# Oligopoly and Oligopsony in International Trade*

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**Abstract**

We study the effects of international trade on the oligopsony power of firms in input markets. We build a theoretical model of international trade in which firms are oligopolists in the market for final goods and oligopsonists in the market for inputs. Consistent with evidence from the literature, firms' markups over unit costs rise with the level of oligopsony power and of oligopoly power. While trade liberalization decreases market power in one market, it has the opposite effect in the other. In particular, international competition between oligopolists in final goods markets causes oligopsony power to increase and oligopoly power to decline. In a simulation, we show that the increase in oligopsony power can more than offset the reduction in oligopoly power, resulting in a net increase in markups over unit costs.

JEL Classification: F12, F13.

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# 1 Introduction

The significant concentration in both exports and imports that has been documented (Freund and Pierola, 2015; Bernard et al., 2018) has led to the growth of a large body of research on large firms.[1] Research has mainly focused on final goods markets in which large firms act as oligopolists and firms' higher market power is associated with higher markups (Atkeson and Burstein, 2008). In this case, international competition between oligopolists reduces their market power and generates pro-competitive gains from trade (Edmond et al., 2015). Recent empirical studies have revealed that the level of market concentration for various inputs of the production function is comparable to the concentration in final goods markets.[2] However, little is known about the link between market power in input markets, which we refer to as *oligopsony power*,[3] and international trade.

The goal of this paper is to analyze the effects of international trade on the oligopsony power of large firms. To achieve this goal, we introduce a tractable model that offers insights into the effects of international economic integration on concentration in input markets and oligopsony power. This link is particularly important as any shifts in oligopsony power due to international competition in final goods markets lead to markup adjustments that can have major welfare implications. In a simulation, we show that although international competition reduces market power in final goods markets, markups over unit costs can still increase because of the increase in oligopsony power.

Our model offers a new perspective on the effect of trade on market concentration and markups. We show that when firms are large in both final goods markets and input markets, greater openness in one market leads to a reduction in market power in that market, but an increase in market power in the other. This effect dampens the typical reduction in markups due to trade and, thus, only economic integration in both markets can reduce firms' market power in each market. These results suggest a dual approach for policymakers: efforts to reduce trade barriers in final goods markets should be accompanied by policies that promote competition in input markets.

Our approach builds on the oligopoly models of Atkeson and Burstein (2008) and Edmond et al. (2015). These models incorporate an inelastically supplied input (labor) in a perfectly

[1] In this context, the term "large firms" refers to those capable of influencing market aggregates and, thus, are typically modeled as oligopolists (Eckel and Neary, 2010; Neary, 2010), whereas "small firms" take market aggregates as given, as in monopolistic competition (Krugman, 1979; Melitz, 2003).

[2] Azar et al. (2020) document high levels of labor market concentration in US commuting zones. Morlacco (2017) finds high buyer power of French firms in foreign input markets. Buyer power, measured by markdowns, is quantitatively important across Chinese and Indian firms (Brooks et al., 2021) and US establishments (Yeh et al., 2022). For an empirical survey on buyer power, see Bhaskar et al. (2002).

[3] A market with few buyers is organized as an oligopsony: each buyer restricts its demand in an effort to keep prices low (Boal and Ransom, 1997).

competitive market, similar to the standard literature (Krugman, 1980; Melitz, 2003). By contrast, we generalize several theories of firms' market power in inputs' markets (Boal and Ransom, 1997; Bhaskar et al., 2002) by assuming an upward-sloping supply curve for the input and that only a few large firms buy the input in an oligopsonistic market. Our interpretation of the input is general and could include labor, capital, raw materials, or intermediate inputs.

In our model, the markup over unit costs is made of two components: a markup over marginal costs, which creates a wedge between the price and the marginal cost, and a markdown, which creates a wedge between the input price and its marginal revenue product (or equivalently, between the marginal cost and the unit variable cost). The product of these two wedges generates the markup over unit costs. The markdown arises as a result of firms exploiting their oligopsony power in the input market by limiting their demand to reduce the input price, in line with the evidence of Azar et al. (2020). The markup over marginal cost arises from oligopoly power, as firms restrict their supply to charge higher prices. Hence, our model features markups over unit costs that increase with both oligopsony power and oligopoly power. In line with the evidence of Morlacco (2017) and Yeh et al. (2022), the oligopsony power of a firm depends on the firm's demand relative to the aggregate demand for the oligopsonistic input: the larger a firm's demand share, the larger its oligopsony power.[4]

In case the input is domestically sourced, such as the labor supplied in local labor markets, international competition among large firms leads to an increase in oligopsony power. This outcome contrasts sharply with a model in which firms solely exploit oligopoly power. For instance, in Edmond et al. (2015), international integration in final goods markets causes firms to become smaller in the final goods market and their oligopoly power declines. Though such an effect persists in our model, the reduction in oligopoly power also reduces profits and forces some firms to exit. This decrease in the number of firms leads to greater market concentration in the domestic input market, resulting in higher oligopsony power of firms. As a result, markups over marginal costs decline, but markdowns increase and the effect of international integration on markups over unit costs depend on which of the two effects dominates, which in turn is a function of the model's parameters and assumptions.

The effects of trade on firms' market power are reversed in case of integration in the market for the oligopsonistic input. For example, consider the case in which firms (such as retailers) import their input internationally and sell their final goods only domestically.

[4]In our model, the oligopsony power of a firm is an increasing function of its demand share in the input market, and the oligopoly power of a firm is an increasing function of the firm's market share in the final goods market. Changes in market power are therefore due to variations in either or both of these shares. A firm's market power also depends on the other constant parameters that control the demand elasticity for final goods and the supply elasticity of the input.

Free trade of the input reduces the oligopsony power of firms: as more firms from various countries buy the same input, each firm's demand share in the input market decreases. Thus, the lower oligopsony power results in a decline in firms' profits, leading to the exit of some firms and increasing the oligopoly power of the remaining firms.

We employ numerical simulations to gain further insights and quantify the effects of oligopsony power on markup changes due to international trade. We calibrate the parameters that control demand and input supply elasticity by matching the observed markup over marginal costs and markdown for the US (De Loecker et al., 2020; Yeh et al., 2022), given the market shares of firms in input and final goods markets.[5] We focus on a domestically sourced input and, in our baseline results, on an initial equilibrium with two symmetric countries. To highlight the role of international competition, we first focus on a 5% reduction in import trade costs. The ensuing rise in import competition causes a 0.06% reduction in markups over marginal costs but an increase in markdowns by 0.36%, resulting in a 0.3% increase in the markup over unit costs after the rise in international competition. The effects of import competition can be mitigated by an increase in export opportunities. In fact, our simulation shows that a 5% reduction in both import and export trade costs significantly reduces the impact of oligopsony power. The markdown increases only by 0.01%, while the markup over marginal cost drops by 0.12%, driving markups over unit costs down by 0.11%.

We use simulations to test the robustness of our results, specifically addressing two primary assumptions in the model: Cournot competition and a single oligopsonistic input. Our analyses reveal that when Bertrand competition is assumed instead, the variations in markups and markdowns that follow an identical reduction in import trade costs are less pronounced than with Cournot competition. Moreover, we also explore a scenario where firms operate with two inputs, with one being accessible in a perfectly competitive market. Our findings indicate that the less significant the cost share of the oligopsonistic input, the smaller the change in the markup over unit costs following a change in trade costs. Additionally, we find that the magnitude of markdown changes increases with the inverse supply elasticity of the oligopsonistic input. On the other hand, the size of changes in markups over unit costs depends positively on the demand elasticity. Hence, when there is a reduction in import trade costs, determining whether the reduction in markups over unit costs outweighs the increase in markdowns relies on the specific values of the two elasticities.

To quantify the effect of oligopsony power on the magnitude of markup changes due to international trade, we also consider a model that only allows for oligopoly power. In this instance, the change in markups over marginal costs is similar to that predicted by our

[5]Although in our model we are agnostic about the nature of the input, for the simulation, we rely on the markdown estimates of Yeh et al. (2022) in the context of US labor markets.

baseline model. As a result, we can conclude that the absence of markdowns, which change in the opposite direction to markups over marginal costs, is the primary drawback of a model that only includes oligopoly power. Finally, we show that ignoring oligopsony power leads to a large underestimation of markup changes when the country experiencing the increase in import competition is large.

**Related Literature.** Our paper contributes to the ongoing discussion on the growing market power of US firms. In the last decades, the market share of the largest firms in the US has risen and so have firms' markups (Council of Economic Advisors, 2016; De Loecker et al., 2020). However, as demonstrated by Rossi-Hansberg et al. (2021), these large US firms have expanded geographically, reducing concentration in local markets. Our model can provide an explanation for the apparently divergent findings of rising national concentration and markups, combined with declining concentration in local markets. The process that generated the reduction in local markets concentration, by reducing markups, led to the exit of some firms. As fewer firms survive in each local market, concentration in domestic US inputs increases. The subsequent rise in oligopsony power can create an increase in markups that is more substantial than the impact of the decline in local market concentration.

The effect of international trade on markups is a critical element of the welfare gains from trade. Generally, international trade reduces markups of domestic firms, while it increases the markups of exporters; whether trade generates pro-competitive gains depends on the markup distribution (Arkolakis et al., 2018). The trade literature has been focusing on markups that depend only on the firm market power in final goods markets. However, our paper extends the conventional approach to better comprehend the role of oligopsony power. Our method is motivated by recent empirical research indicating that firms can also influence their prices in input markets (Morlacco, 2017; Brooks et al., 2021; Yeh et al., 2022).[6]

Although the international trade literature has studied the role played by large oligopolists (Atkeson and Burstein, 2008; Feenstra and Ma, 2007; Eckel and Neary, 2010; Amiti et al., 2014; Edmond et al., 2015; Neary, 2016; Macedoni, 2022b; Dhyne et al., 2022; Impullitti et al., 2022), oligopsony has received little attention until the recent years.[7] Our paper closely relates to the work of MacKenzie (2018) who studies the effect of oligopsony from an allocative efficiency perspective. The author finds that the effects of trade in the presence of

[6]The work by Brooks et al. (2021) also features a model in which firms have oligopoly power in final goods markets and oligopsony power in input markets. While they focus on the estimation of firm-level markups as a function of oligopoly and oligopsony power, we consider the equilibrium effects of economic integration.

