

# **THE MARKET STRUCTURE BENEFITS OF TRADE AND INVESTMENT LIBERALIZATION**

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## **Introduction**

This Working Paper develops a simple method for calculating welfare benefits when the market structure is made more competitive through the removal of import barriers and investment restrictions. Classic instances where trade and investment restrictions serve to preserve monopolistic monopoly market structures in a number of countries include automobiles, petrochemicals, telecommunications, insurance, and civil aviation. The analytic framework set forth in this working paper will be used in studies now underway of the cost of protection in Australia, Canada, China, the European Union and Indonesia.

For simplicity, the diagrammatic analysis is carried out as if the domestic industry acted like a pure monopoly (or perfect cartel); intermediate cases of monopolistic competition are not illustrated in graphic terms. In the mathematical section, and the numerical calculations, however, intermediate cases are considered.

At the conclusion of this chapter, we present numerical examples of four starting and ending market structures: monopoly (or cartel), four-firm monopolistic competition, eight-firm monopolistic competition, and perfect competition. We assume that, when trade and investment liberalization exerts an impact on market structure, it makes markets more competitive. For example, a monopolized (or cartelized) industry might instead act like four-firm monopolistic industry, or a four-firm monopolistic industry might be transformed into an eight-firm monopolistic industry.

Trade restrictions could take the form of tariffs, import quotas, or buy-national procurement policies; investment restrictions could keep foreign firms from opening (or expanding) their industrial and distribution outlets. When the government dismantles its trade and investment restrictions, foreign competition can help make the market structure more competitive. Transformation of the market structure, if it occurs, yields additional benefits on top of the static

efficiency gains from trade liberalization calculated in Measuring the Costs of Protection in the United States.<sup>1</sup>

To simplify the calculations, each industry will be classified in one of four categories: as a pure monopoly (or perfect cartel), as a four-firm monopolistic competitive industry, as an eight-firm monopolistic competitive industry, or as a perfectly competitive industry. The authors of national cost of protection studies will apply their judgment to indicate whether, and to what extent, trade and investment liberalization would change the market structure.

To evaluate the market structure benefits of trade and investment liberalization, we will, in the final analysis, adhere to the first three assumptions for calculating static efficiency gains set forth in Measuring the Costs of Protection in the United States (chapter 2). They are:

- The domestic good and the imported good are imperfect substitutes;
- The supply schedule of the imported good is completely elastic, i.e., flat (the underlying assumption is that the importing country is a small country in economic terms);<sup>2</sup>
- The supply schedule for the domestic good is upwardly sloped (less than perfectly elastic). This implies rising marginal costs as the industry expands.

For illustrative purposes, the diagrams in this Working Paper portray the extreme case where a domestic monopoly (or cartel) is initially protected by a quota (or quota-equivalent barrier), but is then transformed, through trade and investment liberalization, into a perfectly competitive industry. To simplify the analysis, we group domestic production by foreign firms together with imports, and assume that investment and trade restrictions apply with equal force both to imported goods and to goods made domestically by foreign firms. In order to reach the final

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<sup>1</sup> Gary Hufbauer and Kimberly Ann Elliott, 1994. *Measuring the Costs of Protection in the United States*. Washington: Institute for International Economics.

<sup>2</sup> The small country assumption is obviously more appropriate for Australia or Korea than for the European Union, Japan or the United States. We keep the assumption to avoid an extra degree of complexity.

analysis, we proceed in two steps. Readers familiar with this kind of analysis may go straight to the second step.

- First step: we recapitulate the effects of restrictions in a competitive market where the domestic and imported good are perfect substitutes for each other.
- Second step: we analyze the benefits of eliminating restrictions when the industry is monopolized and the goods are imperfect substitutes.

After portraying the problem in simple diagrams that correspond to these two steps, we extend the mathematical model developed in Measuring the Costs of Protection in the United States to calculate the welfare benefits of trade and investment liberalization that makes a monopolistic market structure more competitive. We then proceed to illustrate the model with numerical examples.

We proceed in a two-stage format. Stage one models the elimination of protection through a combination of trade and investment liberalization that leaves the domestic monopoly intact. In stage two, the monopoly is destroyed through deregulatory and pro-competitive policies, which leave the domestic market more competitive.

## **Restrictions in a Competitive Market with Perfect Substitutes**

Here we recapitulate the familiar analysis of static welfare gains and losses in a competitive market with perfect substitutes. Figure 1(a) depicts the perfectly competitive domestic market with and without restrictions on imported goods.<sup>3</sup> The domestic and imported goods are perfect substitutes. To complement Figure 1(a), Figure 1(b) shows events in the market for the imported good, taken by itself. With no restrictions, the domestic price,  $P_{d1}$ , would be the same as the world price,  $P_{m1}$ . This reflects the assumption of perfect substitutes. Domestic producers would supply the quantity  $Q_{s^*}$ , and domestic consumers would buy the quantity  $Q_{d^*}$ . The difference between domestic consumption and production is shown by  $fi$  in Figure 1(a). This corresponds to the quantity of imports,  $Q_{sm^*}$ , shown by segment  $fi$  in Figure 1(b).

An important expositional feature of Figure 1 and the subsequent figures should be mentioned here. The axes of these figures are logarithms to the base  $e$  of the underlying values, e.g.  $P_d$  is really  $\ln P_d$ ,  $P_m$  is really  $\ln P_m$ , and so forth. In order to simplify the figures, the logarithmic notation,  $\ln$ , is omitted.

Quota restrictions are now imposed that limit imports to  $Q_{sm'}$ , causing the price of imports to rise to  $P_{m2}$  (see Figure 1(b)). Because the goods are perfect substitutes, the domestic price also rises to  $P_{d2}$ , as shown in Figure 1(a). Domestic producers increase output to  $Q_{s'}$  to take advantage of the higher price, while domestic consumers respond to the price increase by cutting consumption to  $Q_{d'}$ . The difference between domestic consumption and production is shown by  $cd$  in Figure 1(a). This corresponds to the quantity of imports,  $Q_{sm'}$ , now limited by the quota, and shown by segment  $cd$  in Figure 1(b).

The welfare effects from imposing the restrictions can be analyzed as follows, using Figure 1(a):

- (1) Since the restriction takes the form of a quota, or a quota-equivalent barrier (e.g. strict buy-national procurement by public bodies) then "quota rents", shown by the

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<sup>3</sup> The term "imports" includes domestic production by foreign firms, when that production is restrained by investment restrictions; and the term "goods" includes services.

rectangle  $cdhg$ , will be captured by the lucky firms that control imports -- domestic firms, foreign firms, or some combination.

- (2) If instead the restriction takes the form of a tariff,  $t$ , then rectangle  $cdhg$  represents tariff revenue rather than quota rents, and this amount would be collected by the domestic government.
- (3) Consumers lose surplus measured by trapezoid  $bdie$ .
- (4) Producers gain surplus measured by trapezoid  $bcf e$ .
- (5) When the restriction takes the form of a quota, and when the quota rents are entirely captured by domestic firms, then the amount  $cdhg$  is added back to domestic gain. Hence the net welfare loss to the importing country is just the sum of triangles  $cgf$  and  $dih$ .
- (6) When the import quota rents are captured by foreign firms, then the net national welfare loss is shown by trapezoid  $cdif$ .
- (7) If the restriction instead takes the form of a tariff, the net welfare loss to the importing country would be depicted by the sum of triangles  $cgf$  and  $dih$ . It is worth noting that, with tariff protection, changes in the world price of imports are passed through to consumers, dollar for dollar. With quota protection, changes in the world price of imports are absorbed in larger or smaller quota rents.

## **Restrictions in a Monopolized Market with Imperfect Substitutes**

The assumption of a monopolized market and imperfect substitutes introduces new wrinkles. Imperfect substitution means that the price of the imported good affects the price of the domestic good (and vice versa), but the two prices need not be equal. If, for example, the domestic good has superior quality characteristics, its price per unit will be higher than the imported good. Moreover, since the domestic price affects demand for the imported good, and vice versa, the two demand schedules are interdependent. This interdependence can be accurately portrayed only with a three-dimensional graph, which would be too messy for our needs. Therefore, Figures 2(a) and 2(b) reflect a rough compromise.

In the domestic market, shown in Figure 2(a),  $Dd'$  represents demand for the domestic good when imports (including local production by foreign firms) are unrestricted and their price is  $Pm_2$ ; while  $Dd$  represents demand for the domestic good when imports are limited by a quota to  $Qsm^*$  and their price rises to  $Pm_1$ .<sup>4</sup> The supply schedule for imports in the domestic market,  $Sd$ , reflects the marginal cost curves of domestic firms (in other words,  $Sd = MC$ ). The same is true in Figure 3, discussed later.

In the market for imports, shown in Figure 2(b),  $Dm'$  represents the import demand schedule when there is free trade and domestic goods are priced at  $Pd_2$ ; while  $Dm$  represents the import demand schedule when imports are restricted and the price of domestic goods rises to  $Pd_1$ . The supply schedule for imports is perfectly flat, reflecting the simplifying “small country” assumption mentioned at the outset.

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<sup>4</sup> In terms of equation (11) discussed below, the intercept of the  $Dd'$  schedule with the quantity axis in Figure 2(a) equals  $(\ln a + Edm \ln Pm_2)$ . By contrast, the intercept of the  $Dd$  schedule with the quantity axis equals  $(\ln a + Edm \ln Pm_1)$ . Since  $Pm_2$  is less than  $Pm_1$ , the intercept moves to the left with liberalization. The slope of the schedule stays the same, so long as  $Edd$  remains constant. However, when a quota is removed, the absolute value of  $Edd$  actually increases; hence, it is a simplification to keep the slope unchanged in Figure 2(a). Note: to match up Figure 2(a) with equation (11), the axes in the figure should be read as logarithmic values, e.g.  $\ln Qd$  and  $\ln Pd$ .

