Monopsonistic Competition, Trade, and the Profit Share

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Abstract

I present an international trade model of monopsonistic competition, in which heterogeneous firms face upward sloping labor supply curves, and exploit their monopsony power over the wages of workers. The purpose of the model is to study the effects of monopsonistic competition on the relationship between international trade and the profit share. The model shows that monopsony power increases the profit share and reduces the labor share. Furthermore, the largest and most profitable firms have the largest profit share. While in a standard model with a Pareto distribution of productivity, the profit share is constant and independent of trade openness, in the presence of monopsonistic competition, trade can increase the profit share under reasonable assumptions for the parameter values. Monopsonistic competition is, thus, a contributing factor to the documented decline in the labor share and rise in corporate profits.

Keywords: Monopsonistic Competition, Labor Share, Profit Share, Firm Heterogeneity, Variable Markups.

JEL Code: F12, F16, L11, J42.

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1 Introduction

Since the 1980s, the aggregate labor share of income has declined across countries (Elsby et al., 2013; Karabarbounis and Neiman, 2014) and corporate profits increased (Syverson, 2019). This fact has fostered the growth of a body of literature aimed at understanding the causes of the decline in what was considered a macroeconomic constant included in Kaldor's facts (1957). Autor et al. (2020) argue that a reallocation of resources towards larger, high-markup firms is responsible for this trend. Indeed, De Loecker et al. (2020) document a rise in the market power of firms, as market concentration has been on the rise since the 1980s. The reallocation towards high-markup firms is generally attributed to competitive shocks such as international trade. However, the workhorse trade models, which rely on monopolistically competitive, heterogeneous firms and a Pareto distribution of firm characteristics, predict a constant labor share. Thus, competition-induced changes in the labor share are hard to show theoretically.

I present a novel theoretical model of trade with monopsonistic competition, in which heterogeneous firms face upward sloping labor supply curves. As labor is the only factor of production, aggregate income is divided between the profit share, which goes to firms, with no distinction between capital revenues and pure profits, and the labor share.[1] The main question that the model addresses is how does monopsonistic competition affect the relationship between trade and the profit share. I show that once we take into account monopsonistic competition in labor, trade can indeed reduce the labor share even when firm heterogeneity is Pareto distributed. I provide theoretical conditions on the level of trade costs and the supply elasticity of labor which determine when a reduction in trade costs induces an increase in the profit share.

Unlike standard models, the presence of monopsonistic competition generates a non-trivial relationship between the aggregate profit share and international trade. Standard models generally assume that firms are price takers in perfectly competitive labor markets and, thus, predict a constant profit share in case firm characteristics are Pareto distributed (Autor et al., 2020). However, recent evidence has shown high levels of concentration in the labor market and the market for inputs (Azar et al., 2017; Morlacco, 2017), along with the historically high levels of market concentration in the final goods markets. Higher concentration in factors markets has resulted in the rise of monopsony power (Hershbein et al., 2020), which is associated with lower wages (Brooks et al., 2019) and larger markups (Macedoni and Tyazhelnikov, 2018).

The model of this paper is based on the idea that each firm faces an upward sloping

[1] According to Barkai (2020) the capital share also declined since the 1980s, while pure profits rose.

supply curve for labor. The positive slope of the supply curve originates from workers having heterogeneous preferences over similar jobs: when a firm increases its wages, it will not be able to attract the entire labor force, since some workers will prefer to remain employed at other firms.[2] This idea is embedded in the Melitz and Ottaviano (2008) framework of heterogeneous firms and variable markups. Firm heterogeneity is driven by differences in a firm-specific demand shifter, which is interpreted as a generic product appeal, or quality. Such an assumption is made both for tractability and to account for the growing evidence that heterogeneity on the demand side is the main source of firm size heterogeneity (Hottman et al., 2016).[3] To highlight the role of monopsonistic competition, I follow Helpman et al. (2004) and Chaney (2008), and assume that such product appeal is Pareto distributed.

Firms with higher appeal, which also have larger sales, charge higher markups over their unit costs. This is driven by both monopoly power and monopsony power. In the labor markets, firms with higher appeal face a less elastic labor supply and, thus, restrict more their labor demand to pay lower wages. The difference between the marginal revenue product of labor and the wage, usually referred to as *markdown*, increases in product appeal. This is consistent with the findings of Hershbein et al. (2020), who document that wage markdowns increase in the size of US establishments. In addition, firms with higher appeal face a less elastic demand in final goods markets and, thus, charge higher markups over marginal costs. Because of these two channels, markups over *unit costs* increase in product appeal and, thus, the profit share also increases in product appeal while the labor share declines.[4] This occurs despite the fact that firms with high appeal pay higher wages: since firms face identical upward sloping supply curves, as a firm increases its output and hires additional workers, it moves along the supply curve and pays higher wages.

As a first step in the analysis, I consider a closed economy version of the model, which allows me to study the effect of monopsonistic competition on the profit share in the simplest possible way. Monopsony power increases the profit share at the firm level and at the aggregate level. Thus, rising monopsony power can be a source of rising profit share. Even in the presence of monopsonistic competition, an increase in competition leaves the profit share unchanged. In fact, an increase in competition reduces the firm-level profit share and

[2]Commuting distance is a possible reason why workers value differently the same job at two different firms (Bhaskar et al., 2002). Berger et al. (2019) and Egger et al. (2019) provide the microfoundation that links workers with heterogeneous preferences to a representative worker who chooses how much labor to supply to imperfectly substitutable firms.

[3]In this setup, productivity heterogeneity is highly intractable. However, using numerical methods, I show that the main results of the paper are robust to this specification.

[4]Variable markups and markdowns offer a complementary view of the positive relationship between firm size and firm profit share, which is also driven by other factors such as capital intensity and extent of overhead costs (Bartelsman et al., 2013; Autor et al., 2020).

reallocates production towards firms with higher profit share. Due to the Pareto assumption, the two effects cancel each other. Such a result, however, no longer holds in the presence of trade costs.

To examine the role of trade, I consider a model with two identical countries, in which exporting requires the payment of an iceberg trade cost. In this model, I examine the effects of a reduction in the iceberg trade costs on the profit share. In the presence of monopsonistic competition, trade induces a change in the aggregate profit share even with a Pareto distribution for firm product appeal.[5] Along with the change in the competitive environment, which has the aforementioned effects, the reduction in the trade cost has a twofold effect on exporters. First, it can increase the profit share of existing exporters, which experience a reduction in unit costs across all destinations. Second, by increasing the export quantities, it can reduce the profit share because the additional output increases wages and, thus, costs for all destinations. This channel is particularly important for small exporters. The parameters of the model determine which of these effects, along with the competition effects, dominate, and, thus, whether the profit share declines or increases with trade. A reduction in trade costs has a positive effect on the profit share when the initial trade costs or the initial profit share are large. This further supports the view that international trade played a role in the declining labor share. The opposite occurs when trade costs or the initial profit share are low. A less elastic supply curve for labor magnifies the effects of trade on the labor share.

I examine the changes in firm level markups and wages to further understand the role of monopsonistic competition. Trade tends to have a pro-competitive effect as firms reduce their domestic markups after a reduction in trade costs. Such a reduction is smallest for the largest firms which, under certain circumstances, actually increase their domestic markups. Similarly, firms tend to generally increase their wages after a reduction in trade costs and such a reduction is smallest for the largest firms. Large firms can even reduce their wages, under certain parameter values. This analysis provides further intuition as to why trade can increase the profit share in the presence of monopsonistic competition. Trade not only reallocates production towards the largest high-profit firms, and does so to a larger extent under monopsonistic competition, but these high-profit firms increase by less their wages and can actually reduce them.

To evaluate whether trade increases or decreases the profit share under reasonable parameter values, I calibrate the main parameters of a two-country model, to match the observed US labor share (Karabarbounis and Neiman, 2014), the estimated average markdowns of

[5] I also show that competition can change the aggregate profit share in a closed economy in the presence of productivity heterogeneity.

US plants (Hershbein et al., 2020), and the export propensity of US firms (Bernard et al., 2007). Given the estimated parameters, a reduction in trade costs leads to a small but positive increase in the profit share. A simple back of the envelope calculation shows that the reduction in trade costs from 1980 to 2014 can explain a fifth of the reduction in the labor share, because of the presence of monopsony power.

An additional result of the model is that monopsonistic competition can rationalize the presence of zero trade flows between countries (Baldwin and Harrigan, 2011), without having to rely on infinitely large trade costs or restrictions on the distribution of firm productivity. When a firm increases the export quantity in a destination, it increases the wage of its workers, thus, increasing the marginal costs for all the destinations reached.[6] If trade costs of exporting are too large, the increase in wages more than offsets the additional export profits of any firm. As a result, no firm will export to the given destination. The maximum value of trade costs that allows for positive trade depends on the relative slope of the demand and supply curves faced by firms.

Related Literature. The focus of this paper is on the aggregate, industry-level profit share. Changes in the profit share are due to changes in the firm-level profit share or in the allocation of production across heterogeneous firms. Shocks generally affect both margins; for instance, Autor et al. (2020) examine the effect of a rise in competition, which can be brought about by globalization or by technological progress. In fact, both globalization and changes in technology or technology prices have been considered as causes of the decline in the labor share (Elsby et al., 2013; Karabarbounis and Neiman, 2014). When these shocks cause the exit of firms with low-profit share, the aggregate profit share increases by a composition effect, whereby the surviving firms have higher profit share than the exiting ones. This paper complements the previous literature as it examines the effect of heterogeneous monopsony power across firms on the relationship between trade and the profit share.

The literature on international trade has extensively examined the role of market power in final goods markets on markups and other performance measures (Melitz and Ottaviano, 2008; Atkeson and Burstein, 2008). Only recently, the literature has started to examine the role of market power in the market for factors of production. There have been two types of models proposed to deal with monopsony power. On the one hand, there are oligopolistic models, in which firms restrict their demand for inputs according to their size. However, as these models feature Cournot competition, all firms pay the same price for the input considered (Morlacco, 2017; Macedoni and Tyazhelnikov, 2018; Brooks et al., 2019), which

[6]In contrast, in a standard model without monopsonistic competition, the problem of a firm can be divided into as many problems as there are destinations, with each problem independent of the others.

is at odds with the evidence of firm heterogeneity in wages and input prices.[7] Furthermore, models of oligopsony and oligopoly are less tractable than models with atomistic firms. A second approach, introduced by Egger et al. (2019), considers the more tractable monopsonistic competition, whereby wages of the monopsonistic factor vary across firms. However, in the model of Egger et al. (2019) all firms have a constant monopsony power. This implies that markups are constant across firms. The model presented in this paper combines the positive relationship between firm size and monopsony power that emerges in the oligopsony models with the tractability of a monopsonistic competition model.

