Trade under monopsonistic competition

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Abstract

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We develop a model of trade under monopsonistic competition. We consider two countries: a country in which firms have weak monopsony power and thus high wages (Home) and another country with the opposite features (Foreign). We show that Home is an exporter of the produced good despite it is also the high wage country. The low-wage country exports the non-produced good. Because wages are higher in Home, firms are bigger in order to cover their fixed costs. Hence, fewer resources are wasted in fixed requirements at Home, which allows the country to produce more than its consumption. The opposite holds in Foreign: wages are lower, which promotes entry of more small firms. Hence, more resources are wasted in fixed costs and the country is not able to produce its whole consumption. In other words, the marginal productivity is the same in both countries but the average productivity is higher in Home.

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1 Introduction

Perfect competition in the labor market is the standard assumption in most trade models. Under this assumption, the elasticity of a firm's labor supply tends to the infinity and firms cannot post wages that differ from those of their competitors. Still the empirical estimations of this elasticity range from 2 to 4. This gives a substantial monopsony power to firms. Our question is the following: Does this monopsony power affect our view about the consequences of trade integration? Our answer is that it does inasmuch as monopsony powers differ across countries.

Consider a productive sector in which many firms produce an homogeneous good; some workers work for maintenance tasks (a fixed cost) and each additional worker produces the same output (constant marginal product). Under monopsonistic competition the wage increases with the number of workers that the firm tries to attract. Hence the marginal cost is increasing and firms that set prices equal to their marginal costs make positive operating profits that can cover their fixed costs.

Firms set low wages in an economy with strong monopsony power. Their profit per worker is large and thus many firms enter into this market. This economy is characterized by many small firms, low wages but also low production. Indeed, a large share of the population works for "unproductive" maintenance tasks in many firms rather than for production itself. Under autarchy, the price of the produced good is high because of the low supply of goods. By contrast, few large firms posting high wages have a high production in an economy that is characterized by weak monopsony power. The price of the good is low because of the high production.

Under trade integration, the low price (but high wage) economy with weak monopsony power exports the good to the high price (but low wage) economy with strong monopsony power. The high wage country exports the homogeneous good to the low wage country even though the marginal product of labor is identical across countries. The key difference between countries, is that the average product of labor is higher in the high wage country because fewer firms are located there.

By equalizing prices, trade integration tends to raise the price in the high wage - low price country. It decreases the price in the other country. In monopsony models, wages vary in the same direction as prices. Hence, trade integration increases the wage in the high wage country and it decreases the wage in the low wage country. As a result, some firms exit the high wage country and enter the low wage country: firms become bigger in the first country and smaller in the other country. Trade integration has two opposite effects on a country's welfare: it raises wages and it reduces the number (diversity) of employers in the low monopsony power country. The second effect is negative for workers that positively value the diversity of employers. Nevertheless, we show that the net effect is positive for this country. The opposite holds in the other country.

Kumar et al. (2001) demonstrate that high wage industries have larger firms. Poschke, (2014) also provides evidence that countries with higher per capita in-

come have fewer but larger firms. Lucas (1978) develops a model of occupational choice in which higher wages induce managers to become employees, decreasing the number of firms and thereby increasing their sizes. Our model of monopsonistic competition concurs with this idea that higher wages deter firms from staying in the market, which contributes to increase firm size. It departs from Luca's model in the sense that it does not analyze the occupational choice of managers. In both models, the causality goes from wages to firm size, which explains that high wage industries have bigger firms.[1]

Bernard and Jensen (1995), (1999) show that the wages are higher in exporting firms than in non-exporting firms. This might be due to differences in workforce composition (see for example Verhoogen, 2008 and Yeaple, 2005), or to wage premia for workers with the same characteristics, as in the current paper. Those premia are caused either by labor market frictions (see for example Davidson et al., 1999, Davidson et al. 2008, and Helpman et al. 2010), or by efficiency or fair wages (see for example Amiti and Davis 2012, Davis and Harrigan 2011, and Egger and Kreickemeier 2009). As demonstrated by Bernard et al. (2011) both explanations are empirically validated. In those models, firms offering higher wages are the exporting firms; they compensate their higher labor costs by higher productivities.

