Outsourcing under Monopolistic Competition: Winners and Losers

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Abstract

Using a model of outsourcing by monopolistically competitive firms, we show that, under certain conditions, international outsourcing (and/or re-location of plants to a low-wage economy) by home firms may worsen the welfare of the home country and reduce the profits of all firms in the industry, even though it is individually rational for each firm to choose to outsource. We show that if a social planner for the home country can choose the extent of international outsourcing, his optimal choice will not coincide with the equilibrium outcome under laissez-faire. A wage subsidy may improve welfare.When the wage in the Home country is rigid we show that outsourcing is welfare-improving for the home country if and only if the sum of the "trade creation" effect and the "exploitation effect" exceeds the "trade diversion" effect of the access to the low-wage labour in the foreign country.We also extend the model to a two-period framework, where each domestic firm faces the choice between outsourcing (or re-location) in

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the first period, or in the second period. Delaying outsourcing can be gainful because the fixed cost of outsourcing may fall over time. On the other hand, delaying means the firm's variable production cost in period 1 will be higher than that of rivals who are outsourcing. The equilibrium of this two-period game may involve some firms outsourcing in period 1, while others will outsource in period 2, even though ex-ante they are identical firms. Under monopolistic competition, in equilibium, the sum of discounted profits is identical for all firms. Again, a social planner for the home country may choose a different speed of outsourcing than the speed achieved by an industry under laissez-faire.

1 Introduction

International outsourcing has become an increasingly common phenomenon in advanced economies. Sinn (2004) reports that no fewer than 60% of German small and medium enterprises (SMEs) have established plants outside the old EU. He argues that outsourcing and offshoring have gone too far. Firms that relocate all or parts of their production in low-wage economies have contributed to a rising pool of unemployed workers. Due to wage inflexibility, globalisation "creates unemployment instead of gains from trade" (Sinn, 2004, p. 117). The main losers are obviously the low-skilled manufacturing workers in advanced economies. What can be said about the winners? In popular discussions many people would think that the winners of globalisation are owners of firms that outsource. This view however is implicitly based on the assumption that either outsourcing does not involve a fixed cost, or the outsourcing firm is a monopolist. When outsourcing firms have rivals, and fixed costs of outsourcing are non-negligible, it is not clear that the firms always come out as winners.

In this paper, using a model of outsourcing by monopolistically competitive firms, we show that, under certain conditions, international outsourcing (and/or re-location of plants to a low-wage economy) by home firms may worsen the welfare of the home country and reduce the profits of all firms in the industry, even though it is individually rational for each firm to choose to outsource. If a social planner for the home country can choose the extent of international outsourcing, his optimal choice will not coincide with the equilibrium outcome under laissez-faire. A wage subsidy may reduce the extent of outsourcing and improve welfare.This confirms Sinn's perception that "Wage subsidies make the state into a partner. They do not establish minimum wage demands and create the very flexibility in wage setting that is required for reaping the gains from trade." (Sinn, 2004, p. 119)

When the wage in the Home country is rigid we show that outsourcing is welfare-improving for the home country if and only if the sum of the "trade creation" effect and the "exploitation" effect exceeds the "trade diversion" effect of the access to the low-wage labour in the foreign country.

We also extend the model to a two-period framework, where each domestic firm faces the choice between outsourcing (or re-location) in the first period, or in the second period. Delaying outsourcing can be gainful because the fixed cost of outsourcing may fall over time. On the other hand, delaying means the firm's variable production cost in period 1 will be higher than that of rivals who are outsourcing. The equilibrium of this two-period game may involve some firms outsourcing in period 1, while others will outsource in period 2, even though ex-ante they are identical firms. Under monopolistic competition with homogeneous costs, in equilibium, the sum of discounted profits is identical for all firms. Again, a social planner for the home country may choose a different speed of outsourcing than the speed achieved by an industry under laissez-faire.

Before proceeding, we would like to make some remarks on the literature on international outsourcing. The impacts of outsourcing on wages and profits have been subjected to empirical studies (Feenstra and Hanson, 1999, Kimura, 2002, Görzig and Stephen, 2002, Görg and Hanley, 2004), as well as theoretical analysis (see, for example, Glass and Sagi, 2001, Grossman and Helpman, 2002, 2003, 2005, Grossman and Rossi-Hansberg, 2006a, 2006b, Jones, 2004, Long, 2005, and a special issue of the *International Review of Economics and Finance,* 2005). A related literature is the theory of fragmentation, see Jones and Kierzkowski (1990, 2001a, 2001b), Long, Riezman, and Soubeyran, (2005).

2 The Model

2.1 The basic assumptions

This is basically a partial equilibrium model. We are concerned with international outsourcing decisions of firms in an advanced economy (called the Home country, or H for short), and their impact on wages, profits, consumers surplus, and social welfare. We also want to find out if the gainers in H can compensate the losers in H, and how such compensation may take place.

The structure of the economy of H is simple. There are two industries, producing two goods. The numeraire good is produced by a perfectly competitive industry. The second good is a differentiated good, which consists of many varieties. It is produced by an imperfectly competitive industry consisting of a continuum of monopolistically-competitive firms, indexed by z, where $z \in [0, 1]$. Each of these firms produces a unique variety.The varieties are imperfect substitutes. The price of a unit of variety z is denoted by $p(z)$.Each firm has a constant marginal cost of production, and has incurred a fixed cost (e.g., it bought the patent for the variety it produces). We take the number of firms as fixed, because we wish to focus on the short run issues. (In this respect, we follow the approach of Obstfeld and Rogoff, 1995).

The foreign country is a low-wage economy. It does not have any differentiated-product firms of its own. Any variety produced in the foreign country is made possible only by a firm in the H that sets up a factory abroad to take advantage of the low wage. Thus we do not treat the two countries symmetrically, in contrast to the standard literature on trade under monopolistic competition, as exemplified by the work of Helpman and Krugman (1985),Venables (1987), and others[1].

2.1.1 Consumers

Let $c(z)$ be the quantity of variety z consumed by the representative consumer. The sub-utility obtained from consuming the differentiated good is assumed to be homogeneous of degree one and increasing in the quantities $c(z)$:

$$C \equiv \left[\int_0^1 c(z)^{\frac{\theta-1}{\theta}} dz \right]^{\frac{\theta}{\theta-1}} \quad \text{where } \theta > 1$$

For any given sub-utility level $C \geq 0$, the consumer chooses the amounts of consumption of the varieties so as to minimize the cost of achieving C. It is as if she solved the problem

$$\min \int_0^1 p(z) c(z) dz$$

subject to

$$\left[\int_0^1 c(z)^{\frac{\theta-1}{\theta}} dz \right]^{\frac{\theta}{\theta-1}} = C$$

The solution of this problem is

$$c_i(z) = \left[\frac{p(z)}{P} \right]^{-\theta} C \tag{1}$$

where P is defined by

$$P \equiv \left[\int_0^1 p(z)^{1-\theta} dz \right]^{\frac{1}{1-\theta}}$$

[1] Tariff policies under monopolistic competition are discussed in Gross (1987), Venables (1982), Markusen (1990), Hertel (1992), Sen et al. (1997).

We call P the price index for the differentiated good. It is the cost of achieving one unit of sub-utility.

The utility function of the representative consumer is assumed to be quasi-linear: it is linear in X and non-linear in C

$$U = v(C) + X$$

where X is her consumption of the numeraire good. We assume that $v(C)$ is a strictly concave function, with $v(0) = 0$ and $v'(0) > 0$.

Suppose the consumer i has a budget B_i to be allocated between the two goods. The optimal allocation is the solution of the utility-maximization problem

$$\max v(C_i) + X_i$$

subject to

$$PC_i + X_i = B_i$$

and $X_i \geq 0$, $C_i \geq 0$.

For any given $P < v'(0)$, let C^* be the solution of the equation

$$v'(C^*) = P$$

That is,

$$C^* \equiv v'^{-1}(P) \tag{2}$$

It can be shown that if $PC^*(P) < B_i$, then both goods will be consumed in strictly positive quantities (i.e., we have an interior solution). In what follows we assume that, for all consumer i, the budget B_i is high enough so that the solution of the consumer's allocation problem is interior.

Concerning the labour market, we assume that there are two types of workers: skilled workers and unskilled workers.The population consists of a continuum of individuals, indexed by $i \in [0, 1]$. This continuum is the union of two continuums, $[0, n)$ and $[n, 1]$ where $n < 1$ is the fraction of population that is unskilled. Skilled workers work only in the numeraire good sector. They earn a fixed wage W_s (for example, their marginal product is a constant). Unskilled workers work only in the differentiated good sector. Their wage rate is denoted by W. Each unskilled worker is willing to offer $\overline{L}$ units of labour time, as long as the wage rate W exceeds their reservation wage $W_r = \gamma$. If $W = \gamma$ then they are indifferent between offering $\overline{L}$ or zero unit of labour (or any $L_u \in \left(0, \overline{L}\right)$). We may interpret γ as the disutility of work.

This labour supply behaviour of unskilled individuals may be rationalized by postulating the following overall utility function of the unskilled worker

$$\widehat{U}(C_u, X_u, L_u) = v(C_u) + X_u - \gamma L_u \text{ where } 0 \leq L_u \leq \overline{L}$$

where $\overline{L}$ is his fixed endowment of (unskilled) labour.

The total supply of unskilled labour in this economy is then $n\overline{L}$.

The disposable income of an unskilled worker that supplies L_u units of (unskilled) labour is

$$Y_u = WL_u + T_u$$

where T_u is the real transfer from the government. We assume that $Y_u > PC^*(P)$ so that all individuals consume the same quantity of differentiated good. It is assumed that the aggregate real transfer is zero:

$$\int_0^n T_u du + \int_n^1 T_s ds = 0$$

The welfare of the unskilled worker is calculated as follows. Given P, his demand for the differentiated good is $C^*(P)$. The excess of Y_u over $PC^*(P)$ is used to buy the numeraire good: $X_u = Y_u - PC^*(P)$. His welfare level is therefore

$$\widehat{U_u} = v(C^*(P)) + [Y_u - PC^*(P)] - \gamma L_u$$

where $L_u = \overline{L}$ as long as $W > \gamma$.