The paper is closely related to Brooks et al. (2019), who structurally estimate a large negative effect of monopsony power on wages in China and India. The authors' key channel is at the firm-level: larger market share in the labor market is associated with a larger monopsony power, and the market share, in turn, depends on the labor market concentration. In contrast, this paper focuses both on the firm-level channel of monopsony power, but also on the reallocation across heterogeneous firms brought about by trade. The paper is also closely related to Macedoni and Tyazhelnikov (2018) and MacKenzie (2018), who consider the effects of trade in the presence of oligopsony. Macedoni and Tyazhelnikov (2018) consider a model of homogeneous large firms, and, although oligopsony dampens the pro-competitive gains from trade, the profit share always declines with trade. MacKenzie (2018) considers a model of heterogeneous, large firms and finds that trade increases the profit share, relative to a counterfactual case of perfect competition in labor markets. I show that, depending on the parameters that control firm size distribution and monopsony power, trade can increase or decrease the profit share, thus, generalizing the results of the two papers.

The paper is organized as follows. Second 2 studies the effects of monopsonistic competition on the profit share in a closed economy. Section 3 studies the effects of trade on the profit share in a two-country model. Section 4 discusses the main extensions to the baseline model. Section 5 concludes.

2 Closed Economy

2.1 Consumers

There are L consumers in the country, who derive utility from the consumption of varieties of a differentiated good, which are indexed by $\omega \in \Omega$, and the consumption of a numeraire good. Each consumer has an endowment of one unit of the numeraire good and supplies

[7] An alternative to this approach is to add productivity shocks with are specific to a match between a worker and a firm, as in Heiland and Kohler (2018) and MacKenzie (2018), or assume that firms are imperfect substitutes for workers as in Berger et al. (2019).

$\ell(\omega)$ labor units to the firm producing variety ω. Workers derive disutility from supplying labor to firms, and earn a wage $w(\omega)$.

Wages vary across firms because workers have heterogeneous preferences over similar jobs. As a result, the representative worker is willing to work for multiple firms at different wages. I model such an assumption by use of a disutility function of supplying labor across firms, which mirrors the utility function from consumption, and ensures that workers allocate non-zero shares of their labor across firms. In particular, to trace a parallel between the linear demand and the labor supply faced by firms, I assume that the labor supply is also linear. The microfoundation for upward sloping supply curves can be traced to Bhaskar et al. (2002), who consider a model where workers have different travel times to different jobs, and firms derive monopsony power from such heterogeneity. Egger et al. (2019) provide a more general model, in which firms have different amenities that are heterogeneously appreciated by worker. The authors also provide a microfoundation for a representative worker, starting from a set of workers with heterogeneous preferences.

The representative consumer and worker has the following utility function:

$$U = q_o + \int_{\omega\in\Omega} \left(az(\omega)q(\omega) - \frac{\gamma}{2}q^2(\omega) - \frac{\eta}{2}\left[\int_{\omega\in\Omega} q(\omega)d\omega\right]^2 \right) d\omega + \\ - \int_{\omega\in\tilde{\Omega}} \left(\tilde{a}_L\ell(\omega) + \frac{\tilde{\gamma}_L}{2}\ell^2(\omega) + \frac{\tilde{\eta}_L}{2}\left[\int_{\omega\in\tilde{\Omega}} \ell(\omega)d\omega\right]^2 \right) d\omega \tag{1}$$

where q_o denotes the quantity of the numeraire good consumed and $q(\omega)$ denotes the quantity consumed of the differentiated variety ω, and $\ell(\omega)$ is the unit of labor the worker supplies to firm ω. a, γ, η, a_L, γ_L, and η_L are positive constants. Ω denotes the set of varieties available for consumption, while $\tilde{\Omega}$ denotes the set of varieties produced, which is identical to Ω in a closed economy. $z(\omega)$ is a positive variable that captures the appeal for a particular variety ω and that varies across firms.

The budget constraint of the representative consumer is given by:

$$1 + \bar{\ell}\int_{\omega\in\tilde{\Omega}} w(\omega)\ell(\omega)d\omega = \int_{\omega\in\Omega} p(\omega)q(\omega)d\omega + q_o \tag{2}$$

where $\bar{\ell}$ is a labor supply shifter. Solving the consumer problem, I obtain the following inverse demand function for a variety ω sold:

$$p(\omega) = az(\omega) - \gamma q(\omega) - \eta Q \tag{3}$$

where $Q = \left[\int_{\omega\in\Omega} q(\omega)d\omega\right]$. Firms with higher demand shifter $z(\omega)$ face a less elastic demand curve, with a higher reservation price.

The inverse supply curve is given by:

$$w(\omega) = a_L + \gamma_L \ell(\omega) + \eta_L \mathfrak{L} \tag{4}$$

where $a_L = \frac{\tilde{a}_L}{\ell}$, $\gamma_L = \frac{\tilde{\gamma}_L}{\ell}$, $\eta_L = \frac{\tilde{\eta}_L}{\ell}$, and $\mathfrak{L} = \left[\int_{\omega \in \tilde{\Omega}} \ell_i(\omega) d\omega\right]$. The standard case of perfectly elastic labor is obtained with $\gamma_L = 0$ and $\eta_L = 0$. For $\gamma_L > 0$, hiring an additional worker in a firm ω leads to higher wages.

2.2 Firms

There is a mass J of firms that pay the fixed cost of entry f_E in units of the numeraire. Only a fraction N of firms are active. There is a continuum of firms, which differ in their demand shifter z. Therefore, I replace ω with z in the above expressions for the consumer. I assume that demand shifters are Pareto distributed with shift parameter b and shape parameter θ. Thus, the CDF of the distribution is $G(z) = 1 - \left(\frac{b}{z}\right)^{\theta}$ and the pdf is $g(z) = \frac{\theta b^{\theta}}{z^{\theta+1}}$.

The heterogeneity in the demand shifter, instead of productivity, allows the model to be as tractable as the model of Melitz and Ottaviano (2008).[8] Furthermore, there is mounting evidence that heterogeneity on the demand side is the main source of firm size heterogeneity (Hottman et al., 2016). Firms are monopolistically competitive in the market for final goods and, thus, take Q as given. Furthermore, firms are monopsonistically competitive, as they realize that hiring an additional worker induces an increase in the wage. However, a firm's hiring decision does not affect other firms, as $\mathfrak{L}$ is taken as given in the firm problem. This assumption distinguishes the present model to those of oligopsony by Morlacco (2017), Macedoni and Tyazhelnikov (2018), MacKenzie (2018), and Berger et al. (2019), in which firms realize their effects on market aggregates.

As firm heterogeneity is captured by the demand shifter, I assume that to produce one unit of output, each firm uses one unit of labor. This is a key advantage of the closed economy framework, in which trade costs are absent. Hence, the labor hired by firm z is given by:

$$L\ell(z) = Lq(z) \tag{5}$$

The expression in (5) also implies that $Q = \mathfrak{L}$. We can write firm's profits as:

$$\pi(z) = L(p(z)q(z) - w(z)\ell(z)) = (az - \gamma q(z) - \eta Q)Lq(z) - (a_L + \gamma_L \ell(z) + \eta_L \mathfrak{L})L\ell(z) \tag{6}$$

[8]The lack of tractability in a model with heterogeneity in productivity is due to the fact that the optimal output of a firm, in the presence of monopsonistic competition, is non-linear in productivity. In the appendix, I consider an extension of the model in closed economy with productivity heterogeneity, with similar results.

Firms maximize their profits by choosing $q(z)$, where I substitute $\ell(z)$ using (5). The first order conditions of the firm's problem with respect to $q(z)$ are given by:

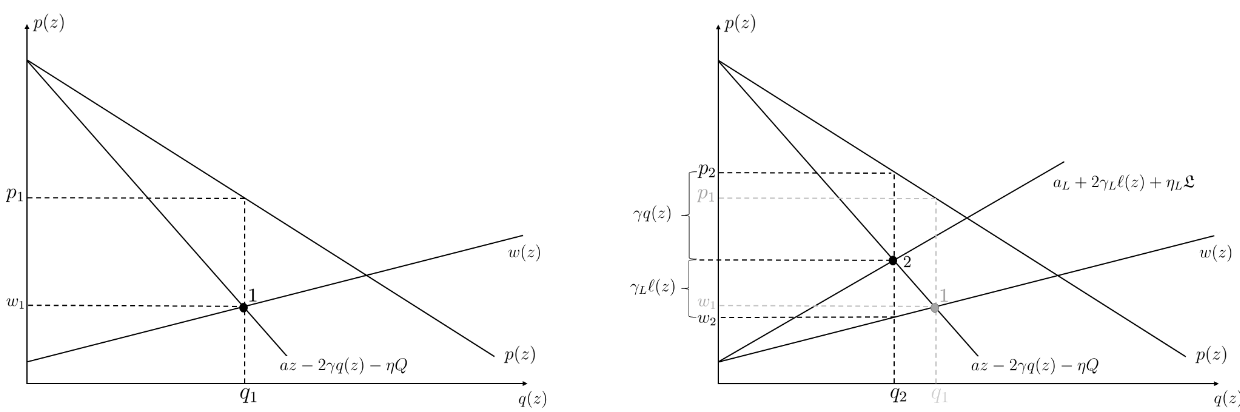
$$az - 2\gamma q(z) - \eta Q = a_L + 2\gamma_L \ell(z) + \eta_L \mathfrak{L} \tag{7}$$
$$p(z) - \gamma q(z) = w(z) + \gamma_L \ell(z)$$
$$p(z) = w(z) + \gamma q(z) + \gamma_L \ell(z) \tag{8}$$

As unit costs are $w(z)$, (additive) markups over unit costs increase in the quantity produced, as in traditional models with decreasing demand elasticity. This paper also allows for markups to increase in the number of workers hired $\ell(z)$, which is a result of monopsony power. Figure 1 illustrates the difference between the current model and a model without monopsonistic competition. In a standard model, the unit cost $w(z)$ is also the marginal cost of the firm. In monopsonistic competition, the marginal cost is higher than the unit cost, as hiring additional workers causes the wage to increase. As firms internalize the effect on the wages, they limit hiring in an effort to keep wages low. Limiting the labor demand reduces output and, thus, raises markups.