[7]The early work of Bishop (1966), Feenstra (1980), Markusen and Robson (1980), and McCulloch and Yellen (1980) studied the effects of a monopsonistic industry in a Heckscher-Ohlin model. Our model confirms some of the authors' predictions: oligopsony generates distortions in the market allocation, which are exacerbated by trade in final goods.

oligopsony are only slightly larger relative to a counterfactual case of perfect competition in labor markets. This difference with our quantitative finding is likely due to the assumption of Bertrand competition both in the market for final goods and in the market for inputs of the model of MacKenzie (2018). In fact, under Bertrand competition, changes in markups and markdowns are much smaller than what predicted by Cournot competition, which is the baseline market structure of our model. Our policy recommendations are similar to those of Heiland and Kohler (2022) who recommend labor market integration along with international trade, since trade alone exacerbates labor market distortions due to monopsony power. Their paper strengthens our policy claim; the authors reach the same conclusion as us using a different model in which labor is the oligopsonistic input and workers are heterogeneous.[8]

Finally, our paper relates to studies that analyze sources of firms' market power beyond oligopoly. For instance, Raff and Schmitt (2009) consider retailers' ability to exercise market power by signing exclusive or non-exclusive contracts with manufacturers, while Bernard and Dhingra (2015) study the effects of exporters-importers contracts on welfare. Eckel and Yeaple (2017) discuss the market power that large multi-product firms have over workers when they are able to invest in identifying workers' skills. One feature shared by these papers and ours is that trade can exacerbate market distortions, leading to ambiguous welfare effects by increasing domestic market concentration.[9]

The remainder of the paper is organized as follows. Section 2 builds the baseline model. Section 3 presents the effects of international trade on firms' market power. Section 4 uses numerical simulations to quantify the role of oligopsony power in the context of a reduction in trade costs. Section 5 concludes.

# 2 Model

We consider a static model of international trade with $I$ countries indexed by $i$ for origin, and $j$ for destination. There are $L_i$ consumers in each country. To maintain tractability in the presence of large firms, we adopt the framework proposed by Eckel and Neary (2010) and Neary (2016), which involves a continuum of industries. Firms in each industry are large, meaning that they have oligopoly and oligopsony power, but they are small compared to the whole economy. We use the index $z \in [0, 1]$ to represent each industry. Since the

[8]The papers mentioned above rely on oligopsonistic competition. A parallel emerging literature introduces monopsonistic competition into models of trade, in which firms are able to affect their firm-specific input demand, while taking market aggregates as given (Egger et al., 2021; Jha and Rodriguez-Lopez, 2021; Macedoni, 2022a).

[9]Markusen (1989) obtains an analogous result in a two-sector model in which an industry features the costless assembly of differentiated inputs. Similarly, Arkolakis et al. (2018) showed that the distortions originating from variable markups are exacerbated by trade.

oligopsony power of firms stems from firms being large, this assumption allows us to focus on the oligopsony power of firms in the input specific to their industry. Since firms are large within their industry, they can impact the input's price, but their size is not sufficient to affect the prices of other inputs. By doing so, we simplify the model by abstracting from any cross-industry interactions.

In each industry $z$ of country $i$, there are $N_i(z)$ firms, indexed by $f$. All firms in a given industry and country are identical in terms of their cost requirements, although they produce differentiated varieties. In equilibrium, they charge the same prices and produce the same quantities. The market for final goods in each industry is oligopolistic. Moreover, to produce the differentiated final good, each firm requires an input, which is specific to the industry, and whose total supply in country $i$ is denoted by $K_i(z)$. The input is provided with an upward-sloping supply curve, and the market for the input is oligopsonistic. Both the input market and the final goods market are characterized by Cournot competition, with the number of firms determined by free entry. To export goods from country $i$ to country $j$, an iceberg trade cost $\tau_{ij}$ is incurred, where $\tau_{ii} = 1$.

## 2.1 Consumers' Problem

Consumers in each country $j = 1, ..., I$ have a two-tier utility function. The first tier is a Cobb-Douglas aggregator over the continuum of industries $z \in [0, 1]$:

$$U_j = \int_0^1 \ln u_j(z) dz \ . \tag{1}$$

Following Atkeson and Burstein (2008) and Edmond et al. (2015), we assume that $u_j(z)$ is a Constant Elasticity of Substitution (CES) quantity index with elasticity of substitution $\sigma(z) > 1$:

$$u_j(z) = \left[ \sum_{i=1}^{I} \sum_{f=1}^{N_i(z)} q_{fij}(z)^{\frac{\sigma(z)-1}{\sigma(z)}} \right]^{\frac{\sigma(z)}{\sigma(z)-1}} \tag{2}$$

where $q_{fij}(z)$ is the quantity of the variety produced by firm $f$, exported from $i$ to $j$, which is sold at the price $p_{fij}(z)$. Consumers maximize utility (1) by choosing $q_{fij}(z)$, subject to the following budget constraint:

$$\int_0^1 \sum_{i=1}^{I} \sum_{f=1}^{N_i(z)} p_{fij}(z) q_{fij}(z) dz \leq y_j \tag{3}$$

where $y_j$ is the per capita income in $j$. The first-order condition with respect to $q_{fij}(z)$ yields:

$$\lambda_j p_{fij}(z) = \frac{q_{fij}(z)^{-\frac{1}{\sigma(z)}}}{\sum_{i=1}^{I}\sum_{f=1}^{N_i(z)} q_{fij}(z)^{\frac{\sigma(z)-1}{\sigma(z)}}} \tag{4}$$

where $\lambda_j = y_j^{-1}$ is the marginal utility of income. To maintain tractability and simplify the model, we adopt the assumption from Eckel and Neary (2010) that firms are large within their industry but small relative to the economy. Analytically, this implies that firms do not internalize their effects on $\lambda_j$. Following Eckel and Neary (2010), we can normalize per capita income to one ($y_j = 1$), which implies, by the definition of $\lambda_j$, that $\lambda_j = 1$: the framework proposed by Eckel and Neary (2010) is equivalent to having a quasi-linear utility function. Although this abstraction implies an absence of income effects, we should note that the price of the oligopsonistic input, which we describe in the next section, is not fixed and can vary across countries.

Letting $x_{fij} = L_j q_{fij}$ denote the aggregate demand for the final good, the aggregate inverse demand is then:

$$p_{fij}(z) = \frac{L_j x_{fij}(z)^{-\frac{1}{\sigma(z)}}}{\sum_{i=1}^{I}\sum_{f=1}^{N_i(z)} x_{fij}(z)^{\frac{\sigma(z)-1}{\sigma(z)}}}\ . \tag{5}$$

For the remainder of the paper, we focus on a single industry and, thus, we drop argument $z$ from our notation. Given the functional form for the upper tier of the utility function, and our income normalization, we can abstract from interactions across industries.

## 2.2 Supply of the Oligopsonistic Input

To model oligopsony, we assume that the supply curve for the specific input $K_i$ is upward-sloping. We assume that the input is supplied with a constant elasticity of $1/\gamma > 0$, to maintain symmetry with the final goods market. Hence, $\gamma$ represents the inverse supply elasticity. Let $r_i$ denote the price for the input in country $i$. The inverse supply curve is given by:

$$r_i = \tilde{\gamma}_i K_i^{\gamma} \tag{6}$$

where $\tilde{\gamma}_i$ is a country-specific supply shifter. In Online Appendix A.1, we provide a microfoundation for (6) by assuming that households experience disutility from supplying the input.

Our approach contrasts with the traditional literature on international trade that deals with both small (Krugman, 1980; Melitz, 2003) and large firms (Eckel and Neary, 2010; Edmond et al., 2015). This literature typically assumes that inputs in production are supplied inelastically. However, if the input is inelastically supplied (i.e., $\gamma \to \infty$), and firms are oligopsonistic, the equilibrium price of the input drops to zero. This occurs because oligopsonistic firms reduce their demand for the input to decrease its price. If the input supply is perfectly inelastic, firms can decrease their demand until the price reaches zero without affecting the equilibrium quantity of the input.

To simplify the notation, we assume that the input is supplied only to domestic firms (we relax this assumption in Section 3.1). Each firm $f$ demands $k_{fij}$ units of the input to produce its differentiated variety and sell it to country $j$. The total demand for the input by firm $f$, denoted by $k_{fi}$, is the sum of $k_{fij}$ across all destinations that the firm serves, i.e., $k_{fi} = \sum_{j=1}^{I} k_{fij}$. Thus, the aggregate demand for the input is given by $\sum_{f=1}^{N_i} k_{fi} = \sum_{f=1}^{N_i} \sum_{j=1}^{I} k_{fij}$. If the input is internationally sourced, the aggregate demand would instead be given by $\sum_{i=1}^{I} \sum_{f=1}^{N_i} \sum_{j=1}^{I} k_{fij}$.

## 2.3 Firms' Problem

Each firm pays a fixed cost $F_i$, which is independent of the quantity produced and is expressed in units of the numeraire. The unit requirement to produce a variety $x_{fij}$ from $i$ to $j$ by firm $f$ is $\tau_{ij} c_{fi}$ and is expressed in units of the oligopsonistic input. Since firms are homogeneous in their unit costs, $c_{fi} = c_i \ \forall f = 1, ..., N_i$. However, we leave the firm subscript $f$ in this section to highlight the relationship between a firm's own input requirement and its effects on the input price. Firm $f$'s demand for the input is $k_{fij} = \tau_{ij} c_{fi} x_{fij}$.

To highlight the effect of a single firm on the price for the input, let us re-write the inverse supply function of $K_i$ (6). From the market-clearing condition $\sum_{f=1}^{N_i} \sum_{j=1}^{I} k_{fij} = K_i$, we have:

$$r_i = \tilde{\gamma}_i K_i^{\gamma} = \tilde{\gamma}_i \left[ \sum_{f=1}^{N_i} \sum_{j=1}^{I} \tau_{ij} c_{fi} x_{fij} \right]^{\gamma} . \tag{7}$$

Firms maximize their profits by choosing the quantity $x_{fij}$ to sell to each destination, taking other firms' choices as given. Given the inverse demand function for the final good (5) and the inverse supply function of the input (7), the profits of firm $f$ are given by:

$$\begin{aligned} \pi_{fi} &= \sum_{j=1}^{I} p_{fij} x_{fij} - r_i \sum_{j=1}^{I} \tau_{ij} c_{fi} x_{fij} - F_i = \\ &= \sum_{j=1}^{I} \frac{L_j x_{fij}^{\frac{\sigma-1}{\sigma}}}{\sum_{i=1}^{I} \sum_{f=1}^{N_i} x_{fij}^{\frac{\sigma-1}{\sigma}}} - \tilde{\gamma}_i \left[ \sum_{f=1}^{N_i} \sum_{j=1}^{I} \tau_{ij} c_{fi} x_{fij} \right]^{\gamma} \sum_{j=1}^{I} \tau_{ij} c_{fi} x_{fij} - F_i \, . \end{aligned} \tag{8}$$

Firms are oligopolists and internalize their effects on the quantity index in the demand function. They are also oligopsonists and internalize their effects on the input price $r_j$ through their demand for the input. Due to oligopsony power, a firm's choice of quantity in one destination $j$ is not independent of the quantity choice in another destination $j'$. Increasing the supply in destination $j$ increases the price of the input $r_i$ and, therefore, the unit costs of the quantity supplied across all destinations.

