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**Trading Blocs and Welfare:  
How Trading Bloc Members Are Affected by New Entrants**

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**Abstract**

This paper uses the three-country duopoly model to examine the effects of lowered trade barriers when a new entrant joins a trading bloc. There are two firms—a small-country firm and a large-country firm within the bloc—and three markets—two within and one (new entrant's) outside the bloc. The analysis generally shows greater gains for the small-country than for the large-country firm. The small-country firm will export more to the external country than the large-country firm. But if tariffs decline, the export share of the large-country firm will increase relative to the small-country firm's, though profits will improve more for the latter.

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## SUMMARY

This paper uses a three-country duopoly model to examine the effects of lowered trade barriers when a new entrant wants to join a preferential trading bloc. There are two firms—a small-country firm and a large-country firm within the bloc—and three markets—two within the bloc and one (the new entrant) outside the bloc.

The model analyzes the effects of reduced tariffs on the quantities produced and sold, the prices charged, and the profits earned by each firm. Under rising marginal costs the results are in line with the main results of Casella (1996). Like Casella's results, this paper's results also generally show *greater* gains for the firm in the small country than for the firm in the large country, although Casella uses a monopolistic competition model.

The main results of the paper (under increasing marginal cost) are as follows. First, the small-country firm will export more to the external country than the large-country firm, though each firm produces more for its own domestic market. Second, as a result of a reduction in tariffs, the export share of the large-country firm will increase relative to that of the small-country firm. Finally, profits will improve more for the small-country firm than for the large-country firm if tariffs decline in the external country.

An important implication can be derived from our results. Firms in small countries such as Austria, Portugal, and Sweden should not necessarily be alarmed when the Eastern European countries join the European Union. This is especially true if these firms have substantial market power in the output market relative to large-country firms. For instance, it is quite likely that Volvo and Saab from Sweden may enjoy greater increases in profits than their German counterparts, Volkswagen and Mercedes-Benz, owing to a reduction in import tariffs in Poland or Estonia.

## I. INTRODUCTION

With the ever-expanding and newly emerging economic unions of today, it is becoming even more important to analyze the implications of new entrants on the welfare of the existing union members. In recent years, there has been a great push toward regionalism as is evident from the successes of European Union (EU), North American Free Trade Agreement (NAFTA), and Asia Pacific Economic Cooperation (APEC). Baldwin (1993) attributes this increased interest to a “domino theory” of regional trading blocs.<sup>1</sup> A question arises as to how production, prices, and income of the existing members are affected as a result of the expansion of the bloc. In addition, does it matter if the existing member is large or small?

Current trade theory generally finds straightforward implications of cost or demand differences between countries when they are allowed to engage in free trade. The basis for these implications is almost always some type of comparative advantage, which is often associated with economies of scale. However, the literature is not clear about the implications of differences between countries when each of these countries simultaneously allows freer trade with other countries (as in the case of trade bloc expansion). Casella (1996) has formulated and tested a model of the relative impact of the entry of new members on large and small trade-bloc members, using the expansion of the European Union as an example. She develops an elegant model based on monopolistic competition with features such as economies of scale, Dixit-Stiglitz preferences, mobility of some types of labor within the trading bloc, and home-market advantage for domestic firms.<sup>2</sup> Using this model, she finds that firms in small countries (Belgium and Ireland in the European Union) will enjoy a higher increase in welfare than firms in larger countries (Germany and France) when new entrants (Spain and Portugal) are permitted to join the trading bloc. The source of the greater increase in welfare for small countries lies in economies of scale. Due to their larger domestic markets, firms in larger countries are able to produce at a lower average cost than firms in small countries. Lower-cost access to markets in countries formerly outside the trading bloc allows both small and large countries to take advantage of larger markets. However, the cost gains from expanding sales are greatest at lower levels of output. Therefore, firms in large countries (which already have a large domestic market) have less to gain than firms in small countries for the same expansion in sales.