Figure 1: Firm Problem

(a) Standard Model

(b) Monopsonistic Competition



Optimal quantity and price resulting from the profit maximization problem of firm z. Figure (a): Standard model without monopsony power. Figure (b): baseline model with monopsony power.

The figure also highlights the contribution of monopoly power and monopsony power to firms' markups over unit costs. The difference between price and unit costs, in fact, can be decomposed in the difference between price and marginal costs, which is traditionally referred to as the additive markup, and the difference between marginal revenue and wage, which is referred to as the additive markdown. The additive markup equals $\gamma q(z)$ and increases in output as in Melitz and Ottaviano (2008). The additive markdown equals $\gamma_L \ell(z)$ and increases in the number of workers hired, which equals to total output.[9] As the labor supply elasticity decreases in labor, larger firms restrict more their demand to keep wages down. As a result, larger firms have higher markups and higher markdowns than smaller firms. With a slight abuse of definition, in the remainder of the paper, I refer to markups as the ratio of prices over unit costs, instead of marginal costs.

For simplicity, I set $\eta = 0$, so that consumer demand is additively separable. There exists a cutoff firm z^*, such that $q(z^*) = 0$. The level of the cutoff product appeal is obtained by evaluating (7) at zero output:

$$z^* = \frac{1}{a}\left(a_L + \eta_L \mathfrak{L}\right) \tag{9}$$

The performance variables of firm z have the following expressions:

$$q(z) = \frac{a(z - z^*)}{2(\gamma + \gamma_L)} \tag{10}$$

$$p(z) = \frac{a\left((\gamma + 2\gamma_L)z + \gamma z^*\right)}{2(\gamma + \gamma_L)} \tag{11}$$

$$r(z) = \frac{a^2(z - z^*)((\gamma + 2\gamma_L)z + \gamma z^*)}{4(\gamma + \gamma_L)^2} \tag{12}$$

$$\pi(z) = \frac{a^2 L(z - z^*)^2}{4(\gamma + \gamma_L)} \tag{13}$$

where $r(z)$ are firm revenues. Firms with larger demand shifter, or appeal, have larger quantities, prices, revenues, and profits. Furthermore, firms with larger product appeal pay higher wages:

$$w(z) = \frac{a}{2(\gamma + \gamma_L)}\left(\gamma_L z + (2\gamma + \gamma_L)z^*\right) \tag{14}$$

This result is due to the upward sloping supply curve of labor: as firms with larger appeal have larger output, they also hire more workers than smaller firms. As a firm size increases, it moves along the labor supply curve, thus, paying higher wages. In a standard model with $\gamma_L = 0$, wages are constant across firms and equal to az^*.

The firm-level profit share is given by the ratio of $\pi(z)$ and $r(z)$:

$$\frac{\pi(z)}{r(z)} = \frac{(\gamma + \gamma_L)(z - z^*)}{(\gamma + 2\gamma_L)z + \gamma z^*} \tag{15}$$

The profit share increases in z: workers in high-appeal firms, despite the higher wages, earn

[9] It is straightforward to show that the ratio of prices over marginal costs, and the ratio of marginal revenues over wages are also increasing in appeal z.

a smaller share of the total income generated by the firm, relative to workers in low-appeal firms. This is a key consequence of monopsony power: firms with larger consumer demand are able to restrict their labor demand to pay lower wages relative to what they would have otherwise paid without monopsony power. Furthermore, the profit share declines in the appeal cutoff z^*. This is in line with the results of the literature whereby larger firms charge higher markups, and tougher competition, modeled as an increase in z^*, reduces markups and, thus, the profit share (Autor et al., 2020).

Let us now consider the role of γ_L. A steeper labor supply curve *reduces* the firm-level profit share. The result means that a less elastic supply curve (larger slope) reduces the profit share and not that the presence of monopsonistic competition reduces the profit share. To isolate the role of monopsonistic competition, consider an extension in which firms face upward sloping supply curves, but do not internalize their effect on wages. It can be shown that, in this extension, the profit share is smaller.

2.3 Aggregation and the Profit Share

The mass of active firms is $N = J\left(\frac{b}{z^*}\right)^\theta$. Expected profits are given by:

$$E[\pi] = b^\theta \int_{z^*}^{\infty} \pi(z)\theta z^{-\theta-1} dz \tag{16}$$

Given the quasi-linear utility function, the equilibrium only depends on the mass of entrants J. In fact, given J, firms choose optimal quantities (10) and wages (14). In equilibrium, expected profits equal the fixed cost of entry:

$$E[\pi] = f_E \tag{17}$$

Even though the expected profits are pinned down by the fixed entry cost, I consider the profit share as the integral of the profits of all active firms from a country divided by the integral of the revenues of all active firms from the same country. Thus, I ignore the fixed cost of entry in the calculation of aggregate profits. This simply implies that the numeraire good is interpreted as an entrepreneurial endowment that agents can consume or use to create a new firm.

The expected profit condition (17) yields the equilibrium level of the cutoff:

$$z^* = \left(\frac{a^2 L b^\theta}{2(\gamma+\gamma_L)(\theta-2)(\theta-1)f_E}\right)^{\frac{1}{\theta-2}} \tag{18}$$

By the cutoff definition (9), I obtain the equilibrium mass of firms:

$$J = \frac{2(\gamma + \gamma_L)(\theta - 1)(az^* - a_L)(z^*)^{\theta-1}}{b^\theta a \eta_L} \tag{19}$$

Let us consider the exercise of Autor et al. (2020), of an increase in the cutoff z^*. This can be obtained with an exogenous increase in the size L of the economy. An increase in the cutoff has two effects on the profit share. On the one hand, the increased competition reduces the profit share of all firms. This reduction is due to the reduction in firm markups, brought about by the standard pro-competitive effect of an increase in the cutoff, and by the additional effect of an increase in the wages for workers of all firms. Second, the increase in the cutoff forces out of the market firms with low-profit share, and production is reallocated towards firms with higher profit share. Confirming the results of Autor et al. (2020), these two effects cancel each other because of the assumption that product appeal is Pareto distributed. This means that the economy-wide profit share is independent of the domestic cutoff:

$$\frac{\Pi}{R} = \frac{J b^\theta \int_{z^*}^{\infty} \pi(z) \theta z^{-\theta-1} dz}{J b^\theta \int_{z^*}^{\infty} r(z) \theta z^{-\theta-1} dz} = \frac{2(\gamma + \gamma_L)}{2(\theta - 1)\gamma + 3\theta\gamma_L} \tag{20}$$

where Π is the aggregate profit bill and R is the total revenues. Similar to the relationship between firm-level profit share and γ_L, the aggregate profit share is declining in γ_L, and reaches the maximum value for $\gamma_L = 0$ at $1/(\theta - 1)$.

3 International Trade and the Profit Share

In this section, I study the effects of trade on the aggregate profit share. To do so, I extend the closed economy model of the previous section to a model with two identical countries.

3.1 Two-country Model

I denote with subscript d variables related to the domestic economy, and with subscript x variables related to the foreign economy. For instance, $q_d(z)$ is the output of firm z for the domestic economy, and $q_x(z)$ for the foreign economy. Exporting requires the payment of an iceberg trade cost denoted by τ. Hence, the labor demand of firm z equals:

$$L\ell(z) = Lq_d(z) + \tau L q_x(z) \tag{21}$$

The profits of a firm equal:

$$\pi(z) = L\left(\sum_{j=d,x} Lp_j(z)q_j(z) - w(z)\ell(z)\right) =$$
$$= L\left(\sum_{j=d,x} (az - \gamma q_j(z) - \eta Q)q_j(z) - (a_L + \gamma_L \ell(z) + \eta_L \mathfrak{L})\ell(z)\right) \tag{22}$$

Firms maximize their profits by choosing $q_j(z)$ for each destination. Contrary to standard models, the firm problem cannot be broken down into destination-specific objective functions: by increasing the output for the foreign market, a firm affects the wage of its workers, which in turn affects unit costs for both the foreign and the domestic market.

Solving the the firm problem yields the optimal quantities produced by firm z:

$$q_j(z) = \frac{1}{2\gamma}\left(az - \eta Q + \tau_j\left(a_L + \eta_L \mathfrak{L}\right) - 2\tau_j \gamma_L \ell(z)\right) \tag{23}$$

For ease of notation, I introduce the general equilibrium object $\tilde{z}_j$, which is given by:

$$\tilde{z}_j = \frac{\eta}{a}Q + \frac{\tau_j}{a}\left(a_L + \eta_L \mathfrak{L}\right) \tag{24}$$

This object is the appeal cutoff in the absence of upward sloping labor supply curves ($\gamma_L = 0$). It corresponds to the demand shifter of a hypothetical marginal firm indifferent between only selling to destination j and not producing. The output equation can be re-written as:

$$q_j(z) = \frac{1}{2\gamma}\left(az - a\tilde{z}_j - 2\tau_j \gamma_L \ell(z)\right) \tag{25}$$

$\tilde{z}_{ij}$ only helps in simplifying the notation and should not be interpreted as a cutoff driving firm selection, which I analyze hereafter. As in the closed economy model, I set $\eta = 0$ for simplicity.

The domestic product appeal cutoff is obtained by setting $\ell(z) = q_d(z) = 0$, and is identical to the cutoff in the closed economy (9):

$$z_d^* = \tilde{z}_d = \frac{a_L}{a} + \frac{\eta_L}{a}\mathfrak{L} \tag{26}$$

Notice that $\tilde{z}_x$ is proportional to the domestic cutoff:

$$\tilde{z}_x = \tau\left(\frac{a_L}{a} + \frac{\eta_L}{a}\mathfrak{L}\right) = \tau \tilde{z}_d = \tau z_d^* \tag{27}$$

Let us now derive the export cutoff z_x^*. First, the firm with appeal equal to the export cutoff hires a positive number of workers $\ell(z_x^*)$ and has zero output in the foreign market: $q_x(z_x^*) = 0$. Setting the export quantity equal to zero, I find the labor demand as:

$$\ell(z_x^*) = \frac{a(z - \tilde{z}_x)}{2\tau\gamma_L}$$

Substituting $\ell(z_x^*)$ into the formula for domestic output $q_d(z_x^*)$ yields the export cutoff:

$$z_x^* = z_d^* \frac{\frac{\tilde{z}_x}{\tilde{z}_d} - \frac{\tau\gamma_L}{\gamma+\gamma_L}}{1 - \frac{\tau\gamma_L}{\gamma+\gamma_L}} = \frac{\tau z_d^* \gamma}{\gamma - (\tau - 1)\gamma_L} \tag{28}$$

We restrict the parameter space so that $\gamma - (\tau - 1)\gamma_L > 0$. It follows that $z_x^* > z_d^*$, which means that only the firms with higher product appeal will be able to export.