2.1.2 Firms

Let $q(z)$ denote the output of firm z. We define the aggregate output of the differentiated good industry by

$$Q \equiv \left[\int_0^1 q(z)^{\frac{\theta-1}{\theta}} dz \right]^{\frac{\theta}{\theta-1}} \text{ where } \theta > 1$$

Each firm z in the differentiated good industry faces the demand function

$$q(z) = \left[\frac{p(z)}{P} \right]^{-\theta} C^*(P)$$

The firm that produces variety z takes P and $C^*(P)$ as given, and thus perceives the following demand function for its output

$$q(z) = p(z)^{-\theta} P^{\theta} C^*(P) = p(z)^{-\theta} P^{\theta} v'^{-1}(P)$$

The perceived elasticity of demand for firm z's output is

$$-\frac{d \ln q(z)}{d \ln p(z)} = \theta > 1$$

The perceived marginal revenue is

$$MR = p(z) \left[1 - \frac{1}{\theta} \right] = \left(\frac{\theta - 1}{\theta} \right) p(z)$$

Suppose the firm uses labour as the only input, and each additional unit of output requires 1 unit of labour. Then marginal cost is

$$MC = W$$

where W is the wage rate in terms of good X. Equating MR to MC, the firm sets its price at

$$p(z) = \frac{\theta}{\theta - 1} W \equiv \mu W \text{ where } \mu > 1$$

We call $\mu - 1$ the constant mark-up on cost.

The profits of firms are redistributed to individuals who are their owners. We denote by Π the aggregate profit of the differentiated good sector. We assume for simplicity that only skilled workers are owners of firms. The disposable income of the representative skilled worker is then

$$Y_s = W_s \overline{L}_s + (1-n)\Pi + T_s$$

and her welfare level is

$$\widehat{U}_s = v(C^*(P)) + [Y_s - PC^*(P)] - \gamma_s L_s$$

2.2 Equilibrium output and equilibrium profit

In what follows, we assume that

$$v(C_i) = \frac{1}{\alpha} C_i^{\alpha} \text{ where } 0 < \alpha < 1$$

Then

$$P = v' = C_i^{\alpha-1} > 0 \Leftrightarrow C_i = P^{-1/(1-\alpha)}$$

$$C_i = v'^{-1}(P) = P^{-\beta} \text{ where } 1 < \beta \equiv \frac{1}{1-\alpha} < \theta$$

The demand function for variety z is then

$$q(z) = p(z)^{-\theta} P^{\theta-\beta} \equiv q(p(z), P)$$

The firm maximizes $\pi(z) = (p(z) - W)q(z)$.

From the firm's first order condition, we obtain a useful relationship between its equilibrium output, $\widehat{q}(z)$, and its equilibrium profit, $\widehat{\pi}(z)$.

$$\frac{d\pi(z)}{dp(z)} = (p(z) - W)\frac{\partial q(z)}{\partial p(z)} + q(z) = 0$$

$$p(z) - W = \frac{\widehat{q}(z)}{-\frac{\partial q(z)}{\partial p(z)}}$$

So, with $\widehat{\pi}(z) = (p(z) - W)\,\widehat{q}(z)$,

$$\widehat{\pi}(z) = \frac{1}{\left(-\frac{\partial q(z)}{\partial p(z)}\right)} \left(\widehat{q}(z)\right)^2$$

In our case, with CES preference for varieties,

$$-\frac{\partial q(z)}{\partial p(z)} = \theta p(z)^{-\theta-1} P^{\theta-\beta} = \theta p^{-1} \widehat{q}(z)$$

So the following expression for equilibrium profit are equivalent

$$\widehat{\pi}(z) = \frac{p(z)}{\theta}\widehat{q}(z) = \frac{\mu W}{\theta}\widehat{q}(z) = \frac{W}{\theta - 1}\widehat{q}(z) = (\mu - 1)W\widehat{q}(z)$$

$$= \left(\frac{p(z)}{\theta}\right) p(z)^{-\theta} P^{\theta-\beta} = \frac{P^{\theta-\beta}}{\theta p(z)^{\theta-1}} \tag{3}$$

This implies that for a given $p(z)$, the higher is the industry price index P, the higher is firm z's equilibrium profit. When all firms charge the same price, equilibrium profit is

$$\widehat{\pi}(z) = \frac{1}{\theta} p(z)^{1-\beta} = \frac{1}{\theta}\left[\mu W\right]^{1-\beta} \text{ where } \beta > 1 \tag{4}$$

Since $\beta > 1$, an increase in W will reduce the equilibrium profit.

2.3 The closed economy

Suppose labour supply is fixed at $n\overline{L}$. If the wage is flexible, full employment will prevail and this implies that the output of the differentiated-product sector is

$$\overline{Q} = \overline{C} = n\overline{L}$$

and the equilibrium price is

$$\overline{P} = v'(\overline{C}) = \left(\overline{C}\right)^{\alpha-1}$$

$$\overline{P} = \left(n\overline{L}\right)^{\alpha-1}$$

Note that, in our model with no fixed cost, output and price under monopolistic competition are *identical* to those under perfect competition. The wage rate under monopolistic competition is **lower** than under perfect competition.

The equilibrium wage rate is

$$W = \overline{W} = \frac{\overline{P}}{\mu} = \frac{\left(n\overline{L}\right)^{\alpha-1}}{\mu}$$

As long as $\overline{W} > \gamma$, the total employment of unskilled workers is $n\overline{L}$.

2.4 Welfare

With full employment, output is at $\overline{Q} = n\overline{L}$.

Consumer surplus is

$$CS = \int_0^{\overline{Q}} v'(Q)dQ - \overline{PQ} = v(\overline{Q}) - \overline{PQ} =$$

$$\frac{\left(n\overline{L}\right)^{\alpha}}{\alpha} - \left(n\overline{L}\right)^{\alpha-1} n\overline{L} = \frac{(1-\alpha)\left(n\overline{L}\right)^{\alpha}}{\alpha}$$

which is identical to that under perfect competition.

The aggregate profit of the differentiated good industry is

$$\Pi = (\overline{P} - \overline{W})\overline{Q} = \frac{\mu\overline{W}}{\theta}\overline{Q}$$

$$= \frac{\overline{W}}{\theta-1} n\overline{L} = \frac{1}{\theta-1}\left[\frac{\left(n\overline{L}\right)^{\alpha-1}}{\mu}\right] n\overline{L} = \frac{\left(n\overline{L}\right)^{\alpha}}{\theta}$$

which is a constant fraction, $1/\theta$, of the value of sales. Aggregate unskilled workers' surplus, denoted by ω, is

$$\omega = \left(\overline{W} - \gamma\right) n\overline{L} = n(\overline{WL} - \gamma\overline{L}) = \left(\overline{W} - \gamma\right)\overline{Q}$$

Social welfare in the closed economy is then

$$\overline{\Omega} = CS + \Pi + \omega = \left[v(\overline{Q}) - \overline{PQ}\right] + \left[(\overline{P} - \overline{W})\overline{Q}\right] + \left(\overline{W} - \gamma\right) n\overline{L} = v(\overline{Q}) - \gamma n\overline{L}$$

Note: The overall utility of the representative unskilled worker is

$$\widehat{U}_u = v(\overline{Q}) + \left[Y_u - \overline{PQ}\right] - \gamma L_u = v(\overline{Q}) - \overline{PQ} + \left[\overline{W} - \gamma\right] L_u + T_u$$

3 International outsourcing: the case of zero fixed cost of outsourcing

Now let us open the economy to trade. To focus on outsourcing, we assume that the foreign country is a low-wage economy, with surplus labour available at the reservation wage $W^f < \overline{W}$. Assume residents of the low-wage economy consume only the numeraire good. In this section, we assume that home firms can relocate their plants to the low-wage economy **costlessly**. The outputs of re-located differentiated-good firms are exported back to the Home country (H), where they are sold at the price p^f per unit, where

$$p^f = \mu W^f$$

Let s be the fraction of Home firms that are relocated to the low-wage economy, and let $\widehat{q}^f$ be the equilibrium output of the representative re-located firm. By assumption, all the outputs are re-exported to Home. The value of exports from the low-wage economy (Foreign) to Home is then $sp^f\widehat{q}^f = s\mu W^f\widehat{q}^f$. The profits of the re-located firms, $s(\mu-1)W^f\widehat{q}^f$, are repatriated to Home. The difference between Foreign's export revenue and the re-patriated profit is $sW^f\widehat{q}^f$, which is used to buy the numeraire good from Home. The current account of each country is therefore balanced. It is as if the relocated firms themselves ship the quantity $sW^f\widehat{q}^f$ of the numeraire good to pay labour in Foreign and ship their output back to H.

We now consider the simplest scenario, where outsoursing does not involve any fixed cost. Under this scenario, all firm would want to relocate, unless the wage rate in home falls to W^f.

