7.1.7 Demand Curve: Bertrand Competition vs Cournot Competition

In this section, the subindex k will be eliminated for simplicity, but results remain equivalent while including it.

Case I: Bertrand Competition

$$\pi_{bj} = p^{finalg}_{k}Q^{finalg}_{k} - \sum_j \frac{1}{e}p_{bj}q_{bj} \quad \text{s.t.} \quad Q_{finalg} = \left(\int_s q_{bj}^{\frac{1-\sigma}{\sigma}}ds\right)^{\frac{\sigma}{\sigma-1}} \quad and \quad q_{bj} = \frac{p_{bj}{}^{\eta-1}}{P_j{}^{\eta-1}}\frac{P_j^{\theta-1}}{P^{\theta-1}}Y \tag{A7.4}$$

The FOC imply that:

$$[p_{bj}] : \frac{\partial(revenue)}{\partial q_{bj}}\frac{\partial q_{bj}}{\partial p_{bj}} - \frac{1}{e}\left[q_{bj} + p_{as}\frac{\partial q_{bj}}{\partial p_{bj}}\right] = 0$$

$$\frac{\partial(revenue)}{\partial q_{bj}} - \frac{1}{e}\left[q_{bj}\frac{\partial p_{bj}}{\partial q_{bj}} + p_{bj}\right] = 0$$

$$\frac{\partial(revenue)}{\partial q_{bj}} - \frac{1}{e}\,p_{bj}\left[\frac{1}{\epsilon_{bj}} + 1\right] = 0$$

where ϵ_{bj} is the supply elasticity. Then, we get that

$$p_{bj} = \frac{\epsilon_{bj}}{1+\epsilon_{bj}}eMRP_{bj} \tag{A7.5}$$

Case II: Cournot Competition

$$\pi_{bj} = p_{finalg}Q_{finalg} - \sum_s \frac{1}{e}p_{bj}q_{bj} \quad \text{s.t.} \quad Q_{finalg} = \left(\int_j q_{bj}^{\frac{1-\sigma}{\sigma}}dj\right)^{\frac{\sigma}{\sigma-1}} \quad and \quad q_{bj} = \frac{p_{bj}{}^{\eta-1}}{P_j{}^{\eta-1}}\frac{P_j^{\theta-1}}{P^{\theta-1}}Y \tag{A7.6}$$

The FOC imply that:

$$[q_{bj}] : \frac{\partial p_{bj} q_{bj}}{\partial q_{bj}} - \frac{1}{e}\left[\frac{\partial p_{bj}}{\partial q_{bj}} q_{bj} + p_{bj}\right] = 0$$

$$MRP(e) - \frac{1}{e} p_{bj}\left[\frac{\partial p_{bj}}{\partial q_{bj} p_{bj}} q_{bj} + 1\right] = 0$$

$$p_{bj} = \frac{\epsilon_{bj}}{1+\epsilon_{bj}} eMRP_{bj} \tag{A7.7}$$

7.1.8 Demand Curve: Choice of Price

In this section, I evaluate alternative scenarios: (a) buyer's production function with one input, (b) buyer's production function with multiple inputs but from one country, and (c) buyer's production function with one input but multiple countries

Case A: Bertrand Competition – One Input

$$\pi_{bjk} = p_k^{finalg} Q_k^{finalg} - \frac{1}{e_k} p_{bj} q_{bj} \quad \text{s.t.} \quad Q_k^{finalg} = \frac{{q_{bjk}}^{\sigma}}{\sigma} \quad and \quad q_{bjk} = \frac{{p_{bjk}}^{\eta}}{{P_{jk}}^{\eta-1}} \frac{{P_{jk}}^{\theta-1}}{{P_k}^{\theta-1}} Y_k \tag{A7.8}$$

The FOC imply that:

$$[p_{bjk}] : \frac{\partial (revenue)}{\partial q_{bjk}} \frac{\partial q_{bjk}}{\partial p_{bjk}} - \frac{1}{e_k}\left[q_{bjk} + p_{bjk} \frac{\partial q_{bjk}}{\partial p_{bjk}}\right] = 0$$

$$\underbrace{MRP_{bjk}}_{\text{Marginal Value of Product } j} \quad - \frac{1}{e_k}\ p_{bjk} \frac{1+\epsilon_{bjk}}{\epsilon_{bjk}} = 0$$

where ϵ_{bjk} is the supply elasticity. Then, we get that

$$p_{bjk} = \frac{\epsilon_{bjk}}{1+\epsilon_{bj}} \frac{1}{e_k} MRP_{bjk} \tag{A7.9}$$

Case B: Bertrand Competition – Only one country

$$\pi_{bjk} = p_k^{finalg} Q_k^{finalg} - \sum_j \frac{1}{e_k} p_{bjk} q_{bjk} \quad \text{s.t.} \quad Q_k^{finalg} = \prod_j z_b q_{bjk}^{\sigma_j} \quad and \quad q_{bjk} = \frac{{p_{bjk}}^{\eta}}{{P_{jk}}^{\eta}} \frac{{P_{jk}}^{\theta}}{P^{\theta}} Y_k \tag{A7.10}$$

The FOC imply that:

$$[p_{bjk}] : \frac{\partial (revenue)}{\partial q_{bjk}} \frac{\partial q_{bjk}}{\partial p_{bjk}} - \frac{1}{e_k}\left[q_{bjk} + p_{bjk} \frac{\partial q_{bjk}}{\partial p_{bjk}} + p_{bkj} \frac{\partial q_{bjk}}{\partial p_{bjk}} + \frac{\partial p_{bjk}}{\partial p_{bjk}} q_{bjk}\right] = 0$$

$$p_{bjk} = \frac{1}{1+\epsilon_{bjk}^{-1}} \frac{1}{e_k} MRP_{bjk} \tag{A7.11}$$

Case C: Bertrand Competition - -Only One Input per Country

$$\pi_{bj} = p_k^{finalg} Q_k^{finalg} - \sum_{origin} \frac{1}{e_k^{origin}} p_{bjk} q_{bjk} \quad \text{s.t.} \quad Q_{finalg} = \prod_j z_b q_{bjk}^{\sigma_{origin}} \quad and \quad q_{bjk} = \frac{p_{bjk}{}^{\eta}}{P_{jk}{}^{\eta}} \frac{P_{jk}{}^{\theta}}{P_k{}^{\theta}} Y_k \tag{A7.12}$$

where origin: Colombia, Ecuador, France, etc.
The FOC imply that:

$$[p_{bj}] : \frac{\partial (revenue)}{\partial q_{bj}} \frac{\partial q_{bjk}}{\partial p_{bjk}} - \frac{1}{e_k^{Colombia}} \left[q_{bj} + p_{bjk} \frac{\partial q_{bj}}{\partial p_{bj}} \right] + \frac{1}{e_k^{France}} \left[\underbrace{\frac{\partial p_{bj'k}}{\partial p_{bjk}}}_{0} q_{bj'k} + \underbrace{p_{bj'k} \frac{\partial q_{bj'k}}{\partial p_{bjk}}}_{0} \right] = 0$$

$$p_{bjk} = \frac{1}{1 + \epsilon_{bjk}^{-1}} \frac{1}{e_k^{Colombia}} MRP_{bjk} \tag{A7.13}$$

7.1.9 Monopolistic Competition for Final Good

Adding a demand function assuming that the aggregate income of the final consumers is given. In particular, assume that the demand for the buyers take the following form:

$$x = X(r/R)^{-\sigma}$$
$$r = Bx^{\frac{-1}{\sigma}}$$

where x is quantity and r is price to final consumers and XR is the total income of final consumers. We are going to take these variables as given. Then, the total revenue of the firm is given by:

$$TR = px = Bx^{\frac{-1}{\sigma}} x = Bx^{\frac{\sigma-1}{\sigma}},$$

where B is a constant that is given, just assume that it is equal to 1. Using the production function we get:

$$TR_{bk} = B \left(q_{bjk}^{\alpha} \right)^{\frac{\sigma-1}{\sigma}}$$

Then the marginal revenue is given by:

$$MR_{bjk} = \alpha \left(\frac{\sigma - 1}{\sigma} \right) q_{bjk}^{\frac{-\alpha}{\sigma}}$$

The only difference with our previous expression is that it is multiplied by the markup assuming some value for σ and adjust the exponent.

7.1.10 Proof of Proposition 2: Aggregate markdown

$$\mu_{bjk} = 1 + \varepsilon^{-1} = 1 + (\theta s_{bjk} + \eta(1 - s_{bjk}))^{-1}$$

$$\sum_{b \in B} s_{bjk}(1 - \epsilon^{-1}) = \sum s_{bjk} + \left(\sum(\theta s_{bjk}^2 + (s_{bjk} - s_{bjk}^2))\right)^{-1}$$

$$1 + \sum s_{bjk}\varepsilon^{-1} = 1 + \left(\theta \sum s_{bjk}^2 + \eta(\sum s_{bjk} - \sum s_{bjk}^2)\right)^{-1}$$

$$1 + \varepsilon_{jk}^{-1} = 1 + \left(\theta HHI_{jk} + \eta(1 - HHI_{jk})\right)^{-1}$$

On the other hand:

$$\mu_{bjk} = \frac{MRP_{bjk}e_k}{p_{bjk}}$$

$$\sum s_{bjk}\mu_{bjk} = \sum s_{bjk}\frac{MRP_{bjk}e_k}{p_{bjk}}$$

$$\sum_b s_{bjk}\mu_{bjk} = \sum_b \frac{p_{bjk}q_{bjk}}{\sum p_{bjk}q_{bjk}} \frac{MRP_{bjk}e_k}{p_{bjk}}$$

$$\sum_b s_{bjk}\mu_{bjk} = e_k \sum_b \frac{q_{bjk}MRP_{bjk}}{\sum p_{bjk}q_{bjk}}$$

$$\sum_b s_{bjk}\mu_{bjk} = e_k \frac{\sum q_{bjk}MRP_{bjk}}{\sum p_{bjk}q_{bjk}}$$

$$\sum_b s_{bjk}\mu_{bjk} = e_k \frac{\sum q_{bjk}MRP_{bjk}}{\sum q_{bjk}} \frac{\sum q_{bjk}}{\sum p_{bjk}q_{bjk}}$$

$$\bar{x}_{jk} \equiv \frac{\sum q_{bjk}x_{bjk}}{\sum q_{bjk}}$$

$$\sum_b s_{bjk}\mu_{bjk} = e_k \frac{M\bar{R}P_{bjk}}{\bar{P_{jk}}}$$

Then:

$$\mu_{jk} = 1 + \varepsilon_{jk}^{-1} = \frac{e_k M\bar{R}P_{jk}}{\bar{P_{jk}}} = 1 + \left(\theta HHI_{jk} + \eta(1 - HHI_{jk})\right)^{-1}$$

7.1.11 Proof of Proposition 3: Direct Pass-through

Log-differentiating equation 3.5, I get that the log change in price, $\text{dln}p_{sbj}$, can be written as:

$$\text{dln}p_{sbjk} = \text{dln}\mu_{bjk} + \text{dln}MRP_{sbjk} + \text{dln}e_k \tag{A7.14}$$

1. **Consider the markdown term:**

$$\text{dln}\mu_{bjk} = \Gamma_{bjk}\, \text{dln}p_{bjk}$$

with $\Gamma_{bjk} = -\frac{\partial \ln \mu_{bjk}}{\partial p_{bjk}} > 0$ as the partial elasticity of bilateral markdowns with respect to the price, p_{bjk}.

$$\begin{aligned} \Gamma_{bjk} &= -\frac{\text{dln}\mu_{bjk}}{\text{dln}p_{bjk}} \\ &= -\frac{\text{dln}\mu_{bjk}}{\text{dln}S_{bjk}} \times \frac{\text{dln}S_{bjk}}{\text{dln}p_{bjk}} \end{aligned}$$

Solving for the first term: $\frac{\text{dln}\mu_{bjk}}{\text{dln}S_{bjk}}$

$$\begin{aligned} \mu_{bjk} &= \frac{1}{1 + \frac{1}{\epsilon_{bjk}}} \\ \frac{\text{dln}\mu_{bjk}}{\text{dln}S_{bjk}} &= \frac{\theta(1 - S_{bjk})}{\frac{1}{S_{bjk}} + \frac{\theta - \eta}{\eta + 1}} \\ &= -\Upsilon_{bjk} < 0 \ (by\ prop\ II) \end{aligned}$$

Solving for the second term:

$$\begin{aligned} S_{bjk} &= \frac{p_{bjk}^{\eta+1}}{\sum_b p_{bjk}^{1+\eta}} \\ \ln S_{bjk} &= ln p_{bjk}^{1+\eta} + \ln(\sum_b p_{bjk}^{1+\eta}) \\ \text{dln}S_{bjk} &= (1+\eta)\frac{dp_{bjk}}{p_{bjk}} - (1+\eta)\frac{1}{\sum_b p_{bjk}^{\eta+1}}\frac{p_{bjk}^{\eta+1}}{p_{bjk}}dp_{bjk} - \sum_{z \neq b}(1+\eta)\frac{p_{zjk}}{\sum_b p_{bjk}^{1+\eta}}\frac{{p_{zjk}}^{1+\eta}}{p_{zjk}}\frac{dp_{zjk}}{dp_{bjk}}dp_{bjk}\frac{p_{bjk}}{p_{bjk}} \\ \text{dln}S_{bjk} &= (1+\eta)\, \text{dln}p_{bjk} - (1+\eta)S_{bjk}\, \text{dln}p_{bjk} - (1+\eta)\sum_z S_{zjk}\frac{p_{bjk}}{p_{zjk}}\frac{dp_{zjk}}{dp_{bjk}}\, \text{dln}p_{bjk} \\ \text{dln}S_{bjk} &= (1+\eta)(1 - S_{bjk} - \sum_z S_{zjk}\frac{\text{dln}p_{zjk}}{\text{dln}p_{bjk}})\, \text{dln}p_{bjk} \end{aligned}$$

Finally,

$$\text{dln}\mu_{bjk} = -\Upsilon_{sbjk}(\eta_{bjk} + 1)(1 - S_{bjk} - \underbrace{\sum_z S_{zjk}\frac{\text{dln}p_{zjk}}{\text{dln}p_{bjk}}}_{Indirect})\, \text{dln}p_{bjk} \tag{A7.15}$$

Note that to simplify Equation A7.15 $\mathrm{dln} p_{zjk} = \mathrm{dln} p_{bjk}$ needs to hold. Moreover, for the direct effect, I assume the indirect effect is equal to zero.