Given the two cutoffs, we can rewrite the performance variables of firms in a more convenient way. The expressions that characterize the performance of firms that only sell domestically ($z \in [z_d^*; z_x^*]$) are identical to the closed economy case previously presented. Relative to non-exporters, the output of exporters ($z > z_x^*$) in the domestic economy and foreign economy have different expressions. I indicate with superscript x that a firm is an exporter. Output equals:

$$q_d^x(z) = \frac{a}{2\gamma(\gamma + \gamma_L(\tau^2 + 1))} \left[(\gamma + \gamma_L\tau(\tau - 1))\, z - \gamma z_d^*\right] \tag{29}$$

$$q_x^x(z) = \frac{a}{2\gamma(\gamma + \gamma_L(\tau^2 + 1))} \left[(\gamma - \gamma_L(\tau - 1))\, z - \gamma\tau z_d^*\right] \tag{30}$$

If the condition $\gamma - \gamma_L(\tau - 1) > 0$ is violated, export quantities as defined by (30) would be negative. I summarize the implication in the following proposition:

Proposition 1. ***Zero Trade Flows.*** *If trade costs are such that $\tau > 1 + \gamma/\gamma_L$, there are zero export flows, i.e., $q_x(z) = 0\ \forall z$.*

The level of the iceberg trade costs that allows for positive export is bounded by the ratio of the demand slope γ and the individual labor supply slope γ_L. When a firm begins to export, its revenues increase because of new export sales. However, because of monopsonistic competition, the hiring of additional workers, which are needed to cover the production of new units of output and the iceberg trade costs, cause an increase in the wage and, thus, in the costs for all domestic units sold. If trade costs are large enough, this latter effect dominates, and no firm exports to a given destination regardless of their product appeal. In the standard model where $\gamma_L = 0$, there are no limits to the iceberg trade costs: only infinite trade costs generate zero trade flows. In contrast, in the presence of monopsonistic competition, large but *finite* trade costs can generate zero trade flows.

Wages paid by exporters have a different expression relative to the wages paid by firms that only sell domestically, to reflect the relationship between iceberg trade costs and labor requirements. Wages are determined by:

$$w^x(z) = \frac{a}{2(\gamma + \gamma_L(\tau^2+1))}\left[\gamma_L(1+\tau)z + (2\gamma + \gamma_L(\tau^2+1))z_d^*\right] \tag{31}$$

Finally, prices of exporters in the domestic and foreign economy are given by:

$$p_d^x(z) = \frac{a}{2(\gamma + \gamma_L(\tau^2+1))}\left[(\gamma + \gamma_L(\tau^2+\tau+2))z + \gamma z_d^*\right] \tag{32}$$

$$p_x^x(z) = \frac{a}{2(\gamma + \gamma_L(\tau^2+1))}\left[(\gamma + \gamma_L(2\tau^2+\tau+1))z + \gamma\tau z_d^*\right] \tag{33}$$

I leave the remaining derivations to the appendix.

3.2 The Profit Share

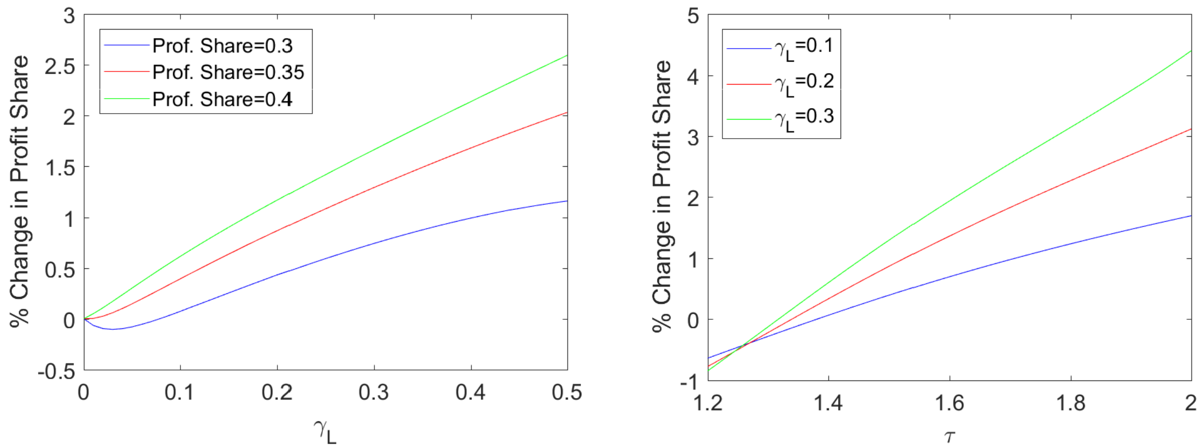
The expression for the aggregate profit share is highly non-linear, and can be written generally as a function of four parameters of the model:

$$\frac{\Pi}{R} = \frac{Jb^\theta\left[\int_{z_d^*}^{z_x^*}\pi^d(z)\theta z^{-\theta-1}dz + \int_{z_x^*}^{\infty}\pi^x(z)\theta z^{-\theta-1}dz\right]}{Jb^\theta\left[\int_{z_d^*}^{z_x^*}r^d(z)\theta z^{-\theta-1}dz + \int_{z_x^*}^{\infty}r^x(z)\theta z^{-\theta-1}dz\right]} = F(\gamma, \gamma_L, \theta, \tau) \tag{34}$$

where $\pi^d(z)$ and $\pi^x(z)$ are the total profit of a non-exporter and an exporter, and $r^d(z)$ and $r^x(z)$ are the total revenues of a non-exporter and an exporter. In a standard model, with $\gamma_L = 0$, $\frac{\Pi}{R} = 1/(\theta-1)$ and is independent of the trade costs. The result is driven by the combination of the standard assumptions of monopolistic competition and Pareto distribution of the underlying firm characteristics. In the presence of monopsonistic competition, the conditions of the results of Autor et al. (2020) no longer hold, and the aggregate profit share depends on trade costs.

Let us consider a reduction in trade costs. Such a reduction has the effect of increasing the domestic cutoff, which reduces the profit share of all firms, and forces out of the market low-profit share firms. These two channels are augmented by two more at the exporter level. A reduction in trade costs, in fact, increases the export profits, but as firms expand their size, their wages increase and, as a result, domestic profits further decline. While the positive effect on profits is more dominant in larger exporters, smaller exporters are more affected by the increase in the firm-level wages. Which of these effects dominate depends on the parameter of the model.

Figure 2: The Effects of a 5% Reduction in Trade Costs on the Profit Share



Percentage change in the aggregate profit share after a 5% reduction in the iceberg trade cost. The left panel shows the results for different values of γ_L (on the x-axis), different values of the initial profit share (listed in the legend), and for $\tau = 1.5$. The right panel shows the results for different values of the initial trade cost τ (on the x-axis), different values of γ_L (listed in the legend), and initial profit share of 0.35.

As the analysis requires a numerical exercise, I consider the following values for the parameters of interest. First, I normalize the parameters in the utility function by setting $\gamma = 1$. This normalization is done without loss of generality for the purpose of the exercise.[10] I consider alternative values for $\tau \in [1.2; 2]$ and $\gamma_L \in [0; 0.5]$. I choose a value of θ in order for the initial profit share $\frac{\Pi}{R}$ to match the profit share in the data, given the chosen values for γ_L and τ. Values of the profit share, computed as one minus the labor share, in rich economies range from 0.3 to 0.4 (Karabarbounis and Neiman, 2014), and thus I consider $\{0.3; 0.35; 0.4\}$ as initial values for $\frac{\Pi}{R}$. I compute the percentage change in the profit share due to a 5% reduction in τ, and show the results in Figure 2.

Panel (a) of Figure 2 shows that a reduction in trade costs causes generally an increase in the profit share, and especially so for higher values of the slope γ_L and for higher values of the initial profit share. Panel (b) shows how the results vary with different initial value of the trade costs. At high trade costs, the profit share increases after an improvement in economic integration. In contrast, with low trade costs, the profit share declines. The result suggests that in the presence of monopsonistic competition, trade reduces the profit share between already integrated countries, and especially if the profit share is already low and the labor supply relatively elastic. In contrast, trade increases the profit share if trade costs are high, the labor supply inelastic, and the initial profit share large.

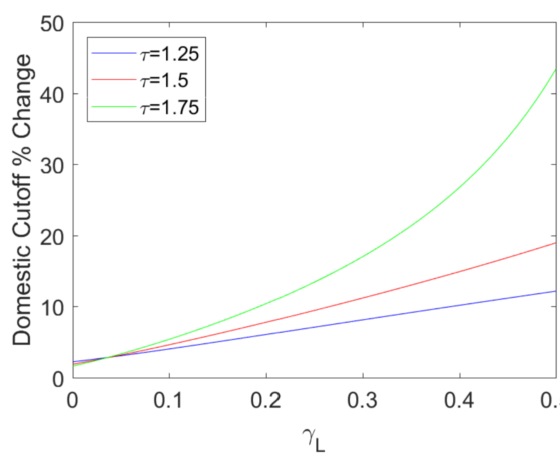
[10]In fact, the equations that are used in this numerical exercise can be expressed as a function of γ_L/γ.

3.3 Trade, Markups, and Wages

To further understand the effects of trade in the presence of monopsonistic competition, this section extends the results from the numerical exercise described in the previous section, by examining the effects of a reduction in trade costs on markups and wages at the firm level. In particular, I consider a reduction of 5% in trade costs and calibrate the value of θ so as to generate an initial aggregate profit share of 0.4, given the alternative values of τ and γ_L shown here.

Figure 3 illustrates the relationship between the percentage change in the domestic cutoff due to trade and the slope of the labor supply γ_L. As expected, trade increases the domestic cutoff, which is larger under larger iceberg trade costs. A model of monopsonistic competition generates a tougher selection of firms than those arising in a standard Melitz and Ottaviano (2008) model (with $\gamma_L = 0$): the change in the domestic cutoff increases. This explains why a higher γ_L is associated with a positive relationship between trade and the aggregate profit share. As steeper labor supply curves are associated with tougher selection, trade forces more low-appeal firms out of the market, and, thus, the surviving firms have relatively higher profit share.