The first-order condition with respect to quantity highlights the effects of market power in the final goods and the inputs markets:

$$\frac{\sigma-1}{\sigma}\frac{L_j x_{fij}^{-\frac{1}{\sigma}}}{\sum_{i=1}^{I}\sum_{f=1}^{N_i} x_{fij}^{\frac{\sigma-1}{\sigma}}}\left[1-\underbrace{\frac{x_{fij}^{\frac{\sigma-1}{\sigma}}}{\sum_{i=1}^{I}\sum_{f=1}^{N_i} x_{fij}^{\frac{\sigma-1}{\sigma}}}}_{\text{Oligopoly Market Share}}\right]-r_i\tau_{ij}c_{fi}\left[1+\gamma\underbrace{\frac{\sum_{j=1}^{I}\tau_{ij}c_{fi}x_{fij}}{\sum_{f=1}^{N_i}\sum_{j=1}^{I}\tau_{ij}c_{fi}x_{fij}}}_{\text{Oligopsony Demand Share}}\right]=0\,. \tag{9}$$

To provide intuition for the first-order condition, we can use revenue and demand shares to represent the extent of oligopoly and oligopsony power. Let $s_{fij}$ denote the oligopoly market share, which is the share of a firm's revenues over total revenues in a destination $j$.[10] Let $s^o_{fi}$ denote the oligopsony demand share, which is the share of a firm's demand for the input over total demand in country $i$. We define the two market shares as:

$$s_{fij}=\frac{x_{fij}p_{fij}}{\sum_{i=1}^{I}\sum_{f=1}^{N_i} x_{fij}p_{fij}}=\frac{x_{fij}^{\frac{\sigma-1}{\sigma}}}{\sum_{i=1}^{I}\sum_{f=1}^{N_i} x_{fij}^{\frac{\sigma-1}{\sigma}}} \tag{10}$$

$$s^o_{fi}=\frac{k_{fi}}{\sum_{f=1}^{N_i} k_{fi}}=\frac{\sum_{j=1}^{I}\tau_{ij}c_{fi}x_{fij}}{\sum_{f=1}^{N_i}\sum_{j=1}^{I}\tau_{ij}c_{fi}x_{fij}}\,. \tag{11}$$

Due to oligopoly power, the firm realizes that by increasing its supply of the good, it increases the aggregate quantity ($\sum_{i=1}^{I}\sum_{f=1}^{N_i} x_{fij}^{\frac{\sigma-1}{\sigma}}$) and reduces its inverse demand function in a way that is proportional to its market share $s_{fij}$. On the other hand, due to oligopsony power, when the firm increases the supply of the good, it also increases the demand for the input, which results in an increase in the input's price $r_i$. This increase in $r_i$ raises the variable costs of production for all the destinations reached by the firm. The effect of an increase in $r_i$ is proportional to the firm's demand share for the input $s^o_{fi}$.

[10] Using (5), the revenues of the firm in a destination equal $x_{fij}p_{fij}=L_j x_{fij}^{1-\frac{1}{\sigma}}\left[\sum_{i=1}^{I}\sum_{f=1}^{N_i} x_{fij}^{\frac{\sigma-1}{\sigma}}\right]^{-1}$.

Using (5), (10), and (11) into (9) yields the pricing rule:

$$p_{fij} = r_i \tau_{ij} c_{fi} \underbrace{\frac{\sigma}{\sigma - 1} \left( \frac{1 + \gamma s^o_{fi}}{1 - s_{fij}} \right)}_{\text{Markup Over Unit Costs}} . \tag{12}$$

For ease of explanation, the theoretical analysis mainly focuses on the markup defined as the ratio of price over input's unit costs $\frac{p_{fij}}{r_i \tau_{ij} c_{fi}}$.[11] In our model, there are two wedges between the price and the unit costs. The first wedge is the markup over marginal costs, which depends on the market share of the firm in the final goods market. The second wedge is the markdown on the input price, which is the ratio of marginal costs to unit costs, and it depends on the market share of the firm in the input market. The two wedges can be expressed as:

$$\text{Markup over marginal costs: } \frac{\sigma}{(\sigma - 1)(1 - s_{fij})} \tag{13}$$

$$\text{Markdown: } 1 + \gamma s^o_{fi} . \tag{14}$$

As in standard models of oligopoly (Atkeson and Burstein, 2008; Edmond et al., 2015), firms with higher market share in the final goods market, enjoy higher markups. In addition, in our model, higher market share in the input market, increases markups as well. A firm with a large $s^o_{fi}$ realizes that increasing its production raises the price of the input. Therefore, at higher values of $s^o_{fi}$, firm $f$ restricts its supply of the final good by charging higher markdowns.

We can obtain a simple expression for the optimal quantity $x_{fij}$ supplied by a firm in a destination $j$ as a function of the firm's market shares in the final goods and input markets. To do this, we rearrange the definition of market share as $x_{fij} = \frac{s_{fij} L_j}{p_{fij}}$, and use the pricing rule (12). This gives us the following expression for $x_{fij}$:

$$x_{fij} = \frac{(\sigma - 1) L_j}{\sigma r_i \tau_{ij} c_{fi}} \frac{s_{fij}(1 - s_{fij})}{1 + \gamma s^o_{fi}} . \tag{15}$$

As a firm's oligopsony share $s^o_{fi}$ increases, its supply of the final good decreases across all destinations. Interestingly, there is a non-monotonic, hump-shaped relationship between the supply of the final good and a firm's market share $s_{fij}$ in a destination. When firms are small, a larger market share is positively related to the supply of the final good. However, when a firm's sales account for more than half of the market, a larger market share reduces the supply of the final good.

[11] In our simulations, we distinguish explicitly between the effects of trade on markups over marginal costs, markdowns, and markups over unit costs.

We exploit the definition of market share, $x_{fij} = \frac{s_{fij}L_j}{p_{fij}}$, to derive a simple expression for a firm's operating profits in a destination as a function of oligopoly and oligopsony power:

$$\pi_{fij} = x_{fij}p_{fij} - r_i\tau_{ij}c_{fi}x_{fij} = s_{fij}L_j - r_i\tau_{ij}c_{fi}\frac{s_{fij}L_j}{p_{fij}} = s_{fij}L_j\left[1 - \frac{\sigma-1}{\sigma}\frac{1-s_{fij}}{1+\gamma s^o_{fi}}\right] . \quad (16)$$

A firm's profits in a given destination $j$ increase with both its oligopoly and oligopsony market shares. Summing up across all destinations and subtracting the fixed cost yields a firm's total profits:

$$\pi_{fi} = \sum_{j=1}^{I}\pi_{fij} - F_i = \sum_{j=1}^{I} s_{fij}L_j\left[1 - \frac{\sigma-1}{\sigma}\frac{1-s_{fij}}{1+\gamma s^o_{fi}}\right] - F_i . \quad (17)$$

## 2.4 Equilibrium

We assume that all firms within an industry have the same variable input requirement level $c_{fi} = c_i \ \forall \ f = 1, ..., N_i$. We focus on the symmetric equilibrium, in which all surviving firms produce the same quantities. Therefore, we can drop the subscript $f$ and treat all firms within an industry as homogeneous in terms of input requirements.

In equilibrium, free entry drives profits (17) to zero:

$$\sum_{j=1}^{I} s_{ij}L_j\left[1 - \frac{\sigma-1}{\sigma}\frac{1-s_{ij}}{1+\gamma s^o_i}\right] = F_i . \quad (18)$$

Since all firms from $i$ are identical, they demand the same number of units of the input and, therefore, the demand share on the domestic input is the reciprocal of the number of firms in a country, namely:

$$s^o_i = \frac{1}{N_i} . \quad (19)$$

Let us derive the total demand for $K_i$ as well as its price $r_i$. Using the definitions of $s^o_i$ (11), $s_{ij}$ (10), and the pricing rule (12), $K_i$ becomes:

$$K_i = N_i k_i = \frac{k_i}{s^o_i} = \frac{1}{s^o_i}\sum_{j=1}^{I} c_i x_{ij}\tau_{ij} = \frac{1}{s^o_i}\sum_{j=1}^{I}\frac{c_i\tau_{ij}L_j s_{ij}}{p_{ij}} =$$

$$= \frac{\sigma-1}{\sigma r_i s^o_i(1+\gamma s^o_i)}\sum_{j=1}^{I} L_j(1-s_{ij})s_{ij} . \quad (20)$$

Combining the aggregate demand for the input (20) with the aggregate supply (6) yields the equilibrium price for the input:

$$r_i = \left[ \tilde{\gamma}_i^{\frac{1}{\gamma}} \frac{\sigma - 1}{\sigma s_{fi}^o (1 + \gamma s_i^o)} \sum_{j=1}^{I} L_j (1 - s_{ij}) s_{ij} \right]^{\frac{\gamma}{1+\gamma}} . \tag{21}$$

The final goods market clearing condition is given by:

$$\sum_{i=1}^{I} N_i s_{ij} = \sum_{i=1}^{I} \frac{s_{ij}}{s_i^o} = 1 . \tag{22}$$

The equilibrium of the model is characterized by a vector of the market shares $s_{ij}$ and $s_i^o$ and input price $r_i$, such that each firm chooses the optimal quantity $x_{ij}$ according to (15), profits (17) equal zero,[12] final goods markets clear, input markets clear, and trade is balanced. Given $s_i^o$, the equilibrium number of firms is given by (19).

# 3 Effects of International Trade

In this section, we examine the impact of international trade on firms' market power by conducting two thought experiments. The first experiment is a replication of the exercise conducted by Eckel and Neary (2010), in which we analyze the consequences of an increase in the number of countries that engage in frictionless trade of final goods or inputs. The second experiment involves investigating the effects of a reduction in iceberg trade costs in a multi-country scenario. While we assume that the countries are symmetric in this section, we account for potential asymmetry in the quantitative analysis.

## 3.1 International Economic Integration

In this section, we investigate the impact of international economic integration modeled as in Eckel and Neary (2010). Specifically, we consider the effects of an increase in the number of countries in a scenario with frictionless trade, where all iceberg trade costs ($\tau_{ij}$) are assumed to be equal to one. This stylized thought experiment allows us to examine the effects of trade in the presence of oligopsony in the simplest manner possible.