Let us start the story with quota restrictions in place, and the domestic market controlled by a monopoly (or cartel). When a monopoly (or cartel) dominates the domestic market, the equilibrium price and quantity,  $P_{d1}$  and  $Q_s^*$  respectively, are determined by the intersection of marginal cost and marginal revenue. To reduce the clutter in Figure 2(a), the marginal revenue schedule corresponding to demand schedule  $D_d$  is not drawn. However, marginal revenue intersects marginal cost at point  $i$ , leading to output of  $Q_s^*$ , which in turn is priced at  $P_{d1}$ .

Suppose that the monopoly is stripped of all trade and investment restrictions. With unlimited imports, their landed price falls from  $P_{m1}$  to  $P_{m2}$  in Figure 2(b). With lower import prices, the domestic demand schedule shifts inwards, to  $D_d'$ . Assuming that the domestic industry is still monopolized (or cartelized), it will continue to exploit the downward slope in the demand schedule by equating the new marginal revenue schedule,  $MR'$ , with marginal cost.

As a logical matter, there is no requirement that trade and investment liberalization be the driving force that ensures more competitive markets. In practice, trade and investment liberalization often act as "drivers"; but in principle domestic deregulation and pro-competitive policies can also promote -- and indeed, may be required -- to ensure the actual or potential entry of new firms.<sup>5</sup>

Thus, in Figures 2(a) and 2(b), the monopolized (or cartelized) market is freed of quota restrictions, but the monopoly (or cartel) remains intact. In Figure 2(b), the landed price of imports drops from  $P_{m1}$  to  $P_{m2}$ . The import demand schedule shifts inward, from  $D_m$  to  $D_m'$ , reflecting reverberations in the domestic market (discussed in a moment). Imports increase from  $Q_{sm}^*$  to  $Q_{sm}'$ . Quota rents of  $rsxw$  vanish.

The domestic market is portrayed by Figure 2(a). The price of the domestic good drops from  $P_{d1}$  to  $P_{d2}$ . The domestic demand schedule shifts inward, from  $D_d$  to  $D_d'$ , because of more intense competition from cheaper imports. The lower price of domestic goods in turn causes the import demand schedule to shift inward from  $D_m$  to  $D_m'$ . In the end, production of domestic goods decreases from  $Q_s^*$  to  $Q_s'$ . (However, depending on the elasticity and position of the new demand schedule  $D_d'$ , compared to the old demand schedule  $D_d$ , and the slope of the supply

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<sup>5</sup> As the literature on industrial structure emphasizes, the potential entry of new firms often causes existing firms to behave in a more competitive fashion.

schedule, output could actually increase.) "Excess profits" captured by the monopoly or cartel decline from *bcih* to *dekj*.

To summarize these events, the elimination of trade protection, leaving the monopoly intact, has the following consequences, which we label **stage one**:

- (1) Consumer surplus on domestic goods increases by trapezoid *bced*. This counts as a welfare gain.
- (2) Monopoly "excess profits" decline from rectangle *bcih* to rectangle *dekj*. This is obviously a matter of concern to monopoly firms and their employees, but we do not score a decline in excess profits as a welfare cost to society at large. The reason is that the decline in excess profits collected by the industry in question is offset by gains elsewhere in the economy, as consumers have more income to buy other products.
- (3) Producer surplus declines by trapezoid *hikj*, with the fall in domestic production. This is scored as a welfare loss. However, it can happen that domestic production increases after the removal of a quota. The reason this could happen is that the domestic demand schedule becomes more elastic, owing to its interaction with an unlimited supply of imports at price  $P_{m2}$ . A more elastic demand schedule means that the marginal revenue schedule becomes "flatter", and hence could intersect the marginal cost schedule at a higher output -- even though the new schedule  $Dd'$  is shifted inwards from schedule  $Dd$ . If output actually rises, then the increment in producer surplus must be counted as a welfare gain.
- (4) Consumer surplus on imported goods increases by trapezoid *rsyw*. This counts as a welfare gain.
- (5) Quota rents on imports, shown by *rsxw* in Figure 2(b), are eliminated. If quota rents were previously captured by foreign producers, their elimination would represent a net gain to the domestic economy (and would be reflected in greater consumer surplus). If quota rents were previously captured by domestic firms,

there would be a redistribution but not a net gain to the domestic economy: that part of the gain in consumer surplus which corresponds to  $rsxw$  would instead be offset by a decline in the income of domestic quota holders.

- (6) If a tariff was in place instead of a quota, tariff revenues represented by rectangle  $rsxw$  would be eliminated. This would count as a welfare loss. However, the tariff revenues previously collected by the domestic government would be redistributed to domestic consumers as part of the gain in consumer surplus (i.e., as part of  $rsyw$ ).

The welfare or efficiency gain to the economy resulting from liberalization without market structure change can thus be calculated as: consumer surplus gain in the domestic market; minus the loss (or plus the gain) in producer surplus; plus consumer surplus gained in the import market; minus the loss of quota rents on imports if those rents were previously captured by domestic firms; and minus the loss of any tariff revenue previously collected on imports. In terms of Figures 2(a) and 2(b), the efficiency gain in **stage one**,  $EG_1$ , resulting from trade liberalization alone, with no change in market structure, can be computed as follows:<sup>6</sup>

$$EG_1 = bced - hikj + rsyw - rsxw \quad (1)$$

Note that the last term  $rsxw$  is only subtracted if the quota rents were previously captured by domestic firms, or if a tariff was imposed instead of a quota.

It is worth spending a moment to connect the foregoing analysis to the description of liberalization in a perfectly competitive market where domestic and imported goods are imperfect substitutes. The competitive case is described and illustrated in chapter 2 of Measuring the Costs of

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<sup>6</sup> An alternative method of scoring the efficiency consequences in the domestic market, when the monopoly stays intact, is the difference between the efficiency cost of the monopoly before trade liberalization, shown by triangle  $cfi$  in Figure 2(a) and the efficiency cost of the monopoly after liberalization, shown by triangle  $egk$ . Note that the efficiency cost of a monopoly measures the loss of **potential** consumer and producer surplus gains that could be had if the market operated according to competitive principles. This alternative scoring method has been suggested by Ben Smith of the Australian National University.

Protection in the United States. Briefly, with perfect competition, the equilibrium before liberalization would be at point  $f$ , and the equilibrium after liberalization would be at point  $g$ . There would be no "excess profits", before or after liberalization. The gain in consumer surplus from the drop in the domestic price would be just offset by the loss in producer surplus. In other words, the welfare effects in the domestic market cancel out. All the **net** welfare effects take place in the market for imports. By contrast, when the market is monopolized before and after liberalization there are positive welfare effects in the domestic market because the gains in consumer surplus exceed the loss (if any) in producer surplus.<sup>7</sup>

Returning now to the liberalization of a monopolized industry, in each of the numerical examples discussed later, we compute three additional values as side calculations. These values are useful to give an overall picture of the industry before and after liberalization:

- (7) The drop in the landed price of the imported good (the landed price is the import price inclusive of tariff and quota rent). This drop reflects the tariff equivalent magnitude of the quantitative restriction, which in turn includes any non-binding tariff that might be imposed.
- (8) The drop in the price of the domestic good.
- (9) The change in the volume of imports and the volume of domestic production. We assume that the loss (or gain) of domestic employment of production workers in the liberalized industry is proportional to the change in volume of domestic products. This calculation could understate the employment impact, since a substantial portion of "excess profits" captured by a monopoly (or cartel) might in turn be absorbed by padded payrolls.

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<sup>7</sup> The reason is that the difference between  $Pd_1$  and  $Pd_2$  (the drop in price paid by consumers) exceeds the difference between  $Pd_3$  and  $Pd_4$  (the drop in marginal revenue) when constant elasticity of demand schedules are assumed (as we have done). Marginal revenue drops less in absolute amount than price because, by operation of equations (4a), (4b) and (4c) below, marginal revenue is a fraction of price. Hence the change in marginal revenue is a fraction of the change in price.

**Stage two** of the story is shown by Figures 3(a) and 3(b). In these figures, the monopoly (or cartel) is destroyed through a combination of trade and investment liberalization and accompanying deregulatory and pro-competitive policies. As a consequence of the assembled array of policies, the domestic market becomes more competitive. In Figure 3(a), the reformed market structure is pictured as perfectly competitive, but that is an extreme case. The market might instead become monopolistically competitive.

The import market is shown in Figure 3(b). The demand schedule shifts down from  $D_m'$  to  $D_m''$ , because domestic goods become more competitive after the break-up of the monopoly (or cartel). The quantity of imports shrinks from  $Q_{sm}'$  to  $Q_{sm}''$ . However, there is no loss of consumer surplus on imports, since their price remains the same,  $P_m$ .

The domestic market, shown in Figure 3(a), is affected by the establishment of perfect competition in the following ways. The price of the domestic good drops from  $P_d$  to  $P_d'$ . The quantity of goods produced increases from  $Q_s$  to  $Q_s'$ , as more domestic producers enter the market, and as firms make their output decisions by equating marginal cost with price, rather than by equating marginal cost with the industry's marginal revenue. (For the moment, ignore rectangle *abgd*.)