Rewriting the log change of each variable A as $\triangle A$,

$$\Delta S_{bjk} = (1+\eta)(1-S_{bjk})\Delta p_{bjk}$$

Now, we replace into $\Delta \mu_{bjk}$

$$\Delta \mu_{bjk} = \frac{\Delta \mu_{bjk}}{\Delta S_{bjk}}(1+\eta)(1-S_{bjk})$$

$$\Delta \mu_{bjk} = \Upsilon_{sbjk}(\eta+1)(1-S_{bjk})\Delta p_{bjk} \tag{A7.16}$$

$$\Delta \mu_{bjk} = -\Gamma_{bjk}\Delta p_{bjk}$$

where $\Gamma_{bjk} = -\frac{\Delta \mu_{bjk}}{\Delta p_{bjk}} = \frac{S_{bjk}}{\left(\frac{\eta}{\theta-\eta}+S_{bjk}\right)\left(1+\frac{\theta-\eta}{\eta+1}S_{bjk}\right)} > 0$

2. **Consider the marginal revenue term:**

$$MRP_{bjk} = \frac{\partial revenues}{\partial q_b jk}$$

$$MRP_{bjk} = x_{bjk}\frac{Q_{bk}}{q_{bjk}}$$

Where:

$$x_{bjk} \equiv \frac{q_{bjk}^{\frac{\sigma-1}{\sigma}}}{\sum_j q_{bjk}^{\frac{\sigma-1}{\sigma}}}$$

$$\ln MRP_{bjk} = \ln x_{bjk} + \ln Q_{b,k} - \ln q_{bjk}$$

Rewriting the log change of each variable A as $\triangle A$,

$$\Delta MRP_{bjk} = \Delta x_{bjk} + \Delta Q_{bk} - \Delta q_{bjk} \tag{A7.17}$$

Zooming in on x_{bjk}

$$\ln x_{bjk} = \frac{\sigma-1}{\sigma}\ln q_{bjk} - \ln\left(\sum_j q_{bjk}^{\frac{\sigma-1}{\sigma}}\right)$$

$$\Delta x_{bjk} = \frac{\sigma-1}{\sigma}\Delta q_{bjk} - \frac{\sigma-1}{\sigma}\frac{q_{bjk}^{\frac{\sigma-1}{\sigma}}}{\sum_j q_{bjk}^{\frac{\sigma-1}{\sigma}}}\Delta q_{bjk}$$

$$\Delta x_{bjk} = \frac{\sigma-1}{\sigma}\left(1-x_{bjk}\right)\Delta q_{bjk} \tag{A7.18}$$

$$\ln Q_{bk} = \frac{\sigma - 1}{\sigma} \ln \sum_j q_{bjk}^{\frac{\sigma-1}{\sigma}}$$

Now, we focus on Q_{bk}

$$\Delta Q_{bk} = x_{bjk} \Delta q_{bjk} \tag{A7.19}$$

Replacing A7.18, and A7.19 into A7.17

$$\Delta MRP_{bjk} = \frac{\sigma - 1}{\sigma}(1 - x_{bjk})\Delta q_{bjk} + x_{bjk}\Delta q_{bjk} - \Delta q_{bjk}$$

$$\frac{\Delta MRP_{bjk}}{\Delta p_{bjk}} = -\frac{1}{\sigma}\left(1 - x_{bjk}\right)\epsilon_{bjk} \tag{A7.20}$$

$$\Phi_{bjk} \equiv -\frac{1}{\sigma}\left(1 - x_{bjk}\right)\epsilon_{bjk}$$

$$\Delta MRP_{bjk} = \Phi_{bjk}\Delta p_{bjk}$$

I then replace A7.16, and A7.20 into the following equation:

$$\Delta p_{bjk} = \Delta MRP_{bjk} - \Delta \mu_{bjk} + \Delta e_k \tag{A7.21}$$

Then,

$$\Delta p_{bjk} = \Upsilon_{sbjk}(\eta + 1)(1 - S_{bjk})\Delta p_{bjk} - \frac{1}{\sigma}\left(1 - x_{bjk}\right)\epsilon_{bjk}\Delta p_{bjk} + \Delta e_k$$

Given a change in the bilateral exchange rate Δe_d, as in Burstein and Gopinath (2014) there is a direct and indirect effect. The direct component of the exchange rate pass-through is:

$$\frac{\Delta p_{bjk}}{\Delta e_k} = \frac{1}{1 - \Upsilon_{sbjk}(\eta + 1)(1 - S_{bjk}) + \frac{1}{\sigma}\left(1 - x_{bjk}\right)\epsilon_{bjk}}$$

We can also writte this as:

$$\frac{\Delta p_{bjk}}{\Delta e_k} = \frac{1}{1 - \Gamma_{bjk} - \Phi_{bjk}}$$

Taking into account that Δp_{sbj} is in USD, we can change this equation into COP using the following:

$$\Delta p_{sbj}^{dolars} = \Delta p_{asd}^{pesos} - \Delta e$$

And so we get:

$$\frac{\Delta p_{bjk}}{\Delta e_k} = 1 - \frac{1}{1 - \underbrace{\Upsilon_{sbjk}(\eta + 1)(1 - S_{bjk})}_{Markdownchannel} + \underbrace{\frac{1}{\sigma}\left(1 - x_{bjk}\right)\epsilon_{bjk}}_{ValueChannel}}$$

where $\Upsilon_{bjk} = -\frac{\Delta\mu_{bjk}}{\Delta S_{bjk}}$ Finally, we can simplify the expression to:

$$\frac{\Delta p_{bjk}}{\Delta e_k} = 1 - \frac{1}{1 - \underbrace{\Gamma_{bjk}}_{Markdownchannel} - \underbrace{\Phi_{bjk}}_{ValueChannel}}$$

7.1.12 Proof of Proposition 4: Pass Through General Case

Taking

$$p_{bjk} = \frac{MRP_{bjk}}{\mu_{bjk}} e_k$$

$$\ln p_{bjk} = -\ln \mu_{bjk} + \ln MRP_{bjk} + \ln e_k$$

Defining $d \ln a$ as Δa we have:

$$\Delta p_{bjk} = -\Delta\mu_{bjk} + \Delta MRP_{bjk} + \Delta e_k$$

We can define μ_{bjk} as a function as follows:

$$\ln \mu_{bjk} = f(\ln p_{bjk} - \ln p_{jk})$$

$$\Delta\mu_{bjk} = \frac{\partial f(\cdot)}{\partial(\ln p_{bjk} - \ln p_{jk})} \left(\Delta p_{bjk} - \Delta p_{jk}\right)$$

$$\zeta bjk \equiv -\frac{\partial f(\cdot)}{\partial(\ln p_{bjk} - \ln p_{jk})}$$

$$\Delta\mu_{bjk} = -\zeta_{bjk} \left(\Delta p_{bjk} - \Delta p_{jk}\right)$$

Now, we can define $\ln MRP_{bjk}$ as a function of $\ln q_{bjk}$

$$\ln MRP_{bjk} = h(lnq_{bjk})$$

Using that, we can find the log change of MRP_{bjk}:

$$\Delta MRP_{bjk} = \frac{\partial h(\cdot)}{\partial \ln q_{bjk}} \Delta q_{bjk}$$

$$MRP_q \equiv \frac{\partial h(\cdot)}{\partial \ln q_{bjk}}$$

$$\Delta MRP_{bjk} = MRP_q \Delta q_{bjk}$$

Replacing into the log change of p_{bjk}:

$$\Delta p_{bjk} = \zeta_{bjk}\left(\Delta p_{bjk} - \Delta p_{jk}\right) + MRP_q \Delta q_{bjk} + \Delta e_k$$

Now, we can define the log demand for q_{bjk}:

$$\ln q_{bjk} = g\left(\ln p_{bjk} - \ln p_{jk}\right) + \ln q_{jk}$$

$$\Delta q_{bjk} = \frac{\partial g(\cdot)}{\partial\left(\ln p_{bjk} - \ln p_{jk}\right)}\left(\Delta p_{bjk} - \Delta p_{jk}\right) + \Delta q_{jk}$$

$$\Psi_{bjk} \equiv \frac{\partial g(\cdot)}{\partial\left(\ln p_{bjk} - \ln p_{jk}\right)}$$

$$\Delta q_{bjk} = \Psi_{bjk}\left(\Delta p_{bjk} - \Delta p_{jk}\right) + \Delta q_{jk}$$

$$\Phi_{bjk} = MRP_q \Psi_{bjk}$$

Replacing Δq_{bjk} into Δp_{bjk}

$$\Delta p_{bjk} = \Delta p_{bjk}\left(\zeta_{bjk} - \Phi_{bjk}\right) - \Delta p_{jk}\left(\zeta_{bjk} - \Phi_{bjk}\right) + MRP_q \Delta q_{jk} + \Delta e_k$$

Then:

$$\frac{\Delta(p_{bjk})}{\Delta(e_k)}\left(1 - \zeta_{bjk} - \Phi_{bjk}\right) = 1 - \left(\zeta_{bjk} + \Phi_{bjk}\right)\frac{\Delta(p_{jk})}{\Delta(e_k)} + MRP_q \frac{\Delta(q_{jk})}{\Delta(e_k)}$$

$$\frac{\Delta(p_{bjk})}{\Delta(e_k)} = \frac{1}{1 - \left(\zeta_{bjk} + \Phi_{bjk}\right)} - \frac{\zeta_{bjk} + \Phi_{bjk}}{1 - \left(\zeta_{bjk} + \Phi_{bjk}\right)}\frac{\Delta(p_{jk})}{\Delta(e_k)} + \frac{MRP_q}{1 - \left(\zeta_{bjk} + \Phi_{bjk}\right)}\frac{\Delta(q_{jk})}{\Delta(e_k)}$$

7.1.13 Proof of Proposition 5: Aggregate Exchange Rate Pass-through

Starting from:

$$P_{jk} = \frac{1}{\overline{\mu}_{jk}} \overline{MRP}_{jk} e_k$$

$$\ln P_{jk} = -\ln \overline{\mu}_{jk} + \ln \overline{MRP}_{jk} + \ln e_k$$

Differentiating:

$$\Delta P_{jk} = -\Delta \overline{\mu}_{jk} + \Delta \overline{MRP}_{jk} + \Delta e_k \tag{A7.22}$$

Taking the markdown as a function of the prices' difference:

$$\ln \overline{\mu}_{bjk} = f\left(\ln P_{jk} - \ln P_k\right)$$

$$\Delta\overline{\mu}_{jk} = \frac{\partial f(\cdot)}{\partial\left(\ln P_{jk} - \ln P_k\right)}\left(\Delta P_{jk} - \Delta P_k\right)$$

$$-\frac{\partial f(\cdot)}{\partial\left(\ln P_{jk} - \ln P_k\right)} \equiv \overline{\Gamma}_{jk}$$

$$\Delta\overline{\mu}_{jk} = -\overline{\Gamma}_{jk}\left(\Delta P_{jk} - \Delta P_k\right) \tag{A7.23}$$

Now, we have the average marginal revenue product as a function of the quantity index:

$$\ln\overline{MRP}_{jk} = h\left(\ln q_{jk}\right)$$

$$\Delta\overline{MRP}_{jk} = \frac{\partial h(\cdot)}{\partial\ln q_{jk}}\Delta q_{jk}$$

$$\frac{\partial h(\cdot)}{\partial\ln q_{jk}} \equiv \overline{MRP}_q$$

$$\Delta\overline{MRP}_{jk} = \overline{MRP}_q\Delta q_{jk}$$

We can define the average log quantity demand as

$$\ln q_{jk} = g\left(\ln P_{jk} - \ln P_k\right) + \ln q_k$$

$$\Delta q_{jk} = \frac{\partial g(\cdot)}{\partial\left(\ln P_{jk} - \ln P_k\right)}\left(\Delta P_{jk} - \Delta P_k\right) + \Delta q_k$$

$$\frac{\partial g(\cdot)}{\partial\left(\ln P_{jk} - \ln P_k\right)} \equiv \overline{\Psi}_{jk}$$

$$\Delta q_{jk} = \overline{\Psi}_{jk}\left(\Delta P_{jk} - \Delta P_k\right) + \Delta q_k$$

$$\Delta\overline{MRP}_{bjk} = \overline{MRP}_q\overline{\Psi}_{jk}\left(\Delta P_{jk} - \Delta P_k\right) + \overline{MRP}_q\Delta q_k$$

$$\overline{MRP}_q\overline{\Psi}_{jk} \equiv \overline{\Phi}_{jk}$$

$$\Delta\overline{MRP}_{bjk} = \overline{\Phi}_{jk}\left(\Delta P_{jk} - \Delta P_k\right) + \overline{MRP}_q\Delta q_k \tag{A7.24}$$

Now replacing A7.23 and A7.24 into A7.22:

$$\Delta P_{jk} = \overline{\Gamma}_{jk}\left(\Delta P_{jk} - \Delta P_k\right) + \overline{\Phi}_{jk}\left(\Delta P_{jk} - \Delta P_k\right) + \overline{MRP}_q\Delta q_{jk} + \Delta e_k$$

$$\Delta P_{jk} = \frac{-\Delta P_k\left(\overline{\Gamma}_{jk} + \overline{\Phi}_{jk}\right) + \overline{MRP}_q \Delta q_k + \Delta e_k}{1 - \left(\overline{\Gamma}_{jk} + \overline{\Phi}_{jk}\right)}$$

So we can express the aggregated pass-through as:

$$\frac{\Delta P_{jk}}{\Delta e_k} = \frac{1 - \Delta P_k\left(\overline{\Gamma}_{jk} + \overline{\Phi}_{jk}\right) + \overline{MRP}_q \Delta q_k}{1 - \left(\overline{\Gamma}_{jk} + \overline{\Phi}_{jk}\right)} \tag{A7.25}$$

7.1.14 General Equilibrium: Incomplete Pass-through

The direct and indirect effects together account for the general equilibrium effect. In this section, I show that as buyers' market share responds differently to ER shocks depending on their size, then the aggregate exchange rate pass through is incomplete.