Let $I$ and $I^o$ represent the number of countries with integrated final goods markets and integrated input markets, respectively. We assume a fully symmetric equilibrium, which

[12] It is important to note that in the interest of tractability, the model ignores the integer problem, which is common in models with large firms that are oligopolists or oligopsonists (Neary, 2010). Assuming homogeneity among firms, free entry implies zero profits. See Atkeson and Burstein (2008) for a model in which free entry does not imply zero profits.

places certain restrictions on the values of $I$ and $I^o$.[13] For this reason, our comparative statics exercise can be best understood as follows. In the initial allocation, countries are in autarky ($I = I^o = 1$). To investigate the effects of international integration in final goods, we compare this initial allocation to one in which $I > 1$ and $I^o = 1$ (or in which $I^o > 1$ and $I = 1$ for the case of integration in input markets). If two countries have integrated, the exercise is equivalent to the traditional two-country models examined in the literature.

Since all firms are identical and there are no iceberg trade costs of exporting, each firm's market share in the final goods market of any country is equal to $s = \frac{1}{IN}$, while their demand share for inputs is $s^o = \frac{1}{I^o N}$. Adapting the zero-profit condition (17) to account for the symmetric countries assumption yields:

$$IsL\left[1 - \frac{\sigma - 1}{\sigma}\frac{1 - s}{1 + \gamma s^o}\right] = F \; . \tag{23}$$

To understand how international economic integration affects the market power in the final goods and input markets, we consider two equilibrium conditions. The first one represents the relative market power (RMP) of firms in the final goods markets as a function of the number of integrated countries:

$$\frac{s}{s^o} = \frac{I^o}{I} \; . \qquad \text{(RMP)}$$

The relative market power of firms $\frac{s}{s^o}$ is inversely related to the relative number of integrated countries $\frac{I^o}{I}$. All else constant, the larger the number of integrated countries in the final goods market, the smaller the market share of each firm in that market. In the $(s, s^o)$ space, RMP is represented by a linear relationship between $s$ and $s^o$, with a slope that depends on the relative number of integrated countries in the two markets. The positive slope indicates that, holding all else constant, an increase in a firm's size leads to an increase in its market power in both markets.

By substituting $I = I^o s^o s^{-1}$ using RMP into the zero-profit condition (23) and rearranging, we obtain the second equilibrium condition:

$$s = 1 - \frac{\sigma}{\sigma - 1}\left[1 + \gamma s^o - \frac{F}{I^o s^o L} - \frac{\gamma F}{I^o L}\right] \; . \qquad \text{(ZP)}$$

In the $(s, s^o)$ space, ZP is represented by a negative relationship between $s$ and $s^o$. To maintain profits constantly at zero, any increase in a firm's market power in one market

[13] For instance, if $I^o = 2$ and $I = 3$, there would be one country without an integrated input market, and this would violate our symmetry assumption, as the oligopsony power of firms in this country would differ from those in the other two countries.

must be offset by a reduction in market power in the other market, all else being equal.[14]

We now examine the impact of integration in the final goods market. Figure 1 illustrates that as the number of countries $I$ participating in the trade of final goods increases, the market share $s$ of each firm declines while the demand share $s^o$ for inputs increases. The integration of final goods markets leads to greater competition among oligopolists, resulting in a reduction in their market share $s$. As per the zero-profit condition, this reduction in market share causes some firms to exit the market, leading to increased concentration in the oligopsonistic input market and, consequently, an increase in the demand share $s^o$. Therefore, while the integration of final goods markets reduces the oligopoly power, it has the opposite effect on the oligopsony power, which increases.

Figure 1: Final Goods Market Integration

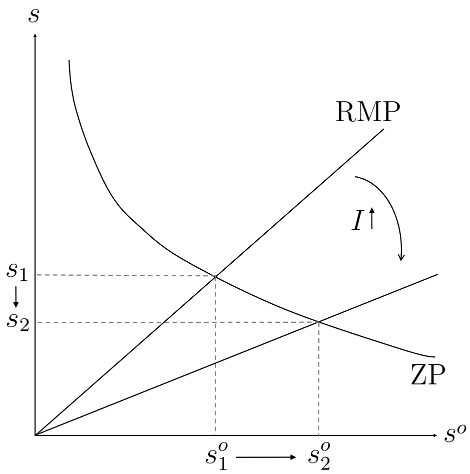
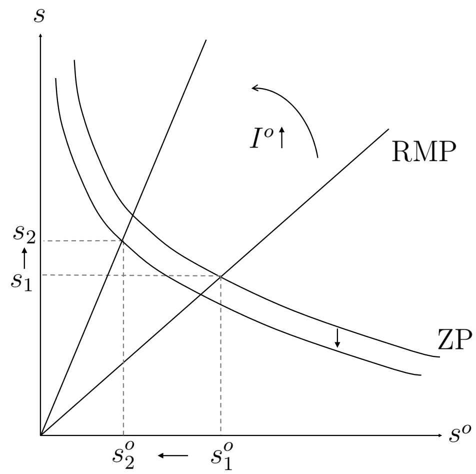



Figure 2: Input Market Integration

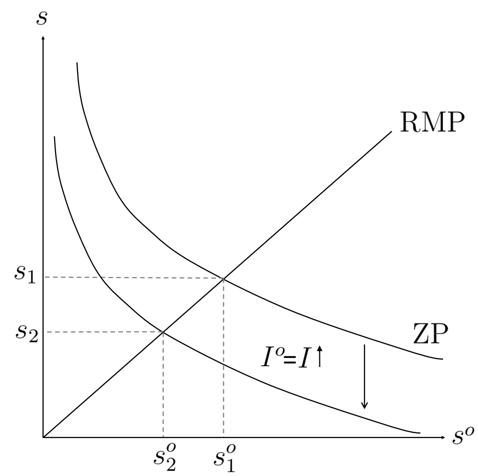



In contrast, the integration of the input market has the opposite effect. As shown in Figure 2, an increase in the number of countries with integrated input markets $I^o$ leads to an increase in the market share $s$ and a decline in the demand share for inputs $s^o$. The increase in $I^o$ rotates RMP counterclockwise and shifts ZP down. Although this suggests that the change in $s$ is ambiguous, we demonstrate unambiguously in Online Appendix A.2.2 that $s$ increases following integration in input markets. As the number of firms in the input market increases, the demand share of each firm declines. This reduction in $s^o$ reduces the profitability of firms, and by the zero-profit condition, some firms exit. As a result, fewer firms serve the final goods market, leading to an increase in their market share $s$.

When firms are large in both the final and input markets, opening up to trade in one of these markets leads to a reduction in market power that is accompanied by an increase in market power in the other market. Only economic integration across all markets can reduce

[14]In Online Appendix A.2.1, we derive the sufficient condition for the existence of the equilibrium.

Figure 3: Final Goods and Input Market Integration




the market power of firms in both final goods and input markets. Figure (3) demonstrates the impact of an increase in the number of integrated countries, assuming that $I = I^o$ for clarity. This shift lowers ZP while keeping RMP unchanged. As firms experience a loss of market power in both markets, both $s^o$ and $s$ decline.

**Input Prices, Markups and Markdowns.** We now summarize the impact of oligopsony power on input prices, markups, and markdowns in the context of an increase in the number of countries with integrated final goods markets, and we assume that $I^o = 1$ for the sake of simplicity in the derivations. These derivations are presented in Online Appendix A.2.3.

International economic integration leads to an increase in the price of inputs. Despite the increase in market concentration, an increase in the number of countries participating in trade results in a higher price for the input. As a result of economic integration, higher production leads to an increase in the demand for inputs, and thus an increase in their price. The magnitude of the increase in the input's price is inversely related to the oligopsony power of firms. Although oligopsony power reduces the gains for the input, it does not completely offset them.

An increase in the number of countries with integrated final goods markets has a twofold effect on markups over unit costs. First, a reduction in the market share $s$ brings down markups over marginal costs. Second, the increase in the oligopsony demand share $s^o$ has a positive effect on markdowns. We demonstrate that, in this scenario, the first effect dominates, resulting in a reduction in markups over unit costs due to economic integration. However, the larger the oligopsony power of firms, the smaller the reduction in markups over unit costs.

## 3.2 Effects of a Reduction in Trade Costs

In this section, we study the effects of international economic integration modeled as a reduction in the iceberg trade costs. We maintain the assumption of $I$ symmetric countries and assume that the input is domestically sourced. Let $\tau_{ij} = \tau_{ji} = \tau$ for $i \neq j$ and $\tau_{ii} = 1$, $c_i = c$ and $L_i = L$ $\forall i = 1, ..., I$. As in the previous section, due to symmetry, $N_i = N$ and $r_i = r$. We leave the detailed derivations to Online Appendix A.3.

To simplify the notation, we define the market share in the final goods market as $s = s_{jj}$ $\forall j = 1, ..., I$ in the domestic economy, and $s^* = s_{ij} = s_{ji}$ $\forall i, j = 1, ..., I$ in export markets. Since the input is domestically sourced, the oligopsony share is the reciprocal of the number of firms from one country: $s^o = \frac{1}{N}$. The domestic and export market shares in final goods are linked by the following relationship:

$$\frac{s^{\frac{1}{\sigma-1}}}{1-s} = \tau \frac{{s^*}^{\frac{1}{\sigma-1}}}{1-s^*} \ . \tag{24}$$

Intuitively, in the presence of iceberg trade costs ($\tau > 1$), the domestic market share is larger than the export market share. Hence, export markups are lower than domestic markups.

We can rewrite (24) as our RMP curve, which reflects the relative domestic market power of firms, using the market-clearing condition $Ns + (I-1)Ns^* = 1$ and the definition $N = \frac{1}{s^o}$. The RMP curve is represented by the following expression:

$$\frac{1-s}{s^{\frac{1}{\sigma-1}}} = \frac{1}{\tau} \frac{1 - \frac{s^o - s}{I-1}}{\left(\frac{s^o - s}{I-1}\right)^{\frac{1}{\sigma-1}}} \ . \tag{RMP}$$

As demonstrated in Online Appendix A.3, RMP is represented by an increasing function in the $(s, s^o)$ space, similarly to the previous section.

In the presence of symmetric countries and iceberg trade costs, a firm's profits are the sum of the profits obtained in the home country and the profits obtained in export markets. Using the market clearing condition, the zero-profit condition becomes:

$$ZP(s, s^o) \equiv s^o + \frac{\sigma-1}{\sigma}\frac{1}{1+\gamma s^o}\left[\frac{s}{I-1}(Is - 2s^o)\right] - \frac{\sigma-1}{\sigma}\frac{1}{1+\gamma s^o}\left(s^o - \frac{1}{I-1}(s^o)^2\right) = \frac{F}{L} \ .$$

By the implicit function theorem:

$$\frac{ds}{ds^o} = -\frac{\partial ZP/\partial s^o}{\partial ZP/\partial s} < 0 \ . \tag{25}$$

Hence, ZP is decreasing in the $(s, s^o)$ space, analogously to the previous section. By holding profits equal to zero, higher market power in domestic final goods markets has to be offset by a decrease in market power in the domestic input market.