The destruction of the domestic monopoly (or cartel) and the establishment of competition have the following welfare effects:

- (1) Monopoly "excess profits", shown by rectangle *dekj*, are eliminated. Rectangle *dekj* reflects a redistribution of income within the market itself from producers (firms and workers) to consumers, and from excess profits to producer surplus within the industry.
- (2) Consumer surplus on domestic goods increases by trapezoid *degf*, which includes part of rectangle *dekj* (erstwhile monopoly profits). Hence, net consumer surplus gains, above and beyond the redistribution from excess profits, are shown by triangle *egh*.

- (3) Producer surplus on domestic goods increases by trapezoid  $fgkj$ . Again, this includes part of rectangle  $dekj$  (erstwhile monopoly profits). Hence, net producer surplus gains are shown by triangle  $hgk$ .

The efficiency gain to the economy resulting from market structure change after liberalization can thus be calculated as: consumer surplus gained in the domestic market; plus producer surplus gained in the domestic market; and minus loss of excess profits in the domestic market. In terms of Figures 3(a) and 3(b), the efficiency gain realized in **stage two**,  $EG_2$ , from transforming a monopoly to a more competitive market, can be computed as follows:

$$EG_2 = degf + fgkj - dekj \quad (2a)$$

Suppose that the result of trade and investment liberalization, and accompanying regulatory and procompetitive domestic policies was to convert the market to monopolistic competition, rather than perfect competition. In that event, the new marginal revenue schedule might intersect marginal cost at point  $g$ , and output would be priced at point  $a$ . The gain in consumer surplus would then be  $deba$ , and the gain in producer surplus would be  $dgkj$ . Firms would still retain excess profits measured by a side calculation as  $abdg$ . The calculation of **stage two** gains would then be:

$$EG_2 = deba + dgkj - (dekj - abdg) \quad (2b)$$

## **Algebraic Solutions**

There are various equilibrium solutions for this model, associated with different starting and ending market structures. The market structure could start with a monopoly, monopolistic competition, or perfect competition. It could be protected by a quota or a tariff -- and there is a big difference between these forms of protection. After liberalization, the market structure could still be a monopoly, or it might evolve into monopolistic competition or even perfect competition.

In Figures 2(a) and 2(b) we assume that the starting market structure was a monopoly protected by a quota and the ending market structure was a monopoly with free trade. In Figure 2(a), with trade and investment restrictions in place, equilibrium in the domestic market is represented by point *c*. Equilibrium in the import market is represented by point *s* in Figure 2(b). In Figures 3(a) and 3(b), we assume that trade and investment have been liberalized, that the monopoly has been destroyed, and that perfect competition reigns in the market. Equilibrium in the domestic market is determined by the intersection of the supply and demand schedules at point *g* in Figure 3(a). Equilibrium in the import market is shown by point *z* in Figure 3(b).

In this section both equilibrium solutions are derived. Also derived are equilibrium solutions for monopoly and various degrees of monopolistic competition with and without trade restrictions. From these solutions, it is possible to calculate the attendant benefits that result from trade and investment liberalization alone (stage one) and, separately, the follow-on change (if any) in market structure (stage two). Numerical examples are used to illustrate the stage one and stage two benefits.

We now turn to the algebraic model for computing the equilibrium solutions and calculating the benefits of liberalization. Initially, the industry in question is monopolized (or cartelized) and imports (including domestic production by foreign firms) are restricted, either by a quota or by a tariff. We assume that the domestic industry produces a single good and that there is a single imported good. Domestic goods and imported goods are imperfect substitutes. The demand and supply functions of the domestically produced and imported goods can be written as follows:

### **Domestic Goods: Demand Schedule**

$$Qd = aPd^{Edd}Pm^{Edm} \quad (3)$$

### **Domestic Goods: Alternative Supply Schedules, Depending on the Market Structure**

$$Qs = bMR_1^{Es} = b\{[1 + 1/(Edd - (Emd \cdot Edm/Emm))]Pd\}^{Es} \quad (4a)$$

(for a monopolized industry protected by a quota)

$$Qs = bMR_2^{Es} = b\{[1 + 1/Edd]Pd\}^{Es} \quad (4b)$$

(for a monopolized industry protected by a tariff)

$$Qs = bMR_3^{Es} = b\{(1 + 1/edd)Pd\}^{Es} \quad (4c)$$

(for a monopolistically competitive industry whether protected by a quota or tariff; note that  $edd = n \cdot Edd$ , where  $n$  is the number of firms in the monopolistically competitive industry; this formulation is explained in Appendix A)

$$Qs = bPd^{Es} \quad (4d)$$

(for a perfectly competitive industry whether protected by a quota or tariff)

### **Imported Goods: Demand and Supply Schedules**

$$Qdm = cPd^{Emd}Pm^{Emm} \quad (5)$$

$$Qsm = Qsm^* \quad (6a)$$

(with import quota or quota-equivalent barrier)

$$P_m = P_w(1 + t) \tag{6b}$$

(with tariff or tariff-equivalent barrier)

$$P_m = P_w \tag{6c}$$

(with free trade)

### **Equilibrium: Demand and Supply Clear in Each Market**

$$Q_d = Q_s \tag{7}$$

$$Q_{dm} = Q_{sm} \tag{8}$$

The terms in equations (3) through (8) are defined as follows:

$Q_d$ : quantity demanded of domestically produced goods

$Q_s$ : quantity supplied of domestic goods

$P_d$ : price of domestic goods

$Q_{dm}$ : quantity demanded of imported goods

$Q_{sm}$ : quantity supplied of imported goods

$P_m$ : domestic selling price of imported goods

$P_w$ : world price under free trade

$t$ : ad valorem tariff or tariff-equivalent rate, either the tariff itself or (if higher) the tariff-equivalent of all trade and investment restrictions

$MR_1$ : marginal revenue for a monopolized or cartelized industry protected by a quota

$MR_2$ : marginal revenue for a monopolized or cartelized industry protected by a tariff

$MR_3$ : marginal revenue for a monopolistic competitive industry

$E_{dd}$ : own-price elasticity of demand for domestic goods

*edd*: the elasticity facing the representative firm in a monopolistic competitive market structure where all firms behave according to Cournot rules (as explained in Appendix A, *edd* can be approximated by  $n \cdot Edd$ , where  $n$  is the number of firms in the industry)

*Edm*: cross-price elasticity of demand for domestic goods with respect to imported goods

*Es*: own-price elasticity of supply for domestic producers

*Emm*: own-price elasticity of demand for imported goods

*Emd*: cross-price elasticity of demand for imported goods with respect to domestic goods

Equations (3) and (5), specify the demand schedules for domestic and imported goods respectively.

Equation (4a) specifies the supply schedule when the domestic industry is monopolized (or cartelized) and protected by a quota. The middle value in equation (4a), namely  $bMR_t^{Es}$ , states that the monopoly (or cartel) increases (or decreases) output in response to higher (or lower) marginal revenue. Marginal revenue can be found by differentiating total revenue,  $Qd \cdot Pd$ , with respect to  $Qd$ . When imports are limited by a quantitative restraint, the domestic selling price (i.e., the landed price) of imported goods becomes an indirect function of the price of domestic goods, and this complicates the calculation of marginal revenue. Put succinctly, by lowering their own price, domestic firms also lower the selling price of the fixed quantity of imports, and this in turn reduces demand for (and hence marginal revenue on) the sale of domestic goods. In algebraic terms, using equations (5), (6a) and (8), the domestic selling price of imports may be expressed as:

$$Pm = [Qsm^*/c]^{1/Emm} Pd^{Emd/Emm} \quad (9)$$

Substituting (9) in (3), and differentiating total revenue,  $Qd \cdot Pd$ , with respect to  $Qd$ , leads to the result that:

$$MR_t = \{1 + 1/[Edd - (Emd \cdot Edm/Emm)]\} Pd \quad (10)$$

Using equation (10), the domestic supply schedule for a monopoly protected by a quota can be written as in the far right side of equation (4a).

In all the other combinations of market structure (four-firm monopolistic competition, etc.) and protection modes (quota or tariff), we assume that marginal revenue reflects only the elasticity of the domestic demand schedule, not the elasticity of the import demand schedule. In other words, we assume that when there is an unlimited supply of imports at the world price marked up by the tariff, or when there is a significant degree of domestic competition, individual firms only think in terms of the impact that their pricing decisions will have on capturing a share of the domestic market, not on influencing the landed price of imports. Hence the supply schedules have a simpler form.

Equation (4b), for example, specifies the supply schedule when the domestic industry is monopolized (or cartelized) and protected by a tariff. The middle term in (4b),  $bMR_2^{Es}$ , states that the monopoly increases (or decreases) output in response to higher (or lower) marginal revenue. When imports are limited by a tariff, the domestic monopoly (or cartel) cannot affect the domestic selling price of imports by raising or lowering the selling price of domestic goods. Instead, the domestic selling price of imports is simply  $P_w(1+t)$ , no matter what the price of domestic goods may be.<sup>8</sup> Differentiating total revenue  $Qd \cdot Pd$ , with respect to  $Qd$  yields equation (4b).

Equation (4c) specifies the supply schedule when the domestic industry is monopolistically competitive. Again, the middle term,  $bMR_3^{Es}$ , states that the firms collectively increase (or decrease) output in response to higher (or lower) marginal revenue. In this case, individual firms do not perceive themselves to be large enough to affect either the prices charged or the quantities supplied by other domestic firms, or the domestic selling price of imports. Instead, each firm assumes that, when it raises (lowers) its own price, all other firms will continue to produce the same quantity and charge the same price, and the firm in question will feel the full impact of the change in quantity demanded by the market. Under these circumstances, the relevant elasticity for calculating marginal revenue is  $edd$ . The parameter  $edd$  can be estimated as the number of firms times the elasticity of market

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<sup>8</sup> We assume that the tariff is not so high that imports are excluded from the domestic market.

demand, or  $n \cdot Edd$  (see Appendix A for more details). As before, differentiating total revenue  $Qd \cdot Pd$ , with respect to  $Qd$  yields equation (4c).