I will consider the following example focusing only on the markdown effect and leaving the marginal revenue product constant [55].

$$P_{bjk} = \frac{\epsilon_{bjk}}{1 + \epsilon_{bjk}} P^f_{bjk}$$

Passthrough:

$$dp_{bjk} = d\mu_{bjk} + dp^f_{bjk}$$

$$dp_{bjk} = -\Gamma_{bjk}(dp_{bjk} - dP_k) + de_k + \tilde{u}_{bjk}$$

$$dp_{bjk} = \frac{1}{1 + \Gamma_{bjk}} de_k + \frac{\Gamma_{bjk}}{1 + \Gamma_{bjk}} dP_{jk} + \tilde{u}_{bjk}$$

If $dP_{jk} = \sum_b s_{bjk} dp_{bjk}$,

$$dp_{bjk} = \frac{1}{1 + \Gamma_{bjk}} de_k + \frac{\Gamma}{1 + \Gamma_{bjk}} \sum_b s_{bjk} dp_{bjk} + \tilde{u}_{bjk}$$

If $dp_{bjk} = dp_{zjk} \forall b \neq z \sum_b s_{bjk} dp_{bjk} = dp_{jk}$ then ERPT would be complete.

$$\frac{1 + \Gamma_{bjk} - \Gamma_{bjk}}{1 + \Gamma_{bjk}} p_{bjk} = \frac{1}{1 + \Gamma_{bjk}} de_k + \tilde{u}_{bjk}$$

$$p_{bjk} = (1 + \Gamma bjk) \frac{1}{1 + \Gamma_{bjk}} de_k + \tilde{u}_{bjk}$$

$$p_{bjk} = de_k + \tilde{u}_{bjk}$$

Since it has been shown markdowns are more sensitive to relative prices $p_{bjk} - p_{jk}$ the higher is the buyer market share S_{bjk}, then $\text{dln}p_{bjk} = dp_{zjk} \forall z \neq b if S_{bjk} \neq S_{zjk}$. These results are qualitatively unchanged if firms compete in quantities (Cournot).[56]

Finally, note that with a finite number of positive-mass buyers per sector, any change in a product's price p_{bjk} has a non-zero effect on the aggregate sector price p_{jk}. Markdowns are constant if $S_{bjk} = 0$ or if $S_{bjk} = 1$. Hence, ERPT (both the direct effect and the sum of the direct and indirect effects) is non-monotonic in size and,

[55] This will be the same with variable MRP_{bjk}, the only difference is that the terms in 3.21 need to be added but it also gives complete ERPT

[56] Results are analogous to a case with variable markups as in Burstein and Gopinath (2014).

at the aggregate level, on the Herfindhal-Hirsh Index for buyer concentration in a market.[57]

More specifically, the sensitivity of p_{jk} to the exchange rate, which determines the indirect effect of ERPT, depends on important details such as the source of the shock to the exchange rate (which shapes the response of e.g. costs and prices of domestic producers competing with foreign exporters), whether the exchange rate shock being considered is idiosyncratic to the bilateral country pair or is a common shock, for instance where the dollar simultaneously depreciates relative to the currencies of all its trading partners. Gopinath, Itskhoki and Rigobon (2010); Auer and Schoenle (2016); Pennings (2017) document this.

7.1.15 Heterogeneous price and share response

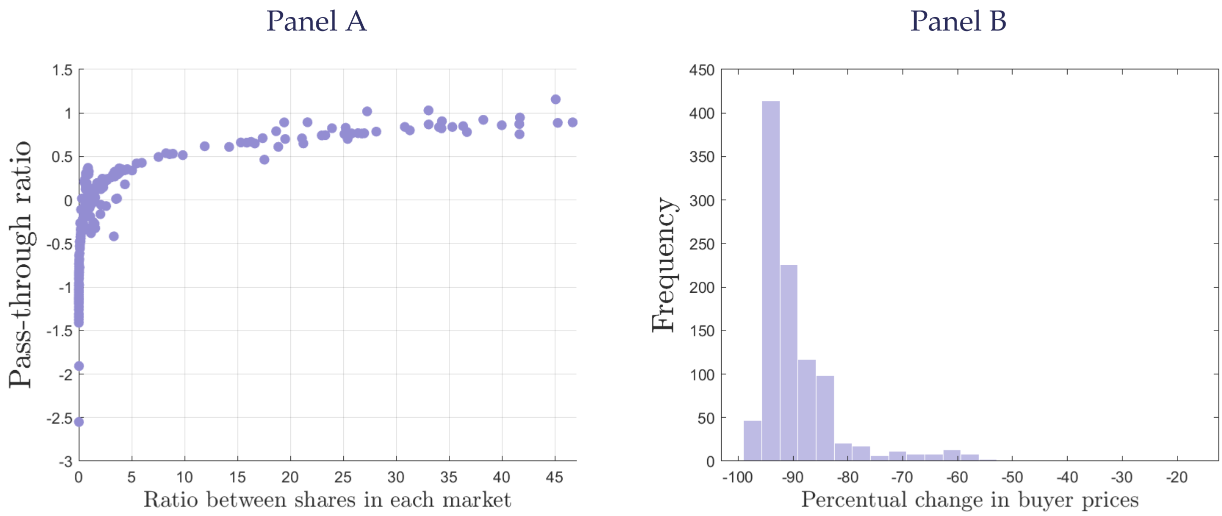
In my model, deviations from the relative PPP at the aggregate level arise as a result of the market power of buyers, and so, buyer market concentration. In this section, I present results from the model on the pricing decision of buyers and the role that heterogeneity in size across them plays in producing my results. In this subsection, I will (i) demonstrate this empirically, (ii) provide a detailed intuition, and (iii) include a mathematical proof.

Numerical Simulation Figure 7 presents a simplified economy with only two buyers per country, affected by an exchange rate shock that increases by 1% for every country. I have evaluated the two terms in the ERPT numerically to understand the dispersion in pricing behavior. Panel A emphasizes the significance of market share in price setting post-shock, showing the extent of the relative change in price by any two firms that buy from a foreign country as a function of the buyer market share. Since every buyer experiences an identical shock, complete pass-through would result in uniform price changes. The Y-axis represents pass-through, measured as the logarithm of the ratio between the price changes of buyers in each country ($log\left(\frac{\Delta p_{1jk}}{\Delta p_{2jk}}\right)$). The X-axis displays the ratio between the market shares of buyers in each country. The resulting curve indicates that countries with larger market share ratios also exhibit greater pass-throughs.

Panel B demonstrates that, despite the same exchange rate shock, prices vary differently, indicating incomplete pass-through. This is illustrated through a histogram showing the distribution of percentage changes in the buyers' prices. The figure reveals that there is a large deal of heterogeneity in pricing-to-market at the firm level, in response to an exchange rate shock. Thus, Figure 7 demonstrates that our finding that our model can generate movements in aggregate price indices similar to those found in the data is accounted for by the pricing behavior of large firms in the model.

[57]Note that alternative approaches could led into a greater variation at the firm level (e.i. firms in a market being exposed differently to a exchange rate shock). Example of this could be; (i) if markets were defined as a product-time combination, that is, two different destinations would be part of the same market - a bilateral ER shock would affect only the firms connected a given destination, (ii) accounting for a fixed cost of importing on the buyer side. On the later case, this would imply some firms exit or entry in the event of a bilateral exchange rate shock, affecting the market shares of the incumbent firms. If that were the case, equation A7.15 would include an extra term accounting for the change in the number of firms in a market.

Figure 7



Notes: This figure shows the existence of incomplete pass-through. Panel A displays the relationship between each buyer's ratio of price changes after a 1% increase in the exchange rate and the ratio of share before the shock. It highlights that buyers increase prices more in the market in which they have a larger share. Panel B illustrates that there is heterogeneity in the percentage change of the buyers' prices after the same shock, which shows the existence of incomplete pass-through.

Intuition The intuition is the following. Given that the prices paid by buyers depend on the markdown, the marginal revenue product (MRP), and the exchange rate, an increase in the exchange rate will impact the price in two ways. Firstly, there will be a direct effect since lower costs (the buyer paying less in their currency) will result in increased willingness to pay. This effect will be consistent for every buyer. However, a second effect arises due to variations in the markdown among buyers. This variability is a result of each buyer having different productivity levels, leading to distinct market shares. Consequently, each buyer faces a unique elasticity reflecting their responsiveness to changes in prices, specifically the direct effect of the exchange rate shock. The indirect effect of the shock is influenced by each buyer's market share, which varies among buyers. Therefore, the indirect effect will differ for each buyer, resulting in varying changes in prices across buyers. Adding both effects, the global change in the price will be heterogeneous across buyers. This leads, also to a heterogeneous changes in market shares and implies incomplete pass-through to market prices.

Theoretical proof In this section, I discuss the conditions under which there is heterogeneity in pass-through for each buyer in general equilibrium. For expositional clarity, I work with a simplified version of the model, which includes one market (a country-product combination), two buyers, and the assumption of perfectly elastic substitution of inputs for a buyer. This simplification allows us to focus on the markdown effect.

Defining the price of each buyer as a function of p_1 and p_2.

$$MRP_1 = z_1, \quad s_1 = \frac{p_1^{1+\eta}}{p_1^{1+\eta} + p_2^{1+\eta}}, \quad \varepsilon_1 = \left(\frac{p_1^{1+\eta}}{p_1^{1+\eta} + p_2^{1+\eta}} \right)(\theta - \eta) + \eta, \quad \mu_1 = \frac{p_1^{1+\eta}(1+\theta) + p_2^{1+\eta}(1+\eta)}{p_1^{1+\eta}\theta + p_2^{1+\eta}\eta}$$

Replacing this in the price:

$$p_1 = \frac{p_1^{1+\eta}\theta + p_2^{1+\eta}\eta}{p_1^{1+\eta}(1+\theta) + p_2^{1+\eta}(1+\eta)} z_1 e \tag{A7.26}$$

$$ln(p_1) = ln(z_1) + ln(e) + ln(p_1^{1+\eta}\theta + p_2^{1+\eta}\eta) - ln(p_1^{1+\eta}(1+\theta) + p_2^{1+\eta}(1+\eta))$$

$$dln(p_1) = \frac{(1+\eta)p_1^\eta \theta dp_1 + (1+\eta)p_2^\eta \eta dp_2}{p_1^{1+\eta}\theta + p_2^{1+\eta}\eta} - \frac{(1+\eta)p_1^\eta(1+\theta)dp_1 + (1+\eta)p_2^\eta(1+\eta)dp_2}{p_1^{1+\eta}(1+\theta) + p_2^{1+\eta}(1+\eta)} + dln(e) \quad \text{(A7.27)}$$

$$d\ln(p_1) = (1+\eta)\left(p_1 d\ln(p_1)\left(\frac{\theta p_1^\eta}{\theta p_1^{1+\eta} + \eta p_2^{1+\eta}} - \frac{(1+\theta)p_1^\eta}{(1+\theta)p_1^\eta + (1+\eta)p_2^{1+\eta}}\right)\right.$$
$$\left. + p_2 d\ln(p_2)\left(\frac{\eta p_2^\eta}{\theta p_1^{1+\eta}\eta p_2^{1+\eta}} - \frac{(1+\eta)p_2^\eta}{(1+\theta)p_1^{1+\eta} + (1+\eta)p_2^{1+\eta}}\right)\right) + d\ln(e)$$

$$d\log(p_1) = d\log(p_2)\frac{\Gamma_1}{1-(1+\eta)\phi_1} + d\log(e)\frac{1}{1-(1+\eta)\phi_1}, \text{where} \quad \text{(A7.28)}$$

$$\Gamma_i \equiv \frac{\eta p_j^{1+\eta}}{\theta p_i^{1+\eta} + \eta p_j^{1+\eta}} - \frac{(1+\eta)p_j^{1+\eta}}{(1+\theta)p_i^{1+\eta} + (1+\eta)p_j^{1+\eta}}, \;\; and \;\; \phi_i \equiv \frac{\theta p_i^{1+\eta}}{\theta p_i^{1+\eta} + \eta p_j^{1+\eta}} - \frac{(1+\theta)p_i^{1+\eta}}{(1+\theta)p_i^{1+\eta} + (1+\eta)p_j^{1+\eta}}$$

Then, the relative change in prices is given by

$$\frac{d\log(p_1)}{d\log(p_2)} = \frac{1-(1+\eta)\phi_2 - \Gamma_1}{1-(1+\eta)\phi_1 - \Gamma_2} \quad \text{(A7.29)}$$

such that they are equal only if A7.29 is equal to one.