3.1 Case 1: flexible wage in the Home country

Assume $W^f \geq \gamma$. All firms would want to relocate to the low-wage economy, unless the wage rate in H falls to W^f. In this sub-section, we assume that the threat of relocation and hence of unemployment in H is sufficient to cause the wage rate in H to fall to W^f. The price falls to

$$P^f = \mu W^f < \mu \overline{W} = v'(\overline{Q})$$

So output of the differentiated good expands to $\widetilde{Q} > \overline{Q}$, where

$$v'\left(\widetilde{Q}\right) = P^f$$

Of the total output $\widetilde{Q}$, the quantity $\overline{Q}$ will be produced in Home. The difference $\widetilde{Q} - \overline{Q}$ is produced in the low-wage country. Home's social welfare is then

$$\Omega^1 = v(\widetilde{Q}) - W^f L^f - \gamma \overline{Q}$$

Proposition 1: *If the wage rate in the Home country is flexible, outsourcing will expand industry output, lower the price, and increase H's aggregate welfare.*

Proof: To show that the change in aggregate welfare in H is positive, note that, from the strict concavity of the function $v(Q)$,

$$v(\widetilde{Q}) - v(\overline{Q}) > v'\left(\widetilde{Q}\right)\left[\widetilde{Q} - \overline{Q}\right]$$

We can then define

$$R(\widetilde{Q}, \overline{Q}) \equiv v(\widetilde{Q}) - v(\overline{Q}) - v'\left(\widetilde{Q}\right)\left[\widetilde{Q} - \overline{Q}\right] > 0$$

The change in welfare is then

$$\Omega^1 - \overline{\Omega} = v(\widetilde{Q}) - v(\overline{Q}) - W^f L^f =$$

$$R(\widetilde{Q},\overline{Q}) + v'\left(\widetilde{Q}\right)\left[\widetilde{Q}-\overline{Q}\right] - W^f L^f =$$

$$R(\widetilde{Q},\overline{Q}) + (\mu W^f)\left[\widetilde{Q}-\overline{Q}\right] - W^f L^f = R(\widetilde{Q},\overline{Q}) + (\mu-1)W^f L^f > 0$$

where $R(\widetilde{Q},\overline{Q}) > 0$ because of the strict concavity of $v(Q)$. ■

Of course, home unskilled workers receive a lower wage income. Their gains in consumer surplus may not be sufficient to offset the fall in wage income. But the gainers (the capitalists and the consumers) can compensate the losers.

3.2 Case 2: wage rigidity in the Home country

Consider now the opposite extreme where unskilled wage is fixed at $\overline{W} > W^f$. All workers in H will become unemployed, even though individually each would be willing to work at any wage $W \geq \gamma$. All the differentiated product firms re-locate to the low-wage country, and since their prices are now $p^f = \mu W^f$, the industry output is $\widetilde{Q}$, where $v'\left(\widetilde{Q}\right) = \mu W^f$. They employ L^f units of foreign labour, where $L^f = \widetilde{Q}$.

Who gain and who lose ?

Under outsourcing, consumer's surplus is

$$\text{CS} = v(\widetilde{Q}) - p^f \widetilde{Q}$$

Firms' aggregate profits are

$$\Pi = \left[p^f - W^f\right]\widetilde{Q}$$

Since the unskilled workers are now unemployed, they lose all their worker's surplus.

The social welfare of the Home country under outsourcing is thus

$$\Omega^2 = \text{CS} + \Pi = v(\widetilde{Q}) - W^f \widetilde{L}^f = v(\widetilde{Q}) - W^f \widetilde{Q} =$$

$$v(\widetilde{Q}) - \frac{1}{\mu} v'\left(\widetilde{Q}\right)\widetilde{Q}$$

Then

$$\Omega^2 = v(\widetilde{Q}) - \frac{v'\left(\widetilde{Q}\right)}{\mu}\widetilde{Q}$$

The change in welfare is

$$\Omega^2 - \overline{\Omega} = \left[v(\widetilde{Q}) - v(\overline{Q})\right] - \left\{\frac{v'\left(\widetilde{Q}\right)}{\mu}\widetilde{Q} - \gamma\overline{Q}\right\}$$

$$= \left[v(\widetilde{Q}) - v(\overline{Q})\right] - W^f\left[\widetilde{Q} - \overline{Q}\right] - \left\{W^f\overline{Q} - \gamma\overline{Q}\right\}$$

$$= \left[v(\widetilde{Q}) - v(\overline{Q}) - \mu W^f\left(\widetilde{Q} - \overline{Q}\right)\right] - \left\{W^f\overline{Q} - \gamma\overline{Q}\right\} + (\mu - 1)W^f\left[\widetilde{Q} - \overline{Q}\right] \tag{5}$$

The first term, $v(\widetilde{Q}) - v(\overline{Q}) - \mu W^f\left(\widetilde{Q} - \overline{Q}\right)$, which is positive, may be called the "**trade creation**" effect of the access to low-wage foreign labour: consumers in H buy more of the differentiated good, because the price is now lower. This term is can be represented by the familiar Harberger triangle. (See Figure 1.)The second term, $W^f\overline{Q} - \gamma\overline{Q}$, may called "**trade diversion**" effect: Home producers are diverted to the foreign labour market because of the lower wage there. But from the point of view of Home's welfare, the true cost of H's labour is only γ per unit, not the fixed wage $\overline{W} > W^f$. The expression $W^f\overline{Q} - \gamma\overline{Q}$ is positive if the reservation wage γ in H is lower than the foreign wage W^f. The third term, $(\mu - 1)W^f\left[\widetilde{Q} - \overline{Q}\right]$ is called the "**exploitation"** effect: Foreign labour is paid W^f but the price of what they produce is μW^f. The change in social welfare of the Home country is therefore *ambiguous;* it is positive if the sum of the trade creation effect and the exploitation effect exceeds the adverse trade diversion effect. A (overly) sufficient condition for this is $\gamma \geq W^f$.

Proposition 2: *If the wage rate in the home country does not fall to the foreign level W^f, unemployent will result, and the effect of outsourcing on social welfare of the Home country is ambiguous, depending on whether* *the sum of the "trade creation" effect and the "exploitation" effect dominates the "trade diversion" effect.*

Corollary 2: (Welfare-enhancing Wage Subsidies) *Assume* $W^f > \gamma$*. To avoid the "trade diversion" effect, the government of the Home country can introduce a wage-subsidy scheme: for each unit of home labour employed, the firms need to pay only* W^f*, and the government pays the difference,* $\overline{W} - W^f$*. In our model, this subsidy is non-distorting. Under this wage subsidy scheme, social welfare is higher, because the "trade diversion" effect of outsourcing is avoided.*

NUMERICAL EXAMPLES

We provide below some numerical examples of changes in welfare as the result of the "trade creation" effect, the "trade diversion" effect and the " exploitation" effect.

Example 2.1: a decrease in welfare

Assume that $\theta = 2$ and $\alpha = \frac{1}{3}$. Then $\beta = 1.5$ and $\mu = 2$. Assume wage rigidity: the home wage is fixed at $\overline{W} = 1$ both before and after outsourcing. The reservation wage in the Home country is $\gamma = 0.1$ and foreign wage is $W^f = 0.9$. The price levels before and after outsourcing are $\overline{P} = \mu\overline{W} = 2$ and $P^f = \mu W^f = 1.8$ respectively. Since $Q = v'^{-1}(P) = P^{\frac{1}{\alpha-1}}$, we have $\overline{Q} = (2)^{-1.5}$ and $\widetilde{Q} = (1.8)^{-1.5}$. The change in welfare, from equation (5), is:

$$
\begin{aligned}
\Omega^2 - \overline{\Omega} &= \left[v(\widetilde{Q}) - v(\overline{Q}) - \mu W^f\left(\widetilde{Q} - \overline{Q}\right)\right] - \left\{W^f\overline{Q} - \gamma\overline{Q}\right\} + (\mu - 1)W^f\left[\widetilde{Q} - \overline{Q}\right] \\
&= \left[3\widetilde{Q}^{\frac{1}{3}} - 3\overline{Q}^{\frac{1}{3}} - 1.8\left(\widetilde{Q} - \overline{Q}\right)\right] - \left\{0.9\overline{Q} - 0.1\overline{Q}\right\} + 0.9\left[\widetilde{Q} - \overline{Q}\right] \\
&= 0.0057877 - 0.28284 + 0.05448 \\
&= -0.22257 < 0
\end{aligned}
$$

The "trade diversion" effect in this example dominates both the "trade creation" effect and the "exploitation" effect. As the result, the net change in welfare is negative, i.e. welfare reduction. The intuition is clear: when the foreign wage falls bellow the home wage, all firms have the incentive to outsource in order to maximize their profits. However, if the wage difference between the foreign country and home country is small, and the reservation wage at home is low, the social welfare will fall. This is because the increase in firm's profits (earned overseas) and the increase in consumer's surplus are not large enough to compensate for the loss in worker's surplus at home.

Example 2.2: an increase in welfare

In this example, the parameters take the same values as in the above example, except now the foreign wage is much lower than the wage rate at home, but still above the home country's reservation wage. Assume $W^f = 0.7$. The price levels before and after outsourcing are: $\overline{P} = \mu\overline{W} = 2$; $P^f = \mu W^f = 1.4$; $\overline{Q} = (2)^{-1.5}$; and $\widetilde{Q} = (0.6)^{-1.5}$. The change in welfare, from equation (5), is

$$\begin{aligned} \Omega^2 - \overline{\Omega} &= [0.063963] - \{0.21213\} + [0.17509] \\ &= 0.026923 > 0 \end{aligned}$$

If the foreign wage falls further bellow the the home wage, say $W^f = 0.3$, then the welfare improves by a larger amount:

$$\begin{aligned} \Omega^2 - \overline{\Omega} &= [0.6728] - \{0.070711\} + [0.53943] \\ &= 1.1415 > 0 \end{aligned}$$

Clearly, when the foreign wage is very low, both the "trade creation" effect and the "exploitation" effect are very large relative to the "trade diversion" effect. In this example, not only firms, but the society as a whole gains from outsourcing.

While outsourcing may result in lower welfare, it remains true that, *given that outsourcing takes place*, a lower W^f always increases welfare.

Proposition 3: *Given that outsourcing takes place and there is no fixed cost, a lower W^f always increases welfare.*

Proof: It suffices to show that

$$\frac{d\Omega^2}{dW^f} < 0$$

Now

$$\frac{d\Omega^2}{dW^f} = \left[v'(\widetilde{Q}) - \frac{v'(\widetilde{Q})}{\mu} - \frac{\widetilde{Q}}{\mu} v''(\widetilde{Q}) \right] \frac{d\widetilde{Q}}{dW^f} < 0$$

because $v'' < 0$ and $\mu > 1$.

4 Outsourcing with homogeneous fixed costs

Now suppose that outsourcing involves a fixed cost $F(z) > 0$ for firm z. In this section, we assume $F(z) = F$ for all $z \in [0, 1]$. In a later section, we will allow for heterogeneity in $F(z)$ across firms. A firm will choose to outsource only if the gain in gross profit (relative to keeping production in H) is sufficient to compensate for the fixed cost of outsourcing that must be incurred.