Figure 3: Trade and the Domestic Cutoff



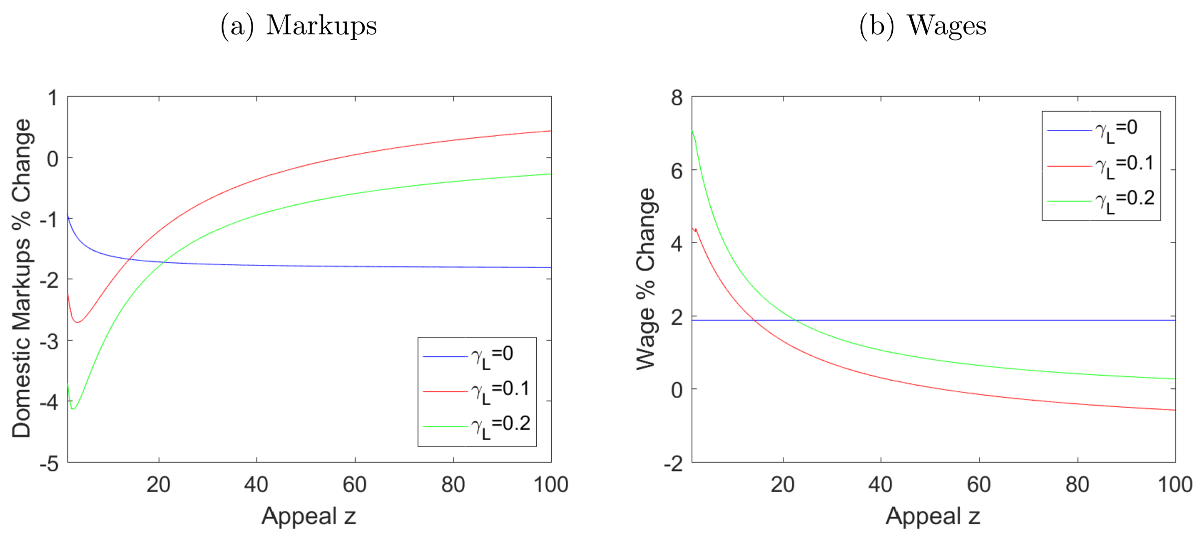
Percentage change in the domestic cutoff after a 5% reduction in trade costs. The results are reported for different values of γ_L (x-axis) and τ (legend). Additional details are in the main text.

Figure 4 illustrates the percentage change in markups and wages from a reduction in trade costs. The effects of trade on these variables depends on the relative position of a firm in the appeal ranking, and on the value of γ_L. Let us first consider markups. In the absence of monopsonistic competition, all firms reduce their domestic markups after trade.

In the presence of monopsonistic competition, the largest firms may surprisingly increase their markups (for instance, in panel (a) with $\gamma_L = 0.1$). Generally, the smaller firms reduce their markups more than the standard model would predict, while larger firms would reduce their markups less.

The effects of trade on wages is opposite that of markups. Generally, firms increase their wages after a reduction in trade costs, although under some parameter choices, the largest firms can reduce their wages (for instance, in panel (b) with $\gamma_L = 0.1$). The smallest firms exhibit the largest increases in the wages, while the largest firms the smallest increases. These results combined further explain why the profit share can increase in the presence of monopsonistic competition. Trade not only reallocates production towards the largest high-profit firms, and does so at a larger extent under monopsonistic competition, but these high-profit firms increase by less their wages and can actually reduce them.

Figure 4: Markups, Wages, and Profit Share



Percentage change in firm-level markups (panel (a)) and wages (panel (b)) after a 5% reduction in trade costs. The results are reported for different values of γ_L (legend) across firms of different appeal z. Additional details are in the main text.

3.4 Calibration

As the effect of trade on the profit share depends on the values of the parameters of the model, in this section, I consider a simple quantitative exercise to verify whether, under reasonably chosen parameters, a reduction in trade costs leads to an increase in the profit share. The three parameters of interest in the model are the labor supply slope γ_L, the shape parameter of the Pareto distribution of product appeal θ, and the iceberg trade cost τ. Since I normalize $\gamma = 1$, I implicitly estimate the labor supply slope relative to the consumer demand slope γ_L/γ, but in the remainder of the section, I only refer to the labor supply slope γ_L.

To calibrate the three parameters, I consider the following three moments. First, Hershbein et al. (2020) estimate an average markdown for US plants of 1.53. The markdowns, denoted by $\tilde{\mu}^d(z)$ for non-exporters and by $\tilde{\mu}^x(z)$ for exporters equal:

$$\tilde{\mu}^d(z) = \frac{z - z_d^*}{z + (1 + 2\gamma/\gamma_L)\, z_d^*}$$
$$\tilde{\mu}^x(z) = \frac{(1+\tau)z - (1+\tau^2)z_d^*}{(1+\tau)z + ((1+\tau^2) + 2\gamma/\gamma_L)\, z_d^*}$$

Then, the average markdown as computed by Hershbein et al. (2020) equals:

$$\bar{\tilde{\mu}} = 1 + \left[\int_{z_d^*}^{z_x^*} \frac{\tilde{\mu}^d(z)^d(z)\theta z^{-\theta-1}}{(z_d^*)^{-\theta} - (z_x^*)^{-\theta}} dz + \int_{z_x^*}^{\infty} \frac{\tilde{\mu}^x(z)\theta z^{-\theta-1}}{(z_x^*)^{-\theta}} dz \right]$$

As shown in the analysis of the firm's problem, a higher level of the slope of the labor supply curve is associated with a larger markdown.

The second moment I target is the labor share, as the profit share is defined as one minus the labor share. Karabarbounis and Neiman (2014) estimate the labor share in the US to be approximately 60%. The global labor share in the corporate sector also equals 60% (Karabarbounis and Neiman, 2014). The third moment is the percentage of US firms that export, which is around 20% according to Bernard et al. (2007).

I calibrate the parameters by minimizing the sum of the squared difference between the moments predicted by the model and the moments in the data. To generate moments from the model, I simulate 500,000 draws of product appeal following the standard approach in the literature (Eaton et al., 2011). Given guesses for the initial parameters, I draw 500,000 realizations u from a uniform distribution. To maximize the number of observations, I condition the simulation on firms that are active in the domestic economy. In practice, I normalize the domestic cutoff to 1, and compute the realization of product appeal as $z = u^{-\frac{1}{\theta}}$. Then, I compute the performance variables of firms as described in the appendix, and derive the moments. Table 1 summarizes the moments used in the calibration, and reports the calibrated values of the parameters.

The estimated labor supply slope is 0.02, and such a small number is sufficient to generate an average 50% markdown. The result indicates that monopsony power can have larger consequences on wages even in the presence of slightly upward sloping labor supply curves. The estimated θ is in line with the results in the literature (Simonovska and Waugh, 2014; Macedoni and Weinberger, 2019). Given these parameters, a reduction in trade costs leads

Table 1: Moments and Parameters

Moment	Data	Model	Source
US Plant Avg. Markdown	1.53	1.53	Hershbein et al.
US Labor Share	0.60	0.60	Karabarbounis and Neiman
US Share of Exporters	0.20	0.20	Bernard et al.
Parameter	Value		
γ_L	0.02		
τ	1.60		
θ	3.33		

to an increase in the profit share. In particular, a 5% reduction in trade costs generates 0.2% increase in the profit share.

We can use the calibrated parameters to evaluate how much monopsony power can explain of the rise in the profit share due to a reduction in trade costs. Fouquin and Hugot (2016) estimates a reduction of a global index of trade cost of approximately 42% from 1980 to the latest year available (2014). Using the calibrated parameters, I compute the profit share resulting from an increase in trade costs to their 1980s level. Due to the increase in trade costs, the profit share declines from 40% to 38.9%. This is equivalent to a fifth of the total change in the profit share from 1980 (35%) till the mid 2010s (40%).

4 Extensions

4.1 Multi-Country Model

In this section, I outline a multi-country extension to the baseline model. There are I countries indexed by i for origin and j for destination, and, in each country, there are L_i consumers.

Firms. The labor hired by firm z is given by:

$$L_i \ell_i(z) = \sum_{j=1}^{I} L_j q_{ij}(z) \tau_{ij} \tag{35}$$

where $L_j q_{ij}(z)$ is total output sold to destination j. We can write firm's profits as:

$$\pi_i(z) = \sum_{j=1}^{I} L_j p_{ij}(z) q_{ij}(z) - w_i(z) L_i \ell_i(z) =$$

$$= \sum_{j=1}^{I} (az - \gamma q_{ij}(z) - \eta Q_j) q_{ij}(z) - (a_L + \gamma_L \ell_i(z) + \eta_L \mathfrak{L}_i) L_i \ell_i(z) \tag{36}$$

The first order conditions yield a system of equations that characterizes the optimal quantities produced by firm z:

$$q_{ij}(z) = \frac{1}{2\gamma} \left[az - \eta Q_j - \tau_{ij} \left(a_L + 2\gamma_L \sum_{j=1}^{I} \frac{L_j}{L_i} q_{ij}(z) \tau_{ij} + \eta_L \mathfrak{L}_i \right) \right] \tag{37}$$

As in the two-country model, for ease of notation, I introduce the general equilibrium object $\tilde{z}_{ij}$, which is given by:

$$\tilde{z}_{ij} = \frac{\eta}{a} Q_j + \frac{\tau_{ij}}{a} (a_L + \eta_L \mathfrak{L}_i) \tag{38}$$

The optimal output equation can be re-written as an implicit function, or as a function of labor demand:

$$q_{ij}(z) = \frac{1}{2\gamma} \left(az - a\tilde{z}_{ij} - 2\tau_{ij}\gamma_L \sum_{j=1}^{I} \frac{L_j}{L_i} q_{ij}(z) \tau_{ij} \right) \tag{39}$$

$$q_{ij}(z) = \frac{1}{2\gamma} (az - a\tilde{z}_{ij} - 2\tau_{ij}\gamma_L \ell_i(z)) \tag{40}$$