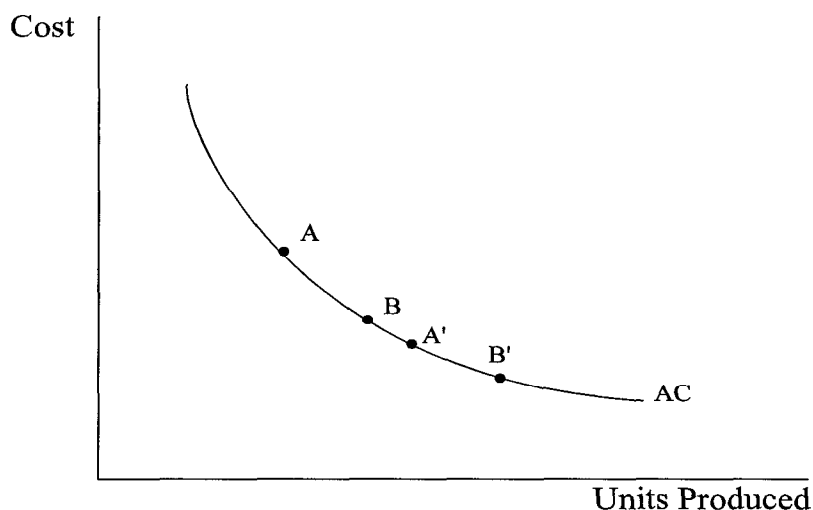
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<sup>1</sup> This effect occurs when the political equilibrium (which balances anti- and promembership forces in a country) is altered by some event, contributing to a country's decision to join a regional trading bloc. As the disadvantages to nonmembers increase, the momentum grows for them to join, resulting in a further enlargement of the bloc.

<sup>2</sup> Her model follows the tradition of Baldwin (1993) and Krugman (1991a, 1991b).

An example of this logic is displayed in Figure 1. Before expanding the trade bloc, suppose that within a single industry, small-country firms produce at point A and large-country firms at point B along the common average cost curve, AC. If the firms from the two countries expand output by the same amount due to the expansion of a trade bloc, then the small-country firms would produce at point A' and large-country firms would produce at point B'. The drop in average cost in this case is greater for the small-country firms, resulting in greater profit gains for these firms in relation to the large-country firms.

Figure 1: Average Cost and Changes in Production Levels



Taking the case of Spain and Portugal's entry into the European Union in 1986, Casella obtains mixed results for her empirical tests. Her results are confirmed for France and the United Kingdom but not for Italy and Germany.<sup>3</sup>

In this paper we use a three-country duopoly model to examine the effects of lowered trade barriers when new entrants want to join the trading bloc. The three countries consist of a small country and a large country, both within the bloc, and an external country being considered for entry into the trade bloc.<sup>4</sup> There are only two firms producing a single homogenous product (hence the duopoly model): one in the small country and the other in the large country. Notice that there is no firm producing the good in the external

<sup>3</sup> Her small country sample consists of Belgium, Denmark, Ireland, and the Netherlands.

<sup>4</sup> The size of the external country does not affect the results of our model.

country. This assumption keeps the model relatively simple and is not unrealistic for many markets. The model is in the theoretical tradition of the Brander (1981) reciprocal dumping model, which deals with a two-country duopoly (see also Brander and Krugman [1983], or chapter 4 in Krugman [1994]). The model here is also related to the spatial Nash equilibrium model of Hashimoto (1985). Hashimoto's model is one of a general oligopoly over a finite number of countries. The three-country duopoly model discussed in this paper is, of course, less general but provides more depth. As noted above, the model in this paper is constructed primarily to analyze the impact of trade bloc expansion, and in that sense is similar to Casella's (1996) model. However, our model is much simpler than Casella's and deals with the same general idea. Small countries may have more to gain than large countries from trade bloc expansion, which allows small-country firms to take advantage of larger markets. This is an advantage which, to a great extent, large-country firms already have in their own domestic market.