We now determine the equilibrium fraction of firms that choose to outsource.

4.1 Equilibrium profit under outsourcing

Suppose that only a fraction δ of firms outsource. Suppose the wage in Home, in the equilibrium with outsourcing, is rigid and fixed at some level W^h(for example, $W^h = \overline{W}$, the equilibrium wage before outsourcing takes place). Foreign wage is $W^f < W^h$. The price of the varieties produced at home is $p^h = \mu W^h$ and the price of the varieties that are outsourced is $p^f = \mu W^f < p^h$. The price index becomes

$$P = \left[(1-\delta)(\mu W^h)^{1-\theta} + \delta(\mu W^f)^{1-\theta}\right]^{1/(1-\theta)} \equiv P(\delta, W^f, W^h)$$

Let

$$K \equiv \left[(1-\delta)(\mu W^h)^{1-\theta} + \delta(\mu W^f)^{1-\theta}\right]$$

Clearly, the price index $P(\delta, W^f, W^h)$ falls as the fraction δ rises:

$$\frac{dP}{d\delta} = \frac{1}{1-\theta} K^{\theta/(1-\theta)} \left[(\mu W^f)^{1-\theta} - (\mu W^h)^{1-\theta} \right]$$

$$= \frac{1}{1-\theta} P^{\theta} \left[\frac{1}{(\mu W^f)^{\theta-1}} - \frac{1}{(\mu W^h)^{\theta-1}} \right] < 0$$

The equilibrium output of a home-produced variety is

$$q^h = (\mu W^h)^{-\theta} P^{\theta-\beta}$$

while that of an outsourced variety is

$$q^f = (\mu W^f)^{-\theta} P^{\theta-\beta}$$

The gross profit of the non-outsourcing firm is

$$\pi^h = q^h \left[\mu - 1 \right] W^h = (\mu W^h)^{-\theta} P^{\theta-\beta} (\mu - 1) W^h$$

$$= \frac{1}{\theta (\mu W^h)^{\theta-1}} P^{\theta-\beta} \tag{6}$$

and that of the outsourcing firm is

$$\pi^f = \frac{1}{\theta (\mu W^f)^{\theta-1}} P^{\theta-\beta}$$

Given δ, the gain in **gross profit** by an outsourcing firm (as compared with the alternative of producing in H) is

$$g(\delta) \equiv \pi^h - \pi^f = \frac{1}{\theta} \left[\frac{1}{(\mu W^f)^{\theta-1}} - \frac{1}{(\mu W^h)^{\theta-1}} \right] \left[P(\delta; W^f, W^h) \right]^{\theta-\beta} > 0$$

Clearly $g(\delta)$ is a decreasing function of δ.

Suppose there exists a number $\delta^* \in (0,1)$ that satisfies the equation

$$F = \frac{1}{\theta} \left[\frac{1}{(\mu W^f)^{\theta-1}} - \frac{1}{(\mu W^h)^{\theta-1}} \right] \left[P(\delta; W^f, W^h) \right]^{\theta-\beta} \tag{7}$$

then in equilibrium, δ^* is the fraction of the industry that chooses to outsource. At the price $P(\delta^*; W^f, W^h)$, any individual firm is indifferent between remaining in the Home country, and re-locating to the low-wage economy.

The RHS of equation (7) is a positive and decreasing function of δ and the LHS is a positive constant.If F is neither too large nor too small, the equation (7) will identify a unique $\delta^* \in (0, 1)$ which is the equilibrium fraction of the industry that choose to outsource.

In fact, we can determine exactly the range (F_L, F_H) that F must belong to in order to generate an equilibrium with fractional outsourcing of the industry. We define

$$F_L \equiv \frac{1}{\theta}\left[\frac{1}{(\mu W^f)^{\theta-1}} - \frac{1}{(\mu W^h)^{\theta-1}}\right]\left[P(1; W^f, W^h)\right]^{\theta-\beta} = g(1) < g(\delta)$$

If the fixed cost F of outsourcing is lower than F_L, every firm will find that outsourcing is better than keeping production in H, regardless of how many firms it thinks will outsource (i.e. regardless of its conjectured δ value).

Next define

$$F_H \equiv \frac{1}{\theta}\left[\frac{1}{(\mu W^f)^{\theta-1}} - \frac{1}{(\mu W^h)^{\theta-1}}\right]\left[P(0; W^f, W^h)\right]^{\theta-\beta} = g(0) > g(\delta)$$

With $F > F_H$, every firm will find that outsourcing is inferior to keeping production in H, regardless of how many firms it thinks will outsource. Note that the upper and lower threshold levels F_L and F_H are functions of the parameters (W^h, W^f).

Example 4.1: upper and lower threshold levels of fixed cost, given wage rates at home and foreign countries

Assume, again, $\theta = 2$ and $\alpha = \frac{1}{3}$. Then $\mu = 2$ and $\beta = 1.5$. Assume the wage rate at home is $W^h = 1$ and the wage rate in the foreign country is $W^f = 0.7$. When every firm chooses to outsource, i.e. $\delta = 1$, the price index will only includes foreign prices and $P_{\delta=1} = \mu W^f = 1.4$. Similarly, when every firm chooses keep production at home, i.e. $\delta = 0$, the price index only include home prices and $P_{\delta=0} = \mu W^h = 2$. Then, the upper and lower threshold levels of fixed cost that generate an equilibrium with fractional outsourcing of the industry are

$$\begin{aligned} F_L &= \frac{1}{\theta}\left[\frac{1}{(\mu W^f)^{\theta-1}} - \frac{1}{(\mu W^h)^{\theta-1}}\right] P_{\delta=1}^{\theta-\beta} \\ &= 0.12677 \\ F_H &= \frac{1}{\theta}\left[\frac{1}{(\mu W^f)^{\theta-1}} - \frac{1}{(\mu W^h)^{\theta-1}}\right] P_{\delta=0}^{\theta-\beta} \\ &= 0.15152 \end{aligned}$$

Therefore, when $0.12677 < F < 0.15152$, we expect a positive fraction of firm will choose to relocate to the foreign country where cheap labour is available. For example, when $F = 0.14$, $\delta^* = 0.4$, i.e. 40% of the firms choose to shift production to the foreign country. As the foreign wage rate falls, we expect both threshold levels of fixed cost to increase and the gap between them to widen. For example, when the foreign wage is $W^f = 0.5$, $F_L = 0.25$ and $F_H = 0.35355$.

Is it possible that the net profit under outsourcing is smaller than the net profit when outsourcing is not an available option? The answer is yes.

Proposition 4: *If the fixed cost F of outsourcing is within the range (F_L, F_H), in equilibrium only a fraction $\delta^* \in (0,1)$ will outsource. The outsourcing firms and the non-outsourcing firms earn the same profit in equilibrium. This profit may be lower than what firms earn when outsourcing is not available. It is definitely lower, if $W^h = \overline{W}$.*

Proof: Suppose $W^h = \overline{W}$, and assume that $F \in (F_L, F_H)$. Then a positive fraction δ of the industry will outsource, and the remaining fraction, $1-\delta$, will keep production at home. Since no individual firm has any influence on industry price and output, and firms do not differ in cost characteristics, at the equilibrium, the net profit of an outsourcing firm is equal to that of a non-outsourcing firm. Now, since the price index P falls (relative to the closed economy level) with outsourcing, while p^h remains at $\mu\overline{W}$, the demand

q^h and is now lower, and the profit π^h is also lower (as compared with the closed economy case), see eq (6). From this result, and the fact that at the outsourcing equilibrium with $\delta \in (0,1)$, all firms earn the same profit level, irrespective of their outsourcing status, it folows that all firms earn less profit when a fraction of the industry outsource in equilibrium. By continuity, if W^h is marginally lower than $\overline{W}$, outsourcing can reduce the profits of all firms. ■

Example 4.2: reduced profit under complete outsourcing

Assume that $\theta = 2$ and $\beta = 1.5$. Then $\mu = 2$. Assume that both before and after outsourcing, the home wage is fixed at $\overline{W} = 1$. In the closed economy, the price is $\overline{P} = \mu\overline{W} = 2$, and the profit of each firm is, from equation (4)

$$\widehat{\pi}_{closed} = \frac{1}{\theta} p(z)^{1-\beta} = \frac{1}{\theta}\left[\mu\overline{W}\right]^{1-\beta} = \frac{1}{2\sqrt{2}}$$

Suppose now outsourcing is available at some wage $W^f < 1$. Suppose that the fixed cost is F_L so that every firm finds that outsourcing is better than keeping production at H, regardless of how many firms it believes to choose to outsource. Therefore all firms will outsource, and the gross profit under outsourcing is

$$\widehat{\pi}_{out} = \frac{1}{\theta}\left[\mu W^f\right]^{1-\beta} = \frac{1}{2\sqrt{2W^f}} > \frac{1}{2\sqrt{2}}$$

The net profit from outsourcing is

$$\widehat{\pi}^{net}_{out} = \widehat{\pi}_{out} - F_L = \frac{1}{2\sqrt{2}\sqrt{W^f}} - 2^{-2}\left[\frac{1}{W^f} - 1\right]\left(2W^f\right)^{0.5}$$

$$= \frac{1}{2\sqrt{2}\sqrt{W^f}}\left[1 - (1 - W^f)\right] > 0$$

Clearly, since $W_f < \sqrt{W^f}$ when $W^f < 1$, the following inequality holds:

$$\widehat{\pi}^{net}_{out} < \widehat{\pi}_{closed}$$

It follows that, given $F = F_L$, the net profit from outsourcing is smaller than the profit that each firm makes when outsourcing is not available.