Substituting (40) into the demand function, I obtain the pricing rule:

$$p_{ij}(z) = \tau_{ij} w_i(z) + \frac{a(z - \tilde{z}_{ij})}{2} \tag{41}$$

Finally, firm revenues in a destination are given by:

$$r_{ij}(z) = \frac{L_j}{2\gamma} (az - a\tilde{z}_{ij} - 2\tau_{ij}\gamma_L \ell_i(z)) \left(\tau_{ij} w_i(z) + \frac{a(z - \tilde{z}_{ij})}{2} \right) \tag{42}$$

while the destination specific profits equal:

$$\pi_{ij}(z) = \frac{L_j}{4\gamma} (az - a\tilde{z}_{ij} - 2\tau_{ij}\gamma_L \ell_i(z)) (a(z - \tilde{z}_{ij})) \tag{43}$$

Selection. Let z^*_{ik} denote the value of the demand shifter of a firm with individual labor demand $\ell_i(z^*_{ik}) \geq 0$, and whose final good demand in destination k is zero ($q_{ik}(z^*_{ik}) = 0$). However, the firm is active in other destinations $j \in D_{k-1}$. Setting the quantity (40) for destination k to zero, I obtain the labor demand $\ell_i(z^*_{ik})$ for the cutoff firm in destination k:

$$\ell_i(z^*_{ik}) = \frac{a}{2\tau_{ik}\gamma_L}(z^*_{ik} - \tilde{z}_{ik}) \tag{44}$$

Substituting (44) into (40) yields the quantity exported to $j \in D_{k-1}$ of firm z^*_{ik}:

$$q_{ij}(z^*_{ik}) = \frac{a}{2\gamma}\left(z^*_{ik}\left(1 - \frac{\tau_{ij}}{\tau_{ik}}\right) - \tilde{z}_{ij} + \frac{\tau_{ij}}{\tau_{ik}}\tilde{z}_{ik}\right) \tag{45}$$

Combining (45) with the definition of firm-level labor demand (35), I obtain:

$$\begin{aligned}\ell_i(z^*_{ik}) &= \sum_{j\in D_{k-1}} \frac{L_j\tau_{ij}q_{ij}(z^*_{ik})}{L_i} = \\ &= \frac{a}{2\gamma}\left[z^*_{ik}\sum_{j\in D_{k-1}}\frac{L_j\tau_{ij}\left(1-\frac{\tau_{ij}}{\tau_{ik}}\right)}{L_i} + \frac{\tilde{z}_{ik}}{\tau_{ik}}\sum_{j\in D_{k-1}}\frac{L_j\tau^2_{ij}}{L_i} - \sum_{j\in D_{k-1}}\frac{L_j\tau_{ij}\tilde{z}_{ij}}{L_i}\right]\end{aligned} \tag{46}$$

Combining (46) with (44), I obtain the product appeal cutoff z^*_{ik} such that only firms with appeal $z > z^*_{ik}$ export to k:

$$\begin{aligned}\gamma(z^*_{ik} - \tilde{z}_{ik}) &= \gamma_L\left(z^*_{ik}\sum_{j\in D_{k-1}}\frac{L_j\tau_{ij}\left(\tau_{ik}-\tau_{ij}\right)}{L_i} + \tilde{z}_{ik}\sum_{j\in D_{k-1}}\frac{L_j\tau^2_{ij}}{L_i} - \sum_{j\in D_{k-1}}\frac{L_j\tau_{ij}\tau_{ik}\tilde{z}_{ij}}{L_i}\right) \\ z^*_{ik}\left(\gamma - \gamma_L\sum_{j\in D_{k-1}}\frac{L_j\tau_{ij}\left(\tau_{ik}-\tau_{ij}\right)}{L_i}\right) &= \tilde{z}_{ik}\left(\gamma + \sum_{j\in D_{k-1}}\frac{L_j\tau^2_{ij}}{L_i}\right) - \sum_{j\in D_{k-1}}\frac{L_j\tau_{ij}\tau_{ik}\tilde{z}_{ij}}{L_i} \\ z^*_{ik} &= \tilde{z}_{ik}\frac{\gamma + \gamma_L\sum_{j\in D_{k-1}}\frac{L_j}{L_i}\left(\tau^2_{ij} - \tau_{ij}\tau_{ik}\frac{\tilde{z}_{ij}}{\tilde{z}_{ik}}\right)}{\gamma + \gamma_L\sum_{j\in D_{k-1}}\frac{L_j}{L_i}\left(\tau^2_{ij} - \tau_{ij}\tau_{ik}\right)}\end{aligned} \tag{47}$$

Given the general equilibrium objects $\tilde{z}_{ij}$, I can then compute the cutoffs using (47). Furthermore, the cutoff z^*_{ik} is monotonically increasing in $\tilde{z}_{ik}$. This means that only the firms with higher appeal will be able to export, and the larger the appeal, the larger the number of destinations reached. As $\tilde{z}_{ik}$ increases in market size (Q_j) and iceberg trade costs τ_{ij}, only firms with high product appeal can reach more distant destinations or destinations with smaller markets.

We can use the cutoffs determined to solve for the output of firms:

$$q_{ij}(z) = \begin{cases}\frac{1}{2\gamma}\left(az - a\tilde{z}_{ij} - 2\tau_{ij}\gamma_L\sum_{j=1}^{I}\frac{L_j}{L_i}q_{ij}(z)\tau_{ij}\right) & \text{if } z \geq z^*_{ij} \\ 0 & \text{if } z < z^*_{ij}\end{cases} \tag{48}$$

For the subset of destinations with non-zero demand, optimal output can be derived with the following matrix notation:

$$\mathbf{q}_i(z) = a\mathbf{A}_i(z)^{-1}(z - \tilde{\mathbf{z}}_{ij}) \tag{49}$$

where $\mathbf{q}_i(z)$ is a vector with elements $q_{ij}(z)$, $\tilde{\mathbf{z}}_{ij}$ is a vector with elements $\tilde{z}_{ij}$, and $\mathbf{A}_i(z)$ is a matrix with diagonal elements $A_{jj} = 2(\gamma + \gamma_L \tau_{ij}^2 \frac{L_j}{L_i})$ and off diagonal elements $A_{jk} = 2\tau_{ij}\tau_{ik}\gamma_L \frac{L_k}{L_i}$.

Expected Profits. Expected profits are given by:

$$E[\pi_i] = b_i^\theta \left[\sum_{k=1}^{I-1} \int_{z_{ik}^*}^{z_{ik+1}^*} \left(\sum_{j \in D_k} \pi_{ij}^k(z) \right) \theta z^{-\theta-1} dz + \int_{z_{iI}^*}^{\infty} \left(\sum_{j \in D_I} \pi_{ij}^I(z) \right) \theta z^{-\theta-1} dz \right] \tag{50}$$

where I rank destinations by increasing product appeal cutoff. $\pi_{ij}^k(z)$ are the profits from i to j of a firm z who exports to destinations $j \in D_k$, and $D_k = \{1, .., k\}$. Given the quasi-linear utility function, the only equilibrium object that needs solving for is the mass of entrants J_i. In fact, given J_i, firms choose optimal quantities (48) and wages (4). In equilibrium, expected profits equal the fixed cost of entry:

$$E[\pi_i] = f_E \tag{51}$$

4.2 Productivity Heterogeneity

For robustness, I consider an extension of the model in which firms differ in terms of productivity and firms' product appeal is a function of the firm productivity, similar to Feenstra and Romalis (2014). Such an extension is highly intractable, as it requires numerical methods for the solution of the model, even in a closed economy. The main result of the closed economy model also applies to this extension: monopsonistic competition reduces the labor share, and the labor share declines in firm size.

The key implication of the extension is that higher productivity reduces the wage elasticity with respect to output. When a firm expands its output, it needs to hire more workers and, thus, pay higher wages. More productive firms need to hire fewer workers for the same increase in output, relative to less productive firm. In contrast, in the baseline model, the wage elasticity with respect to output only depends on the output level. The effect of productivity on the wage elasticity has a clear effect on the relationship between productivity and wages. In fact, if the elasticity of product appeal with respect to productivity is small enough, there is a non-monotone hump shaped relationship between productivity and wages. At small values of productivity, increases in productivity are associated with an increase in the wage as firms hire additional workers. Vice versa, for high values of initial productivity, further increases in productivity reduce the wage. The most productive firms have such a strong monopsony power, that they are able to lower their wages through labor savings.

Finally, in this extension, the result of Autor et al. (2020) does not hold even in the closed economy setting. In fact, an increase in the productivity cutoff reduces the aggregate profit share for low values of the elasticity of product appeal with respect to productivity, and it increases the profit share for high values of such elasticity.

5 Conclusions

The model presented in the paper studies the effects of monopsonistic competition on the relationship between trade and profit share. As firms realize their market power on workers, they restrict their supply to charge a lower wage. The model generates a positive relationship between the size of a firm and the firm markups and markdowns. As a result, there is a positive relationship between firm size and profit share.

Unlike in a standard monopolistic competition model with a Pareto distribution of productivity, in the presence of monopsonistic competition, a reduction in trade costs can change the profit share. In case of initial low profit share or low trade costs, the profit share is likely going to decline, while in case of high initial profit share or higher trade costs, the profit share can increase. Less elastic labor supply curve are associated with an increase in the aggregate profit share following a reduction in trade costs.

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6 Appendix

6.1 Two-country model

This section provides the detailed derivations for the two-country model. I first focus on the performance variables of domestic firms. I denote with superscript d the performance variables of non-exporters and with superscript x of exporters.