Equation (4d) specifies the supply schedule when the domestic industry is perfectly competitive. Under perfect competition, domestic output responds to price since, for perfectly competitive firms, marginal revenue is the same as price.

Equation (6a) states that imports are limited to  $Qsm^*$  with a quota. Equation (6b) shows the domestic selling price of imports with an ad valorem tariff or tariff-equivalent barrier. Equation (6c) shows the domestic selling price of imports under free trade.

Equations (7) and (8) are the familiar equilibrium equations required for the two markets to clear.

Figures (2) and (3) can be matched to the foregoing equations once the underlying quantities are transformed from ordinary magnitudes (e.g., tons or dollars per ton) into logarithmic values. The logarithmic transformation, applied to equations (3) and (8), leads to a series of linear equations which then correspond to the straight line schedules in Figures (2) and (3):

$$\ln Qd = \ln a + Edd \ln Pd + Edm \ln Pm \quad (11)$$

$$\ln Qs = \ln b + Es \ln \{1 + 1/[Edd - (Emd \cdot Edm / Emm)]\} + Es \ln Pd \quad (12a)$$

(monopolized market with quota)

$$\ln Qs = \ln b + Es \ln \{1 + 1/Edd\} + Es \ln Pd \quad (12b)$$

(monopolized market with tariff)

$$\ln Qs = \ln b + Es \ln \{1 + 1/edd\} + Es \ln Pd \quad (12c)$$

(monopolistically competitive market with a quota or tariff)

$$\ln Qs = \ln b + Es \ln Pd \quad (12d)$$

(perfectly competitive market with a quota or tariff)

$$\ln Q_{dm} = \ln c + E_{md} \ln P_d + E_{mm} \ln P_m \quad (13)$$

$$\ln Q_{sm} = \ln Q_{sm}^* \quad (14a)$$

(with import quota)

$$\ln P_m = \ln P_w + \ln(1 + t) \quad (14b)$$

(with import tariff)

$$\ln P_m = \ln P_w \quad (14c)$$

(with free trade)

$$\ln Q_d = \ln Q_s \quad (15)$$

$$\ln Q_{dm} = \ln Q_{sm} \quad (16)$$

For simplicity, in Figure 2(b) the landed price (i.e., the price inclusive of quota rent or tariff) for the imported good, when imports are restricted,  $P_{mi}$ , is defined to equal one. In conceptual terms, this means that the quantity unit of the imported good is defined so that the price of the unit, before trade liberalization, is one. Again for simplicity, the price of the domestic good before liberalization,  $P_{di}$ , is also defined to equal one.

We now want to use the market models embodied in equations (11) to (16) to calculate the welfare effects of the shift, in two stages, from a monopoly to a competitive market.

The first step is to nail down the elasticity parameters and the constant terms. From country-specific econometric estimates, and from a survey of the literature, we have values of the elasticity parameters,  $E_{dd}$ ,  $E_{dm}$ ,  $E_s$ ,  $E_{mm}$ ,  $E_{md}$  and  $edd$ . From a study of industry statistics, we have base year values of  $\ln Q_s^*$ ,  $\ln Q_{sm}^*$ ,  $\ln P_{di}$ , and  $\ln P_{mi}$ . Hence, we can use equations (11), (12a) and (13)

respectively to solve for  $\ln a$ ,  $\ln b$ , and  $\ln c$ , when the market is initially monopolized and protected by a quota or a tariff. At this juncture, we have all the constant terms and elasticity parameters necessary to calculate equilibrium prices in **stage one** after trade is liberalized; and, in the **stage two**, after a competitive market is established.

The framework can be used to find  $MR_1$ , the equilibrium marginal revenue for a monopoly protected by a quota. In Figure 2(a),  $MR_1$  is the same as  $Pd_3$ . This value is necessary to calculate the monopoly "excess profits" before the quota is removed, shown by rectangle  $bcih$  in Figure 2(a). The marginal revenue relationship specified by equation (10) can be used to find the value of  $\ln Pd_3$ :

$$\ln Pd_3 = \ln\{1 + 1/[Edd - (Emd \cdot Edm/Emm)]\} + \ln Pd_1 \quad (17a)$$

When the monopolized market is protected by a tariff, the relevant marginal revenue is denoted by  $MR_2$ , which can also be depicted by  $Pd_3$  in Figure 2(a), and can be found as:

$$\ln Pd_3 = \ln[1 + 1/Edd] + \ln Pd_1 \quad (17b)$$

When the monopolized market has no trade restrictions, but remains a monopoly in terms of domestic structure, the relevant marginal revenue, shown by  $Pd_4$  in Figure 2(a), can be calculated as:

$$\ln Pd_4 = \ln[1 + 1/Edd] + \ln Pd_2 \quad (17c)$$

Side calculations can be used to compute several other magnitudes: the loss of any tariff revenue entailed by liberalization (in those cases where a tariff supplements the quantitative restriction); the tariff-equivalent magnitude of the quantitative restriction; the loss (or gain) of domestic production and employment; and the change in the volume of imports.

## Monopolistically Competitive Equilibrium

Under perfect competition, individual firms are unable to set the prices of their products. If a perfectly competitive firm sets its price above the market level, it will have no demand; if it sets its price below the market level, it will be overwhelmed with orders. Monopolies (and cartels), on the other hand, dominate a particular industry and can set their own prices, provided they are willing to adjust the output level to correspond with the price set. The monopolistically competitive case lies between these two extremes: firms do not collude before making output and pricing decisions, nor are they completely powerless in setting prices. Instead, they are interdependent. Each firm sets its price to correspond with its individual output decisions, yet each firm also has some impact on other firms in the industry.

With this in mind, our previous equations must be revised to reflect the differences between the industry's overall demand elasticity,  $E_{dd}$ , and the demand elasticities facing the representative individual firm in a monopolistically competitive industry,  $e_{dd}$ . As shown in Appendix A,  $e_{dd}$  can be derived by multiplying the industry demand elasticity,  $E_{dd}$ , by the number,  $n$ , of firms actually or potentially in the industry to calculate the value of  $e_{dd}$ .<sup>9</sup>

In light of these results, the marginal revenue schedule confronting the representative firm is not equation (10), but rather:

$$MR_2 = [1 + 1/e_{dd}]Pd \quad (18)$$

Equation (18) reflects the assumption that monopolistically competitive firms do not anticipate the impact of their own pricing decisions on the prices charged by other firms or the price of imports.

The supply schedule for a monopolistically competitive market therefore becomes the schedule earlier shown by equation (12c):

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<sup>9</sup> Recall that firms in the industry will price on a more competitive basis if they fear the imminent entry of new firms who smell the scent of very generous profits.

$$\ln Q_s = \ln b + E_s \ln[1 + 1/edd] + E_s \ln P_d \quad (12c)$$

Similarly,  $\ln P_{d_i}$  is no longer specified by equation (17a) or (17b), but instead by:

$$\ln P_{d_i} = \ln[1 + 1/edd] + \ln P_{d_2} \quad (17c)$$

With these changes, it is possible to calculate the welfare effects of transforming a monopolistically competitive market into a perfectly competitive market. The welfare effects may be calculated using equations (22) to (31); these equations are discussed in a later section.

## Competitive Equilibrium

For the competitive equilibrium, as portrayed in Figures 3(a) and 3(b), our task is to find the values of  $Pd_5$  and  $\ln Qs''$  (for the domestic market) and  $\ln Qsm''$  (for the import market).

The place to start is with  $\ln Pm_2$ , the world price (i.e.,  $\ln Pw$ ), which is also the landed price of imports under free trade. This value is found from trade statistics or other sources. The next value to determine is  $\ln Pd_5$ , the competitive equilibrium price in the domestic market. This price can be found by setting  $\ln Qd$ , determined from the right hand side of equation (11), equal to  $\ln Qs$ , determined from the right hand side of equation (12d), and solving for  $Pd_5$ :

$$\ln Pd_5 = [1/(Es - Edd)][\ln a - \ln b + Edm \ln Pm_i] \quad (19)$$

Next, we determine the quantity of domestic goods produced by a perfectly competitive industry,  $\ln Qs''$ . The quantity can be found from equation (12d):

$$\ln Qs'' = \ln b + Es \ln Pd_5 \quad (20)$$

Finally, we determine the quantity of imports, indicated by  $\ln Qsm''$ , using equations (13) and (16):

$$\ln Qsm'' = \ln c + Emd \ln Pd_5 + Emml \ln Pm_2 \quad (21)$$

## Welfare Effects

The welfare effects of eliminating a quota or tariff on imports (stage one), and then destroying the domestic monopoly (or cartel) to establish competition (stage two), have been described earlier. We now calculate this process in the same two stages. These welfare effects can be calculated using the price and quantity terms in Figures 2(a) and 2(b). For these calculations, we use the actual magnitudes (e.g., tons and dollars per ton) rather than their logarithmic transformations.