We have a similar result in the sense that high-wage firms export toward countries with lower wages; the reason being that their average productivity is higher. By contrast with the existing literature, the higher average productivity is not caused by any difference in production function or in the skill or ability composition of the labor force but directly by the combination of high wages and increasing returns to scale: higher wages push some firms to the exit; the remaining firms are bigger and in a better position to exploit the economies of scale, which is in line with the facts demonstrated by Kumar et al. (2001). Note a difference with Helpman et al. (2010). In their model a country with lower frictions on the labor market gains a competitive advantage, which promotes export and attracts more firms whereas in our model, the higher wages induce some of the firms to exit the market, concurring with Kumar et al. (2001).

We build on Thisse and Toulemonde (2010). They have developed a simple model of monopsonistic competition that considers the workers heterogeneous perception of firms non wage attributes. We extend the Thisse and Toulemonde (2010) model to account for two countries, Home and Foreign. We simplify the model by assuming that firms' production is sold under perfect competition. The paper proceeds as follows. In Section 2, we describe monopsonistic competition in a closed economy. In Section 3, we characterize the equilibrium in the open economy.

[1] The reverse causality is well documented at the firm level: larger firms pay higher wages (see Oi and Idson, 1999, who reports a wage gap of 35% due to firm size). Oi and Idson advance three explanations: large firms pay efficiency wages to deter shirking, they share rents with employees, they are matched with more productive employees.

2 The closed economy

2.1 Technology

We consider an economy with two homogeneous goods. One good is unproduced whereas the other is produced under increasing returns by a continuum of N firms. When firm $i \in [0, N]$ hires $\ell(i)$ workers, it supplies

$$q(i) = \varphi \ell(i) - f \tag{1}$$

units of the good. The marginal productivity is φ and f is a fixed requirement needed for the firm to operate. The total number of workers is denoted by L.

2.2 Consumers and workers

Goods preferences. Consumers share the same quasi-linear preferences:

$$U(x, h) = \alpha \ln x + h \qquad \alpha > 0 \tag{2}$$

where x is the consumption of the produced good and h is the consumption of the unproduced good that we use as the numeraire. In this expression, α is a taste parameter that expresses the intensity of preferences for the produced good. The supply of the unproduced good is perfectly inelastic and equal to H. The budget constraint of a worker hired by firm i is given by

$$px + h = Y(i) \equiv w(i) + \frac{H}{L} + \frac{1}{L}\int_0^N \pi(j)\,\mathrm{d}j$$

where p is the price of the produced good, $w(i)$ the nominal wage earned by the worker in firm i, $\pi(j)$ the profit made by firm j. We make the innocuous assumption that the endowments of the unproduced good and the total profits are shared equally between workers. The individual income $Y(i)$ is composed of the individual wage, the individual endowment of the unproduced good, and the individual share of total profits. The individual demand for each good is as follows:

$$x = \frac{\alpha}{p} \qquad h = Y(i) - \alpha \tag{3}$$

where it is assumed that the initial endowments are sufficiently high to ensure a positive consumption of the unproduced good h. This hypothesis explains why the initial distribution of the endowments is immaterial for the market outcome.

Job preferences. A worker perception of the desirability of being employed by firm i is bidimensional: on the one-hand she considers the nominal wage offered by firm i, and on the other hand, she evaluates the specific non-wage attributes associated to the firm. The evaluation of the non-wage attributes is worker-specific and unobservable by the firms. The indirect utility of a worker hired by firm i is given by

$$V(i) = \alpha(\ln \alpha - 1) - \alpha \ln p + \frac{H}{L} + \frac{1}{L}\int_0^N \pi(j)\,\mathrm{d}j + w(i) + \varepsilon(i)$$

The five first terms of the expression denote the indirect utility of consumption, which increases linearly with the nominal wage. The last term $\varepsilon(i)$ denotes the evaluation by one worker of firm i non-wage attributes. It is a random variable whose realization is known to the worker only.