Corollary 4: *If $W^h = \overline{W}$, and fractional outsourcing takes place (i.e., $\delta \in (0,1)$), then employent in H will fall.*

Proof: Since q^h falls relative to the output of the representative firm in the closed economy case, the total employment in H falls from $n\overline{L}$ to δq^h. ■

Remark 4.1: Let us consider a given $F > 0$. At the initial closed economy equilibrium, the output is $\overline{Q} \equiv n\overline{L}$, the price is $\overline{P} = (n\overline{L})^{-1/\beta}$, and the wage rate is $\overline{W} = \overline{P}/\mu$. If W^f is just marginally lower than $\overline{W}$, there will be no outsourcing, because the saving in variable cost is not sufficient to outweight the fixed cost of outsourcing. Outsourcing begins only when W^f falls below the *critical* threshold value W^{fc} (which is a function of F and $\overline{W}$) defined by

$$F = \frac{1}{\theta}\left[\frac{1}{(\mu W^{f_c})^{\theta-1}} - \frac{1}{(\mu\overline{W})^{\theta-1}}\right]\left[P(0; W^{fc}, \overline{W})\right]^{\theta-\beta}$$

$$= \frac{1}{\theta}\left[\frac{1}{(\mu W^{f_c})^{\theta-1}} - \frac{1}{(\mu\overline{W})^{\theta-1}}\right](\mu\overline{W})^{\theta-\beta}$$

i.e.

$$\mu W^{fc} = \left[\frac{\left(\mu\overline{W}\right)^{\theta-\beta}}{\theta F + \left(\mu\overline{W}\right)^{1-\beta}}\right]^{\frac{1}{\theta-1}}$$

Further falls in W^f will lead to a positive δ. If W^h remains fixed at $\overline{W}$ due to institutional wage rigidity, the employment level in H will fall, as described in Corollary 3 above.

Example 4.3: Critical level of foreign wage, given fixed cost of outsourcing

Assume the parameters take the same values as in Example 3, except now there is a fixed cost of outsourcing, $F = 0.3$. Given this fixed cost, firms will relocate only if the foreign wage falls bellow a critical level W^{fc} which satisfies

$$\begin{aligned} \mu W^{fc} &= \left[\frac{\left(\mu \overline{W}\right)^{\theta-\beta}}{\theta F + \left(\mu \overline{W}\right)^{1-\beta}} \right]^{\frac{1}{\theta-1}} \\ W^{fc} &= 0.54097 \end{aligned}$$

As the fixed cost becomes larger, say $F = 1.0$, this critical level of foreign wage falls to $W^{fc} = 0.2612$. The fall in foreign wage is necessary to compensate for a large cost of relocating production facilities.

On the other hand, if W^h is **flexible**, then it will fall to preserve full employment in H. In that case, we have the following two conditions that simultaneously determine the equilibrium value of δ and W^h, denoted by δ^* and W^{h^*}:

$$(1-\delta)q^h = n\overline{L} \tag{8}$$

and

$$F = \frac{1}{\theta} \left[\frac{1}{(\mu W^f)^{\theta-1}} - \frac{1}{(\mu W^{h^*})^{\theta-1}} \right] \left[P(\delta; W^f, W^{h*}) \right]^{\theta-\beta} \tag{9}$$

where

$$q^h = (\mu W^{h*})^{-\theta} \left[P(\delta; W^f, W^{h*}) \right]^{\theta-\beta}$$

We can then compute the gains in consumer surplus, the loss in worker's surplus, the gains (or losses) in net profits, the net welfare gains, etc., associated with a given pair (F, W^f) where W^f is assumed to be below the *critical* threshold value W^{fc} .

Remark 4.2: (0n consumer's surplus under fractional outsourcing. Before outsourcing, the consumer's surplus is

$$\overline{CS} = v(\overline{Q}) - \overline{PQ}$$

where

$$\overline{Q} = \left(\overline{P}\right)^{-\beta} = \left(\mu\overline{W}\right)^{-\beta} \text{ or } \overline{P} = \left(\overline{Q}\right)^{\alpha-1}$$

Thus

$$\overline{CS} = \frac{1}{\alpha}\left(\overline{Q}\right)^{\alpha} - \left(\overline{Q}\right)^{\alpha} = \left(\overline{Q}\right)^{\alpha}\left[\frac{1}{\alpha} - 1\right] = \left(\mu\overline{W}\right)^{-\alpha\beta}\left(\frac{1-\alpha}{\alpha}\right)$$

After outsourcing, with δ^* being the fraction of firms that outsource, the price level is

$$P(\delta^*; W^f, W^{h*})$$

and the associated consumption index is

$$\widehat{Q} = \left[P(\delta^*; W^f, W^{h*})\right]^{-\beta} \tag{10}$$

The CS after outsourcing is

$$\widehat{CS} = \frac{1}{\alpha}\left(\widehat{Q}\right)^{\alpha} - \left(\widehat{Q}\right)^{\alpha} = \left(\widehat{Q}\right)^{\alpha}\left[\frac{1}{\alpha} - 1\right] = \left[P(\delta^*; W^f, W^{h*})\right]^{-\alpha\beta}\left(\frac{1-\alpha}{\alpha}\right)$$

Example 4.4: consumer's surplus, profit, and worker surplus under fractional outsourcing

As before, we assume $\theta = 2$ and $\alpha = \frac{1}{3}$, then $\mu = 2$ and $\beta = 1.5$. Assume the home wage rate before outsourcing is $\overline{W} = 1$. Assume the fixed cost of production relocation is $F = 0.3$. As shown in example 4, the critical value of foreign wage is $W^{fc} = 0.54097$. As foreign wage falls bellow this critical level, a fraction of firm will choose to outsource their production. Assume foreign wage is $W^f = 0.5$. We first calculate the level of consumer's surplus before outsourcing. This quantity is given by

$$\begin{aligned}\overline{CS} &= \frac{1}{\alpha}\left(\overline{Q}\right)^{\alpha} - \left(\overline{Q}\right)^{\alpha} = \left(\overline{Q}\right)^{\alpha}\left[\frac{1}{\alpha} - 1\right] = \left(\mu\overline{W}\right)^{-\alpha\beta}\left(\frac{1-\alpha}{\alpha}\right) \\ &= 1.4142\end{aligned}$$

The profit and worker surplus (assuming $\gamma = 0$) in the closed economy case are

$$\pi_{closed} = 0.35355$$

$$\omega_{closed} = 1$$

Assume the home wage rate is **flexible**, then W^h will fall bellow $\overline{W}$ to preserve full employment in home country. The equilibrium values δ^* and W^{h^*} can be obtained from the systems of equation (8) and (9):

$$\begin{aligned} (1-\delta^*)q^h &= n\overline{L} = \overline{Q} = (\mu\overline{W})^{-\beta} \\ F &= \frac{1}{\theta}\left[\frac{1}{(\mu W^f)^{\theta-1}} - \frac{1}{(\mu W^{h^*})^{\theta-1}}\right]\left[P(\delta^*, W^f, W^{h*})\right]^{\theta-\beta} \end{aligned}$$

where

$$\begin{aligned} q^h &= (\mu W^{h*})^{-\theta}\left[P(\delta; W^{fc}, W^{h*})\right]^{\theta-\beta} \\ P(\delta^*, W^f, W^{h^*}) &= \left[(1-\delta^*)(\mu W^{h^*})^{1-\theta} + \delta^*(\mu W^f)^{1-\theta}\right]^{\frac{1}{1-\theta}} \end{aligned}$$

Substitute the parameter values in the above equations and solve for equilibrium values, we have $\delta^* = 0.27343$ and $W^{h^*} = 0.8589$. The price level after outsourcing is $P(\delta^*, W^f, W^{h^*}) = 1.4360$ and the associated consumption index is $\widehat{Q} = \left[P(\delta^*, W^f, W^{h^*})\right]^{-\beta} = 0.58112$. Therefore, the CS after outsourcing is

$$\begin{aligned} \widehat{CS} &= \frac{1}{\alpha}\left(\widehat{Q}\right)^{\alpha} - \left(\widehat{Q}\right)^{\alpha} = \left(\widehat{Q}\right)^{\alpha}\left[\frac{1}{\alpha} - 1\right] \\ &= 1.6690 \end{aligned}$$

The profit and worker surplus (assuming $\gamma = 0$) in the fractional outsourcing case are

$$\pi_{out} = 0.34879$$

$$\omega_{out} = 0.8589$$

This example shows a net increase in welfare when oursourcing takes place: $\widehat{CS} + \pi_{out} + \omega_{out} > \overline{CS} + \pi_{closed} + \omega_{closed}$.

4.2 Possibility of social welfare loss under outsourcing with fixed cost

With positive fixed cost of outsourcing, it is possible to construct numerical examples where the gains from increased consumer surplus is not enough to compensate for the reduction in profits caused by outsourcing. This is the case even if $\gamma = \overline{W}$ (so that unskilled worker's surplus is zero).

While (Nash) **equilibrium** outsourcing (under laissez-faire) may reduce welfare given a set of parameter values (for $\overline{W}, \beta, \theta, W^f, F$), this does not mean that under those parameter values, any amount of outsourcing is welfare reducing: It is possible that the socially optimal extent of outsourcing is strictly greater than zero, but smaller than the (Nash) equilibrium extent of outsourcing.

Can we determine the optimal extent of outsourcing, and compare it to the equilibrium extent? Is the former always smaller than the latter, or does this depend on the size of the fixed cost?

We know, from eq (5) that if (i) the fixed cost is zero, and (ii) $\gamma = W^f$, then the socially optimal extent of outsourcing is $\delta^{so} = 1$, and this coincides with the equilibrium extent of outsourcing.

5 Fixed cost of outsourcing: Heterogeneous fixed costs

Assume that firms differ with respect to fixed cost of outsourcing. Rank them in the increasing order of fixed costs, and assume that $F(0) = 0$ and $F(1) = \infty$.

We now determine the equilibrium fraction of firms that choose to outsource when fixed costs differ across firms.