However, in our model the source of the advantage derived from sales expansion is different from that in Casella's model. In our model, rising marginal costs and identical price elasticities of demand across countries, rather than falling average costs, drive the results. The law of demand and the existence of market power mean that the two firms in the model face falling prices as they expand output in any market. However, the price level must be lowered more quickly in a small population market than in a large population market to increase sales by one unit.<sup>5</sup> All else being equal, a firm with a larger market is thus willing to sell more. Since a firm from a small country faces a smaller domestic market than a firm from a large country, the small-country firm will be willing to produce and sell less in general. However, the small-country firm then has an advantage in selling to the external country, because this firm will have lower marginal costs (assuming that marginal costs rise with output).<sup>6</sup> This advantage results in the small-country firm generally selling more to the external country than the large-country firm. When the transaction costs of selling to the external country are lowered (owing to its entry into the trade bloc, or for any other reason), the profits of the small-country firm will increase more than those of the large-country firm for two reasons. First, the small-country firm will have a larger volume of exports for which the transaction costs will be lowered. Second, the small-country firm will increase its exports to the external country through trade diversion more than the large-country firm will, so the small-country firm

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<sup>5</sup> Each country has the same demand elasticity at any price, but a smaller population results in lower demand at any price (where the quantity demanded is greater than zero). Considering the case of linear demand, the price intercept is the same for each country's demand curve (guaranteeing equal price elasticity at any price), although a smaller population results in a steeper curve.

<sup>6</sup> This paper also considers the case in which marginal costs are falling, but the results are not as clear in that situation. It also considers the case in which marginal costs are constant, but that case is trivial (see Section II [E]).

saves more on the transaction costs associated with the previous sales of those diverted exports. This second reason is not intuitively obvious, but it will be shown in the paper.

Another difference between our paper and Casella's is the specification of the factor markets. Casella assumes a well-specified labor market with skilled labor (immobile within the bloc) and unskilled labor (fully mobile within the bloc).<sup>7</sup> This paper treats factor markets as given and analyzes only the product market. Although fully endogenizing factor market variables would be desirable in this model, we believe that not doing so keeps the model tractable and does not change the results qualitatively.

Within the framework of the three-country duopoly model, this paper attempts to analyze how the reduction in transaction costs on exports to the external country affects activities and outcomes within a single industry. The paper considers the impact on quantities produced and sold, prices charged, and profits earned by each firm in each country. This model has wide applications. For example, it can be used to predict the manner in which existing firms within trading blocs will be affected, once new countries are allowed into the bloc at some point in the near future (for example, the inclusion of Central and East European countries into the European Union). Moreover, it can be used to empirically analyze the effects of previous expansions of preferential trading blocs in the world. The next section presents the model, which will be followed by the conclusion.

## II. A THREE-COUNTRY DUOPOLY MODEL

### A. Assumptions

We assume that there are three countries—a small country (the “S-country”), a large country (the “L-country”), and an external country (the “E-country”). We also assume that there are only two firms in the single industry we are considering—one in the small country (the “S-firm”) and one in the large country (the “L-firm”). The two firms produce identical products, competing with each other in terms of quantity produced in all the three markets.

The term “C-country” is used when referring to any of the three countries, and the term “F-firm” is used when referring to either of the two firms. The single letter references noted so far (S, L, E, C, and F) are used as prefixes as well as subscripts on variables.

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<sup>7</sup> Casella's assumptions about labor mobility may not apply well to Europe. It is not clear whether unskilled workers in Europe are very mobile, considering the marked variations in languages and cultures. Also, some types of skilled laborers (such as doctors) may be more mobile than unskilled laborers, whereas other types of skilled laborers (such as factory workers with skills particular to one factory) are less mobile than unskilled laborers.

The quantity produced by the F-firm for the C-country is given by  $Q_{FC}$ , where  $F \in \{S, L, T\}$ ,  $C \in \{S, L, E, T\}$ , and the subscript T refers to total (i.e.,  $Q_{TC} \equiv Q_{SC} + Q_{LC}$  and  $Q_{FT} \equiv Q_{FS} + Q_{FL} + Q_{FE}$ ). For example,  $Q_{LS}$  is the quantity sold by the L-firm to the S-country,  $Q_{TS}$  is the total amount sold by both firms in the S-country, and  $Q_{ST}$  is the total amount sold by the S-firm in all the three countries.