A graph similar to Figure 1 can be used to study the effects of a reduction in iceberg trade costs. The RMP curve is rotated clockwise as trade costs decrease. As a result, the new equilibrium has a higher oligopsony market share $s^o$ and a lower oligopoly domestic market share $s$. The effects of reducing trade costs are analogous to the effects of increasing the number of integrated countries, which were explored in the previous section. By lowering iceberg trade costs, domestic oligopoly power in final goods decreases, but oligopsony power in the input market increases.

Reducing trade costs increases export revenues while decreasing domestic sales. Consequently, oligopoly power in export markets increases, while domestic oligopoly power declines. The shift in oligopoly power forces firms to reallocate their resources from high-markup domestic production to low-markup export production. As a result, firms' profits decline, leading to some firms exiting the market. With fewer firms demanding the domestic input, oligopsony power increases.

**Input Prices, Markups and Markdowns.** Similar to the experiment of increasing the number of integrated countries, a reduction in iceberg trade costs has a positive effect on input prices. Lowering trade costs leads to an increase in the input price, but the extent of the increase is lower with higher oligopsony power.

A reduction in iceberg trade costs leads to higher markdowns and lower markups over marginal costs due to the higher oligopsony power and lower oligopoly power. However, it is unclear which of these changes dominates, and markups over unit costs can either increase or decrease in this version of the model. In the next section, we use numerical methods to explore the conditions under which the increase in markdowns dominates the reduction in markups over marginal costs.

# 4 Simulations

In this section, we use numerical simulations to quantify the effects of oligopsony power on markups in the context of a reduction in trade costs. We use these simulations to complement the analytical findings from the previous section by examining more complex frameworks that are less amenable to analytical treatment, such as those with asymmetric countries. We also explore the sensitivity of our results to different model parametrizations and extensions. Finally, we evaluate the role of oligopsony power by comparing our simulation results to those from a model without oligopsony power.

## 4.1 Calibration of Parameters

In our baseline exercise, we examine a two-country model featuring iceberg trade costs. Initially, the two countries are symmetric, as described in section 3.2. We use the subscript $h$ to denote the home country and the subscript $a$ to denote the foreign country ($a$ as in abroad). To carry out our numerical exercise, we need to make choices regarding the values of several variables. These variables include the initial market shares of home and foreign firms, as well as the demand and supply parameters $\sigma$ and $\gamma$. These two parameters determine the degree of oligopoly and oligopsony power, given a level of market shares. Additionally, we need to select parameters for the fixed requirements of production and the initial variable requirements of production and delivery.

We begin by setting the oligopsony share for both home and foreign firms in the baseline, symmetric country model to $s_h^o = s_a^o = 0.06$. This value is based on the average oligopsony share across sectors calculated for the US using UNIDO data from 2005. UNIDO provides information on the number of establishments in each sector. In a model with homogeneous firms and domestically sourced inputs, the oligopsony share is the reciprocal of the number of establishments (see (19)). The average oligopsony share across all sectors in the US was found to be 0.06. Next, we set the export market share to $s_h^* = s_a^* = 0.02$. This value, in accordance with the market clearing condition (22), results in a domestic market share in the final goods market equal to $s_h = s_a = 0.04$.

We calibrate the parameters $\sigma$ and $\gamma$ using the average markup over marginal costs and the average markdown estimated in the literature. In our baseline model, the domestic markup over marginal costs is given by $\frac{\sigma}{(\sigma-1)(1-s_h)}$ (see (13)). De Loecker et al. (2020) have estimated the average domestic markup for the US to be 1.61. For a domestic market share of 0.04, this corresponds to a value of $\sigma = 2.83$. In our baseline model, the markdown on the price of the input is $1 + \gamma s_h^o$ (see (14)). Our model does not make any assumptions about the specific type of input being considered, but the empirical literature has estimated markdowns for particular factors of production. To set our baseline specification, we rely on recent findings by Yeh et al. (2022), who study the labor market and estimate the average markdown on wages in the US to be 1.53. We assume that labor serves as the oligopsonistic input and set $\gamma = 8.83$ for an oligopsony share of 0.06, which are both US-based targets.

We assume that both countries are identical in size, with $L_h = L_a = 0.5$. With the given values for the market shares of firms, the size of the two countries, and the parameters $\sigma$ and $\gamma$, we can calculate the remaining parameters by applying the equilibrium conditions. Specifically, we use the zero-profit conditions to determine the fixed cost of production (18), and we use the connection between the relative revenues of exporters to domestic firms to derive the relative input requirements for production and delivery.

Online Appendix B.1 provides a detailed derivation of the baseline model and its extensions, as well as the calibration procedure. In our simulation, the exogenous parameters include the supply and demand elasticities $\gamma$ and $\sigma$, the fixed costs of production $F_i$ for $i = h, a$, the relative input requirements of production and delivery $\tau_{ij}c_i/\tau_{jj}c_j$ for $i, j = h, a$, and the size of the two countries $L_i$ for $i = h, a$. Given a change in the relative input requirements of production and delivery, we can solve for the equilibrium values of the endogenous variables, i.e., the oligopsony and oligopoly market shares ($s_i^o$, $s_i$, and $s_i^*$ for $i = h, a$) and the input prices $r_i$ for $i = h, a$.

## 4.2 The Effects of a Reduction in Trade Costs

In our baseline numerical exercise, we examine how a decrease in import trade costs $\tau_{ah}$ for the home country affects home markups and markdowns. A reduction in $\tau_{ah}$ can be interpreted as a unilateral trade liberalization measure implemented by the home country. This action leads to an increase in the level of competition in the final goods market of the home country, making it an ideal scenario to illustrate the main argument of our paper.

We first present a graphical analysis of how the oligopsony and oligopoly shares respond to variations in import trade costs. As shown in Figure 4, a decrease in the import iceberg trade costs from 4 to 1 results in an increase in the oligopsony share $s_h^o$ from 5.5% to 7%, while the oligopoly share $s_h$ decreases from 5% to 4%. Both changes are of a similar magnitude but of opposite sign, consistent with the theoretical predictions.

In Figure 5, we examine how markups and markdowns respond to changes in import iceberg trade costs. As predicted by theory, an increase in competition in final goods markets leads to a decrease in markups over marginal costs and an increase in markdowns. While in section 3.2, which of the two effects dominates is ambiguous, in our numerical exercise, we find that the increase in markdowns actually outweighs the reduction in markups over marginal costs, resulting in an increase in the markup over unit costs. Specifically, a decrease in $\tau_{ah}$ from 4 to 1 leads to a 1.1% reduction in markups over marginal costs, but an 8.7% increase in markdowns. Notably, the magnitude of these changes is larger when trade costs are initially low, indicating that markups and markdowns are more responsive to changes in trade costs when trade costs are already low.

Figure 4: Market Shares

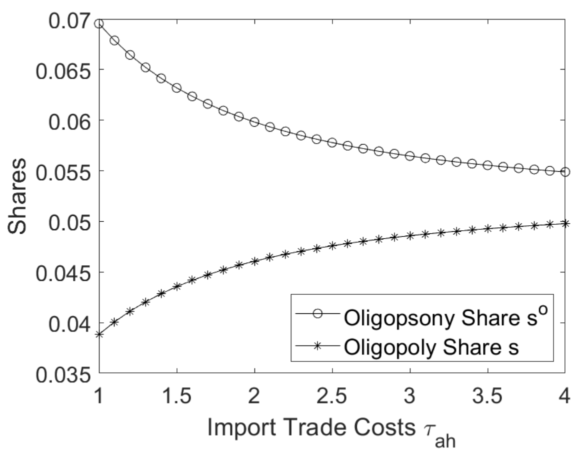



Figure 5: Markups and Markdowns

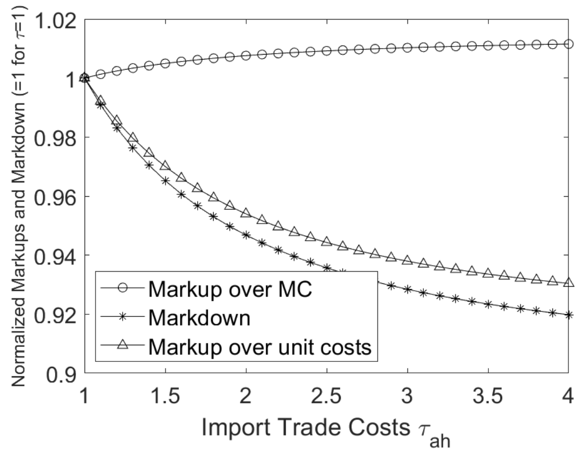



Figure 4 displays how the market shares $s_h$ and $s_h^*$ vary with different levels of trade costs. In Figure 5, we illustrate the changes in markup over marginal costs, markdown, and markup over unit costs for different levels of trade costs. The values of the three variables are normalized by their value at $\tau_{ah} = 1$. We assume an export iceberg trade cost of $\tau_{ha} = 2$. The calibrated parameters used in the exercise are: $\sigma = 2.83$, $\gamma = 8.83$, $F_h = F_a = 0.018$, $L_h = L_a = 0.5$, and $c_h = c_a = 1$.

In the first column of Table 1, we show the results of a 5% reduction in $\tau_{ah}$ on the home country's variables in our baseline specification. This scenario assumes that the countries are initially symmetric in equilibrium, and we use the parameters calibrated according to the procedure described in the previous section. A 5% reduction in $\tau_{ah}$ leads to a 0.06% decrease in the markup over marginal costs, and an increase in the markdown by 0.36%. As a result, markups over unit costs increase by 0.3%. The change in the markups and markdowns are driven by a 1% increase in the oligopsony share and a 1.4% reduction in the oligopoly share.[15]

We also consider the case in which both import $\tau_{ah}$ and export trade costs $\tau_{ha}$ fall by 5% from their initial calibrated value. Given that the two countries are identical, we have $\tau_{ah} = \tau_{ha}$, and this exercise allows us to analyze the model with symmetric countries presented in Section 3.2. In this scenario, the reduction in markups over marginal costs is larger (0.12%) and the increase in markdowns is much smaller (0.01%). In contrast to the previous case, markups over unit costs fall by 0.11%. The changes in market shares are significantly diminished in this case. The difference in results is driven by the fact that a decrease in export costs results in less exit of home firms. While an increase in import competition leads to home firms exiting due to lower profits, a reduction in export costs partly offsets this exit by increasing profits. Consequently, the increase in markdowns, which is driven by firm exit, is greatly reduced.

[15] In Appendix A.1, we report the percentage point differences (i.e, the level changes) in the variables.

This latter result has an important policy implication: unilateral trade liberalizations (i.e., a reduction in import costs) have a more significant positive impact on markdowns compared to a reduction in both import and export costs. Therefore, policymakers who wish to limit oligopsony power should consider pairing a reduction in import costs with reductions in export costs.