Solving and simplifying we get:

$$\frac{(1+\eta)(1+\theta)\left(p_1^{2(1+\eta)} - p_2^{2(1+\eta)}\right)}{\left((1+\eta)p_1^{1+\eta} + (1+\theta)p_2^{1+\eta}\right)\left((1+\theta)p_1^{1+\eta} + (1+\eta)p_2^{1+\eta}\right)} = \frac{\eta\theta\left(p_1^{2(1+\eta)} - p_2^{2(1+\eta)}\right)}{\left(\eta p_1^{1+\eta} + \theta p_2^{1+\eta}\right)\left(\theta p_1^{1+\eta} + \eta p_2^{1+\eta}\right)}$$

Given that:

$$\frac{(1+\eta)(1+\theta)}{\left((1+\eta)p_1^{1+\eta} + (1+\theta)p_2^{1+\eta}\right)\left((1+\theta)p_1^{1+\eta} + (1+\eta)p_2^{1+\eta}\right)} \neq \frac{\eta\theta}{\left(\eta p_1^{1+\eta} + \theta p_2^{1+\eta}\right)\left(\theta p_1^{1+\eta} + \eta p_2^{1+\eta}\right)} \forall p_1, p_2$$

Therefore,

$$d\ln(p_1) = d\ln(p_2) \iff p_1 = p_2$$

For the absolute derivatives to be equal, prices also have to be equal. Therefore, only buyers with the same characteristics will have the same pass-through.

7.1.16 Marginal Revenue Effect

In this section, I evaluate alternative scenarios to quantify the marginal revenue effect: (a) one input production function, (b) a Cobb Douglas production function, and (c) a CES production function. Case I: One Input

$$Q_k^{finalgood} = \left(\frac{q_{bjk}}{\sigma}\right)^\sigma$$

If the price charge by the buyer does not change:

$$MRP = \frac{\partial revenues}{\partial q_{bjk}} = \sigma \frac{Q_{finalgood}}{q_{bjk}}$$

$$\frac{\text{dln}MRP_{bjk}}{\text{dln}p_{bjk}} = \frac{\text{dln}MRP_{bjk}}{\text{dln}q_{bjk}} \frac{\text{dln}q_{bjk}}{\text{dln}p_{bjk}} = \frac{dMRP}{dq_{bjk}} \frac{q_{bjk}}{MRP_{bjk}} \epsilon_{bjk}$$

$$\frac{\text{dln}MRP_{bjk}}{\text{dln}p_{bjk}} = (\sigma - 1)\epsilon_{bjk}$$

Case II: Cobb-Douglas

$$Q_{finalgood} = \prod_j \left(\frac{q_{bjk}}{\sigma}\right)^{\sigma}$$

If the price charge by the buyer does not change:

$$\frac{\text{dln}MRP_{bjk}}{\text{dln}p_{bjk}} = \frac{\partial MRP_{bjk}}{\partial p_{bjk}} \frac{p_{bjk}}{MRP_{bjk}}$$

$$\frac{\text{dln}MRP_{bjk}}{\text{dln}p_{bjk}} = \left[-\frac{Q_{finalgood}}{q_{bjk}^2} \frac{\partial q_{bjk}}{\partial p_{bjk}} + \frac{\partial Q_{finalgood}}{\partial q_{bjk}} \frac{\partial q_{bjk}}{\partial p_{bjk}} \frac{1}{q_{bjk}} + \sum_{j' \neq j} \frac{\partial Q_{finalgood}}{\partial q_{bj'k}} \frac{\partial q_{bj'k}}{\partial p_{bjk}} \frac{1}{q_{bjk}} \right] \frac{p_{bjk}}{MRP_{bjk}}$$

$$\frac{\text{dln}MRP_{bjk}}{\text{dln}p_{bjk}} = -\frac{\sigma}{\sigma}\epsilon_{bjk} + \sigma\epsilon_{bjk} + \sum_{j' \neq j} \frac{\partial Q_{finalgood}}{\partial q_{bj'k}} \frac{\partial q_{bj'k}}{\partial p_{bjk}} \frac{1}{q_{bjk}} \frac{p_{bjk}}{MRP_{bjk}}$$

$$\frac{\text{dln}MRP_{bjk}}{\text{dln}p_{bjk}} = \epsilon_{bjk}(\sigma - 1) + \sum_{j' \neq j} \frac{\partial Q_{finalgood}}{\partial q_{bj'k}} \frac{\partial q_{bj'k}}{\partial p_{bjk}} \frac{1}{q_{bjk}} \frac{p_{bjk}}{MRP_{bjk}} < 0$$

Case III: CES

With a CES production function, we have that:

$$Q_{bk} = \left(\sum_{jk} q_{bjk}^{\frac{\sigma-1}{\sigma}}\right)^{\frac{\sigma}{\sigma-1}}$$

Then we get that:

$$MRP_{bsk} \propto \left(\frac{Q_{bk}}{q_{bsk}}\right) \left(\frac{q_{bsk}^{\frac{\sigma-1}{\sigma}}}{\left(\sum_s q_{bjk}^{\frac{\sigma-1}{\sigma}}\right)}\right) = x_{bsk} \frac{Q_{bk}}{q_{bsk}}$$

where x_{bsk} is the expenditure share of Buyer b on Seller s.[58] Totally differentiating in logs we get:

[58] Note that this s could be also product.

$$\text{dln}MRP_{bks} = \text{dln}x_{bks} + \text{dln}Q_{bk} - \frac{\text{dln}q_{bks}}{\text{dln}p_{bks}}$$

We get that k

$$\text{dln}x_{bks} = \frac{\sigma - 1}{\sigma}\,\text{dln}q_{bks} - \frac{\sigma - 1}{\sigma}x_{bks}\,\text{dln}q_{bks} = \frac{\sigma - 1}{\sigma}(1 - x_{bks})\frac{\ln q_{bks}}{k\,\text{dln}p_{bks}}$$

Similarly:

$$\text{dln}Q_{bk} = x_{bks}\frac{\text{dln}q_{bks}}{\text{dln}p_{bks}}$$

Replacing this in the previous equation we get:

$$\text{dln}MRP_{bks} = \left(\frac{\sigma - 1}{\sigma} - 1\right)(1 - x_{bks})\frac{\text{dln}q_{bks}}{\text{dln}p_{bks}} = \frac{-1}{\sigma}(1 - x_{bks})\frac{\text{dln}q_{bks}}{\text{dln}p_{bks}}$$

$$\frac{\text{dln}MRP_{bks}}{\text{dln}p_{bks}} = \frac{-1}{\sigma}(1 - x_{bks})\epsilon_{bks}$$

7.1.17 Increasing Relationship between Markdown Channel and Buyer Size

Start by the markdown equation: $\mu_{bjk} = 1 + \epsilon_{bjk}^{-1}$ where $\epsilon_{bjk} = \eta + (\theta - \eta)S_{bjk}$

$$markdown\ channel = \frac{\partial \ln \mu_{bjk}}{\partial \ln p_{bjk}} = \frac{\partial \mu_{bjk}}{\partial S_{bjk}}\frac{\partial S_{bjk}}{\partial p_{bjk}}\frac{p_b jk}{\mu_{bjk}}$$

$$\frac{d\mu_{bjk}}{dS_{bjk}} = -[\eta + (\theta - \eta)S_{bjk}]^{-1}(\theta - \eta)$$

$$markdown\ channel = \frac{\partial \ln \mu_{bjk}}{\partial \ln p_{bjk}} = \frac{-(\eta + 1)(1 - S_{bjk})S_{bjk}}{\left(\frac{\eta}{\theta - \eta}\right)\left(\eta + (\theta - \eta)S_{bjk} + 1\right)}$$

Note that for values $\eta > \theta > 1$

$$\frac{markdown\ channel}{dS_{bjk}} > 0$$

7.1.18 Log Linearization and First-Order Approximation

Starting from the pass-through equation:

$$\text{dln}p_{\text{bjk}} = \frac{1}{1 - \underbrace{\Gamma_{bjk}}_{\text{Mark down channel}} - \underbrace{\Phi_{bjk}}_{\text{Marginal Revenue Channel}}}\,\text{dln}e_k$$

$$\mathrm{dln}p_{\mathrm{bjk}} = \frac{1}{1 - \frac{\mathrm{dln}\mu_{bjk}}{\mathrm{dln}S_{bjk}}(1+\eta)(1-S_{bjk}) - \frac{1}{\sigma}(1-x_{bjk})\varepsilon_{\bar{bjk}}} de_k, \text{ where } \mathrm{Y} = \frac{\mathrm{dln}\mu_{bjk}}{\mathrm{dln}p_{bjk}}$$

Doing a first-order approximation in S_{bjk} and dividing by $\mathrm{dln}e_k$:

$$\frac{\mathrm{dln}p_{\mathrm{bjk}}}{\mathrm{dln}e_k} \approx \frac{1}{1+\bar{Y}_{bjk}(1-\eta)\left(1-\bar{S}_{\mathrm{bjk}}\right) - \frac{1}{\sigma}(1-x_{bjk})\varepsilon_{\bar{bjk}}} + \frac{\left.\frac{\partial Y_{bjk}}{\partial S_{bjk}}\right|_{\bar{S}_{bjk}} \cdot (1+\eta)(1-\bar{S}_{bjk}) - \bar{Y}_d(1+\eta)\cdot \left.\frac{\partial \epsilon_{bjk}}{\partial S_{bjk}}\right|_{\bar{S}_{bjk}}(1-\alpha_j)}{\left[1+\bar{Y}_{bjk}(1-\eta)\left(1-\bar{S}_{\mathrm{bjk}}\right) - \frac{1}{\sigma}(1-x_{bjk})\varepsilon_{\bar{bjk}}\right]^2}(S_{bjk}-\bar{S}_{bjk})$$

Separating terms multiplied by BS and $\bar{BS}$:

$$\frac{\mathrm{dln}p_{\mathrm{bjk}}}{\mathrm{dln}e_k} \approx \left[\frac{1}{1+\bar{Y}_{bjk}(1-\eta)\left(1-\bar{S}_{\mathrm{bjk}}\right) - \frac{1}{\sigma}(1-x_{bjk})\varepsilon_{\bar{bjk}}} - \frac{\left.\frac{\partial Y_d}{\partial S_{bjk}}\right|_{\bar{S}_{bjk}} \cdot (1+\eta)(1-\bar{S}_{bjk}) - \bar{Y}_d(1+\eta)\cdot \left.\frac{\partial \epsilon_{bjk}}{\partial S_{bjk}}\right|_{\bar{S}_{bjk}}(1-\alpha_j)}{\left[1+\bar{Y}_{bjk}(1-\eta)\left(1-\bar{S}_{\mathrm{bjk}}\right) - \frac{1}{\sigma}(1-x_{bjk})\varepsilon_{\bar{bjk}}\right]^2}\right]\cdot \bar{S}_{bjk}$$
$$+\left[\frac{\left.\frac{\partial Y_d}{\partial S_{bjk}}\right|_{\bar{S}_{bjk}} \cdot (1+\eta)(1-\bar{S}_{bjk}) - \bar{Y}_d(1+\eta)\cdot \left.\frac{\partial \epsilon_{bjk}}{\partial S_{bjk}}\right|_{\bar{S}_{bjk}}(1-\alpha_j)}{\left[1+\bar{Y}_{bjk}(1-\eta)\left(1-\bar{S}_{\mathrm{bjk}}\right) - \frac{1}{\sigma}(1-x_{bjk})\varepsilon_{\bar{bjk}}\right]^2}\right]\cdot S_{bjk}$$