**Stage one** gains and losses are calculated as follows, based on Figures 2(a) and 2(b):

Increase in consumer surplus on domestic goods:

$$bcd = (Pd_1 - Pd_2)Qs' + 1/2(Pd_1 - Pd_2)(Qs^* - Qs') \quad (22)$$

Increase in consumer surplus on imported goods:

$$rsyw = (Pm_1 - Pm_2)Qsm^* + 1/2(Pm_1 - Pm_2)(Qsm' - Qsm^*) \quad (23)$$

Elimination of monopoly "excess profits" on domestic goods:

$$(bcih - dekj) = (Pd_1 - Pd_3)Qs^* - (Pd_2 - Pd_4)Qs' \quad (24)$$

Decrease (or increase) in producer surplus on domestic goods:

$$hikj = (Pd_3 - Pd_4)Qs' + 1/2(Pd_3 - Pd_4)(Qs^* - Qs') \quad (25)$$

Elimination of quota rent on imports (if quota rents were captured by domestic firms, this amount should be recorded as a loss to the national economy; if quota rents were instead captured by foreign

firms, this amount is not a loss to the national economy; note, in both cases, domestic consumers register a gain corresponding to  $rsxw$ ):

$$rsxw = (Pm_1 - Pm_2)Qsm^* \quad (26)$$

Loss of tariff revenue, in cases where the quantitative restriction is supplemented by a tariff:

$$\text{revenue loss} = tPm_1Qsm^* \quad (27)$$

where  $t$  is the ad valorem tariff rate. In these cases, the tariff revenue loss is recorded as a loss to the national economy. However, an adjustment must be made to the calculated amount of quota rent by subtracting the tariff revenue.

Tariff equivalent rate of the quantitative restriction (inclusive of any tariff):

$$\text{tariff equivalent rate} = (Pm_1 - Pm_2)/Pm_2 \quad (28)$$

Employment loss (or gain), based on change in volume of domestic production:

$$\text{employment loss (or gain)} = N[(Qs^* - Qs')/Qs^*] \quad (29)$$

where  $N$  is the base year number of production workers.

Net welfare or efficiency gain to the economy in **stage one**:

$$EG_1 = bced + rsyw - (bcih - dekj) - hikj - rsxw \quad (1)$$

The last term,  $rsxw$ , is only subtracted to the extent that quota rents were captured by domestic firms prior to liberalization. If a tariff was imposed, in addition to or instead of a quota, then  $tPm_2Qsm^*$  would also be subtracted, as well as any part of  $rsxw$  captured by domestic firms prior to liberalization.

In **stage two**, the domestic monopoly or cartel is destroyed to establish competition. These welfare effects are described below:

Increase in consumer surplus on domestic goods:

$$degf = (Pd_2 - Pd_5)Qs' + 1/2(Pd_2 - Pd_5)(Qs'' - Qs') \quad (30)$$

Increase in producer surplus on domestic goods:

$$fgkj = (Pd_5 - Pd_4)Qs' + 1/2(Pd_5 - Pd_4)(Qs'' - Qs') \quad (31)$$

Elimination of cartel "excess profits":

$$dekj = (Pd_2 - Pd_4)Qs' \quad (32)$$

Net welfare or efficiency gain to the economy in the **stage two**:

$$EG_2 = degf + fgkj - dekj \quad (2)$$

Welfare effects in other cases, where trade and investment liberalization exerts a different impact on market structure, can be analyzed using the same basic formulas with a suitable reinterpretation of Figures 3(a) and 3(b).

Taking stage one and stage two together, our numerical examples evaluate the cases listed in Box 1, classified according to starting (pre-liberalization) and ending (post-liberalization) market structure. For example, the analysis just discussed starts with a monopoly protected by a quota in stage one and ends with perfect competition under free trade in stage two.

To evaluate the other cases, the first step is to estimate the appropriate value of parameter  $b$  for the supply schedule that corresponds to the starting market structure, based on equation (12a), (12b), (12c), or (12d), as appropriate. The next step is to calculate the ending import price, under conditions of free trade. The third step is to calculate the domestic price after liberalization, assuming the market structure remains the same, again using equation (12b), (12c), or (12d), but now assuming that there is no tariff or quota. With these three steps, it is possible to calculate the stage one benefits of trade liberalization, with no change in the market structure. The next step is to calculate the equilibrium marginal revenue for a more competitive market structure ( $MR_3$  for a monopolistic competitive industry, or  $Pd_5$  for a perfectly competitive industry (see Figure 3(a)). With these values, it is possible to apply equations (22) to (32) to calculate the welfare effects.

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**Box 1. Possible Market Structure Changes as a Consequence of Trade and Investment Liberalization, and Accompanying Domestic Deregulatory and Pro-Competitive Policies.****Starting Market Structure****Ending Market Structure**

Perfect competition  
protected by a quota  
or tariff

1. Perfect competition under  
free trade

Eight-firm monopolistic  
competitors protected by  
a quota or tariff

1. Eight-firm monopolistic  
competition under free trade
2. Perfect competition under  
free trade

Four-firm monopolistic  
competitors protected by  
a quota or tariff

1. Four-firm monopolistic  
competition under free trade
2. Eight-firm monopolistic  
competition under free trade
3. Perfect competition under  
free trade

Monopoly (cartel) protected  
by a tariff

1. Monopoly (cartel) under  
free trade
2. Four-firm monopolistic  
competition under free trade
3. Eight-firm monopolistic  
competition under free trade
4. Perfect competition under  
free trade

Monopoly (cartel) protected  
by a quota

1. Monopoly (cartel) under  
free trade
  2. Four-firm monopolistic  
competition under free trade
  3. Eight-firm monopolistic  
competition under free trade
  4. Perfect competition under  
free trade
-

## **Illustrative Examples**

The following tables provide **illustrative** calculations of **hypothetical** welfare and employment effects in four cases, using parameters and data for four US sectors: ceramic articles, frozen concentrated orange juice, apparel and machine tools. The basic data are observed levels of US production, imports and prices, coupled with elasticity parameters, as presented in Measuring the Costs of Protection in the United States.<sup>10</sup>

We impose on these data five alternative counterfactual assumptions concerning the initial market structure. Given the alternative counterfactual scenarios, and corresponding assumptions about the marginal revenue calculations of firms in the industry, we estimate initial demand and supply schedules. The alternative counterfactual market structures are: perfect competition with a tariff, 8-firm monopolistic competition with a tariff, 4-firm monopolistic competition with a tariff, monopoly with a tariff, and monopoly with a quota.

The analysis is divided into two stages. By separating the welfare consequences into two stages, we attempt to isolate the trade liberalization effects from the market structure effects. In **stage one**, trade is assumed to be liberalized by removing the tariff or quota, but the market structure remains the same. Tables 1 through 4 display the results of the tariff or quota removal only, keeping market structure the same.

In **stage two**, the market structure is assumed to change in a more competitive direction, both because trade barriers are removed and because corresponding investment restraints are eliminated. If the market structure does not become more competitive, stage two is irrelevant; all the benefits of trade liberalization have already occurred in stage one. Under each hypothetical starting market structure in stage two, the tables list possible ending market structures which reflect greater degrees of competition. For instance, an 8-firm monopolistically competitive industry after stage one might

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<sup>10</sup> The domestic elasticity parameters, *E<sub>dd</sub>*, have been increased in absolute value to ensure positive solutions in the cases where the starting market structure is monopoly or monopolistic competition.

become a 4-firm monopolistically competitive market or even a perfectly competitive market in stage two.

In the illustrative tables, the welfare effects of the two stages are sized up using various indicators, all scaled as percentages of pre-liberalization import values: gains in consumer surplus on domestic and imported goods; gain or loss in producer surplus; loss of tariff revenues or quota rents (the quota holders are assumed to be domestic firms); decline in excess profits; total efficiency gains.<sup>11</sup> We also measure changes in prices and volumes of domestic and imported goods. In our model, employment is assumed to change by the same percentage as domestic production volume. However, a bigger decline might occur when padded staffs flourish under monopolistic market structures. In other words, employment would decline by a greater percentage than production.

In the following description, commonality across illustrative cases described in the tables is emphasized. Exceptions to the common features are mentioned parenthetically or as footnotes.

Consider first the **stage one** analysis where the tariff or quota is removed, but the market structure remains the same. In Table 1 (Case A), the first row contrasts a perfectly competitive industry protected by a tariff of 11 percent with a perfectly competitive industry under free trade and investment. Consumer surplus on domestic goods increases by 1.83 percent of the pre-liberalization import value, and producer surplus falls by 1.83 percent of pre-liberalization import value -- so the two just cancel out. Consumer surplus on imported goods increases by 10.24 percent of the pre-liberalization import value, but this is partly offset by a tariff revenue decrease of 9.91 percent. The net effect is an efficiency gain of 0.33 percent, again measured as a percent of the pre-liberalization import value. There is no change in excess profits (since, with perfect competition, there are no excess profits).<sup>12</sup> The domestic price decreases by 4.22 percent, while the import price decreases by 9.91 percent; domestic production decreases by 8.25 percent (as does employment); and import volume increases by 6.65 percent.

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<sup>11</sup> In stage one, the decline in excess profits is ignored for purposes of calculating efficiency gains; in stage two, the decline in excess profits is taken into consideration in calculating efficiency gains.

<sup>12</sup> In these examples, perfect competition is modeled as an industry with 10,000 firms, so in a few illustrative cases there are slight changes in excess profits.

Much the same results occur under a scenario of monopolistic competition when the market structure remains unaltered after the tariff is removed. For example, in Table 1 (Case A), moving from 8-firm monopolistic competition with a tariff to 8-firm monopolistic competition under free trade, yields welfare effects that are close to the perfect competition scenario just described. A similar story can be told when 4-firm monopolistic competition experiences trade and investment liberalization, and the market structure remains unaltered as 4-firm monopolistic competition, but the efficiency gains are somewhat larger. When a monopoly is protected by a tariff, the changes in all dimensions are still larger than the previous scenarios, but in the same ballpark. These results tend to be repeated in the other illustrative examples described in Tables 2 through 4.<sup>13</sup>

The big difference occurs when a monopoly protected by a quota is liberalized. In this case, the domestic industry increases its output very substantially, even when it remains a monopoly. The reason is that the monopoly can no longer be indifferent to the possibility that consumers will buy more imports to escape the high prices charged for domestic goods once trade is liberalized.<sup>14</sup> Hence, the monopoly will substantially cut its price (by 37 percent in Table 1) and increase its own output (by 291 percent in Table 1).