Table 1: Effects of a 5% Reduction in Trade Costs (Percent Changes)

| 5% Reduction in | Import Trade Costs | All Trade Costs |
|---|---|---|
| Markup over Marginal Costs | −0.06 | −0.12 |
| Markdown | 0.36 | 0.01 |
| Markup over Unit Costs | 0.30 | −0.11 |
| Oligopsonistic Share $s^o$ | 1.03 | 0.04 |
| Oligopoly Share $s$ | −1.43 | −2.98 |

The table reports the percent change in the variables listed on the rows following a 5% reduction in the import trade costs of the home country (Column: Import Trade Costs) and a 5% reduction in import and export trade costs of the home country (Column: All Trade Costs). All values are multiplied by 100. The calibrated parameters are as follows: $\sigma = 2.83$, $\gamma = 8.83$, $F_h = F_a = 0.018$, $L_h = L_a = 0.5$, and $\left(\frac{\tau_{ha}c_h}{\tau_{aa}c_a}\right) = \left(\frac{\tau_{ah}c_a}{\tau_{hh}c_h}\right) = 1.49$. Table A.4 in the appendix reports the percentage point difference in the variables given the same change in trade costs.

**Robustness: Bertrand Competition.** For the sake of analytical simplicity, our baseline model assumes Cournot competition both in the final goods market and in the input market. However, it is well-known that the different demand elasticities implied by Cournot competition and Bertrand competition lead to larger changes in markups under Cournot competition compared to Bertrand competition, given the same change in market shares. To investigate the extent to which the difference in demand and supply elasticities drives our results, we consider an extension to the baseline model that allows for Bertrand competition. We examine two scenarios: 1) Bertrand competition in the final goods market and Cournot competition in the input market, and 2) Bertrand competition in both markets. The second scenario requires a further departure from our baseline model: we need to assume some degree of imperfect substitutability for the input across firms. The derivations for these scenarios are available in Online Appendix B.2.

In Table 2, we present the results of our exercise examining the impact of Bertrand competition on our model. To compare the three models properly, we calibrate the parameters $\sigma$ and $\gamma$ such that the markup over marginal costs equals 1.61 and the markdown equals 1.53 for each extension, given the same market shares of home firms described in Section 4.1. Therefore, the value of $\sigma$ implied by the models with Bertrand competition in the final goods market is slightly smaller than the baseline case (2.71), and the value of $\gamma$ implied by the model with Bertrand competition in the input market is much smaller (2.01) than the baseline case.

As expected, assuming Bertrand competition reduces the magnitude of the changes in markups and markdowns compared to the baseline model with Cournot competition. In particular, markups over marginal costs and markdowns change by a smaller amount when only the final goods market adopts Bertrand competition. The most notable result is observed in the scenario with Bertrand competition in both markets, where markups and markdowns barely change (-0.02% and +0.03%, respectively). This finding suggests that our assumption of Cournot competition produces larger effects of a small reduction in trade costs on markups and markdowns than Bertrand competition.

Table 2: Effects of a 5% Reduction in Import Trade Costs (Percent Changes)

| | Baseline | Bertrand + Cournot | Bertrand + Bertrand |
|---|---|---|---|
| Calibrated $\sigma$ | 2.83 | 2.71 | 2.71 |
| Calibrated $\gamma$ | 8.83 | 8.83 | 2.01 |
| Markup over Marginal Costs | −0.06 | −0.02 | −0.02 |
| Markdown | 0.36 | 0.35 | 0.03 |
| Markup over Unit Costs | 0.30 | 0.33 | 0.01 |
| Oligopsonistic Share $s^o$ | 1.03 | 1.01 | 1.20 |
| Oligopoly Share $s$ | −1.43 | −1.38 | −1.17 |

The table reports changes in variables following a 5% reduction in import trade costs (values multiplied by 100). The first column displays the baseline model with Cournot competition in both final goods and the input market. In the second column, we introduce Bertrand competition in the final goods market and maintain Cournot competition in the input market. In the third column, we assume Bertrand competition in both markets. The parameters $\sigma$ and $\gamma$ are calibrated based on a markup over marginal costs equal to 1.61 (De Loecker et al., 2020) and a markdown of 1.53 (Yeh et al., 2022). The values for the other calibrated parameters are provided in Online Appendix B.2. Table A.5 in the appendix reports the percentage point difference in the variables given the same change in trade costs.

**Robustness: Multiple Inputs.** As an additional robustness check, we consider the case in which firms employ a perfectly competitive input in their production function in addition to the oligopsonistic input. In particular, we assume that the production function of a firm $f$ is a Cobb-Douglas combination of the oligopsonistic input ($k$) and the numeraire ($n$): $x = Ak^{\alpha}n^{1-\alpha}$, where $A$ is total factor productivity and $\alpha \in [0, 1]$.[16] In Online Appendix B.3, we derive the equilibrium equations of this model and the implied markups and markdowns. The markup over marginal costs and the markdown on the price of the input are identical to

[16]We use the numeraire as input to avoid having to solve for its equilibrium price level.

the baseline model. The difference with the baseline model is, intuitively, in the markup over unit costs, since now unit costs comprise of both the oligopsonistic input and the numeraire.

Table 3 shows that the effect of a reduction in trade costs on the markup over unit costs is smaller than in the baseline model for all values of $\alpha < 1$, but the effect on the markdown is larger. This suggests that the role of the oligopsonistic input in production affects the magnitude of the effect of trade costs on markups over unit costs. A smaller value of $\alpha$ corresponds to a smaller cost share of the oligopsonistic input in production and, as a result, a smaller increase in the markup over unit costs after a reduction in trade costs. However, a smaller value of $\alpha$ also corresponds to a larger increase in the markdown. The increase in the oligopsonistic share following trade liberalization drives this result, implying that smaller values of $\alpha$ correspond to a larger number of firms exiting the market. Recall that our model's key mechanism is that unilateral trade liberalization leads to a decrease in the oligopoly market share. The subsequent reduction in markups causes some firms to exit the market, which in turn increases the oligopsonistic share along with the markdown. The increase in markdowns compensates for some of the initial profitability loss, thereby reducing the number of firms exiting the market. In a model with two inputs, the contribution of the markdown to the markup over unit costs is limited and decreases with $\alpha$. Consequently, the exit of firms is greater than predicted in the baseline model.

Table 3: Effects of a 5% Reduction in Import Trade Costs (Percent Changes)

| | $\alpha = 1$ (Baseline) | $\alpha = 0.5$ | $\alpha = 0.25$ |
|---|---|---|---|
| Markup over Marginal Costs | −0.06 | −0.05 | −0.03 |
| Markdown | 0.36 | 0.83 | 1.64 |
| Markup over Unit Costs | 0.30 | 0.28 | 0.26 |
| Oligopsonistic Share $s^o$ | 1.03 | 2.39 | 4.73 |
| Oligopoly Share $s$ | −1.43 | −1.19 | −0.72 |

Table 3 shows the impact of a 5% reduction in import trade costs (values multiplied by 100) on various model variables for different values of $\alpha$. This parameter is the exponent on the oligopsonistic input in a Cobb-Douglas production function that combines the oligopsonistic input with the numeraire. The parameters $\sigma$ and $\gamma$ are calibrated based on a markup over marginal costs equal to 1.61 (De Loecker et al., 2020) and a markdown of 1.53 (Yeh et al., 2022) in a model with Cournot competition in both markets, and the values for the other calibrated parameters are reported in Online Appendix B.3. Table A.6 in the appendix reports the percentage point difference in the variables given the same change in trade costs.

## 4.3 The Role of Oligopsony Power

In this section, we compare the outcomes of two models: our baseline model and a model that features only oligopoly power. The goal is to quantify the mismeasurement in the effects of reduction in trade costs when we ignore one of the sources of firm's market power. To make a proper quantitative comparison, we choose the parameters and variables of the oligopoly power model to have identical levels of market shares and markup over marginal costs as the baseline model. We also assume an upward sloping supply curve for the input and keep the same value of $\gamma$ of our baseline quantitative exercise. The equilibrium equations of the model imply the other parameters of the model, including fixed and variable input requirements for production and delivery. Details are available in Online Appendix B.1.2.

Table 4 presents a comparison between our baseline model and a model that considers oligopoly power only, for different values of $\gamma$, which correspond to different levels of markdowns in our baseline model. In the first three columns of 4, we maintain the baseline calibrated value for $\sigma$, while in the last three columns, we consider an alternative specification where the calibrated markup is 1.1 and the resulting value for $\sigma$ is 18.9.

In the model with oligopoly power only, markups over marginal costs react similarly to a reduction in import trade costs as they do in our baseline model, where oligopsony power is also considered. Specifically, using the baseline value for $\sigma$, the markups over marginal costs decrease by 0.05-0.04% in the oligopoly power model, while they fall by 0.06-0.05% in our baseline model. This implies that the omission of oligopsony power mainly affects the change in markdowns, which in turn drives up the markups over unit cost. Furthermore, the table reveals that the extent of the bias decreases as $\gamma$ becomes smaller. This finding is logical since it suggests that the effect of oligopsony power on markup changes is more significant for larger calibrated markdown values.[17]

A similar result holds when we consider a much higher value for $\sigma$. When the demand elasticity of consumers is higher, markups over marginal costs are more responsive to changes in trade costs than in our baseline results. In fact, a reduction in trade costs is associated with a reduction in markups over marginal costs of about 0.42-0.44%. In this case, the reduction is greater than the increase in the markdown. and markups over unit costs fall. Hence, the anti-competitive effect of oligopsony power is diminished when markdowns respond less to trade shocks, which occurs at low levels of $\gamma$, and when markups respond more to trade shocks, which occurs at high levels of $\sigma$.

In our previous findings, a unilateral reduction in trade costs typically correlates with a

[17] A similar conclusion can be drawn by fixing $\gamma$ and adjusting the various markup levels using different $s_h^o$ values, as demonstrated in Table A.1 of the appendix. This outcome confirms the results of our theory, showing that the larger the initial $s_h^o$, the greater the impact of oligopsony power.

rise in the markup over unit costs. This correlation is fueled by an increase in markdowns, which more than offsets the decline in markups over marginal costs. Whether the increase in markdowns or the reduction in markups prevails primarily depends on the extent to which shifts in market shares influence changes in markups and markdowns. These shifts are dictated by the variables $\gamma$ and $\sigma$, as well as by the initial market share levels.

Indeed, as shown in the final three columns of Table 4, when we employ a larger value for the variable $\sigma$ (achieved by matching a lower markup given the same market share), the surge in markdowns no longer counteracts the decrease in markups over marginal costs. Consequently, this leads to a decline in the markup over unit costs. Table A.2 in the appendix further demonstrates that markups over unit costs can contract following a unilateral trade liberalization, given larger initial values of the oligopsonistic share (0.25) and the export market share (0.125). With an increase in the oligopsonistic share, the model matches the observed markdown with a smaller calibrated $\gamma$ than what is seen in the baseline result. This causes a reduction in the change in markdowns, allowing the declining markups over marginal costs to dominate.