Getting together the terms with $\frac{\Delta \ln p_{\mathrm{bjk}}}{\Delta \ln e_k}$ and taking common factor of terms with BS and $\bar{BS}$:

$$\frac{\mathrm{dln}p_{\mathrm{bjk}}}{\mathrm{dln}e_k} \approx \alpha_{bjk} + \beta_{bjk}S_{bjk}$$

where:

$$\alpha_{bjk} = \left[\frac{1}{1+\bar{Y}_{bjk}(1-\eta)\left(1-\bar{S}_{\mathrm{bjk}}\right) - \frac{1}{\sigma}(1-x_{bjk})\varepsilon_{\bar{bjk}}} + \frac{\left.\frac{\partial Y_d}{\partial S_{bjk}}\right|_{\bar{S}_{bjk}} \cdot (1+\eta)(1-\bar{S}_{bjk}) - \bar{Y}_d(1+\eta)\cdot \left.\frac{\partial \epsilon_{bjk}}{\partial S_{bjk}}\right|_{\bar{S}_{bjk}}(1-\alpha_j)}{\left[1+\bar{Y}_{bjk}(1-\eta)\left(1-\bar{S}_{\mathrm{bjk}}\right) + -\frac{1}{\sigma}(1-x_{bjk})varep\bar{s}ilon_{bjk}\right]^2}\right]$$

$$\beta_{bjk} = \left[\frac{\left.\frac{\partial Y_d}{\partial S_{bjk}}\right|_{\bar{S}_{bjk}} \cdot (1+\eta)(1-\bar{S}_{bjk}) - \bar{Y}_d(1+\eta)\cdot \left.\frac{\partial \epsilon_{bjk}}{\partial S_{bjk}}\right|_{\bar{S}_{bjk}}(1-\alpha_j)}{\left[1+\bar{Y}_{bjk}(1-\eta)\left(1-\bar{S}_{\mathrm{bjk}}\right) - \frac{1}{\sigma}(1-x_{bjk})\varepsilon_{\bar{bjk}}\right]^2}\right]$$

7.1.19 HHI and Markdowns

In this equation, κ is the effect of an exogeneous Exchange Rate shock (ER) on the Hirsh- Herfindhal Index. To derive the expression, plug in $\mu_{jk} = 1 + \epsilon_{jk}^{-1}$ and differentiate:

$$
\begin{aligned}
\kappa = \frac{d\mu_{jk}}{dER} &= \frac{d(1+\epsilon_{jk}^{-1})}{dER} \\
&= \left[\frac{d(1+\epsilon_{jk}^{-1})}{dHHI_{jk}}\frac{dHHI_{jk}}{dER}\right] \\
&= \left[\frac{d(1+\epsilon_{jk}^{-1})}{dHHI_{jk}}\kappa\right] \\
&= \left(\frac{1}{\theta}-\frac{1}{\eta}\right)\kappa
\end{aligned}
$$

I then compute the standard errors for κ_t under the assumption that the effect on concentration and the input supply parameters are independent. It follows that:

$$
\begin{aligned}
\text{var}(\kappa) &= \text{var}\left[\left(\frac{1}{\theta}-\frac{1}{\eta}\right).\kappa\right] \\
&= \text{var}\left[\left(\frac{1}{\theta}-\frac{1}{\eta}\right)^2\right]\mathbb{E}[\kappa^2] - \left[\mathbb{E}\left(\frac{1}{\theta}-\frac{1}{\eta}\right)\right]^2[\mathbb{E}(\kappa)]^2 \\
&= \text{var}\left[\left(\frac{1}{\theta}-\frac{1}{\eta}\right)+\left[\mathbb{E}\left(\frac{1}{\theta}-\frac{1}{\eta}\right)\right]^2\right]\left[\text{var}(\kappa)+[\mathbb{E}(\kappa)]^2\right] - \left[\frac{1}{\theta}-\frac{1}{\eta}\right]^2[\mathbb{E}(\kappa)]^2
\end{aligned}
$$

whose components can all be plugged-in using sample estimates.

7.1.20 Extensive Margin: Fixed Cost of Importing

In this section, I introduce an alternative scenario with a fixed cost of importing, κ_m denominated in buyers' currency. A firm can choose to buy zero units of inputs from foreign countries to avoid paying the fixed cost κ_m. I introduce fixed costs in order to account for changes in the buyer market shares associated with entry and exit of buyers to the market.
The problem of the buyer in its imports market is essentially identical to the baseline case except there is an extra term accounting for this cost. However, there is an additional restriction which is a firm imports if[59]:

$$
z_{bjk}\left(q_{bjk}\right)^{\alpha} - \frac{1}{e_k}p_{bjk}q_{bjk} \geq \frac{1}{e_k}\kappa_{bjk}
$$

We can now concentrate on the impact of fixed costs on the exchange rate pass-through. The primary distinction from the baseline model lies in the expression for the change in buyer market shares due to an exchange rate shock.

The buyer market share can be rewritten as:

$$
S_{bjk} = \frac{p_{bjk}^{1+\eta}}{\sum_{z=1}^{B(e_k)} p_{bjk}^{1+\eta}}
$$

[59] In line with Atkeson and Burstein (2008), within each market, I arrange buyers based on their physical productivity. Our focus is on equilibria where firms make sequential decisions regarding whether to enter or not. The most productive firm makes the initial decision, followed by the second most productive firm (assuming no less productive firm is importing), and this sequence continues. The specific order has minimal quantitative impact when we calibrate the model to align with the strong concentration observed in the data.

In this modified scenario, the number of buyers, B, is a function of the exchange rate e_k. Note that equation A7.15 would have an extra term that accounts for the change in the number of buyers after an exchange rate shock.

$$d\ln S_{bjk} = (1+\eta)\left(1 - S_{bjk} - \sum_z S_{zjk}\frac{d\ln p_{zjk}}{d\ln p_{bjk}} - \underbrace{p_{B(e_k)}^{1+\eta}\frac{dB(e_k)/de_k}{dp_{bjk}/de_k}}_{\text{Entry/Exit of buyers}}\right) d\ln p_{bjk}$$

I expect $\frac{dB(e_k)}{de_k} < 0$, due to iceberg importation costs: as the exchange rate depreciates (increases) it reduces the fixed importation cost. In addition, I expect $\frac{dp(e_k)}{de_k} > 0$. [60]

7.2 Appendix: Empirical Part

7.2.1 Data Sources

Table 7: Data Sources

Data	Data Source	Note
Colombian Exports	DANE (2007-2020)	Data accessed through Datamyne
Colombian Imports	DANE (2007-2020)	Data accessed through Datamyne
Rauch Classification	Rauch (1999)	4-digit SIC Rev. 3.1 classification
Exchange Rates Shocks	IMF (2007-2020)	Bilateral nominal exchange rates

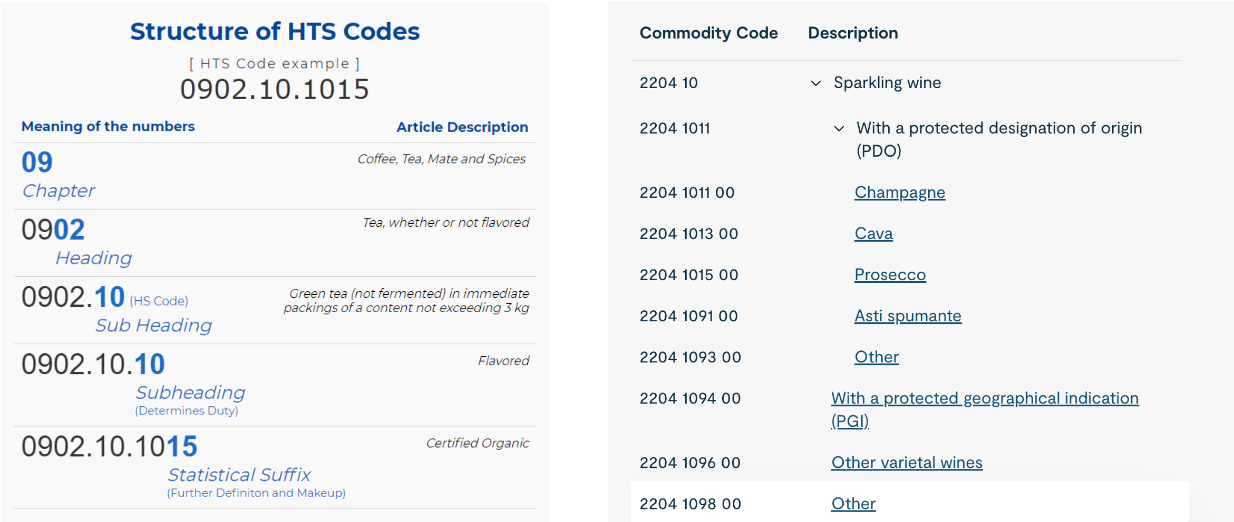
Notes: This table shows a summary of the datasets I combine in the empirical section and their sources

7.2.2 HS10 examples

[60] If there were a continuous number of buyers, the expression would be the following:

$$\frac{d\ln S(b',j,k)}{dlnp(b',j,k)} = (1+\eta)\left(1 - \int_0^1 S(b,j,k)\frac{\partial lnp(b,j,k)}{\partial lnp(b',j,k)}\,db\right) - p^{1+\eta}(B(e(k)),j,k)\frac{dB(e_k)}{dlnp(b',j,k)}$$

Figure 8: Examples of HS10 Code Descriptions



Notes: These images illustrate examples of products classified under HS10 codes for coffee, tea, spices, and wine.

7.2.3 Buyer Size and Level Price

In this section, I explore the relationship in the data between the size of the buyer and the price. For doing so, I run the following regression:

$$\ln(price_{sbjkt}) = \xi BS_{bjkt} + FE_{sjkt} + X_{kt} + \epsilon_{sbjkt} \tag{A7.30}$$

where $\ln(price_{sbjkt})$ is the price of Product j, Seller s charges to Buyer b at Destination k in period t and $X_{k,t}$ are control variables at the country and time level. To represent this relationship, I plot the bin scatter of the demeaned variables, as well as the fitted line. The slop of this line is the main coefficient of the regression (ξ). Figure 9 Panel A shows that the price of the same product, sold to the same destination in a given year is increasing in the buyer's size. This is true, even controlling for destination and time specific variables. The reason for this is that even though the markdowns for firms with higher market shares are larger, the marginal-revenue product for larger firms is also larger. Therefore, large firms are willing to pay larger prices.[61]

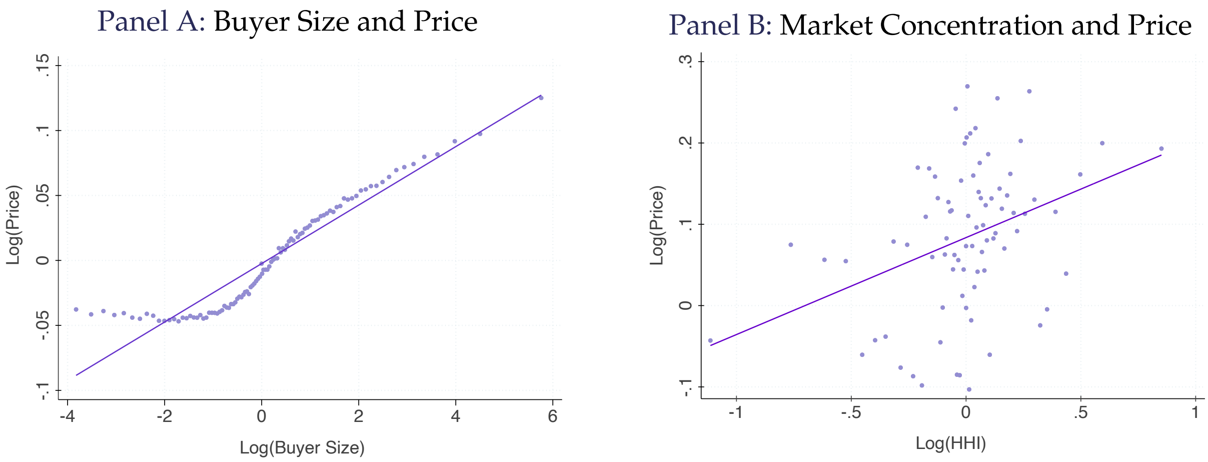
Then, I turn to the market-level predictions of the model. I aggregate equation A7.30 at the market level such that price in a market can be expressed as a weighted average of prices for a given product in a given destination where the weights correspond to the buyers' market share. I obtain the average price of a product for a destination for a given year as a function of the concentration of the market, expressed as the market's HHI, $HHI_k t = \sum_{b=1}^{B} S_{bjkt}^2$.[62]

$$\ln(price_{jkt}) = \xi HHI_{jkt} + FE_{jkt} + X_{kt} + \epsilon_{jkt} \tag{A7.31}$$

Figure 9 Panel B shows the correlation between the market price of a product and the concentration of buyers in that given market. It can be noted how for a bigger concentration of buyers, prices tend to be lower in that market.[63]

[61] Note that this results is analogous to Berger, Herkenhoff and Mongey (2022) where large firms pay higher wages.
[62] See the Appendix for proof.
[63] Given the potential endogeneity in this regression, as mention in Bresnahan (1989), in the Appendix, I use an IV equal to how big is the buyer in other markets to estimate this relationship. Results hold.