5.1 Equilibrium fractional outsourcing: the pivot firm

Suppose that only a fraction δ of firms outsource. Suppose the wage in Home is rather rigid and is **fixed** at W^h. Foreign wage is $W^f < W^h$. The price of the varieties produced at home is $p^h = \mu W^h$ and the price of the varieties that are outsourced is $p^f = \mu W^f < p^h$. The price index becomes

$$P = \left[(1-\delta)(\mu W^h)^{1-\theta} + \delta(\mu W^f)^{1-\theta}\right]^{1/(1-\theta)} \equiv P(\delta, W^f, W^h)$$

Let

$$K \equiv \left[(1-\delta)(\mu W^h)^{1-\theta} + \delta(\mu W^f)^{1-\theta}\right]$$

Clearly, the price index $P(\delta, W^f, W^h)$ falls as the fraction δ rises:

$$\begin{aligned} \frac{dP}{d\delta} &= \frac{1}{1-\theta} K^{\theta/(1-\theta)} \left[(\mu W^f)^{1-\theta} - (\mu W^h)^{1-\theta}\right] \\ &= \frac{1}{1-\theta} P^\theta \left[\frac{1}{(\mu W^f)^{\theta-1}} - \frac{1}{(\mu W^h)^{\theta-1}}\right] < 0 \end{aligned} \quad (11)$$

because $\theta > 1$

Note:

$$\frac{\partial P}{\partial W^f} = P^\theta \delta \left(\mu W^f\right)^{-\theta} \mu > 0$$

Taking into account the fixed cost of outsourcing, there is a "pivot firm", say firm z^*, that is indifferent between outsourcing and keeping producion at home; clearly z^* satisfies the equation

$$F(z) = \frac{1}{\theta} \left[\frac{1}{(\mu W^f)^{\theta-1}} - \frac{1}{(\mu W^h)^{\theta-1}}\right] \left[P(z, W^f, W^h)\right]^{\theta-\beta} \quad (12)$$

Assume $\theta > \beta$. Then the RHS of equation (12) is a positive and decreasing function of z^* and the LHS is increasing in z^*. Since $F(z^*)$ is increasing in z^*, there is a unique z^*(which depends on the fixed W^h and W^f).

Lemma 5.1 : *Given* (W^h, W^f), *the equilibrium fraction of firms that choose to outsource is unique, and satisfies equation* (12).

Comparative statics: For a fixed W^h, a **decrease** in W^f will shift the RHS of equation (12) up , leading to a larger z^*, as expected. More formally, define

$$\psi(z^*, W^f) = F(z^*) - \frac{1}{\theta}\left[\frac{1}{(\mu W^f)^{\theta-1}} - \frac{1}{(\mu W^h)^{\theta-1}}\right]\left[P(z^*, W^f, W^h)\right]^{\theta-\beta} = 0$$

We want to show that

$$\frac{dz^*}{dW^f} = \frac{\left[\frac{\partial\psi}{\partial W^f}\right]}{\left[-\frac{\partial\psi}{\partial z}\right]} < 0$$

where

$$P(z^*; W^f, W^h) = \left[(1-z^*)(\mu W^h)^{1-\theta} + z^*(\mu W^f)^{1-\theta}\right]^{\theta/(1-\theta)}$$

The denominator $\left[-\frac{\partial\psi}{\partial z}\right]$ is negative, because $F' > 0$ and $\partial P(z^*; W^f, W^h)/\partial z < 0$ for $W^f < W^h$. The numerator is positive because $0 < \frac{\partial P(z^*;W^f)}{\partial W^f}\frac{W^f}{P} < 1$.

Lemma 5.2: *An increase in W^f will reduce z^*.*

Suppose the wage in H is fixed at W^h. Does outsourcing decrease employment at home?

Before outsourcing, employment at home is $n\overline{L}$.

$$n\overline{L} = (\mu W^h)^{-\theta}\left[P(0, W^f, W^h)\right]^{\theta-\beta}$$

Now, after outsourcing, employment at home is

$$(1-z^*)q^h = (1-z^*)(\mu W^h)^{-\theta}\left[P(z^*, W^f, W^h)\right]^{\theta-\beta} \qquad (13)$$

The right-hand side of eq (13) is decreasing in z^*. So **employment falls,** if W^h is fixed at $\overline{W}$.

The quantity of foreign labour employed by firms that outsource abroad is

$$L^f = z^*(\mu W^f)^{-\theta}\left[P(z^*)\right]^{\theta-\beta}$$

Assume all workers prefer being employed at wage W^h to being unemployed with assistance payment W_A. Then the labour market allocates the fixed number of jobs at random.

5.2 Welfare

Social welfare consists of the utility of consuming the quantity Q (all output are consumed at home) minus (i) the effort cost of home labour, $\gamma(nL_u)$, where $nL_u = (1-z^*)q^h \leq n\overline{L}$, and (ii) the value of all payments to foreign factors of production. Note that (ii) is the sum of fixed costs and variable costs:

$$\int_0^{z^*} F(z)dz + W^f\left[z^* q^f\right] =$$
$$\Phi(z^*) + z^* W^f (\mu W^f)^{-\theta} P(z^*, W^f, \overline{W})^{\theta-\beta}$$

Recall that

$$Q = C \equiv \left[\int_0^1 c(z)^{\frac{\theta-1}{\theta}} dz\right]^{\frac{\theta}{\theta-1}} = \left[\int_0^1 q(z)^{\frac{\theta-1}{\theta}} dz\right]^{\frac{\theta}{\theta-1}} =$$

$$\left[\int_0^{z^*} q^f(z)^{\frac{\theta-1}{\theta}} dz + \int_{z^*}^1 q^h(z)^{\frac{\theta-1}{\theta}} dz\right]^{\frac{\theta}{\theta-1}} =$$

$$\left[z^*\left(q^f\right)^{\frac{\theta-1}{\theta}} + (1-z^*)\left(q^h\right)^{\frac{\theta-1}{\theta}}\right]^{\frac{\theta}{\theta-1}}$$

where

$$q^f = (\mu W^f)^{-\theta}\left[P(z^*, W^f, \overline{W})\right]^{\theta-\beta}$$
$$q^h = (\mu W^h)^{-\theta}\left[P(z^*, W^f, \overline{W})\right]^{\theta-\beta}$$

Welfare under outsourcing is

$$\widehat{\Omega} = v(\widehat{Q}) - \gamma(1-z^*)(\mu W^h)^{-\theta}\left[P(z^*, W^f, \overline{W})\right]^{\theta-\beta} - \Phi(z^*) - z^* W^f (\mu W^f)^{-\theta} P(z^*, W^f, \overline{W})^{\theta-\beta}$$

where, using a modified version of equation (10),

$$\widehat{Q} = \left[P(z^*; W^f, \overline{W})\right]^{-\beta} \tag{14}$$

$$v(\widehat{Q}) = \frac{1}{\alpha}\left[P(z^*; W^f, \overline{W})\right]^{-\alpha\beta}$$

The net gain (or loss) due to outsourcing is

$$\widehat{\Omega} - \overline{\Omega} = \left[v(\widehat{Q}) - v\left(\overline{Q}\right) \right] - \left\{ \gamma(1-z^*)q^h + z^* W^f q^f - \gamma \overline{Q} \right\} - \Phi(z^*)$$

Again, this expression is ambiguous in sign. It can be negative if $W^f - \gamma$ is sufficiently large.

Example 5.1: heterogeneous fixed cost and welfare change

Assume the same set of parameter values, i.e. $\theta = 2$ and $\alpha = \frac{1}{3}$, then $\mu = 2$ and $\beta = 1.5$. The home wage rate is assumed to be fixed at $W^h = \overline{W} = 1$, the foreign wage is $W^f = 0.5$ and the reservation wage at home is $\gamma = 0.2$. Assume the "pivot firm" has the fixed cost of outsourcing $F(z^*) = 0.27$. By substituting $F(z^*)$ into $F(z^*) = \frac{1}{\theta}\left[\frac{1}{(\mu W^f)^{\theta-1}} - \frac{1}{(\mu W^h)^{\theta-1}}\right]\left[P(z^*, W^h, W^f\right]^{\theta-\beta}$, we can calculate the value of $z^* = 0.71468$. Given the value of z^*, the price index is $P\left(z^*, W^h, W^f\right) = 1.1664$. The price index before outsourcing is $P(0, W^h, W^f) = 2$. To facilitate the calculation of welfare change, we calculate the following quantities

$$\begin{aligned}
q^h &= (\mu W^h)^{-\theta}\left[P(z^*, W^f, \overline{W})\right]^{\theta-\beta} = 0.27 \\
q^f &= (\mu W^f)^{-\theta}\left[P(z^*, W^f, \overline{W})\right]^{\theta-\beta} = 1.08 \\
\overline{Q} &= \left[P(0, W^h, W^f\right]^{-\beta} = 2^{-1.5} \\
\widehat{Q} &= \left[P(z^*, W^h, W^f\right]^{-\beta} = 1.1664^{-1.5} \\
v(\overline{Q}) &= \frac{1}{\alpha}\overline{Q}^{\alpha} = 3(2)^{-0.5} \\
v(\widehat{Q}) &= \frac{1}{\alpha}\widehat{Q}^{\alpha} = 3(1.1664)^{-0.5} \\
\Phi(z^*) &= \int_0^{z^*} F(z)dz < z^* F(z^*)
\end{aligned}$$

Using the above quantities, we calculate the change in welfare when outsourcing is allowed, given heterogeneous fixed costs of relocation:

$$\begin{aligned}
\widehat{\Omega} - \overline{\Omega} &= \left[v(\widehat{Q}) - v\left(\overline{Q}\right) \right] - \left\{ \gamma(1-z^*)q^h + z^* W^f q^f - \gamma \overline{Q} \right\} - \Phi(z^*) \\
&\geq [0.65646] - \{0.33062\} - 0.19296 > 0
\end{aligned}$$

In this example, the positive change in CS is sufficient large to offset variable costs and fixed costs of outsourcing, resulting in a net positive change in social welfare.

6 Optimal outsourcing vs equilibrium outsourcing

Suppose the government can influence the fraction of firms that outsource, e.g., by subsidizing the fixed costs of outsourcing. What is the optimal z? This depends on whether W^h is fixed (which implies an increase in unemployment when there is an increase in outsourcing), or W^h is flexible (so that full employment is maintained at home).