The two firms are assumed to have identical technologies available and face identical total cost functions of the form:

$$tc_F = fc + 0.5m(Q_{FT})^2 + a_m Q_{FT}, \quad (1)$$

where  $tc_F$  is the total production cost for the F-firm,  $fc$  is fixed cost,  $m$  and  $a_m$  are constants, and  $Q_{FT}$  is the total quantity sold by the F-firm. This functional form is chosen because it provides a marginal cost function that is linear with respect to  $Q_{FT}$  (a simplifying assumption).<sup>8</sup> The marginal production cost functions for the S-firm and L-firm are

$$MC_S = m(Q_{ST}) = m(Q_{SS} + Q_{SL} + Q_{SE}) + a_m, \quad (2a)$$

and

$$MC_L = m(Q_{LT}) = m(Q_{LS} + Q_{LL} + Q_{LE}) + a_m, \quad (2b)$$

where  $m$  represents the *additional* marginal cost of producing another unit by the F-firm.

When a firm sells to an outside market, it accrues an additional transaction cost. Each unit exported between the small and large country costs an additional  $t_w$  to the exporting firm (the W subscript stands for “within” a union of the small country and the large country). Each unit exported to the E-country costs an additional  $t_e$  to the exporting firm. Demand in each of the three countries is linear with the same price elasticity in each. The inverse demand function in country C is

$$P_C = a_d - (1/B_C)Q_{TC}, \quad (3)$$

where  $a_d$  and  $B_C$  are constants.

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<sup>8</sup> This form may be regarded as an average of the linear approximations for the two firms’ nonlinear marginal cost functions around their production points. However, if the linear approximations are very different, the results may be misleading.



The demand function in each country must have the same price-axis intercept,  $a_d$ , in order to have the same price elasticity at every price. The higher demand resulting from a larger population is represented by a larger  $B_C$ . The only difference in demand between the small country and the large country is  $B_S < B_L$ .

## B. Equilibrium

Our first goal is to find the Nash equilibrium, in which each firm is optimally setting its quantities in each market given what the other firm is selling in those markets. Each firm will want to set the marginal revenue from selling another good in a country equal to the marginal cost of selling to that country. Equations (4a)–(4f) provide the set of implicit reaction functions. The left-hand side of each equation shows the marginal revenue for the F-firm selling in the C-country,  $MR_{FC}$ , for each of the six cases ( $MR_{SS}$ ,  $MR_{SL}$ ,  $MR_{SE}$ ,  $MR_{LS}$ ,  $MR_{LL}$ ,  $MR_{LE}$ , in that order). The right-hand side of equations (4a)–(4f) includes the relevant marginal cost ( $MC_S$  or  $MC_L$ ), plus any relevant transaction cost ( $t_w$  or  $t_E$ ).

Therefore, we obtain the following implicit reaction functions:

$$a_d - (2Q_{SS} + Q_{LS})/B_S = m(Q_{SS} + Q_{SL} + Q_{SE}) + a_m \quad (\text{provides profit-maximizing } Q_{SS}), \quad (4a)$$

$$a_d - (2Q_{SL} + Q_{LL})/B_L = m(Q_{SS} + Q_{SL} + Q_{SE}) + a_m + t_w \quad (\text{provides profit-maximizing } Q_{SL}), \quad (4b)$$

$$a_d - (2Q_{SE} + Q_{LE})/B_E = m(Q_{SS} + Q_{SL} + Q_{SE}) + a_m + t_E \quad (\text{provides profit-maximizing } Q_{SE}), \quad (4c)$$

$$a_d - (Q_{SS} + 2Q_{LS})/B_S = m(Q_{LS} + Q_{LL} + Q_{LE}) + a_m + t_w \quad (\text{provides profit-maximizing } Q_{LS}), \quad (4d)$$

$$a_d - (Q_{SL} + 2Q_{LL})/B_L = m(Q_{LS} + Q_{LL} + Q_{LE}) + a_m \quad (\text{provides profit-maximizing } Q_{LL}), \quad (4e)$$

$$a_d - (Q_{SE} + 2Q_{LE})/B_E = m(Q_{LS} + Q_{LL} + Q_{LE}) + a_m + t_E \quad (\text{provides profit-maximizing } Q_{LE}). \quad (4f)$$