Figure 9: Proposition I and II

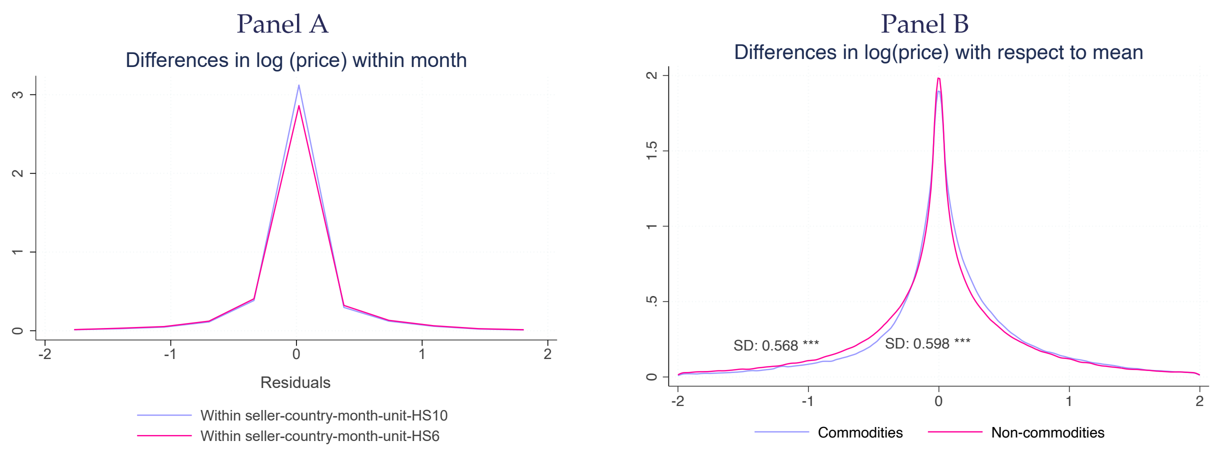


Notes: This figure illustrates Propositions I and II using Colombian data. Panel A examines the relationship between buyer market share and transaction-level log prices of the inputs, while Panel B explores the relationship between the average log price in a market (Year-Destination-HS10 combination) and buyer market concentration, measured by the Herfindahl-Hirschman Index of the market. In both cases, it is evident that the marginal revenue product is the driving factor behind the results. Larger buyers are more likely to purchase inputs that are more efficient and have a higher marginal revenue product.

7.2.4 Robustness: Price Dispersion

In this section, I investigate whether price differences can be attributed to various factors, as opposed to the same seller discriminating among buyers. Firstly, I examine the nature of the product being sold; differentiated products are more likely to exhibit price variations. However, when we consider commodities, which are identical products, we can argue that all price differences may be attributed to discrimination. Secondly, given the high volatility of exchange rates, differences in prices could potentially be explained by monthly fluctuations in the price of the goods. To test this hypothesis, I analyze price dispersion at the monthly level. It becomes evident that price discrimination even occurs at this level.

Figure 10: Price Dispersion



Notes: This figure illustrates the heterogeneity in prices in a different time period and for different types of products. In Panel A, we observe the price dispersion for monthly prices, which represents the range of prices for a given HS10 product, destined for a specific location and offered by a particular seller within the same month. Panel B highlights the variations in price dispersion based on the type of product, distinguishing between commodities and non-commodities

Table 8: Price Dispersion in different HS levels

	Products	Products with different prices	%
HS6	3654	2299	62,9
HS10	4889	2811	57,5

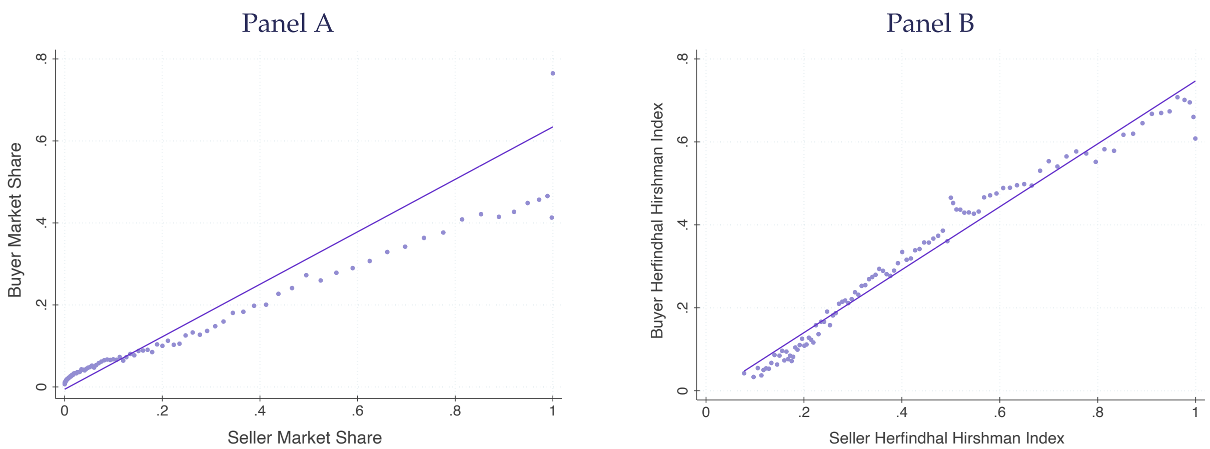
Notes: The table shows how many products have variations in their prices depending on the HS level.

Table 8 shows the standard deviation of $\ln(price)$ within seller-country-month-unit-HS10 is 0.5302. At the HS6 level, it is 0.5627. This is only for 2019.

7.2.5 Assortative Matching

Figure 11 shows that is more likely large buyers buy from larger sellers and that highly concentrated markets in terms of buyers are also highly concentrated in terms of sellers.

Figure 11: Assortative Matching



Notes: This figure illustrates the correlation between major buyers and sellers and market concentration in terms of both buyers and sellers. Panel A displays the correlation between buyer market share and seller market share within a transaction, while Panel B demonstrates the correlation between the Hirschman-Herfindahl Index for buyer market concentration and the Hirschman-Herfindahl Index for seller market concentration. Throughout the paper, we define a market as a Year-Country of destination-HS10 combination.

7.2.6 Colombia Time Series

I find a negative relationship between the concentration of sales in buyers and the exchange rate pass-through. Figure 12 shows how this correlation holds in the time series for Colombia 2008–2020.

Figure 12: Time Series Variation

Notes: This figure shows the relationship between exchange rate pass through and concentration throughout the years for Colombian Imports. Note that concentration in imports is decreasing over time which is consistent with concentration on exports for buyers increasing, giving Colombia is a small open economy.

7.2.7 Mechanism: Consistency with Seller Side Results

In this section, I detailed how my paper is consistent with the existent literature on the sellers power in a monopolistic competition environment. In the presence of seller market power, sellers charge a mark up above their marginal cost. In the presence of a cost shock (an exchange rate shock would work in the same way), firms with higher market share internalize this shock (Atkeson and Burstein, 2008; Amiti, Itskhoki and Konings, 2014). In other words, firms that have more market power, that is, charging higher mark ups, adjust their mark up in order to keep prices more stable in the currency of the buyer. They keep quantities more stable by keeping prices more stable. This corresponds to a more incomplete pass-through for sellers with higher market share.

In the presence of buyer market power, the mechanism works analogously, although it bring the opposite outcome. Buyers that have more market power, that is, buyers who charge a lower markdown, adjust more their markdowns in order to keep prices more stable in the currency of the seller. This in turn, cause prices to be less stable in the currency of the buyer and results in a more complete pass-through. The underlying mechanism here happens because, as the buyer faces a supply curve, to keep quantities more stable, he needs to let the prices they accept change prices more.

7.2.8 Robustness: Seller Market Power

In the theoretical appendix, I propose an alternative theoretical model that takes into account the power of the seller. In this section, I include a variable in the baseline regressions that will allow us to isolate the buyer market power effect from the seller side. Table 9 shows that estimates are still significant and have the expected sign.

Table 9: Robustness with Seller Size

	(1)	(2)	(3)	(4)	(5)
	△ Log(Price)	△ Log(Price)	△ Log(Price)	△ Log(Price)	△ Log(Price)
$\ln(\triangle ER)$	0.106**	0.116**	-0.0178	0.0218	0.0160
	(0.0488)	(0.0506)	(0.0408)	(0.0428)	(0.0433)
S_{t-1}	-0.0198***	-0.0425***			
	(0.00571)	(0.00613)			
$\ln(\triangle ER) \times S_{t-1}$	-0.118**	-0.124*			
	(0.0485)	(0.0654)			
X_{t-1}	-0.0146*		-0.0357***	-0.0458***	
	(0.00805)		(0.00695)	(0.00777)	
$\ln(\triangle ER) \times X_{t-1}$	0.00952		0.0673	0.0722	
	(0.0364)		(0.0497)	(0.0510)	
$Xhsyear_{t-1}$		-0.000597			
		(0.0144)			
$\ln(\triangle ER) \times Xhsyear_{t-1}$		-0.00642			0.126*
		(0.0333)			(0.0682)
$Shsyear_{t-1}$			-0.0586***	-0.0543***	-0.0682***
			(0.0196)	(0.0193)	(0.0194)
$\ln(\triangle ER) \times Shsyear_{t-1}$			-0.354***	-0.346***	-0.357***
			(0.128)	(0.129)	(0.133)
HS - Year - Seller FE			✓	✓	✓
Country-HS-Seller FE	✓	✓			
Country FE				✓	✓
Buyer FE		✓			
N	499308	480223	525080	525080	525080

Standard errors in parentheses
* p¡0.1, ** p¡0.05, *** p¡0.01

Notes: The table shows results for equation 4.3 that include a variable corresponding to the size of the seller (X_{t-1} or $Xhsyear_{t-1}$). One of the columns includes an alternative measure for buyer size (S_{t-1}). Standard errors are clustered at the country-time level and are shown in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

7.2.9 Robustness: Import Intensity and Exchange Rate Pass-through

Table 10 includes information on the import intensity when evaluating the exchange rate pass-through.

Table 10: Import Intensity and Exchange Rate Pass-through

	(1) $\triangle$ Log(Price)	(2) $\triangle$ Log(Price)	(3) $\triangle$ Log(Price)
$\ln(\triangle ER)$	0.142***	0.157***	
	(0.0538)	(0.0565)	
$S\_t - 1$	-0.0492***	-0.0546***	-0.0493***
	(0.00647)	(0.00704)	(0.00909)
$\ln(\triangle ER) \times S\_t - 1$	-0.103*	-0.136*	-0.245***
	(0.0610)	(0.0694)	(0.0654)
Import Intensity	0.000287	-0.00106	-0.000153***
	(0.000662)	(0.000678)	(0.0000348)
$\ln(\triangle ER) \times$ Import Intensity	0.00733***	0.0134***	0.00210***
	(0.00192)	(0.00225)	(0.000446)
Country-HS FE	✓		
Period-Seller FE	✓	✓	
Country-Seller FE	✓		✓
Country-HS-Seller FE		✓	
Period-Country-HS FE			✓
N	604221	562960	524209

Notes: The table shows results for Equation 4.3 including as a control the interaction between log changes in the exchange rate and import intensity of the exporter, named *Import Intensity*. Standard errors are clustered at the country-time level and are shown in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

7.2.10 Robustness: Other measures of Buyer Market Power

Table 11 includes other measures of buyer market share. Columns (1)-(2) include an interaction of the exchange rate with buyer market share defined as Buyer b's share of the nominal value of all exports of Product j to Country k in Year t.

Table 11: Robustness with Other Measures of Buyer Market Power

	(1) $\triangle$ Log(Prices)	(2) $\triangle$ Log(Prices)	(3) $\triangle$ Log(Prices)	(4) $\triangle$ Log(Prices)
$\ln(\triangle ER)$	0.0527		0.0703*	
	(0.0378)		(0.0381)	
$Shsyear_{t-1}$	-0.0902***	-0.0906***		
	(0.0263)	(0.0260)		
$\ln(\triangle ER) \times Shsyear_{t-1}$	-0.363**	-0.334**		
	(0.152)	(0.153)		
$Sseller_{t-1}$			-0.0583***	-0.0574***
			(0.00690)	(0.00693)
$\ln(\triangle ER) \times Sseller_{t-1}$			-0.0701	-0.0947*
			(0.0476)	(0.0515)
HS - Year - Seller FE	✓	✓	✓	✓
Country-HS-Seller FE	✓	✓		
Country-Year FE		✓		✓
Country FE			✓	
N	494237	494211	525080	525063

Notes: The table shows results for Equation 4.3 including alternative measures of buyer market power. Standard errors are clustered at the country-time level and are shown in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

7.2.11 Robustness: Length of Contracts and Volatility Unrelated to Exchange Rate Shocks

Barro (1977) and Carlton (1991) argue that buyer–seller prices could be less responsive to shocks due to the use of contracts which specify fixed prices for a period of time. Given the existence of long-term relationships might be more likely to use either implicit or explicit contracts, they could exhibit lower pass-through of shocks (Heise, 2019). importer-exporter-product (HS10) triplets in the data. In this section, I will examine the potential connection between relationship length and size of the buyer. This could potentially bias (upward) the estimators if the length of the relationship implies lower pass-through.

Table 12 shows different specifications that aim to control for the length of the relationship in my baseline regression. Column (1) adds buyer-seller fixed effects, and Columns (2)-(3) include two different measures of relationship length: length of a relationship in the triplet buyer-seller-HS10 and length of a buyer-seller relationship. I include these two measures given that it could be the case that firms, that are already trading in other products are more likely to have fixed contracts.