Table 4: Effects of a 5% Reduction in Import Trade Costs (Percent Changes)

| | | | | | | |
|---|---|---|---|---|---|---|
| Calibrated Markup: | 1.61 | 1.61 | 1.61 | 1.1 | 1.1 | 1.1 |
| Calibrated $\sigma$: | 2.83 | 2.83 | 2.83 | 18.86 | 18.86 | 18.86 |
| Calibrated Markdown: | 1.53 | 1.3 | 1.1 | 1.53 | 1.3 | 1.1 |
| Calibrated $\gamma$: | 8.83 | 5.00 | 1.67 | 8.83 | 5.00 | 1.67 |
| Baseline Model | | | | | | |
| Markup over Marginal Costs | −0.06 | −0.06 | −0.05 | −0.44 | −0.44 | −0.42 |
| Markdown | 0.36 | 0.26 | 0.15 | 0.41 | 0.32 | 0.20 |
| Markup over Unit Costs | 0.30 | 0.20 | 0.10 | −0.03 | −0.12 | −0.22 |
| Oligopoly Only | | | | | | |
| Markup over Marginal Costs | −0.05 | −0.05 | −0.04 | −0.36 | −0.36 | −0.36 |

The first two rows of the table report the targeted markup over marginal costs and the resulting level of $\sigma$, which is calibrated by matching the markup given $s_h = 0.04$. The second and third rows of the table report the targeted markdown and the resulting level of $\gamma$, which is calibrated by matching the markdown given $s_h^o = 0.06$. The remaining rows report the percent change in the listed variables following a 5% reduction in import trade costs (values multiplied by 100) in our baseline model and in a model with oligopoly power only. It is worth noting that in a model that considers oligopoly power only, there is no change in markdowns, and markups over unit costs are equivalent to markups over marginal costs. Moreover, in the model with oligopoly power only, we assume an upward sloping supply curve for the input and keep the same value of $\gamma$ calibrated with our baseline model. Table A.7 in the appendix reports the percentage point difference in the variables given the same change in trade costs.

**Robustness: Asymmetric Countries.** To test the robustness of our findings, we explore the effects of asymmetric countries. Specifically, we investigate the impact of a 5% reduction in $\tau_{ah}$ on countries of different sizes, where the home country's size is $L_h = \{0.25, 0.5, 0.75\}$, and the foreign country's size is calculated as $1 - L_h$. The results are presented in Table 5, which demonstrates that the increase in markdowns and markups over unit costs following a reduction in import trade costs is larger for larger home economies. Therefore, ignoring oligopsony power leads to a greater degree of mismeasurement in the presence of larger countries. Furthermore, we test the sensitivity of the results to variations in foreign firms' market shares in export and domestic input markets. The results, as shown in Table A.3 of the appendix, remain consistent across these different sources of country-level asymmetry.

Table 5: Effects of a 5% Reduction in Import Trade Costs (Percent Changes)

| Home Size: | 0.25 | 0.5 | 0.75 |
|---|---|---|---|
| Baseline Model | | | |
| Markup over Marginal Costs | −0.09 | −0.06 | −0.04 |
| Markdown | 0.21 | 0.36 | 0.45 |
| Markup over Unit Costs | 0.13 | 0.30 | 0.41 |
| No Oligopsony | | | |
| Markup over Marginal Costs | −0.08 | −0.05 | −0.02 |

The table reports changes in variables following a 5% reduction in import trade costs in our baseline model and in a model with oligopoly power only (values multiplied by 100). It is worth noting that in a model that considers oligopoly power only, there is no change in markdowns, and markups over unit costs are equivalent to markups over marginal costs. Moreover, in the model with oligopoly power only, we assume an upward sloping supply curve for the input and keep the same value of $\gamma$ of our baseline quantitative exercise. Across columns, we vary the home size $L_h = \{0.25, 0.5, 0.75\}$ and foreign size $L_a = 1 - L_h$. Table A.8 in the appendix reports the percentage point difference in the variables given the same change in trade costs.

# 5 Conclusions

Within the international trade literature, research has been conducted on the consequences of large exporters' oligopoly power on firms' prices (Eckel and Neary, 2010; Edmond et al., 2015). However, this paper argues that firms' market power in the input market, where they use their oligopsony power, has significant implications for the impact of trade on markups and markdowns.

Our theoretical model shows that the integration of international markets for final goods causes a decrease in firms' market power in the final goods market. However, this integration has the opposite effect on market power in the input market, where the reduction of market power arising from international competition between oligopolists is accompanied by an increase in market power. Through our quantitative analysis, we demonstrate that this increase can cause a rise in the markup over unit costs. Only the integration of both final goods and input markets can successfully diminish firms' market power.

The policy implication is straightforward: to achieve the maximum welfare benefits from trade, trade agreements should encourage trade in both final goods and input markets. When domestic inputs are present, policies that decrease market concentration in the domestic input market could alleviate the increase in concentration resulting from trade in final goods.

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# A Appendix

Tables A.1, A.2, and A.3 show the effects of a 5% reduction in import trade costs on markups and markdowns with different parameter values. In Table A.1, we vary the initial oligopsony share to attain different markdowns levels (holding constant the value of $\gamma = 8.83$). In Table A.2, we vary the calibrated markups and markdowns starting from a high initial value of the oligopsonistic share. In Table A.3, we vary the foreign oligopsony and export shares.

Table A.1: Effects of a 5% Reduction in Import Trade Costs (Percent Changes)

| | | | |
|---|---|---|---|
| Calibrated Markdown: | 1.53 | 1.6 | 1.7 |
| Calibrated $s_h^o$: | 0.06 | 0.07 | 0.09 |
| Markup over Marginal Costs | −0.06 | −0.08 | −0.12 |
| Markdown | 0.36 | 0.40 | 0.48 |
| Markup over Unit Costs | 0.30 | 0.32 | 0.36 |
| Oligopsonistic Share $s^o$ | 1.03 | 1.08 | 1.07 |
| Oligopoly Share $s$ | −1.43 | −1.89 | −2.87 |

The first two rows of the table report the targeted markdown and the resulting $s_h^o$, which is determined by matching the markdown when $\gamma = 8.83$. We also fix $s_h = 0.04$ and compute the new $s_h^*$ given the different values of $s_h^o$. The remaining rows report the percent change in the listed variables following a 5% reduction in import trade costs (values multiplied by 100). Table A.9 reports the percentage point difference in the variables given the same change in trade costs.

Table A.2: Effects of a 5% Reduction in Import Trade Costs (Percent Changes)

| | | | | | | |
|---|---|---|---|---|---|---|
| Calibrated Markup: | 1.61 | 1.61 | 1.61 | 1.4 | 1.4 | 1.4 |
| Calibrated Markdown: | 1.53 | 1.3 | 1.1 | 1.53 | 1.3 | 1.1 |
| Calibrated $\sigma$: | 3.45 | 3.45 | 3.45 | 5.44 | 5.44 | 5.44 |
| Calibrated $\gamma$: | 2.12 | 1.20 | 0.40 | 2.12 | 1.20 | 0.40 |
| Baseline Model | | | | | | |
| Markup over Marginal Costs | −0.39 | −0.39 | −0.41 | −0.56 | −0.58 | −0.60 |
| Markdown | 0.55 | 0.48 | 0.40 | 0.54 | 0.47 | 0.40 |
| Markup over Unit Costs | 0.17 | 0.08 | −0.01 | −0.02 | −0.11 | −0.20 |
| Oligopoly Only | | | | | | |
| Markup over Marginal Costs | −0.34 | −0.34 | −0.35 | −0.51 | −0.51 | −0.52 |

The table reports the percent change in the listed variables following a 5% reduction in import trade costs (values multiplied by 100) in our baseline model and in a model with oligopoly power only. The initial oligopsonistic share is 0.25 while the export market share equals 0.125. It is worth noting that in a model that considers oligopoly power only, there is no change in markdowns, and markups over unit costs are equivalent to markups over marginal costs. Moreover, in the model with oligopoly power only, we assume an upward sloping supply curve for the input and keep the same value of $\gamma$ calibrated with our baseline model. Table A.10 reports the percentage point difference in the variables given the same change in trade costs.

Table A.3: Effects of a 5% Reduction in Import Trade Costs (Percent Changes)

| | | | |
|---|---|---|---|
| Foreign Oligopsonistic Share: | 0.03 | 0.06 | 0.12 |
| Foreign Export Share: | 0.01 | 0.02 | 0.04 |
| Baseline Model | | | |
| Markup over Marginal Costs | $-0.06$ | $-0.06$ | $-0.06$ |
| Markdown | 0.36 | 0.36 | 0.35 |
| Markup over Unit Costs | 0.30 | 0.30 | 0.30 |
| No Oligopsony | | | |
| Markup over Marginal Costs | $-0.05$ | $-0.05$ | $-0.05$ |

The table reports the percent change in the listed variables following a 5% reduction in import trade costs (values multiplied by 100) in our baseline model and in a model with oligopoly power only. We vary the foreign oligopsony share and the foreign export share as described in the first two rows. It is worth noting that in a model that considers oligopoly power only, there is no change in markdowns, and markups over unit costs are equivalent to markups over marginal costs. Moreover, in the model with oligopoly power only, we assume an upward sloping supply curve for the input and keep the same value of $\gamma$ of our baseline quantitative exercise. Table A.11 reports the percentage point difference in the variables given the same change in trade costs.

## A.1 Percentage Point Differences (Level Changes)

In this section, we present the results of our simulations using percentage point differences, defined as the differences in levels of our variables multiplied by 100. This approach differs from our baseline tables, which present the percentage change in variables. Table A.4 presents the results of our baseline exercise, which involves a 5% reduction in import trade costs and a 5% reduction in both import and export trade costs. Table A.5 provides the results from a robustness exercise, assuming Bertrand competition in final goods and input markets. Table A.6 reports results under the assumption of having two inputs. Table A.7 contrasts our baseline model with a model that only features oligopoly power, considering different initial markup and markdown values. In Table A.9, we adjust the initial oligopsony share to attain different markdown levels, while maintaining a constant value of $\gamma = 8.83$. Table A.10 presents the results under variations in the calibrated markups and markdowns, starting from a high initial value of the oligopsonistic share. Lastly, in Table A.11, we explore variations in the foreign oligopsony and export shares.