Each worker compares the indirect utility provided by each firm and chooses to work for the firm that grants her with the highest *hedonic wage* given by

$$\max_i(w(i)+\varepsilon(i))$$

We assume that the random variables $\varepsilon(i)$ are independently and identically distributed according to the Gumbel distribution with zero mean.[2] As demonstrated by McFadden (1976), Ben-Akiva et al. (1985) and Dagsvik (2002), the probability that a worker chooses to work in firm i is given by the *continuous logit*:

$$\mathbb{P}(i)=\frac{\exp\left(\frac{w(i)}{\gamma}\right)}{\int_0^N \exp\left(\frac{w(j)}{\gamma}\right)\mathrm{d}j} \tag{4}$$

where γ stands for the standard-deviation of $\varepsilon(i)$ (up to the numerical factor $\pi/\sqrt{6}$). Workers react differently to the same wage schedule because they exhibit heterogeneous tastes about firms. The *diversity of preferences* across workers is captured by the standard deviation of $\varepsilon(i)$, i.e., by the index γ. Workers do not diverge much in their evaluation of the firms non-wage attributes when the diversity index γ is low. In this case, many workers are willing to change jobs in response to a wage cut. By contrast, few workers respond to a wage cut by changing job when the diversity index is high. Workers are then strongly attached to one employer because of their idiosyncratic evaluation of the non wage job attributes.

To conclude this section, note that the expected hedonic wage is equal to[3]

$$\gamma\ln\int_0^N \exp\left(\frac{w(j)}{\gamma}\right)\mathrm{d}j.$$

Since the expected hedonic wage increases with the number of firms, workers' heterogeneity translates into a preference for job variety. For instance, when wages are the same across firms, this expression becomes $w+\gamma\ln N$, which increases at a decreasing rate with the number of firms.

2.3 Firms

In standard models of imperfect competition, firms use their monopoly power on the product market to cover their fixed costs, the input market being perfectly competitive. In this paper, firms operate under perfect competition on the

[2] As noted by Thisse and Toulemonde (2010), a worker's highest hedonic wage could be negative because the support of the Gumbel distribution is the real line. However, we may disregard this issue because each worker faces a continuum of firms.

[3] See Ben-Akiva et al. (1985).

product market. By contrast, the diversity of workers' preferences about non-wage attributes endows firms with monopsony power on the labor market, which allows them to cover their fixed costs.

A firm i setting wage $w(i)$ attracts

$$\ell(i) = L\mathbb{P}(i) \tag{5}$$

workers. Thus the elasticity of firm i's labor supply is

$$e(i) = \frac{w(i)}{\gamma}$$

Clearly, the higher is the heterogeneity of workers, γ, the less a firm's labor supply is responsive to nominal wages.

Substituting (1) for $q(i)$ yields the following expression for firm i's profits:

$$\pi(i) = p\varphi\ell(i) - w(i)\ell(i) - pf. \tag{6}$$

The wage $w(i)$ is chosen by the firm. The market price, p, and the level of fixed costs, pf, are exogenous to the firm, but endogenously determined through market interactions. Firm i chooses its wage $w(i)$ to maximize (6) subject to (5), which yields

$$w(i) = p\varphi - \gamma \tag{7}$$

In words, firms facing an heterogenous labor force are able to set wages lower than the marginal value product $p\varphi$. This is because workers not only care about wages but also about non-wage attributes. As a consequence, workers do not massively quit an employer if another employer offers them a slightly higher wage. An increase in the heterogeneity of workers, γ, lowers the elasticity of a firm's labor supply, which, in turn, reduces the equilibrium wage. The expression (7) also shows that the equilibrium wage responds to the market price.

In order to disentangle the various effects at work, we distinguish a *short-run equilibrium*, in which the number of firms is fixed, and a *long-run equilibrium* in which the number of firms is endogenously determined through free entry and exit.