Table 12: : Robustness with length of buyer-seller relationships

	(1) △ Log(Prices)	(2) △ Log(Prices)	(3) △ Log(PricesBS)
$\ln(\triangle ER)$	0.0237	0.178**	0.204***
	(0.0564)	(0.0714)	(0.0725)
$Tenure_t$	0.00552	0.00718	
	(0.0109)	(0.00473)	
$\ln(\triangle ER) \times Tenure_t$	0.0607*	-0.0152	
	(0.0332)	(0.0248)	
S_{t-1}		-0.0567***	-0.0563***
		(0.00682)	(0.00693)
$\ln(\triangle ER) \times S_{t-1}$		-0.134*	-0.129*
		(0.0686)	(0.0682)
$TenureHS_t$			0.00576
			(0.00529)
$\ln(\triangle ER) \times TenureHS_t$			-0.0394
			(0.0290)
HS - Dest FE	✓	✓	✓
Dest - HS - Seller FE	✓		
Year FE			
Buyer FE	457488	562960	562960

Notes: The table presents results for Equation 4.3, which includes variables corresponding to the tenure of the relationship between a buyer and a seller. The variable $Tenure_t$ represents the number of years the buyer and the seller have been interacting prior to the transaction at time t. The variable $TenureHS_t$ indicates the number of years the buyer and the seller have interacted but within the same HS10 product category. Standard errors are clustered at the country-time level and are displayed in parentheses. Standard errors are clustered at the country-time level and are shown in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

In all the cases, even though the fact that longer relationships have less change in prices in the buyer currency, they do not seem to be explaining the mechanism this paper proposes.

7.2.12 Robustness: Dominant Currency Paradigm

In this section, I replicate my findings following the data cleaning and specification of Gopinath et al. (2020). First, I restrict the data to the manufacturing sector, using the HS codes proposed in the paper. Second, I start as a benchmark specification with Gopinath et al. (2020)'s main regression, that is, including only destination-industry-seller. The relevant difference with my specification is that in their study they do not include time fixed effects. The reason for this is their variable of interest (the USD-to-COP exchange rate) is at the year level. In table 13, it can be shown that when including the time fixed effects, the coefficient changes, and becomes smaller but still significant and preserves the sign.

Table 13: Dominant Currency Paradigm and Exchange Rate Pass-Through

	(1) △ Log(Price)	(2) △ Log(Price)	(3) △ Log(Price)
L(△ ER) = α	0.887***	0.464***	0.108*
	(0.284)	(0.162)	(0.0601)
BS_{t-1}		-0.0170	-0.0330***
		(0.0103)	(0.00934)
L(△ER)xBS_{t-1} = β		-0.395**	-0.149**
		(0.196)	(0.0721)
Country-HS-Seller	x	x	x
HS - Period FE			
HS - Period - Seller FE			x
Year FE		x	
N	165100	170796	163463

Notes: The table shows results for an equivalent version of equation 4.3 in Gopinath et al. (2020). Standard errors are clustered at the country-time level and are shown in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

7.2.13 Robustness: Alternative Samples

Table 14: Exchange Rate Pass-through into prices

	OECD Destinations		All Destinations			
	(1)	(2)	(3)	(4)	(5)	(6)
	△ Log(Price)	△ Log(Price)	△ Log(Price)	△ Log(Price)	△ Log(Price)	△ Log(Price)
$\ln(\triangle ER)$	0.356***	0.357***	0.200***	0.172***	0.158***	0.158***
	(0.0836)	(0.0862)	(0.0542)	(0.0577)	(0.0603)	(0.0479)
S_{t-1}	-0.0797***	-0.0889***	-0.0338***	-0.0552***	-0.0707***	-0.0402***
	(0.0104)	(0.0119)	(0.0110)	(0.0145)	(0.00947)	(0.00752)
$\ln(\triangle ER) \times S_{t-1}$	-0.442***	-0.475***	-0.350***	-0.258**	-0.196**	-0.198***
	(0.0837)	(0.0879)	(0.0890)	(0.109)	(0.0964)	(0.0639)
Period-Seller FE	✓	✓	✓	✓	✓	✓
Country-HS-Seller FE	✓	✓	✓	✓	✓	✓
N	235688	225054	196499	164783	474959	220482
Sample	A	D	C	H	D	R

Notes: Results from equation 4.3 for alternative samples.The sample includes all HS products (A) in column (1), only commodities (C) in column (3), only homogeneous goods (H) in column (4), only differentiated goods (D) in columns (2) and (5) and only referenced goods (R) in column (6). Standard errors are clustered at the country-time level and are shown in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

7.2.14 Robustness: Devaluations versus Appreciation

In this section I estimate the different effects for the case where there is a devaluation vs appreciation. As shown in Table 15, I find the effects are stronger for devaluations. One caveat about this effect, is that my sample does not contain a lot of appreciation events of a relevant magnitude for COP. Potentially the reason why I find almost no effect for appreciation is the appreciation events are insignificant and reverted shortly after they occur.

Table 15: Positive or negative Δ ER

	Appreciations		Depreciations	
	(1)	(2)	(3)	(4)
	△ Log(Price)	△ Log(Price)	△ Log(Price)	△ Log(Price)
$\ln(\triangle ER)$	0.195**		0.146*	
	(0.0889)		(0.0744)	
S_{t-1}	-0.0252**	-0.0255**	0.00253	0.00258
	(0.0107)	(0.0105)	(0.0138)	(0.0137)
$\ln(\triangle ER) \times S_{t-1}$	-0.207**	-0.192*	0.00456	-0.00267
	(0.100)	(0.0987)	(0.128)	(0.128)
Period-Seller FE	✓		✓	
Country-HS-Seller FE	✓	✓	✓	✓
Country-Period FE		✓		✓
N	297342	297580	171620	174940

Notes: This table presents the results derived from equation 4.3 under two scenarios: first, when the exchange rate change signifies an appreciation of the Colombian currency, shown in Columns (1) and (2); and second, when it indicates a depreciation of the Colombian currency, displayed in Columns (3) and (4). Standard errors are clustered at the country-time level and are shown in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

7.2.15 Robustness: Prices vs Quantities

Table 16: Robustness with Disaggregated Price and Quantity Effects

	(1) △ Log(ExportValue)	(2) △ Log(ExportValue)	(3) △ Log(Quantity)	(4) △ Log(Quantity)	(5) △ Log(Price)	(6) △ Log(Price)
$\ln(\triangle ER)$	0.275**	0.319**	0.133	0.231	0.142**	0.129**
	(0.1000)	(0.0834)	(0.122)	(0.0921)	(0.0548)	(0.0474)
S_{t-1}	-1.211**		-1.158**		-0.0530**	
	(0.0183)		(0.0183)		(0.00696)	
$\ln(\triangle ER) \times S_{t-1}$	-0.00597		0.169		-0.175	
	(0.128)		(0.139)		(0.0795)	
$Shsyear_{t-1}$		-1.392**		-1.365**		-0.0348**
		(0.0334)		(0.0327)		(0.0108)
$\ln(\triangle ER) \times Shsyear_{t-1}$		-0.489**		-0.394		-0.220
		(0.173)		(0.186)		(0.103)
Period-Seller FE	✓	✓	✓	✓	✓	✓
Country-HS FE		✓		✓		✓
Country-HS-Seller FE	✓		✓		✓	
N	536252	564720	536252	564720	536252	578890

Notes: The table displays results for equation 4.3 under different scenarios. Columns (1) and (2) present outcomes when the dependent variable is the exported value. Columns (3) and (4) showcase results when the dependent variable is the quantity exported, while Columns (5) and (6) depict results considering prices. For each case, results are provided for both the market share in the baseline model and an alternative definition of the market share, $Shsyear_{t-1}$. This alternative definition represents the share a buyer holds of the total sales of Colombia for a specific product HS in a given year. Standard errors are clustered at the country-time level and are shown in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

7.2.16 Decreasing Market Concentration

The existence of large firms, especially, large buyers has been a growing concern for policy makers, given their macroeconomics effects (De Loecker, Eeckhout and Unger, 2020; Eggertsson, Robbins and Wold, 2021). These consequences become even more relevant in international markets, given there are not only a small number of high-performance players (Bernard et al., 2007; Morlacco, 2019) but also high entry costs that create barriers to competition (Antras, Fort and Tintelnot, 2017).

In this section, I study the quantitative implications of a reduction of the concentration of buyers. I use my estimated coefficients to calculate the average exchange rate pass-through in a market. I start from the firm level expression for the pass-through:

$$\frac{\mathrm{dln}p_{sbjk}}{\mathrm{dln}e_k} = \alpha + \beta S_{bjk}$$

Plugging in for the estimated coefficients, $\hat{\alpha}$, $\hat{\beta}$ and each firm's buyer size, I obtain a firm-level exchange rate pass-through which I then aggregate to the market level, using weights ω

$$\sum_{b'} w_{b'} \frac{\mathrm{dln}p_{sbjk}}{\mathrm{dln}e_k} = \hat{\alpha} + \hat{\beta} \sum_{b'} w_{b'} S_{bjk}$$

Note that when I use the weight equal to the buyer shares, this leads to the following expression with the HHI:

$$\sum_{b'} S_{jb'k} \frac{\mathrm{dln}p_{sbjk}}{\mathrm{dln}e_k} = \hat{\alpha} + \hat{\beta} HHI_{jk}$$

Table 17 shows the exchange rate pass-through for scenarios with different concentrations compared to the actual concentration in Colombia, Column (2). Comparing to these benchmark values, I propose three other scenarios: a) A merge between the two biggest firm (in terms of buyer share) in every market. So this means an increase in concentration, Column (1), b) leaving fixed the number of buyers in each market and assigning a symmetric share of sales to each buyer, Column (3), and c) assigning the same number of buyers to each market (the median number of buyers across all markets with a symmetric distribution of sales among them, column(4).

For each case, I present two sets of results corresponding to different weight matrices. The first line corresponds to the case where the weights are the share of the buyer. The second line corresponds to having weights equal to the trade flow share the buyer has in the year, and the exchange rate pass-through at the country-year level.

Table 17: Average Exchange Rate Pass-through

ω	Merger	Benchmark	Symmetric shares Different #
Buyer share	0.04%	**20.50%**	24.10%
Trade flow	0.02%	**15.20%**	22.30%

Notes: The table illustrates counterfactual scenarios. In column 1, I allocate a symmetric share to each firm within that market, period-destination-HS combination. In column 2, I simulate a merger between the two largest buyers in each market. In column 3, I distribute the same number of firms to each market, each with an equal share of sales within the market.

Results show that for cases with mergers, that is, when the market concentration increases, the exchange rate pass-through decreases. For all other cases, when concentration is decreased the exchange rate pass-through increases.

7.3 Appendix: Estimation

7.3.1 Indirect Inference

Set Up the Model Let's simulate the economy in the baseline equilibrium using an exchange rate of one for every currency.

1. Establish the size of the economy (number of countries, and products)
2. Define the parameters' (η, θ, and σ) values.
3. Simulate a random vector of productivity's z from the log-normal distribution.
4. For each country guess an initial matrix of p_{bjk}.
5. For each country, find s_{bjk}, ϵ_{bjk}, μ_{bjk}, and $\frac{q_{bjk}}{Q_k}$.
6. Given the equilibrium values, update p_{bjk}.
7. Find the distance between p^r_{bjk} and p^{r-1}_{bjk}.
8. Repeat the whole process until p_{bjk} converges.

Now, let's find the equilibrium after the shock.

1. Simulate a random vector of exchange rates from a log-normal distribution.
2. Set the initial guesses to be the solution of the baseline model.
3. Repeat the same algorithm as for the baseline model.

Changes in quantity Given that the model is solved using the quantities scaled by Q_k, it is necessary to recover the original quantities. First, there is no algebraic way to recover q_{bjk} so it is necessary to find the numerically. To do this I follow these steps:

1. Guess a matrix of q_{bjk}
2. Construct Q_k from the guessed q_{bjk}
3. Find a new q_{bjk} like this: $q_{bjk}^{implied} = \left(\frac{q_{bjk}}{Q_k}\right)^{simulated} Q_k^{guessed}$
4. Find the distance between the guessed and the implied q_{bjk}
5. Iterate until q_{bjk} converges

Estimate for σ To estimate σ using the structure of the model, I use the ratio between prices of different products from the same buyer. I derive an expression that can be estimated through regression using the available data, and its coefficient becomes a function of σ, specifically $\frac{1}{\sigma}$.

$$p_{bjk} = \frac{\varepsilon_{bjk}}{1+\varepsilon_{bjk}} z_{bjk} \left(\frac{Q_{finalg}}{q_{bjk}}\right)^{\frac{1}{\sigma}} e_k$$

$$\frac{p_{bjk}}{p_{bj'k}} = \frac{\varepsilon_{bjk}\left(1+\varepsilon_{bj'k}\right)}{\left(1+\varepsilon_{bjk}\right)\varepsilon_{bj'k}} \frac{z_{bjk}}{z_{bj'k}} \left(\frac{q_{bj'k}}{q_{bjk}}\right)^{\frac{1}{\sigma}}$$

$$\ln\left(\frac{p_{bjk}}{p_{bj'k}}\right) = \ln\left(\frac{\varepsilon_{bjk}\left(1+\varepsilon_{bj'k}\right)}{\left(1+\varepsilon_{bjk}\right)\varepsilon_{bj'k}}\right) + \ln\left(\frac{z_{bjk}}{z_{bj'k}}\right) + \frac{1}{\sigma}\ln\left(\frac{q_{bj'k}}{q_{bjk}}\right)$$

$$\ln\left(\frac{p_{bjk}}{p_{bj'k}}\right) \approx \omega_0 + \omega_1\left(\frac{q_{bj'k}}{q_{bjk}}\right)$$

$$\omega_0 \approx \ln\left(\frac{\varepsilon_{bjk}\left(1+\varepsilon_{bj'k}\right)}{\left(1+\varepsilon_{bjk}\right)\varepsilon_{bj'k}}\right) + \ln\left(\frac{z_{bjk}}{z_{bj'k}}\right)$$

$$\omega_1 \approx \frac{1}{\sigma}$$

To integrate this into the indirect inference estimation, I initially conduct the corresponding regression on the data. Next, I replicate the panel using the model outcomes and estimate the regression within the model. Finally, I include in the vector of parameters being searched for in the indirect inference algorithm.