Domestic firms: $z \in [z_d^*; z_x^*]$**.** Similarly to the closed economy case, the optimal quantity in the domestic economy for firms that only sell to the domestic economy is:

$$q^d(z) = \frac{a}{2(\gamma + \gamma_L)}(z - z_d^*)$$

Individual labor supply $\ell^d(z)$ equals to:

$$\ell^d(z) = \frac{a}{2(\gamma + \gamma_L)}(z - z_d^*) \quad z \in [z_d^*; z_x^*] \tag{52}$$

Hence, the wages equal:

$$w^d(z) = az_d^* + \gamma_L \ell^d(z) = \frac{a}{2(\gamma + \gamma_L)}\left(\gamma_L z + (2\gamma + \gamma_L)z_d^*\right) \quad z \in [z_d^*; z_x^*] \tag{53}$$

Prices of non-exporters are then:

$$p^d(z) = \frac{a}{2(\gamma + \gamma_L)} \left[(\gamma + 2\gamma_L)z + \gamma z_d^*\right] \tag{54}$$

Markups equal:

$$\mu^d(z) = \frac{(\gamma + 2\gamma_L)z + \gamma z_d^*}{\gamma_L z + (2\gamma + \gamma_L)z_d^*} \tag{55}$$

Revenues and profits are given by:

$$\begin{aligned} r^d(z) &= \frac{a^2 L}{4(\gamma + \gamma_L)^2} \left[(\gamma + 2\gamma_L)z^2 - 2\gamma_L z z_d^* - \gamma (z_d^*)^2\right] \\ \pi^d(z) &= \frac{a^2 L}{4(\gamma + \gamma_L)} (z - z_d^*)^2 \end{aligned}$$

The average revenues conditional on firms being active are:

$$\bar{r}^d = \int_{z_d^*}^{z_x^*} r^d(z) \frac{\theta}{\left((z_d^*)^{-\theta} - (z_x^*)^{-\theta}\right) z^{\theta+1}} dz = \frac{a^2 L (z_d^*)^{-(\theta-2)} G_1(\tau)}{\left((z_d^*)^{-\theta} - (z_x^*)^{-\theta}\right)}$$

where $G_1(\tau)$ is a constant that equals:

$$\begin{aligned} G_1(\tau) = \frac{1}{4(\gamma + \gamma_L)^2} &\left[\frac{\theta(\gamma + 2\gamma_L)}{\theta - 2} \left[1 - \left(\frac{\tau\gamma}{\gamma - (\tau - 1)\gamma_L} \right)^{-(\theta-2)} \right] - \frac{2\theta\gamma_L}{\theta - 1} \left[1 - \left(\frac{\tau\gamma}{\gamma - (\tau - 1)\gamma_L} \right)^{-(\theta-1)} \right] + \right. \\ &\left. - \gamma \left[1 - \left(\frac{\tau\gamma}{\gamma - (\tau - 1)\gamma_L} \right)^{-(\theta)} \right] \right] \end{aligned} \tag{56}$$

The average profits conditional on firms being active are:

$$\begin{aligned} \bar{\pi}^d &= \int_{z_d^*}^{z_x^*} \pi^d(z) \frac{\theta}{\left((z_d^*)^{-\theta} - (z_x^*)^{-\theta}\right) z^{\theta+1}} dz \\ &= \frac{a^2 L (z_d^*)^{-(\theta-2)} G_2(\tau)}{\left((z_d^*)^{-\theta} - (z_x^*)^{-\theta}\right)} \end{aligned} \tag{57}$$

where $G_2(\tau)$ is a constant that equals:

$$\begin{aligned} G_2(\tau) = \frac{1}{4(\gamma + \gamma_L)} &\left[\frac{2}{(\theta - 2)(\theta - 1)} - \frac{\theta}{\theta - 2} \left(\frac{\tau\gamma}{\gamma - (\tau - 1)\gamma_L} \right)^{-(\theta-2)} + \frac{2\theta}{\theta - 1} \left(\frac{\tau\gamma}{\gamma - (\tau - 1)\gamma_L} \right)^{-(\theta-1)} + \right. \\ &\left. - \left(\frac{\tau\gamma}{\gamma - (\tau - 1)\gamma_L} \right)^{-\theta} \right] \end{aligned} \tag{58}$$

Hence, the component of the aggregate revenues and expected profits made by domestic firms equal:

$$\bar{r}^d b^\theta \left((z_d^*)^{-\theta} - (z_x^*)^{-\theta}\right) = a^2 L (z_d^*)^{-(\theta-2)} G_1(\tau) \tag{59}$$
$$\bar{\pi}^d b^\theta \left((z_d^*)^{-\theta} - (z_x^*)^{-\theta}\right) = a^2 L (z_d^*)^{-(\theta-2)} b^\theta G_2(\tau) \tag{60}$$

We can now examine the problem of exporters.

Exporters: $z \in [z_x^*, \infty)$**.** Using (48), I find the following optimal quantity produced by exporting firms for the domestic and export market:

$$q_d^x(z) = \frac{a}{2\gamma(\gamma + \gamma_L(\tau^2+1))} \left[(\gamma + \gamma_L \tau(\tau - 1))\, z - \gamma z_d^*\right] \tag{61}$$
$$q_x^x(z) = \frac{a}{2\gamma(\gamma + \gamma_L(\tau^2+1))} \left[(\gamma - \gamma_L(\tau - 1))\, z - \gamma\tau z_d^*\right] \tag{62}$$

The (individual) labor demand equals:

$$\ell^x(z) = q_d^x(z) + \tau q_x^x(z) = \frac{a}{2\gamma(\gamma + \gamma_L(\tau^2+1))} \left[\gamma(1+\tau)z - \gamma(1+\tau^2) z_d^*\right] \tag{63}$$

Thus, wages are equal to:

$$w^x(z) = \frac{a}{2(\gamma + \gamma_L(\tau^2+1))} \left[\gamma_L(1+\tau)z + (2\gamma + \gamma_L(\tau^2+1)) z_d^*\right] \tag{64}$$

Hence, prices in the domestic and foreign economy are given by:

$$p_d^x(z) = \frac{a}{2(\gamma + \gamma_L(\tau^2+1))} \left[(\gamma + \gamma_L(\tau^2 + \tau + 2))z + \gamma z_d^*\right] \tag{65}$$
$$p_x^x(z) = \frac{a}{2(\gamma + \gamma_L(\tau^2+1))} \left[(\gamma + \gamma_L(2\tau^2 + \tau + 1))z + \gamma\tau z_d^*\right] \tag{66}$$

Markups in the domestic economy and foreign are:

$$\mu_d^x(z) = \frac{(\gamma + \gamma_L(\tau^2 + \tau + 2))z + \gamma z_d^*}{\gamma_L(1+\tau)z + (2\gamma + \gamma_L(\tau^2+1)) z_d^*} \tag{67}$$
$$\mu_x^x(z) = \frac{(\gamma + \gamma_L(2\tau^2 + \tau + 1))z + \gamma\tau z_d^*}{\gamma_L(1+\tau)z + (2\gamma + \gamma_L(\tau^2+1)) z_d^*} \tag{68}$$

Firm revenues in the domestic and foreign economy equal:

$$r_d^x(z) = \frac{a^2 L}{4\gamma(\gamma + \gamma_L(\tau^2+1))^2}\left[(\gamma^2 + 2\gamma\gamma_L(\tau^2+1) + \gamma_L^2(\tau^2 - \tau)(\tau^2 + \tau + 2))z^2 + 2\gamma\gamma_L(1+\tau)z z_d^* - \gamma^2 (z_d^*)^2\right]$$

$$r_x^x(z) = \frac{a^2 L}{4\gamma(\gamma+\gamma_L(\tau^2+1))^2}[(\gamma^2+2\gamma\gamma_L(\tau^2+1)-\gamma_L^2(\tau-1)(2\tau^2+\tau+1))z^2+ \\ -2\gamma\gamma_L\tau^2(\tau+1)zz_d^*-\gamma^2\tau^2(z_d^*)^2]$$

Thus, total revenues of an exporter equal to:

$$r^x(z) = \frac{a^2 L}{4\gamma(\gamma+\gamma_L(\tau^2+1))^2}[(2\gamma^2+4\gamma\gamma_L(\tau^2+1)+\gamma_L^2(\tau-1)^2(\tau^2+1))z^2+ \\ -2\gamma\gamma_L(1+\tau)(\tau^2-1)zz_d^*-\gamma^2(\tau^2+1)(z_d^*)^2]$$

Average revenues equal:

$$\bar{r^x} = \int_{z_x^*}^{\infty} \theta r^x(z)\frac{(z_x^*)^\theta}{z^{\theta+1}}dx = a^2L(z_x^*)^2G_3(\tau) \tag{69}$$

where $G_3(\tau)$ is a constant, and equals:

$$G_3(\tau) = \frac{1}{4\gamma(\gamma+\gamma_L(\tau^2+1))^2}\left[\frac{\theta(2\gamma^2+4\gamma\gamma_L(\tau^2+1)+\gamma_L^2(\tau-1)^2(\tau^2+1))}{\theta-2}+ \right. \\ \left. -\frac{2\theta\gamma\gamma_L(1+\tau)(\tau^2-1)}{\theta-1}\left(\frac{\gamma-\gamma_L(\tau-1)}{\tau\gamma}\right)-\gamma^2(\tau^2+1)\left(\frac{\gamma-\gamma_L(\tau-1)}{\tau\gamma}\right)^2\right]$$

Finally, profits in the two destinations equal:

$$\pi_d^x(z) = \frac{a^2 L}{4\gamma(\gamma+\gamma_L(\tau^2+1))}\left[(\gamma+\gamma_L\tau(\tau-1))z^2-(2\gamma+\gamma_L\tau(\tau-1))z\tilde{z}_d+\gamma\tilde{z}_d^2\right] \tag{70}$$

$$\pi_x^x(z) = \frac{a^2 L}{4\gamma(\gamma+\gamma_L(\tau^2+1))}\left[(\gamma-\gamma_L(\tau-1))z^2-(2\gamma-\gamma_L(\tau-1))z\tilde{z}_x+\gamma\tilde{z}_x^2\right] \tag{71}$$

Thus, profits of exporters, given by the sum of $\pi_d^x(z)$ and $\pi_x^x(z)$, equal:

$$\pi^x(z) = \frac{a^2 L}{4\gamma(\gamma+\gamma_L(\tau^2+1))}\left[\left(2\gamma-\gamma_L(\tau-1)^2\right)z^2-2\gamma\left(1+\frac{1}{\tau}\right)z\tilde{z}_x+\gamma\left(1+\frac{1}{\tau^2}\right)\tilde{z}_x^2\right] = \\ = \frac{a^2 L}{4\gamma(\gamma+\gamma_L(\tau^2+1))}\left[\left(2\gamma-\gamma_L(\tau-1)^2\right)z^2-2\gamma(\tau+1)zz_d^*+\gamma\left(\tau^2+1\right)(z_d^*)^2\right]$$