Let us consider the case where the wage rate in H is rigid. Social welfare consists of gross consumer surplus, minus the payments of fixed costs (to foreigners), minus the disutility of work of home workers.

$$\Omega = v(Q) - W^f z q^f - \int_0^z F(s)ds - \gamma(1-z)q^h$$

We take W^f and W^h as given, poosibly with $W^h = \overline{W}$.

Differentiating Ω with respect to z, we obtain the FOC

$$v'(Q)\frac{dQ}{dz} + \gamma q^h - \gamma(1-z)\frac{dq^h}{dz} - W^f q^f - W^f z\frac{dq^f}{dz} - F(z) = 0$$

Now $v'(Q) = P$ and

$$Q = P^{-\beta}$$

So

$$\frac{dQ}{dz} = -\beta P^{-\beta-1}\frac{dP}{dz} = -\beta P^{-\beta-1}\frac{1}{1-\theta}K^{\theta/(1-\theta)}\left[\frac{1}{(\mu W^f)^{\theta-1}} - \frac{1}{(\mu W^h)^{\theta-1}}\right]$$

$$= -\beta P^{-\beta-1}\frac{1}{1-\theta}P^{\theta}\left[\frac{1}{(\mu W^f)^{\theta-1}} - \frac{1}{(\mu W^h)^{\theta-1}}\right]$$

$$v'(Q)\frac{dQ}{dz} = P^{\theta-\beta}\frac{\beta}{\theta-1}\left[\frac{1}{(\mu W^f)^{\theta-1}} - \frac{1}{(\mu W^h)^{\theta-1}}\right] > 0$$

Let z^{so} be the socially optimal fraction of the industry to outsource. Then z^{so} satisfies eq:

$$F(z^{so}) = P^{\theta-\beta}\frac{\beta}{\theta-1}\left[\frac{1}{(\mu W^f)^{\theta-1}} - \frac{1}{(\mu W^h)^{\theta-1}}\right] - W^f\left[(\mu W^f)^{-\theta}P^{\theta-\beta}\right] - W^f z^{so}\frac{dq^f}{dz} \tag{15}$$

where

$$W^f\frac{dq^f}{dz} = W^f(\mu W^f)^{-\theta}(\theta-\beta)P^{\theta-\beta-1}\frac{dP}{dz}$$

$$= W^f(\mu W^f)^{-\theta}(\theta-\beta)P^{\theta-\beta-1}\frac{1}{1-\theta}P^{\theta}\left[\frac{1}{(\mu W^f)^{\theta-1}} - \frac{1}{(\mu W^h)^{\theta-1}}\right] < 0$$

So equation (15) becomes

$$\frac{1}{P^{\theta-\beta}}F(z^{so}) = \frac{\beta}{\theta-1}\left[\frac{1}{(\mu W^f)^{\theta-1}} - \frac{1}{(\mu W^h)^{\theta-1}}\right] -$$

$$W^f(\mu W^f)^{-\theta}\left\{1 - z\frac{(\theta-\beta)}{(1-\theta)}P^{\theta-1}\left[\frac{1}{(\mu W^f)^{\theta-1}} - \frac{1}{(\mu W^h)^{\theta-1}}\right]\right\} \tag{16}$$

On the other hand, under laissez-faire, the equilibrium fraction of firms that outsource, denoted by z^*, satisfies the equation

$$\frac{1}{P^{\theta-\beta}}F(z^*) = \frac{1}{\theta}\left[\frac{1}{(\mu W^f)^{\theta-1}} - \frac{1}{(\mu W^h)^{\theta-1}}\right] \tag{17}$$

Since $\theta\beta > \theta > \theta - 1$, we can have $z^{so} = z^*$ only if

$$1 > z^*\frac{(\theta-\beta)}{(1-\theta)}P^{\theta-1}\left[\frac{1}{(\mu W^f)^{\theta-1}} - \frac{1}{(\mu W^h)^{\theta-1}}\right]$$

Proposition 5: *In general, the equilibrium extent of outsourcing, z^*, does not coincide with the socially optimal extent, z^{so}. A necessary condition for the values to coincide is that the inequality (17) holds.*

7 A two-period model

Now consider an extension of the model to a two-period framework. Assume that any firm that outsources incurs the fixed cost only once. (For example, the cost of setting up a plant.) By delaying outsourcing to the second period, a firm can save on the fixed cost, but at the same time, it cannot take advantage of the low wage in period 1.

There are three strategies that a firm can adopt. We denote by (f, f) the strategy of outsourcing in both periods (and thus incurring the fixed cost in period 1). The strategy (h, f) means producing in H in period 1, and outsourcing in period 2. Finally, the strategy (h, h) means to keep production in H in both periods.

Let us consider the case where firms are ex ante identical, i.e., the fixed cost of outsourcing is the same for all. Let F_t be the fixed cost that a firm must pay if it begins outsourcing in period t. Let z_1 denote the measure of firms that choose (f, f), $z_2 > z_1$ denote the measure of firms that choose (h, f), and $1 - z_2$ denote the measure of firms that choose (h, h). Let W^f be the wage in the foreign country, which we assume to be the same in both periods. Let $\overline{W}$ be the fixed wage in H.

The price index for the differentiated good in period 1 is

$$P_1 = P(z_1, W^f, \overline{W}) = \left[(1 - z_1)(\mu W^h)^{1-\theta} + z_1(\mu W^f)^{1-\theta}\right]^{1/(1-\theta)} \tag{18}$$

and for period 2,

$$P_2 = P(z_2, W^f, \overline{W}) = \left[(1 - z_2)(\mu W^h)^{1-\theta} + z_2(\mu W^f)^{1-\theta}\right]^{1/(1-\theta)} < P_1 \tag{19}$$

The period-1 demand and period-2 for the output of the firm that chooses (f, f) are

$$q_1(f, f) = (\mu W^f)^{-\theta} \left[P(z_1, W^f, \overline{W})\right]^{\theta-\beta}$$

$$q_2(f, f) = (\mu W^f)^{-\theta} \left[P(z_2, W^f, \overline{W})\right]^{\theta-\beta}$$

The period-1 demand and period-2 for the output of the firm that chooses (h, f) are

$$q_1(h,f) = (\mu\overline{W})^{-\theta}\left[P(z_1, W^f, \overline{W})\right]^{\theta-\beta}$$

$$q_2(h,f) = (\mu W^f)^{-\theta}\left[P(z_2, W^f, \overline{W})\right]^{\theta-\beta} = q_2(f,f)$$

The period-1 demand and period-2 for the output of the firm that chooses (h, h) are

$$q_1(h,h) = (\mu\overline{W})^{-\theta}\left[P(z_1, W^f, \overline{W})\right]^{\theta-\beta} = q_1(h,f)$$

$$q_2(h,h) = (\mu\overline{W})^{-\theta}\left[P(z_2, W^f, \overline{W})\right]^{\theta-\beta} < q_1(h,h)$$

Let $r > 0$ denote the interest rate. Define $R = (1+r)$. The present value of net profits of a representative firm of type (f, f) is

$$V(f,f) = \frac{1}{\theta}(\mu W^f)^{1-\theta}\left[P(z_1, W^f, \overline{W})\right]^{\theta-\beta} - F_1 + \frac{1}{\theta}R^{-1}(\mu W^f)^{-\theta}\left[P(z_2, W^f, \overline{W})\right]^{\theta-\beta} \quad (20)$$

That of a representative firm of type (h, f) is

$$V(h,f) = \frac{1}{\theta}(\mu\overline{W})^{1-\theta}\left[P(z_1, W^f, \overline{W})\right]^{\theta-\beta} - R^{-1}F_2 + \frac{1}{\theta}R^{-1}(\mu W^f)^{-\theta}\left[P(z_2, W^f, \overline{W})\right]^{\theta-\beta} \quad (21)$$

and that of a representative firm of type (h, h) is

$$V(h,h) = \frac{1}{\theta}(\mu\overline{W})^{1-\theta}\left[P(z_1, W^f, \overline{W})\right]^{\theta-\beta} + \frac{1}{\theta}R^{-1}(\mu\overline{W})^{-\theta}\left[P(z_2, W^f, \overline{W})\right]^{\theta-\beta} \quad (22)$$

All three types of firms co-exist in equilibrium if and only if there are values $z_1^* \in (0,1)$ and $z_2^* \in (z_1^*, 1)$ that satisfy the following pair of equations:

$$V(f,f) = V(h,f) \quad (23)$$

$$V(f,f) = V(h,h) \quad (24)$$

In this case, all firms earn the same present value of net profits, and they all make less profit than in the closed economy equilibrium. (Of course, lower profits do not necessarily mean lower welfare; the gain in consumer's surplus may dominates the fall in profits.)

Example 7.1: Fractional outsourcing in a two period model

We assume $\theta = 2$ and $\alpha = \frac{1}{3}$, then $\mu = 2$ and $\beta = 1.5$. Assume the home wage rate is rigid and stays at $\overline{W} = 1$ both before and after outsourcing. Assume foreign wage is $W^f = 0.5$. Firms can choose to outsource in period 1, when the fixed cost of outsourcing is $F_1 = 0.55$. If they wait until period 2, the fixed cost of outsourcing falls to $F_2 = 0.27$. Assume a discount rate $r = 0.1$, then $R = 1.1$. We're interested in finding out the proportion of firms that decide to outsource in the first period, and the corresponding proportion in the second period. It is straight forward to solve the system of equations (23) and (24) given

$$\begin{aligned}
V(f,f) &= \frac{1}{2}(1)^{-1}P_1^{0.5} - 0.55 + (1.1)^{-1}\frac{1}{2}(1)^{-1}P_2^{0.5} \\
V(h,f) &= \frac{1}{2}(2)^{-1}P_1^{0.5} - (1.1)^{-1}0.27 + (1.1)^{-1}\frac{1}{2}(1)^{-1}P_2^{0.5} \\
V(h,h) &= \frac{1}{2}(2)^{-1}P_1^{0.5} + (1.1)^{-1}\frac{1}{2}(2)^{-1}P_2^{0.5} \\
P_1 &= \left[(1-z_1)(2)^{-1} + z_1(1)^{-1}\right]^{-1} \\
P_2 &= \left[(1-z_2)(2)^{-1} + z_2(1)^{-1}\right]^{-1}
\end{aligned}$$

The equilibrium values are $z_1^* = 0.34771$ and $z_2^* = 0.71468$.