Standard Errors The standard errors are the diagonal's square root of the key parameters' varcov (V) given the following specification:

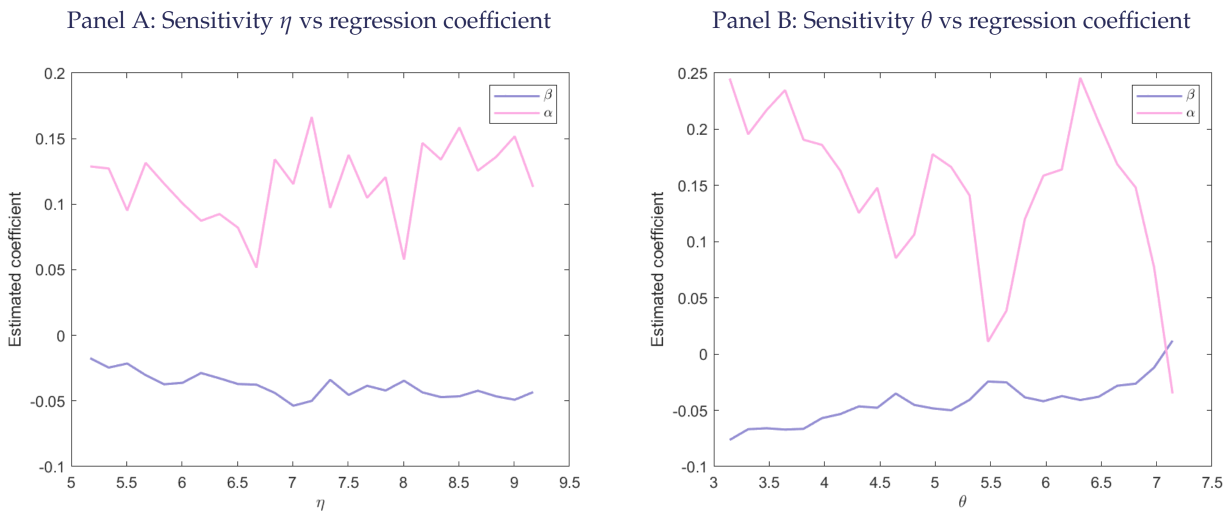
$$V = \left(1 + \frac{1}{s}\right)\left(G'\Omega^{-1}G\right)^{-1}$$

Where G is the matrix of partial derivatives of the model moments $m(\beta_1, \beta_2)$ with respect to (η, θ). The term Ω denotes the varcov matrix of the moments, and S indicates the number of simulations used for estimation. These components are estimated through bootstrapping (involving S simulations). In each simulation, the seed of the shock is varied, and the key parameters are re-estimated. This process enables the estimation of the varcov matrix of the moments. Finally, the matrix of derivatives of the moments is estimated numerically. The estimation uses the mean of the bootstrapping estimates as the starting point.

7.3.2 Sensitivity Analysis

To perform a sensitivity analysis, I will observe how the equilibrium and regression coefficients change when the parameters of the model change. In particular, I will study the impact of changes in η, and θ. For each of these scenarios, I will change only the desired parameter, re-simulate the model, and, using the new equilibrium, run the regression to estimate α and β. Then, I will graph the values of each variable $(p_{bjk}, q_{bjk}, \alpha, \beta)$ against the corresponding parameter value. Figure 13 shows this.

Figure 13: Sensitivity Analysis

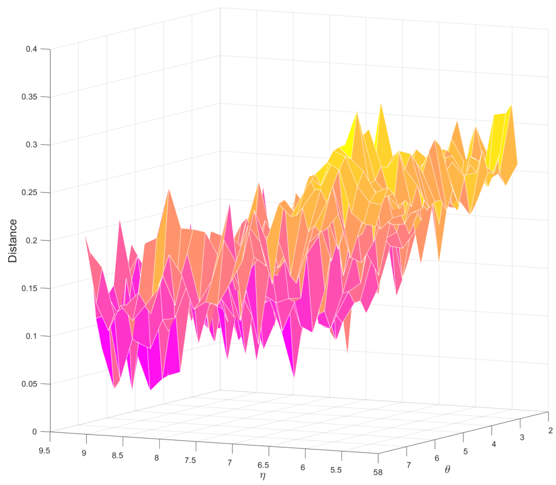


Notes: This figure shows.In these figures, we hold all parameters constant at the estimated values, except one parameters which varies along the horizontal axis. The vertical axis reports the values taken by a given target moment.

7.3.3 Uniqueness

In this section, I challenge the uniqueness of the estimated elasticities, η and θ. The estimators minimize the distance between the simulated data and the model's expressions while matching the ERPT coefficients. Considering that the estimated parameters are approximately $\eta = 6.98$ and $\theta = 4.01$, one can see a clear convexity around that point, and it seems like a feasible minimum of the objective function. Furthermore, given the observable trends, the estimated values are consistent with a global value and, therefore, with a unique set of equilibrium values.

Figure 14: Uniqueness of values



Notes: This figure illustrates the distance between the reduced form estimated values for α and β and the ones in the simulated data for pairs of η and θ.

References

Adão, Rodrigo, Paul Carrillo, Arnaud Costinot, Dave Donaldson, and Dina Pomeranz. 2022. "Imports, Exports, and Earnings Inequality: Measures of Exposure and Estimates of Incidence." *Quarterly Journal of Economics*, 137(3): 1553–1614. https://doi.org/10.1093/qje/qjac012.

Alviarez, Vanessa I, Michele Fioretti, Ken Kikkawa, and Monica Morlacco. 2023. "Two-sided market power in firm-to-firm trade." National Bureau of Economic Research.

Alviarez, Vanessa, Michele Fioretti, Ken Kikkawa, and Monica Morlacco. 2022. "Two-sided market power in firm-to-firm trade." Inter-American Development Bank. https://doi.org/10.18235/0003493.

Amiti, Mary, Oleg Itskhoki, and Jozef Konings. 2014. "Importers, Exporters, and Exchange Rate Disconnect." *American Economic Review*, 104(7): 1942–78.

Antras, Pol, Teresa C Fort, and Felix Tintelnot. 2017. "The Margins of Global Sourcing: Theory and Evidence from US Firms." *American Economic Review*, 107(9): 2514–64.

Atkeson, Andrew, and Ariel Burstein. 2008. "Pricing-to-Market, Trade Costs, and International Relative Prices." *American Economic Review*, 98(5): 1998–2031.

Auer, Raphael A, and Raphael S Schoenle. 2016. "Market Structure and Exchange Rate Pass-Through." *Journal of International Economics*, 98: 60–77.

Autor, David, David Dorn, Lawrence F Katz, Christina Patterson, and John Van Reenen. 2020. "The Fall of the Labor Share and the Rise of Superstar Firms." *Quarterly Journal of Economics*, 135(2): 645–709.

Azar, José, Ioana Marinescu, and Marshall Steinbaum. 2019. "Measuring Labor Market Power Two Ways." In *AEA Papers and Proceedings*. Vol. 109, 317–21. American Economics Association.

Barro, Robert J. 1977. "Long-Term Contracting, Sticky Prices, and Monetary Policy." *Journal of Monetary Economics*, 3(3): 305–16.

Berger, David W, Kyle F Herkenhoff, and Simon Mongey. 2022. "Labor Market Power." *American Economic Review*, 112(4): 1147–1193. https://doi.org/10.1257/aer.20191521.

Bernard, Andrew B, Emmanuel Dhyne, Glenn Magerman, Kalina Manova, and Andreas Moxnes. 2019. "The Origins of Firm Heterogeneity: A Production Network Approach." National Bureau of Economic Research. Working Paper 25441. https://www.nber.org/system/files/working_papers/w25441/w25441.pdf.

Bernard, Andrew B, J Bradford Jensen, Stephen J Redding, and Peter K Schott. 2007. "Firms in International Trade." *Journal of Economic Perspectives*, 21(3): 105–30.

Bernard, Andrew B, J Bradford Jensen, Stephen J Redding, and Peter K Schott. 2018. "Global Firms." *Journal of Economic Literature*, 56(2): 565–619.

Boz, Emine, Eugenio Cerutti, and Evgenia Pugacheva. 2019. "Dissecting the global trade slowdown: A new database." IMF Working Paper, International Monetary Fund, Washington, DC.

Bresnahan, Timothy F. 1989. "Empirical Studies of Industries with Market Power." *Handbook of Industrial Organization*, 2: 1011–57.

Burstein, Ariel, and Gita Gopinath. 2014. "International Prices and Exchange Rates." In *Handbook of International Economics*. Vol. 4, 391–451. Elsevier.

Carlton, D. W. 1991. "A Theory of Allocation and Its Implications for Marketing and Industrial Structure: Why Rationing Is Efficient." *Journal of Law and Economics*, 34(2): 231–62.

De Loecker, Jan, and Frederic Warzynski. 2012. "Markups and Firm-Level Export Status." *American Economic Review*, 102(6): 2437–71.

De Loecker, Jan, Jan Eeckhout, and Gabriel Unger. 2020. "The Rise of Market Power and the Macroeconomic Implications." *Quarterly Journal of Economics*, 135(2): 561–644.

De Loecker, Jan, Pinelopi K Goldberg, Amit K Khandelwal, and Nina Pavcnik. 2016. "Prices, Markups, and Trade Reform." *Econometrica*, 84(2): 445–510.

Devereux, Michael B, Wei Dong, and Ben Tomlin. 2017. "Importers and Exporters in Exchange Rate Pass-Through and Currency Invoicing." *Journal of International Economics*, 105: 187–204.

Dhyne, Emmanuel, Ayumu Ken Kikkawa, Magne Mogstad, and Felix Tintelnot. 2021. "Trade and Domestic Production Networks." *Review of Economic Studies*, 88(2): 643–68.

Eaton, Jonathan, and Samuel Kortum. 2002. "Technology, Geography, and Trade." *Econometrica*, 70(5): 1741–79.

Edmond, Chris, Virgiliu Midrigan, and Daniel Yi Xu. 2023. "How costly are markups?" *Journal of Political Economy*, 131(7): 1619–1675.

Eggertsson, Gauti B, Jacob A Robbins, and Ella Getz Wold. 2021. "Kaldor and Piketty's Facts: The Rise of Monopoly Power in the United States." *Journal of Monetary Economics*, 124: S19–S38.

Felix, Mayara. 2022. "Trade, Labor Market Concentration, and Wages." Massachusetts Institute of Technology. Job Market Paper.

Gopinath, Gita, Emine Boz, Camila Casas, Federico J Díez, Pierre-Olivier Gourinchas, and Mikkel Plagborg-Møller. 2020. "Dominant Currency Paradigm." *American Economic Review*, 110(3): 677–719.

Gopinath, Gita, Oleg Itskhoki, and Roberto Rigobon. 2010. "Currency Choice and Exchange Rate Pass-Through." *American Economic Review*, 100(1): 304–36.

Gutiérrez, Germán, and Thomas Philippon. 2019. "Fading Stars." In *AEA Papers and Proceedings*. Vol. 109, 312–16. American Economics Association.

Heise, Sebastian. 2019. "Firm-to-Firm Relationships and the Pass-Through of Shocks: Theory and Evidence." Federal Reserve Board of New York. Staff Report Number 896.

Hottman, Colin J, and Ryan Monarch. 2020. "A Matter of Taste: Estimating Import Price Inflation across US Income Groups." *Journal of International Economics*, 127: Article 103382. https://doi.org/10.1016/j.jinteco.2020.103382.

Huneeus, Federico. 2018. "Production Network Dynamics and the Propagation of Shocks." PhD diss. Princeton University, Princeton, NJ.

Kikkawa, Ayumu Ken, Glenn Magerman, and Emmanuel Dhyne. 2019. "Imperfect competition in firm-to-firm trade." *Available at SSRN 3389836*.

Lamadon, Thibaut, Magne Mogstad, and Bradley Setzler. 2022. "Imperfect Competition, Compensating Differentials, and Rent Sharing in the US Labor Market." *American Economic Review*, 112(1): 169–212.

Lim, Kevin. 2018. "Endogenous Production Networks and the Business Cycle." Working Paper.

Lucas, Robert E. 2003. "Macroeconomic Priorities." *American economic review*, 93(1): 1–14.

Morlacco, Monica. 2019. "Market Power in Input Markets: Theory and Evidence from French Manufacturing." Toulouse School of Economics.

Pennings, Steven. 2017. "Pass-through of competitors' exchange rates to US import and producer prices." *Journal of International Economics*, 105: 41–56.

Rauch, James E. 1999. "Networks versus markets in international trade." *Journal of international Economics*, 48(1): 7–35.

Zavala, Lucas. 2022. "Unfair Trade? Monopsony Power in Agricultural Value Chains." The World Bank.