Average profits for exporters equal:

$$\bar{\pi}^x = a^2L(z_x^*)^2G_4(\tau) \tag{72}$$

where $G_4(\tau)$ is a constant, and equals:

$$G_4(\tau) = \frac{1}{4\gamma(\gamma+\gamma_L(\tau^2+1))}\left[\frac{\theta}{\theta-2}\left(2\gamma-\gamma_L(\tau-1)^2\right) - \frac{2\gamma\theta}{\theta-1}\left(1+\frac{1}{\tau}\right)\left(\frac{\gamma-\gamma_L(\tau-1)}{\gamma}\right) + \right.$$
$$\left. +\gamma\left(1+\frac{1}{\tau^2}\right)\left(\frac{\gamma-\gamma_L(\tau-1)}{\gamma}\right)^2\right] =$$
$$= \frac{1}{4\gamma(\gamma+\gamma_L(\tau^2+1))}\left[\frac{\theta}{\theta-2}\left(2\gamma-\gamma_L(\tau-1)^2\right) - \frac{2\theta}{\theta-1}\left(\frac{\gamma(\tau+1)-\gamma_L(\tau^2-1)}{\tau}\right) + \right.$$
$$\left. + \left(1+\frac{1}{\tau^2}\right)\frac{(\gamma-\gamma_L(\tau-1))^2}{\gamma}\right]$$

Thus, the component of exporters in the aggregate revenues and expected profits equal:

$$a^2Lb^\theta(z_x^*)^{-(\theta-2)}G_3(\tau) = a^2Lb^\theta(z_d^*)^{-(\theta-2)}\left(\frac{\tau\gamma}{\gamma-(\tau-1)\gamma_L}\right)^{-(\theta-2)}G_3(\tau) \tag{73}$$

$$a^2Lb^\theta(z_x^*)^{-(\theta-2)}G_4(\tau) = a^2Lb^\theta(z_d^*)^{-(\theta-2)}\left(\frac{\tau\gamma}{\gamma-(\tau-1)\gamma_L}\right)^{-(\theta-2)}G_4(\tau) \tag{74}$$

Thus, combining (74) and (60) the zero expected profit condition pins down the domestic cutoff:

$$(z_d^*)^{\theta-2} = \frac{a^2Lb^\theta}{f_E}\left[G_2(\tau) + \left(\frac{\tau\gamma}{\gamma-(\tau-1)\gamma_L}\right)^{-(\theta-2)}G_4(\tau)\right] \tag{75}$$

Let us normalize the cutoff in autarky to one. That implies that:

$$(z_d^*)^{\theta-2} = 2(\gamma+\gamma_L)(\theta-2)(\theta-1)\left[G_2(\tau) + \left(\frac{\tau\gamma}{\gamma-(\tau-1)\gamma_L}\right)^{-(\theta-2)}G_4(\tau)\right] \tag{76}$$

Finally, the profit share, defined as the ratio between total profits and total revenues, equals:

$$\frac{\Pi}{R} = \frac{G_2(\tau) + \left(\frac{\tau\gamma}{\gamma-(\tau-1)\gamma_L}\right)^{-(\theta-2)}G_4(\tau)}{G_1(\tau) + \left(\frac{\tau\gamma}{\gamma-(\tau-1)\gamma_L}\right)^{-(\theta-2)}G_3(\tau)} \tag{77}$$

6.2 Model Extension: Heterogeneity in Productivity

This section reports the analytical derivations for the model extension, in which firms are heterogeneous in productivity, denoted by φ. I consider a closed economy framework for simplicity. Hence, the individual labor requirement for firm φ equals:

$$\ell(\varphi) = \frac{q(\varphi)}{\varphi}$$

Let us assume that the firm specific demand shifter is a function of firm's productivity: $z = \varphi^{\alpha}$, with $\alpha \geq 0$. This captures the idea that most productive firms have higher product appeal, or higher quality. The inverse demand and inverse supply are given by:

$$p(\varphi) = a\varphi^{\alpha} - \gamma q(\varphi)$$
$$w(\varphi) = a_L + \frac{\gamma_L q(\varphi)}{\varphi} + \eta_L \mathfrak{L}$$

Thus, firm profits equal:

$$\pi(\varphi) = L\left[p(\varphi)q(\varphi) - w(\varphi)\ell(\varphi)\right] = L\left[a\varphi^{\alpha}q(\varphi) - \gamma q^2(\varphi) - a_L\frac{q(\varphi)}{\varphi} - \frac{\gamma_L q^2(\varphi)}{\varphi^2} - \eta_L \mathfrak{L}\frac{q(\varphi)}{\varphi}\right]$$

The first order condition with respect to $q(\varphi)$ is:

$$a\varphi^{\alpha} - 2\gamma q(\varphi) - \frac{a_L}{\varphi} - \frac{2\gamma_L q(\varphi)}{\varphi^2} - \frac{\eta_L \mathfrak{L}}{\varphi} = 0 \tag{78}$$

The productivity cutoff is defined by setting output of the cutoff firm to zero $q(\varphi^*) = 0$:

$$\varphi^* = \left[\frac{1}{a}\left(a_L + \eta_L \mathfrak{L}\right)\right]^{\frac{1}{\alpha+1}} \tag{79}$$

Thus, the optimal quantity equals:

$$q(\varphi) = \frac{a\left(\varphi^{\alpha} - \frac{(\varphi^*)^{\alpha+1}}{\varphi}\right)}{2\left(\gamma + \frac{\gamma_L}{\varphi^2}\right)} \tag{80}$$

Output is increasing in productivity. Relative to the baseline model, the productivity term also appears at the denominator of (80). This stems from the fact that productivity reduces the effect of an increase in output on wages. In the baseline model, an small increase in output causes an increase in the wage by γ_L for all firms, because $\ell(z) = q(z)$. In this extension, instead, the increase in output does not generate the same increase in the wage across firms, because the most productive firms need to hire fewer workers. The optimal price equals to:

$$p(\varphi) = \frac{a\left(\gamma\varphi^{\alpha} + 2\gamma_L\varphi^{\alpha-2} + \gamma(\varphi^*)^{\alpha+1}\varphi^{-1}\right)}{2\left(\gamma + \frac{\gamma_L}{\varphi^2}\right)} \tag{81}$$

Firm wages equal:

$$w(\varphi) = \frac{a\left(2\gamma(\varphi^*)^{\alpha+1} + \gamma_L\varphi^{\alpha-1} + \gamma_L(\varphi^*)^{\alpha+1}\varphi^{-2}\right)}{2\left(\gamma + \frac{\gamma_L}{\varphi^2}\right)} \tag{82}$$

Let us consider the derivative of wages with respect to productivity:

$$\frac{dw(\varphi)}{d\varphi} = \frac{a\gamma_L\left(\gamma(\alpha-1)\varphi^{\alpha} + \gamma_L(\alpha+1)\varphi^{\alpha-2} + 2\gamma(\varphi^*)^{\alpha+1}\varphi^{-1}\right)}{2\left(\gamma + \frac{\gamma_L}{\varphi^2}\right)^2\varphi^2} \tag{83}$$

If the elasticity of product appeal with respect to productivity is small enough, wages exhibit a non-monotone hump shaped relationship with respect to productivity. Consider the case in which $\alpha = 0$. The derivative of wages with respect to φ equals:

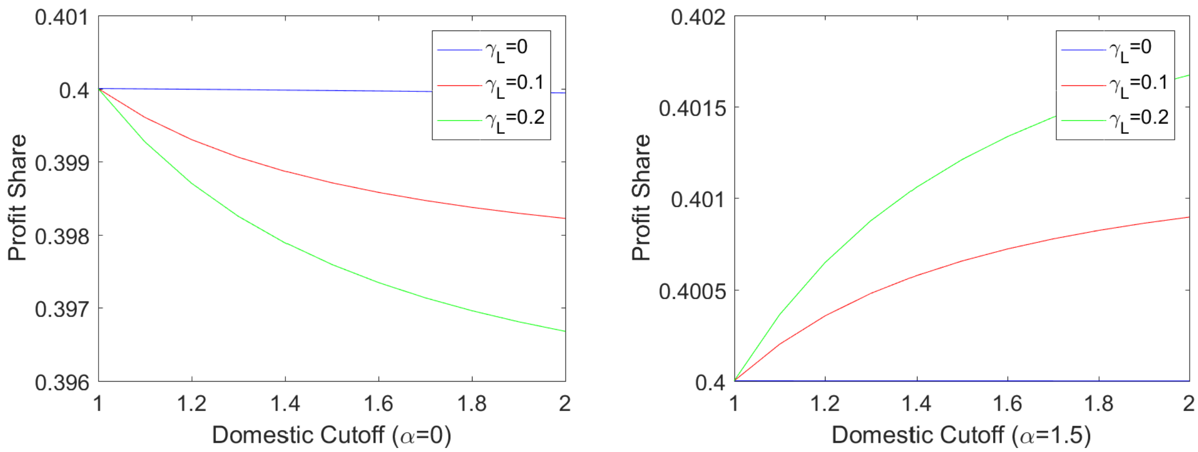
$$\frac{dw(\varphi)}{d\varphi} = \frac{a\gamma_L\left(2\gamma\frac{\varphi^*}{\varphi} + \frac{\gamma_L}{\varphi^2} - \gamma\right)}{2\left(\gamma + \frac{\gamma_L}{\varphi^2}\right)^2\varphi^2}$$

Wages are increasing in productivity for $\varphi \leq \varphi^* + ((\varphi^*)^2 + \gamma/\gamma_L)^{0.5}$ and decreasing for $\varphi > \varphi^* + ((\varphi^*)^2 + \gamma/\gamma_L)^{0.5}$. Thus, in this case, the effects of monopsonistic competition are stronger than in the baseline model. Because workers in more productive firms are more efficient, these firms are able to further decrease their demand, which reduces their wages.

For some values of α, it is analytically feasible to derive the profit share by computing the average revenues and profits. However, such a procedure results in a complicated expression that depends on several hypergeometric functions. Since these functions are slow to compute, I use numerical methods to compute the average revenues and profits directly as a function of the productivity cutoff.

I normalize the parameters in the utility function by setting $\gamma = 1$. I consider three values for $\gamma_L = \{0; 0.1; 0.2\}$ and for the cutoff $\varphi^* \in [1; 5]$. As in the baseline model, I assume that productivity is Pareto distributed with shape parameter θ determined by matching a profit share of 0.3. I consider approximately 1,000,000 values of productivity from the cutoff till 1000, and compute the integral of the average revenues and average profits using the trapezoidal rule. As this is a closed economy, the ratio of average profits to average revenues equals the profit share. Figure 5 shows the relationship between the profit share and the domestic productivity cutoff.

Figure 5: Profit Share and Domestic Cutoff



Level of the aggregate profit share as a function of the domestic productivity cutoff φ^*. Both panels show the results for different values of γ_L. In the left panel, $\alpha = 0$ while in the right panel $\alpha = 1$.