We now turn to the **stage two** effects, the stage where the market structure becomes more competitive.<sup>15</sup> In Table 1 (Case A), when the market structure evolves from 8-firm monopolistic competition to perfect competition, the following effects are calculated: the consumer surplus on domestic goods increases by 0.54 percent of the pre-liberalization import value; there is no change on

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<sup>13</sup> In Tables 2 and 3, the monopoly scenarios show a significantly greater loss of excess profits after the tariff is removed. This reflects the large ad valorem tariffs in these two cases (30 percent in Table 2, 19 percent in Table 3). Hence, the monopolist's excess profits are severely affected by the tariff removal.

<sup>14</sup> Pre-liberalization domestic prices in this scenario are high relative to calculated marginal costs, but they start at the same absolute level as in all the other scenarios.

<sup>15</sup> Since a perfectly competitive market cannot, by definition, become more competitive, there is no entry in stage two for a starting market structure of perfect competition.

the consumer surplus of imported goods, an expected result since the landed price of imports does not change; producer surplus on domestic goods increases by 0.92 percent with the expansion of domestic output; and there is no change in tariff revenue, since the tariff was already removed in stage one. These effects are countered by the decline in excess profits of 1.42 percent, which leads to a 0.03 percent increase in total efficiency gain. The domestic price decreases by 1.31 percent, causing domestic production to increase by 4.74 percent (along with employment). The import price does not change at all (again, since the tariff was already gone in stage one) while the import volume decreases by 1.31 percent.

The same magnitude of changes is calculated in **stage two** when a 4-firm monopolistic competitive market becomes an 8-firm competitive market or a perfectly competitive market. Again, this result is mirrored across Tables 2 through 4. In three of the illustrative cases, the most extensive efficiency gains occur in stage one; stage two gains are generally less than a third of stage one gains. The exception is Case D, where a low 4 percent tariff produces much smaller gains following trade liberalization in stage one than the gains resulting from market structure changes in stage two.

When the initial market structure is a monopoly, the **stage two** effects are substantial. In Table 1 (Case A), where the market structure changes from a monopoly to 4-firm monopolistic competition, the following effects are calculated: consumer surplus on domestic goods increases by 4.34 percent of the pre-liberalization import value while producer surplus increases by 6.19 percent. Somewhat larger effects are reported when a monopoly is transformed to 8-firm monopolistic competition or to perfect competition. But most of the gains are achieved by the seemingly modest change in market structure from monopoly to 4-firm monopolistic competition.<sup>16</sup>

By far the most dramatic outcome occurs when a monopoly (or a cartel) once protected by a quota undergoes trade, investment and market structure liberalization. These are rare cases, but the scenario could describe automotive assembly, telecommunications and insurance in some Asian nations. By removing the quota insulating a monopoly in **stage one**, given the data and parameter values in Table 1 (Case A), the following effects are calculated: consumer surplus on domestic goods

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<sup>16</sup> This result is paralleled in Tables 2 through 4, but the magnitude of the welfare effects is greater in these cases than in Table 1, due to different elasticity parameters.

increases by 40.87 percent of the pre-liberalization import value; consumer surplus on imported goods increases by 8.45; and producer surplus on domestic goods increases by 24.88 percent, owing to the large expansion of domestic output.

In **stage two**, by moving from monopoly to 4-firm monopolistic competition under free trade and investment, consumer surplus on domestic goods increases by another 12.23 percent of the pre-liberalization import value; consumer surplus on imported goods remains unchanged; and producer surplus on domestic goods increases by 17.45 percent. These effects are larger than the effects measured for a monopoly initially protected by a tariff. The reason is that different marginal cost curves were calculated from the initial data in the two cases.<sup>17</sup>

At the foot of Tables 1 through 4, the combined consumer savings and total efficiency gains of stages one and two are calculated. In other words, the effects of tariff liberalization are combined with the market structure liberalization effects. Total consumer savings are calculated by adding consumer surplus gains on domestic goods and consumer surplus gains on imported goods in both stages one and two. Similarly, the efficiency gains in stage one are added to the efficiency gains in stage two to calculate the total efficiency gains.

The combined outcomes in the perfect competition and monopolistic competition cases across all four illustrative cases are rather similar. However, in scenarios where monopolies are liberalized, the gains are far larger.

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<sup>17</sup> While the results of Tables 2 through 4 are broadly similar, there are differences reflecting the varying elasticity parameters of the illustrative industries.

## **APPENDIX A.      The Case of Monopolistic Competition**

When the protected domestic industry operates in a state of monopolistic competition, its price setting behavior lies between the extremes of a monopoly and perfect competition. The purpose of this appendix is to show that, under certain conditions, the welfare gains that result from transforming a monopolistically competitive industry into a perfectly competitive industry -- as a consequence of trade and investment liberalization -- can be calculated using an approach that is similar to the method developed in the text for the transformation of a monopolized industry.<sup>18</sup>

Under monopolistic competition, firms do not collude to the extent of agreeing on their respective market shares before making output and pricing decisions, as they would under a monopoly or a cartel. Unlike the case of perfect competition, however, individual firms are not completely powerless in setting the prices they receive for their products. Instead, firms in a monopolistically competitive industry are interdependent -- each firm's output decisions affect its own price and the prices realized by other firms in the industry.

The relationship between the industry's overall demand elasticity, *Edd*, and the demand elasticities facing the representative individual firm, *edd*, differ sharply in the three cases under consideration: a pure monopoly (or perfect cartel), perfect competition, and monopolistic competition. In a monopoly or well functioning cartel, each firm regards its own demand elasticity as identical with the industry's demand elasticity, *Edd*. The reason is that each firm agrees to supply a fixed share of the market (in the case of a monopoly, 100 percent of the market), so the firm neither surrenders nor captures market share from other producers when industry price and output change.

By contrast, in a perfectly competitive industry each individual firm views its demand elasticity as indefinitely large. The reason is that each firm is so small relative to the size of the industry, and its goods are so interchangeable with the products of other firms, that it can vastly

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<sup>18</sup> The exposition here follows the analysis by J. David Richardson in "Empirical Research on Trade Liberalization with Imperfect Competition: A Survey", *Statistics Working Papers* 58 (1989). Paris: OECD.

enlarge its sales by pricing slightly below the prevailing market; conversely, the perfectly competitive firm will lose most of its sales if it prices slightly above the going market.

In the intermediate case of monopolistic competition, each firm holds a significant share of the market, and its goods are not perfectly interchangeable with the products of other firms. To calculate the demand elasticity facing the representative firm in this case, we first need to introduce the concept of an "imperfection weight" which relates the overall demand elasticity for the product to the demand elasticity facing the individual firm. For expositional purposes, we initially assume that all firms are exactly the same size and that their products are equally interchangeable with the goods made by other firms.

Let:

$edd$  = the representative firm's perceived demand elasticity; and  
 $w$  = the degree of imperfection for the representative firm  
(where  $0 < w < 1$ ).

Conceptually,  $edd$  is defined as follows:

$$edd = (1/w)Edd \tag{A1}$$

We now assume an important case of imperfect competition, known as Cournot competition, or Cournot-Nash behavior. In this case, all firms produce the same good. However, each firm perceives the output levels of rival firms as given, and then decides on its own optimal output. In this situation,  $w$  equals the representative firm's share of the market,  $s$ .

Thus equation (A1) becomes:

$$edd = (1/s)Edd \tag{A2}$$

The proposition that  $w = s$  under Cournot competition can be shown as follows.

Let  $Edd$  = market demand elasticity

$edd$  = representative firm  $i$ 's demand elasticity

$P$  = price per unit

$Q$  = output of the industry

$Q_i$  = output of representative firm  $i$

$n$  = number of firms in the industry

$s$  = representative firm  $i$ 's share of the market

Let lower case variables represent percentage changes:

$p$  = percentage change in price

$q$  = percentage change in output of the industry

$q_i$  = percentage change in output of the representative firm  $i$

Let the price,  $P$ , drop by a certain percentage,  $p$ . By definition:

$$q = p \cdot Edd \tag{A3}$$

$$DQ = q \cdot Q \tag{A4}$$

Combining (A3) and (A4) gives:

$$DQ = p \cdot Q \cdot Edd \tag{A5}$$

Under Cournot competition, when firm  $i$  cuts its price by  $p$ , it expects to get all of the change in output. Combining this condition with (A5), we get:

$$DQ_i = DQ = p \cdot Q \cdot Edd \quad (A6)$$

Dividing both sides of (A6) by  $Q_i$ :

$$q_i = DQ_i/Q_i = p \cdot Q \cdot Edd/Q_i \quad (A7)$$

From (A7), we can derive:

$$edd = q_i/p = (p \cdot Q \cdot Edd)/(p \cdot Q_i) = Edd/(Q_i/Q) = Edd(1/s) \quad (A8)$$

In other words, under Cournot competition, the imperfection weight for a representative firm equals its market share. This result can be illustrated with a simple example. Suppose that:

$Edd = -2$  (market demand elasticity)

$P = \$10$  (price per unit)

$Q = 40$  (output of the industry)

$Q_i = 10$  (output of the representative firm,  $i$ )

Suppose that the representative firm drops its price by 10 percent from \$10 to \$9. Since  $Edd$  is -2, the firm expects market demand,  $Q$ , to rise by 8 units, or 20 percent. Under the rules of Cournot behavior, the representative firm, which produces 10 units before the price cut, expects that other firms will not alter their output in response to the drop in price, so it expects that its own output will rise by the entire 8 units. In percentage terms, it expects its output to increase by 80 percent (8/10). Therefore, it perceives the elasticity of demand for its product,  $edd_i$ , to be -8, namely the percentage change in the quantity it supplies (80 percent), divided by the percentage change in its price (-10 percent). Equation (A9), below, which is based on equation (A8), gives this result with a

straightforward calculation. Since the representative firm produces 25 percent of total output ( $10/40 = 0.25$ ),  $s$  is 0.25, and it follows that:

$$edd = (1/s)Edd = (1/0.25)(-2) = -8 \quad (A9)$$

Equation (A8) can be used to generate some useful results. For instance, as the number of equal-sized firms increases, each firm's market share ( $s$ ) decreases, and its perceived demand elasticity, ( $edd$ ), consequently becomes larger. In the extreme case of perfect competition,  $edd$  becomes indefinitely large. By contrast, in the case of a monopoly or perfect cartel,  $s$  equals 1.00, and the firm and industry demand elasticities are the same.