8 Concluding Remarks

We have developed a theoretical model to evaluate the effects of outsourcing on consumer surplus, profits, worker's surplus, and welfare. One of the conclusions is that outsourcing is not necessarily profit-enhancing in equilibrium, even though it is individually rational for each firm to choose to outsource. This is because firms do not internalize the effect of their outsourcing decision on the industry price level. With a sufficiently large fall in price, the benefits of the low wage in the foreign country turns out to be a curse. Another source of welfare loss from outsourcing is the "trade diversion" effect of access to the foreign labour pool. Firms prefer foreign labour to domestic labour because of the low foreign wage rate. However, from the perspective of social welfare of the advanced economy, the true labour cost in the home country is not the high wage there, but only the disutility of work. In general, outsourcing need not be welfare improving.

We have also indicated that the extent and the speed of outsourcing in a laissez-faire equilibrium may not be socially optimal. Under certain conditions, a slowing down of the speed of outsourcing can improve welfare.

References

[1] Antras, P., and E. Helpman, 2004, "Global Outsourcing," *Journal of Political Economy*, Vol. 112, 552-80.

[2] Egger, H. and P. Egger. 2003, "On Market Concentration and International Outsourcing," *Applied Economics Quarterly*, vol. 49, 49-64.

[3] Feenstra, R. and G. Hansen, 1999, "The Impact of Outsourcing and High-technology Capital on Wages: Estimates for the United States 1979-1990," *Quarterly Journal of Economics,* Vol. 114, pp 907-40.

[4] Geishecker, I., and H. Görg, 2004, "Winners and Loses: Fragmentation, Trade and Wages Revisited," *Discussion Paper* 385, German Institute for Economic Research (DIW), Berlin.

[5] Glass, Amy, and Kamal Saggi, 2001, "Innovation and Wage Effects of International Outsourcing," *European Economic Review*, vol. 45, 67-86.

[6] Görg, H. and A. Hanley, 2004, "Does Outsourcing Increase Profitability?" *Economic and Social Review*, vol. 35, 367-87.

[7] Görzig, B. and A. Stephen, 2002, "Outsourcing and Firm-level Performance," *Discussion Paper* 309, German Institute for Economic Research (DIW), Berlin.

[8] Gross, D., 1987, "A Note on Optimal Tariff, Retaliation and the Welfare Loss from Tariff Wars in a Framework with Intra-industry Trade," *Journal of International Economics,* Vol. 23, 357-67.

[9] Grossman, G.M. and E. Helpman, 2002, "Integration versus Outsourcing in Industry Equilibrium," *Quarterly Journal of Economics*, Vol. 117, 58-119.

[10] Grossman, G.M. and E. Helpman, 2003, "Outsourcing versus FDI in Industry Equilibrium," *Journal of the European Economic Association*, vol. 1, 317-27.

[11] Grossman, G.M. and E. Helpman, 2005, "Outsourcing in a Global Economy," *Review of Economic Studies*, Vol. 72, 135-59.

[12] Grossman, G.M. and Esteban Rossi-Hansberg, 2006a, "Trading Tasks: A Simple Theory of Offshoring," Manuscript, Princeton University.

[13] Grossman, G.M. and Esteban Rossi-Hansberg, 2006b, " The Rise of Offshoring: It's Not Wine for Cloth Anymore," Manuscript, Princeton University.

[14] Helpman, E. and P. Krugman, 1985, *Increasing Returns, Imperfect Competition and International Trade,* MIT Press, Cambridge, MA.

[15] Hertel, T. W., 1994, "The 'Procompetitive' Effects of Trade Policy Reform in a Small, Open Economy," *Journal of International Economics,* Vol. 36 (1994), 391-411.

[16] Jones, R.W., 2004, "Immigration versus Outsourcing: Effects on Labor Markets," manuscript, University of Rochester.

[17] Jones, Ronald W., and Henryk Kierzkowski, (1990), "The Role of Services in Production and International trade: A Theoretical Framework", in Ronald Jones and Anne Krueger, eds., *The Political Economy of International Trade*, 31-48 (Blackwell, Cambridge , MA.)

[18] Jones, Ronald W., and Henryk Kierzkowski, (2001a), "Globalization and the Consequence of International Fragmentation," Chapter 10 (365-87), in G. A. Calvo, Rudi Dornbush, and Maurice Obstfeld, eds., *Money, Capital Mobility, and Trade: Essays in Honor of Robert Mundell,* MIT Press.

[19] Jones, Ronald W., and Henryk Kierzkowski, (2001b), "A Framework for Fragmentation," in Sven Arndt and H. Kierzkowski, eds., *Fragmentation and International Trade*, Oxford University Press, 17-34.

[20] Kimura, F., 2002, "Subcontracting and the Performance of Small and Medium Firms in Japan," *Small Business Economics,* vol. 18, 1049-65.

[21] Long, Ngo Van, 2005, "Outsourcing and Technology Spillovers," *International Review of Economics and Finance,* Vol. 16(1), 2005, 137-152.

[22] Long, Ngo Van, Raymond Riezman, and Antoine Soubeyran, 2005, "Fragmentation and Services," *North American Journal of Economics and Finance,* Vol. 16 (1), 137-152.

[23] Markusen, J. R., 1990, "Derationalizing Tariffs with Specialized Intermediate Inputs and Differentiated Final Goods," *Journal of International Economics*, Vol. 28, 375-83.

[24] Obstfeld, M. and K. Rogoff, 1995, "Exchange Rate Dynamics Redux," *Journal of Political Economy,* Vol. 103 (3), 624-60.

[25] Sen, Partha, A. Ghosh, and A. Barman, 1997, "The Possibility of Welfare Gains with Capital Inflows in a Small Tariff-Ridden Economy," *Economica*, Vol. 64, 345-352.

[26] Sinn, Hans-Werner, 2004, "The Dilemma of Globalisation: A German Perspective," *Economie Internationale,* Vol. 100, pp. 111-120.

[27] Venables, A. J., 1982, "Optimal Tariffs for Trade in Monopolistically Competitive Commodities," *Journal of International Economics,* Vol. 12 (1982), 225-241.

[28] Venables, A. J., 1987, "Trade and Trade Policy with Differentiated Products: A Chamberlinian-Ricardian Model," *Economic Journal,* Vol. 97, pp. 700-717.

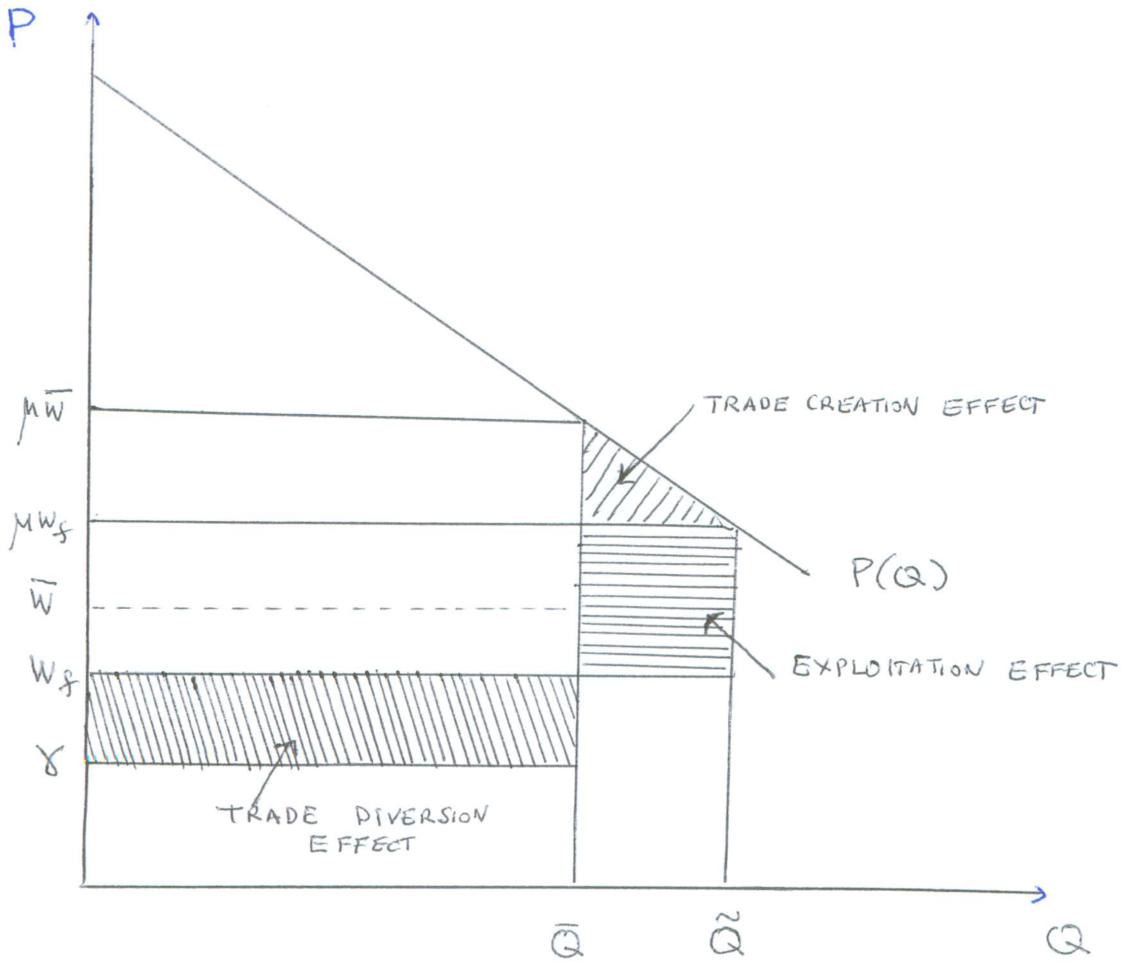

FIGURE 1

Decomposition of gains and losses