2.4 Market equilibrium in the short-run

In equilibrium, all firms set the same wage and attract the same number of workers, $\ell(i) = L/N$. The production volume available for consumption is equal to $\varphi L - Nf$, whereas demand is given by $\alpha L/p$. Market clearing implies

$$p = \frac{\alpha L}{\varphi L - Nf}. \tag{8}$$

As expected, the price increases with α and with the fixed requirement f; it decreases with the marginal productivity φ. Less expected, the market price

increases with N. The reason is that the entry of a new firm requires the duplication of the unproductive fixed labor requirement. Given the fixed aggregate labor supply, fewer workers are now available for the production. Thus the entry of a firm reduces the produced good's supply, which raises the price. Last, the price decreases with the size of the economy, L. On the one hand, the supply per worker ($\varphi - Nf/L$) is increasing with the number of workers because a smaller proportion of workers is allocated to the fixed labor requirement. On the other hand the demand per worker is constant and equal to α. By aggregating over all workers, the market supply for the produced good increases faster with L than the market demand, which leads to a lower market price.

Using (7) and $\ell(i) = L/N$, it is readily verified that individual profits are equal to

$$\pi(i) = -fp + \gamma \frac{L}{N}$$

In this expression, the first term is the value of the fixed cost that must be covered by a firm operating under perfect competition on the product market. The second term is the profit margin earned per worker (γ) times the firm's workforce. Plugging (8) into this expression and summing profits across firms yields

$$\Pi = -fN \frac{\alpha L}{\varphi L - Nf} + \gamma L$$

which decreases with N.

2.5 Market equilibrium in the long-run

In the long run, profits earned from exploiting workers are washed out by free entry. Profits are equal to zero when

$$N = N_{\text{AUT}} \equiv \varphi \frac{\gamma}{\alpha + \gamma} \frac{L}{f}. \tag{9}$$

Thus, the equilibrium number of firms increases with workers' heterogeneity because a higher value of γ raises firms' monopsony power and, therefore, their profits. Furthermore, N decreases with α because a higher demand raises the market price, hence the fixed cost, which deters entry.

During the entry process, both price and wage increase. When this process comes to an end, price and wage are given by p_{AUT} and w_{AUT}:

$$\begin{aligned} p_{\text{AUT}} &\equiv \frac{\alpha + \gamma}{\varphi} \\ w_{\text{AUT}} &\equiv \varphi p_{AUT} - \gamma = \alpha \end{aligned}$$

In the long run, a stronger monopsony power yields higher market prices which in turn raises wages, counteracting the direct negative effect of monopsony on wages. Both prices and wages are independent from the market size L. Nevertheless, the expected hedonic wage, given by

$$V_c \equiv \alpha + \gamma \ln \left(\varphi \frac{\gamma}{\alpha + \gamma} \frac{L}{f} \right)$$

increases with L because a bigger market is able to sustain a larger number of firms, thus widening the portfolio of jobs.

3 The open economy case

We consider two countries, *Home* and *Foreign*, where variables associated with Foreign are starred. To be as complete as possible, we assume that the two countries are different in four dimensions: the size of the population, L and L^*, the diversity of preferences across workers, γ and γ^*, the taste parameter, α and α^*, and the productivity φ and φ^*. Trade costs are zero, and thus both goods are sold in both countries at the same price, which is p for the produced good and 1 for the unproduced good.

3.1 Wages

For the same given price p, the maximization of firms' profits yields the wages (see (7)):

$$w = p\varphi - \gamma \qquad w^* = p\varphi^* - \gamma^*$$

Without loss of generality, suppose that marginal productivities are equal ($\varphi = \varphi^*$) and that Home workers are more homogeneous than Foreign workers, $\gamma \leq \gamma^*$. In other words, Home workers are more sensitive to nominal wages than Foreign workers. The monopsony power of Home firms is smaller than that of Foreign firms. As a consequence, Home firms set higher wages that are closer to the marginal revenue product than the Foreign wages.

Wages differ across countries, the product is homogeneous and there is no costs to restrain trade across countries. Nevertheless, *firms do not massively exit the high-wage country.* Indeed, Home firms have a markup per worker that is lower than that of Foreign firms. However a Home firm attracts more workers than a Foreign firm precisely because it sets higher wages. The profit per worker is smaller in Home but firms are bigger and attract more workers which compensate for the lower profit per worker.