Firms in an industry are seldom all the same size. However, if each firm calculates its own  $edd_j$  using the same arithmetic that would be appropriate under Cournot rules as if all firms in the industry were its own size [i.e., as  $Edd(1/s_j)$ ] then a sales-weighted average of individual values of  $edd_j$  will give  $edd$ , namely, the price elasticity of demand that would face the hypothetical representative firm if all firms were in fact the same size. This can be seen by working out the algebra of a sales-weighted average. In this algebra,

$$\sum_{j=1}^n Sedd_j \cdot s_j = n[Edd(1/s_j)s_j] = n \cdot Edd = Edd(1/s) = edd \quad (A10)$$

where  $n$  is the actual number of firms in the industry.

In other words, under our simplifying assumptions, a sales-weighted elasticity average is simply  $n$  multiplied by  $Edd$ , which is the same as  $edd$  when all firms are in fact the same size. Within limits, this result should hold even though the individual firms are of disparate size. However, the result will break down when some firms are large and nimble enough that they can collude with one another, and when some firms are so small that they act like perfect competitors.

## **REFERENCES**

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Hufbauer, Gary, and Kimberly Ann Elliott. 1994. *Measuring the Costs of Protection in the United States*. Washington: Institute for International Economics.

Figure 1. Effects of Imposing a Quota or Tariff in a Competitive Market (Perfect Substitutes)

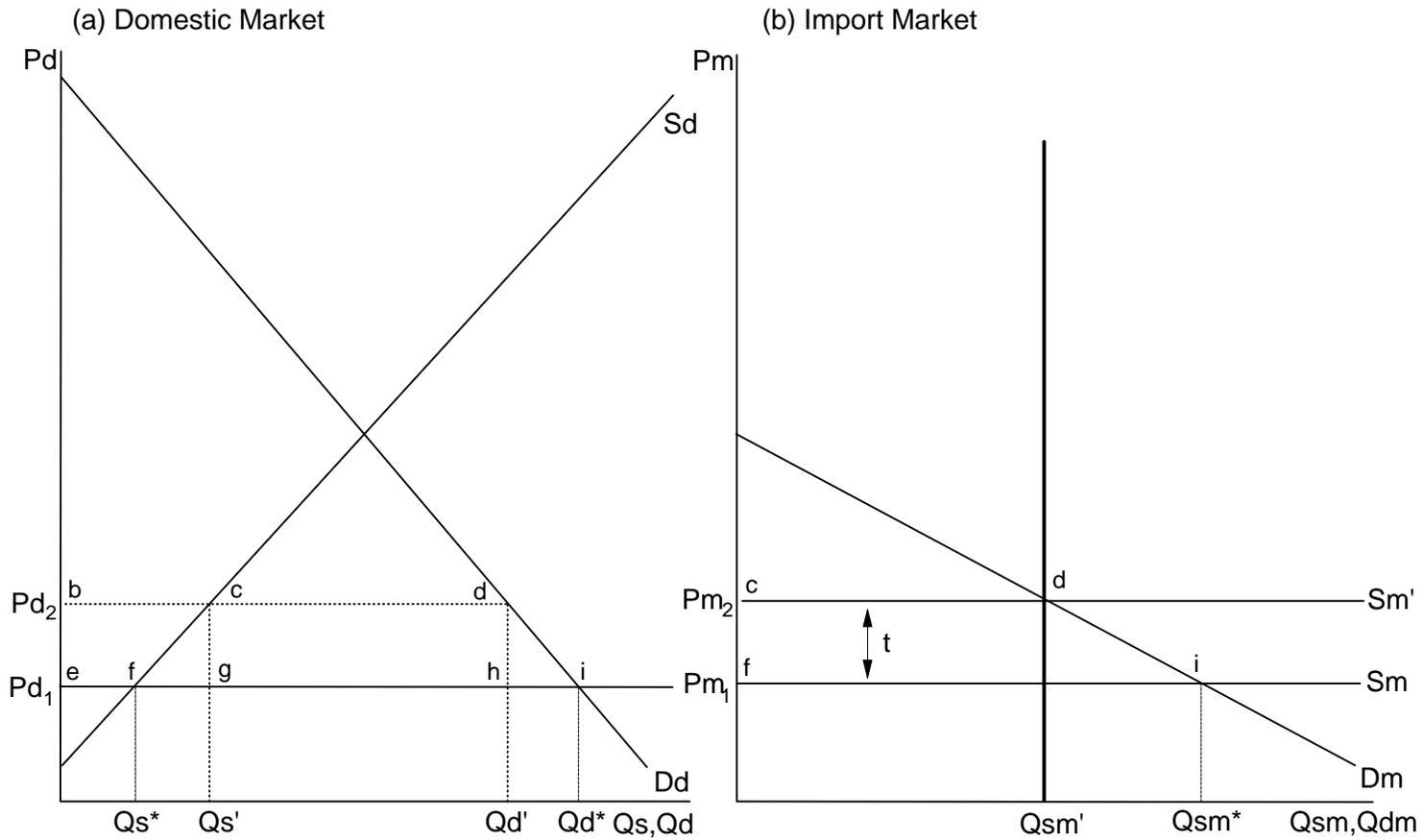


Figure 2. Effects of Removing a Quota in a Market that Remains Monopolized after Trade Liberalization (Imperfect Substitutes)