Table A.4: Effects of a 5% Reduction in Trade Costs (Percentage Point Differences)

| 5% Reduction in | Import Trade Costs | All Trade Costs |
|---|---|---|
| Markup over Marginal Costs | −0.10 | −0.20 |
| Markdown | 0.54 | 0.02 |
| Markup over Unit Costs | 0.73 | −0.27 |
| Oligopsonistic Share $s^o$ | 0.06 | 0.00 |
| Oligopoly Share $s$ | −0.06 | −0.12 |

The table reports the percentage point difference in the variables listed on the rows following a 5% reduction in the import trade costs of the home country (Column: Import Trade Costs) and a 5% reduction in import and export trade costs of the home country (Column: All Trade Costs). The values are obtained by calculating the difference between the new and old values of a variable, and then multiplying that difference by 100. The calibrated parameters are as follows: $\sigma = 2.83$, $\gamma = 8.83$, $F_h = F_a = 0.018$, $L_h = L_a = 0.5$, and $\left(\frac{\tau_{ha} c_h}{\tau_{aa} c_a}\right) = \left(\frac{\tau_{ah} c_a}{\tau_{hh} c_h}\right) = 1.49$.

Table A.5: Effects of a 5% Reduction in Import Trade Costs (Percentage Point Differences)

| | Baseline | Bertrand + Cournot | Bertrand + Bertrand |
|---|---|---|---|
| Calibrated $\sigma$ | 2.83 | 2.71 | 2.71 |
| Calibrated $\gamma$ | 8.83 | 8.83 | 2.01 |
| Markup over Marginal Costs | −0.10 | −0.04 | −0.03 |
| Markdown | 0.54 | 0.53 | 0.04 |
| Markup over Unit Costs | 0.73 | 0.81 | 0.02 |
| Oligopsonistic Share $s^o$ | 0.06 | 0.06 | 0.07 |
| Oligopoly Share $s$ | −0.06 | −0.06 | −0.05 |

The table reports the percentage point difference in variables following a 5% reduction in import trade costs. The values are obtained by calculating the difference between the new and old values of a variable, and then multiplying that difference by 100. The first column displays the baseline model with Cournot competition in both final goods and the input market. In the second column, we introduce Bertrand competition in the final goods market and maintain Cournot competition in the input market. In the third column, we assume Bertrand competition in both markets. The parameters $\sigma$ and $\gamma$ are calibrated based on a markup over marginal costs equal to 1.61 (De Loecker et al., 2020) and a markdown of 1.53 (Yeh et al., 2022). The values for the other calibrated parameters are provided in Online Appendix B.2.

Table A.6: Effects of a 5% Reduction in Import Trade Costs (Percentage Point Differences)

| | $\alpha = 1$ (Baseline) | $\alpha = 0.5$ | $\alpha = 0.25$ |
|---|---|---|---|
| Markup over Marginal Costs | −0.10 | −0.08 | −0.05 |
| Markdown | 0.54 | 1.27 | 2.51 |
| Markup over Unit Costs | 0.73 | 0.54 | 0.46 |
| Oligopsonistic Share $s^o$ | 0.06 | 0.14 | 0.28 |
| Oligopoly Share $s$ | −0.06 | −0.05 | −0.03 |

The table reports the percentage point difference in variables following a 5% reduction in import trade costs on various model variables for different values of $\alpha$. The values are obtained by calculating the difference between the new and old values of a variable, and then multiplying that difference by 100. This parameter is the exponent on the oligopsonistic input in a Cobb-Douglas production function that combines the oligopsonistic input with the numeraire. The parameters $\sigma$ and $\gamma$ are calibrated based on a markup over marginal costs equal to 1.61 (De Loecker et al., 2020) and a markdown of 1.53 (Yeh et al., 2022) in a model with Cournot competition in both markets, and the values for the other calibrated parameters are reported in Online Appendix B.3.

Table A.7: Effects of a 5% Reduction in Import Trade Costs (Percentage Point Differences)

| | | | | | | |
|---|---|---|---|---|---|---|
| Calibrated Markup: | 1.61 | 1.61 | 1.61 | 1.1 | 1.1 | 1.1 |
| Calibrated $\sigma$: | 2.83 | 2.83 | 2.83 | 18.86 | 18.86 | 18.86 |
| Calibrated Markdown: | 1.53 | 1.3 | 1.1 | 1.53 | 1.3 | 1.1 |
| Calibrated $\gamma$: | 8.83 | 5.00 | 1.67 | 8.83 | 5.00 | 1.67 |
| Baseline Model | | | | | | |
| Markup over Marginal Costs | −0.10 | −0.09 | −0.08 | −0.48 | −0.48 | −0.46 |
| Markdown | 0.54 | 0.34 | 0.17 | 0.63 | 0.41 | 0.22 |
| Markup over Unit Costs | 0.73 | 0.43 | 0.18 | −0.05 | −0.17 | −0.27 |
| Oligopoly Only | | | | | | |
| Markup over Marginal Costs | −0.08 | −0.08 | −0.07 | −0.40 | −0.40 | −0.40 |

The first two rows of the table report the targeted markup over marginal costs and the resulting level of $\sigma$, which is calibrated by matching the markup given $s_h = 0.04$. The second and third rows of the table report the targeted markdown and the resulting level of $\gamma$, which is calibrated by matching the markdown given $s_h^o = 0.06$. The remaining rows report the percentage point difference in variables following a 5% reduction in import trade costs in our baseline model and in a model with oligopoly power only. The values are obtained by calculating the difference between the new and old values of a variable, and then multiplying that difference by 100. It is worth noting that in a model that considers oligopoly power only, there is no change in markdowns, and markups over unit costs are equivalent to markups over marginal costs. Moreover, in the model with oligopoly power only, we assume an upward sloping supply curve for the input and keep the same value of $\gamma$ calibrated with our baseline model.

Table A.8: Effects of a 5% Reduction in Import Trade Costs (Percentage Point Differences)

| Home Size: | 0.25 | 0.5 | 0.75 |
|---|---|---|---|
| Baseline Model | | | |
| Markup over Marginal Costs | −0.14 | −0.10 | −0.06 |
| Markdown | 0.33 | 0.54 | 0.69 |
| Markup over Unit Costs | 0.31 | 0.73 | 1.02 |
| No Oligopsony | | | |
| Markup over Marginal Costs | −0.13 | −0.08 | −0.03 |

The table reports the percentage point difference in variables following a 5% reduction in import trade costs in our baseline model and in a model with oligopoly power only. The values are obtained by calculating the difference between the new and old values of a variable, and then multiplying that difference by 100. It is worth noting that in a model that considers oligopoly power only, there is no change in markdowns, and markups over unit costs are equivalent to markups over marginal costs. Moreover, in the model with oligopoly power only, we assume an upward sloping supply curve for the input and keep the same value of $\gamma$ of our baseline quantitative exercise. Across columns, we vary the home size $L_h = \{0.25, 0.5, 0.75\}$ and foreign size $L_a = 1 - L_h$.

Table A.9: Effects of a 5% Reduction in Import Trade Costs (Percentage Point Differences)

| Calibrated Markdown: | 1.53 | 1.6 | 1.7 |
|---|---|---|---|
| Calibrated $s_h^o$: | 0.06 | 0.07 | 0.09 |
| Markup over Marginal Costs | −0.10 | −0.13 | −0.19 |
| Markdown | 0.54 | 0.65 | 0.86 |
| Markup over Unit Costs | 0.73 | 0.84 | 1.04 |
| Oligopsonistic Share $s^o$ | 0.06 | 0.07 | 0.10 |
| Oligopoly Share $s$ | −0.06 | −0.08 | −0.11 |

The first two rows of the table report the targeted markdown and the resulting $s_h^o$, which is determined by matching the markdown when $\gamma = 8.83$. We also fix $s_h = 0.04$ and compute the new $s_h^*$ given the different values of $s_h^o$. The remaining rows report the percentage point difference in variables following a 5% reduction in import trade costs. The values are obtained by calculating the difference between the new and old values of a variable, and then multiplying that difference by 100.

Table A.10: Effects of a 5% Reduction in Import Trade Costs (Percentage Point Differences)

| | | | | | | |
|---|---|---|---|---|---|---|
| Calibrated Markup: | 1.61 | 1.61 | 1.61 | 1.4 | 1.4 | 1.4 |
| Calibrated Markdown: | 1.53 | 1.3 | 1.1 | 1.53 | 1.3 | 1.1 |
| Calibrated $\sigma$: | 3.45 | 3.45 | 3.45 | 5.44 | 5.44 | 5.44 |
| Calibrated $\gamma$: | 2.12 | 1.20 | 0.40 | 2.12 | 1.20 | 0.40 |
| Baseline Model | | | | | | |
| Markup over Marginal Costs | $-0.62$ | $-0.63$ | $-0.66$ | $-0.79$ | $-0.81$ | $-0.84$ |
| Markdown | 0.85 | 0.62 | 0.45 | 0.83 | 0.61 | 0.44 |
| Markup over Unit Costs | 0.41 | 0.17 | $-0.01$ | $-0.05$ | $-0.20$ | $-0.32$ |
| Oligopoly Only | | | | | | |
| Markup over Marginal Costs | $-0.55$ | $-0.55$ | $-0.56$ | $-0.71$ | $-0.72$ | $-0.73$ |

The table reports the percentage point difference in variables following a 5% reduction in import trade costs in our baseline model and in a model with oligopoly power only. The values are obtained by calculating the difference between the new and old values of a variable, and then multiplying that difference by 100. The initial oligopsonistic share is 0.25 while the export market share equals 0.125. It is worth noting that in a model that considers oligopoly power only, there is no change in markdowns, and markups over unit costs are equivalent to markups over marginal costs. Moreover, in the model with oligopoly power only, we assume an upward sloping supply curve for the input and keep the same value of $\gamma$ calibrated with our baseline model.

Table A.11: Effects of a 5% Reduction in Import Trade Costs (Percentage Point Differences)

| | | | |
|---|---|---|---|
| Foreign Oligopsonistic Share: | 0.03 | 0.06 | 0.12 |
| Foreign Export Share: | 0.01 | 0.02 | 0.04 |
| Baseline Model | | | |
| Markup over Marginal Costs | $-0.10$ | $-0.10$ | $-0.09$ |
| Markdown | 0.55 | 0.54 | 0.54 |
| Markup over Unit Costs | 0.74 | 0.73 | 0.73 |
| No Oligopsony | | | |
| Markup over Marginal Costs | $-0.08$ | $-0.08$ | $-0.07$ |

The table reports the percentage point difference in variables following a 5% reduction in import trade costs in our baseline model and in a model with oligopoly power only. The values are obtained by calculating the difference between the new and old values of a variable, and then multiplying that difference by 100. We vary the foreign oligopsony share and the foreign export share as described in the first two rows. It is worth noting that in a model that considers oligopoly power only, there is no change in markdowns, and markups over unit costs are equivalent to markups over marginal costs. Moreover, in the model with oligopoly power only, we assume an upward sloping supply curve for the input and keep the same value of $\gamma$ of our baseline quantitative exercise.