3.2 Market equilibrium in the short-run

The production available for consumption is given by $\varphi L - Nf + \varphi^* L^* - N^* f$, whereas demand is given by $(\alpha L + \alpha^* L^*)/p$. Market clearing implies

$$p = \frac{\alpha L + \alpha^* L^*}{\varphi L - Nf + \varphi^* L^* - N^* f} = W \frac{\alpha L}{\varphi L - Nf} + W^* \frac{\alpha^* L^*}{\varphi^* L^* - N^* f} \tag{10}$$

where

$$W \equiv \frac{\varphi L - Nf}{\varphi L - Nf + \varphi^* L^* - N^* f} \text{ and } W^* \equiv \frac{\varphi^* L^* - N^* f}{\varphi L - Nf + \varphi^* L^* - N^* f}$$

are weights that denote the production shares of each country. The short-run equilibrium price in the open economy is thus a weighted average of the Home and Foreign autarchic prices (8).

As in the closed economy, the price increases with the demand for the good, α and α^* and it decreases with the population, L and L^*.

3.3 Market equilibrium in the long-run

Under free entry and exit of firms, the profits of all firms are equal to zero. The value of the total fixed costs Npf must be equal to the total earnings brought by the workers, i.e., the number of workers times the difference between the marginal value product $p\varphi$ and their wage $p\varphi - \gamma$:

$$N = \frac{\gamma L}{pf} \text{ and } N^* = \frac{\gamma^* L^*}{pf} \tag{11}$$

Plugging those values in (10) and solving for p gives the price in the long-run:

$$p = \Omega p_{AUT} + \Omega^* p^*_{AUT} \tag{12}$$

where

$$\Omega \equiv \frac{L\varphi}{L\varphi + L^*\varphi^*}, \Omega^* \equiv \frac{L^*\varphi^*}{L\varphi + L^*\varphi^*}$$

are weights that denote the *potential* production shares of each country, i.e., the production share if the mass of firms in each country was an infinitesimally small, N and $N^* \to 0$.

First, note that *both countries supply the produced good* since N and N^* are both positive. Second, it is readily checked that everything else equal, an increase in the diversity of preferences in Home raises the monopsony power and the profitability of Home firms, which increases the number of Home firms. However, the total production available for consumption decreases with the number of firms. As a result, the price of the produced good goes up with γ. Similarly, an increase in the diversity of preferences in Foreign raises the market price. It also increases the value of the fixed requirement, which reduces firms' profits in Home. Consequently, N decreases with γ^*.

An increase in the Home marginal productivity φ increases the Home profitability and thus, it increases N. Similarly and increase in the Foreign productivity raises N^*, which in turn reduces the total production and thus raises the price and the number of Home firms.

The price is a weighted average of the autarchic Home and Foreign prices, p_{AUT} and p^*_{AUT}. The weights are given by the respective shares of potential production. For the sake of the argument, let us consider Home as the low price country under autarchy, $p_{\text{AUT}} < p^*_{\text{AUT}}$. By opening its trade to a high price country, Home increases its price, which raises the value of the fixed requirement and reduces entry at Home. Indeed, it is readily checked that

$$p_{\text{AUT}} < p^*_{\text{AUT}} \Longrightarrow p > p_{\text{AUT}} \Longrightarrow N < N_{\text{AUT}}$$

An increase in the Foreign population leaves the Foreign autarchic price unchanged but raises Ω^* and reduces Ω. Under trade integration, the international price increases because the weight associated with the high foreign price

increases. In turn, this raises the value of the fixed requirement at Home and reduces the profitability of Home firms. The number of Home firms decreases with the size of the Foreign population.

For the same reason, the number of Home firms increases with the size of the Home population if Home is the low price country. Even if Home is the high price country, the increase in the size of the Home population raises the number of Home firms because firms are now able to hire and exploit more workers.