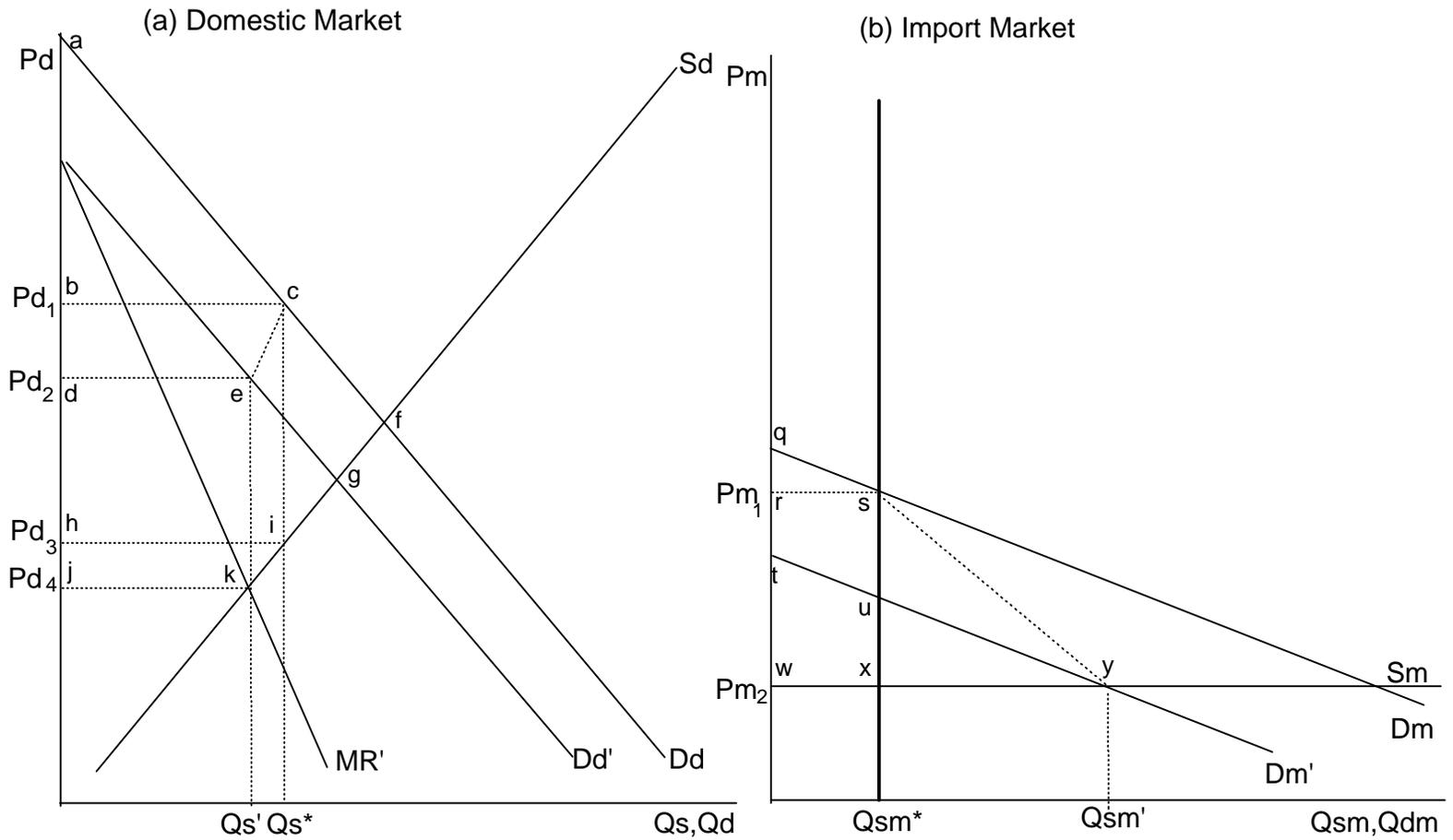
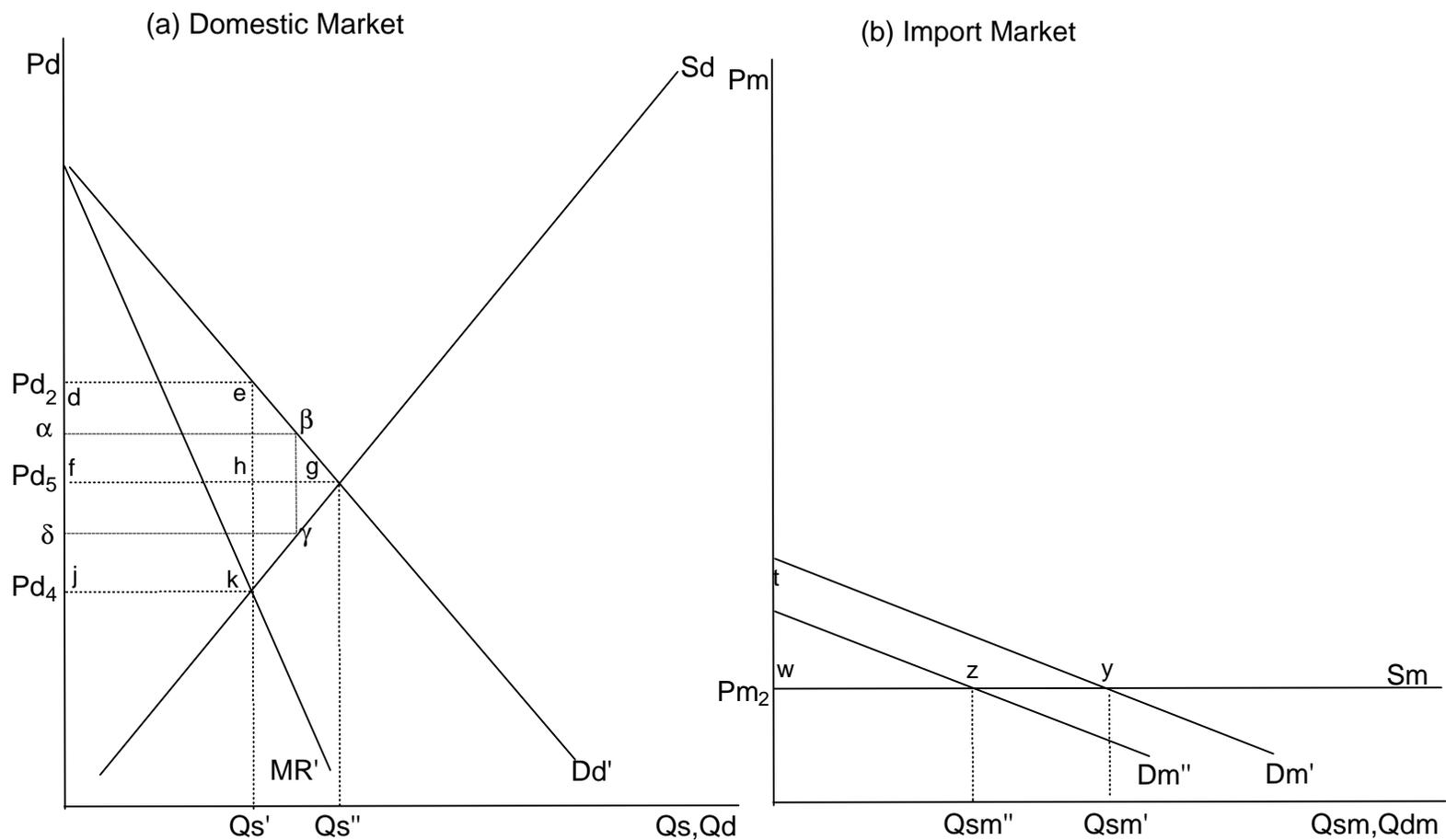


Figure 3. Effects of Trade Liberalization on a Cartelized Market (Imperfect Substitutes)



**Table 4. Case D -- Illustrative Consequences of Trade Liberalization Expressed as a Function of Market Structure**

Starting and Ending Market Structure	Consumer Surplus Gain		Producer Surplus Gain or Loss	Loss of Tariff Revenue (or quota rents)	Total Efficiency Gain	Decline in Excess Profits	Change in Price (percent of base level)		Change in Volume (percent of base level)	
	domestic goods	imported goods					domestic goods	imported goods	domestic goods	imported goods
<b>STAGE 1:</b>										
PC w/ to w/o tariff	0.98	3.89	-0.97	-3.85	0.05	0.01	-0.90	-3.85	-0.89	2.41
8-firm MC w/ to w/o tariff	0.97	3.89	-0.91	-3.85	0.11	0.12	-0.90	-3.85	-0.90	2.41
4-firm MC w/ to w/o tariff	0.97	3.89	-0.85	-3.85	0.17	0.24	-0.90	-3.85	-0.90	2.41
Monopoly w/ to w/o tariff	0.97	3.89	-0.49	-3.85	0.53	0.97	-0.90	-3.85	-0.90	2.41
Monopoly w/ to w/o quota	32.65	3.54	21.44	-3.85	53.78	14.52	-22.77	-3.85	63.18	-15.90
<b>STAGE 2:</b>										
<b>From 8-firm MC</b>										
to PC	2.33	0.00	4.51	0.00	0.15	-6.69	-2.13	0.00	4.40	-1.69
<b>From 4-firm MC</b>										
to 8-firm MC	2.49	0.00	4.51	0.00	0.47	-6.53	-2.27	0.00	4.71	-1.80
to PC	4.88	0.00	9.12	0.00	0.62	-13.38	-4.35	0.00	9.31	-3.46
<b>From Monopoly (formerly w/tariff)</b>										
to 4-firm MC	22.33	0.00	29.67	0.00	14.61	-37.39	-17.02	0.00	45.22	-13.70
to 8-firm MC	25.49	0.00	35.10	0.00	15.34	-45.26	-18.90	0.00	52.06	-15.26
to PC	28.56	0.00	40.66	0.00	15.71	-53.51	-20.63	0.00	58.74	-16.68
<b>From Monopoly (formerly w/quota)</b>										
to 4-firm MC	28.65	0.00	38.07	0.00	18.74	-47.97	-17.02	0.00	45.22	-13.70
to 8-firm MC	32.71	0.00	45.04	0.00	19.68	-58.08	-18.90	0.00	52.06	-15.26
to PC	36.65	0.00	52.18	0.00	20.17	-68.66	-20.63	0.00	58.74	-16.68

Note: Changes in consumer surplus, tariffs, quota rents, efficiency, and excess profits, are all expressed as percentages of pre-liberalization import values. Changes in price and volume are reported as percentages of base levels. Employment is assumed to change by the same percentage as domestic production. Declines in excess profits are counted in computing efficiency gains in stage two, but not in stage one because the loss of excess profit in stage one.

PC: perfect competition; MC: monopolistic competition.

**Table 4. Case D -- Illustrative Consequences of Trade Liberalization Expressed as a Function of Market Structure (Cont.)**

<b>Total Effects</b> (Stages 1 and 2 combined)	<i>Consumer Savings</i>	<i>Total Efficiency Gain</i>
<b>From PC w/tariff</b>		
to PC w/o tariff	<b>4.87</b>	<b>0.05</b>
<b>From 8-firm MC w/tariff</b>		
to 8-firm MC w/o tariff	<b>4.87</b>	<b>0.11</b>
to PC w/o tariff	<b>7.19</b>	<b>0.25</b>
<b>From 4-firm MC w/tariff</b>		
to 4-firm MC w/o tariff	<b>4.87</b>	<b>0.17</b>
to 8-firm MC w/o tariff	<b>7.36</b>	<b>0.64</b>
to PC w/o tariff	<b>9.74</b>	<b>0.79</b>
<b>From Monopoly w/tariff</b>		
to Monopoly w/o tariff	<b>4.87</b>	<b>0.53</b>
to 4-firm MC w/o tariff	<b>27.19</b>	<b>15.14</b>
to 8-firm MC w/o tariff	<b>30.36</b>	<b>15.87</b>
to PC w/o tariff	<b>33.43</b>	<b>16.25</b>
<b>From Monopoly w/quota</b>		
to Monopoly w/o quota	<b>36.19</b>	<b>53.78</b>
to 4-firm MC w/o quota	<b>64.84</b>	<b>72.52</b>
to 8-firm MC w/o quota	<b>68.90</b>	<b>73.46</b>
to PC w/o quota	<b>72.84</b>	<b>73.94</b>

**Key parameters: (Machine Tools)**

Edd =	<b>-2.00</b>
Edm =	<b>0.69</b>
Es =	<b>1.00</b>
Emm =	<b>-0.79</b>
Emd =	<b>0.79</b>

**Pre-liberalization data:**

Import volume (Thous. of units)	<b>21</b>
Average ad valorem tariff (percent)	<b>4.0</b>
Domestic output (Thous. of units)	<b>16</b>
Employment	<b>10,870</b>