3.4 Wages and expected hedonic wages

It is readily checked that the wages are

$$w = w_{\rm AUT} + \varphi\Omega^* \left(p^*_{\rm AUT} - p_{\rm AUT}\right)$$

Thus, trade integration raises the wages of all workers from the country with the lowest autarchic price, i.e. from the country where the demand parameter α and/or the diversity of preferences of workers, γ, are low and where the productivity φ is high. A sharp result is

$$w > w_{\rm AUT} \iff w^* < w^*_{\rm AUT},$$

i.e., trade integration raises the wage in one country but it lowers the wage in the other country.

To get further insight, suppose that both countries have the same taste for the consumed good ($\alpha = \alpha^*$) and the same productivity ($\varphi = \varphi^*$). Then $p_{\rm AUT} < p^*_{\rm AUT}$ if and only if Home has the lowest diversity of preferences. In this case, it is the country with the lowest diversity of preferences that gains (in terms of nominal wages) from the opening to trade. The other country loses. Next suppose instead that all workers share the same dispersion parameters, ($\gamma = \gamma^*$) and the same productivity. It is then the workers with the lowest taste for the produced good that earn more following the opening to trade.

A country with a low diversity of preferences is more likely to gain from trade integration in terms of nominal wages. However high labor costs reduce the number of firms and the diversity of employers. What is the net effect of the opening on the welfare? The expected hedonic wage is

$$V = w_{\rm AUT} + \varphi\Omega^* \left(p^*_{\rm AUT} - p_{\rm AUT}\right) + \gamma \ln\left(\frac{\gamma L}{pf}\right)$$

To track the effect of the opening to trade on the expected hedonic wage, it suffices to check how V changes with L^*. It is readily checked that the derivative with respect to L^* is

$$\frac{dV}{dL^*} = \varphi\left(p^*_{\rm AUT} - p_{\rm AUT}\right)\frac{d\Omega^*}{dL^*} - \frac{\gamma}{p}\frac{dp}{dL^*}$$

where

$$\frac{d\Omega^*}{dL^*} = \frac{\Omega\Omega^*}{L^*} \text{ and } \frac{dp}{dL^*} = \frac{\Omega\Omega^*}{L^*}\left(p^*_{\rm AUT} - p_{\rm AUT}\right)$$

Hence,

$$\frac{dV}{dL^*} = \frac{\varphi p - \gamma}{p} \frac{\Omega\Omega^*}{L^*} \left(p^*_{\mathrm{AUT}} - p_{\mathrm{AUT}}\right)$$

which is unambiguously positive if $p^*_{\mathrm{AUT}} > p_{\mathrm{AUT}}$. Thus all workers living in the low price country gain from trade integration. It is readily checked that dV^*/dL is negative if $p^*_{\mathrm{AUT}} > p_{\mathrm{AUT}}$. Foreign workers living in the high price / low wage region lose from trade integration despite the increase in the mass of firms.

3.5 Exports

The difference between the Home production and consumption defines the Home exports. It is readily checked that these exports are equal to

$$X \equiv \left(p^*_{\mathrm{AUT}} - p_{\mathrm{AUT}}\right) \left(\frac{1}{\varphi^* L^*} p_{\mathrm{AUT}} + \frac{1}{\varphi L} p^*_{\mathrm{AUT}}\right)^{-1}$$

which is positive if and only if $p^*_{\mathrm{AUT}} > p_{\mathrm{AUT}}$.

Assume that $\alpha = \alpha^*$, $\varphi = \varphi^*$ and $\gamma < \gamma^*$. Then, Home is an exporter of the produced good despite it is also the high wage country. The low-wage country, Foreign, exports the non-produced good. Because wages are higher in Home, firms are bigger in order to cover their fixed costs. Hence, fewer resources are wasted in fixed requirements at Home, which allows the country to produce more than its consumption. The opposite holds in Foreign: wages are lower, which promotes entry of more small firms. Hence, more resources are wasted in fixed costs and the country is not able to produce its whole consumption. In other words, the marginal productivity is the same in both countries but the average productivity is higher in Home. The lower is the dispersion parameter in Home and the higher is the dispersion parameter in Foreign, the larger are the Home exports. Of course, Home exports less of the produced good if its own consumers demand higher quantities of the produced good than Foreign consumers or if Home is less productive than Foreign.

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