The above implicit reaction functions (4a)–(4f), can be written explicitly and solved simultaneously. This results in a single Nash equilibrium set of six quantities (each defined as an equation based on the exogenous variables). Owing to the length of the resulting equations, these equations are relegated to Appendix I (equations A2.a–A2.f), along with the explicit reaction functions (equations A.1a–A.1f). However, by taking derivatives and differences among the equations for Nash equilibrium quantities, we obtain some very clear characteristics about the Nash equilibrium solution. The conclusions we get are applicable only to *internal solutions*—that is, where the Nash equilibrium results in positive quantities sold by each firm in each of the three markets. The conclusions also apply only when the second-order conditions are met.<sup>9</sup> In the rest of

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<sup>9</sup> The second-order conditions are simply given by  $m > -2/B_C$  for each C (the slope of marginal cost is greater than the slope of marginal revenue in each country). In case of rising marginal cost (the main focus of the paper), the second-order conditions are

this paper, variables with the \* superscript represent equilibrium values (provided they are internal solutions and satisfy second-order conditions).

The next two subsections, C and D, use the assumption of rising marginal cost, which not only provides the clearest results but also is applicable under a wide variety of scenarios.<sup>10</sup> Subsection C compares the price levels and quantities sold in each country and the quantities produced by each firm. Subsection D considers the effect of a change in the tariffs of the external country on sales, prices, and profits. Subsection E discusses how the results in subsections C and D would change if we instead assume constant or falling marginal cost.

### **C. Comparison of Quantities Produced and Sold and Prices, Between Countries Under Rising Marginal Cost**

#### **Comparison of Quantities Produced**

Let us consider the difference in total production between the firms. We find that

$$Q_{LT}^* - Q_{ST}^* = t_w(B_L - B_S)/(mB_L + mB_S + mB_E + 1) > 0. \quad (5)$$

Since  $B_L > B_S$ , the implication of equation (6) is that overall the L-firm must sell more than the S-firm.

It is also possible to compare the quantities sold by each firm in each country. We find the following:

$$Q_{SS}^* - Q_{LS}^* = t_w(2mB_L + mB_E + 1)B_S/(mB_L + mB_S + mB_E + 1) > 0, \quad (6)$$

$$Q_{LL}^* - Q_{SL}^* = t_w(2mB_S + mB_E + 1)B_L/(mB_L + mB_S + mB_E + 1) > 0, \text{ and} \quad (7)$$

$$Q_{SE}^* - Q_{LE}^* = t_w(mB_L - mB_S)B_E/(mB_L + mB_S + mB_E + 1) > 0. \quad (8)$$

Equations (6) and (7) are both positive, showing that each firm produces more for its domestic market than the foreign firm. Since  $B_L > B_S$  and all the other variables are positive, equation (8) shows that the S-firm will export more to the external country than the L-firm. Note that if the transaction cost between the small country and large country,

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automatically met, since the upward-sloping marginal cost curve must intersect the downward-sloping marginal revenue curve from below.

<sup>10</sup> Note that with the typical U-shaped average cost curve, rising marginal cost is associated with some cases of economies of scale and all cases of diseconomies of scale.

$t_w$ , were zero, then both firms would sell exactly the same amount in each market, as we would expect.

### Comparison of Prices

By plugging the equilibrium quantities into the inverse demand relation, (3), for each country, and then finding the difference in prices between countries, we arrive at simple equilibrium relationships in prices (see Appendix I):

$$P_L^* = P_S^* \quad (9)$$

$$\text{and } P_E^* - P_L^* = P_E^* - P_S^* = 2t_E/3 - t_w/3. \quad (10)$$

Owing to the identical price elasticity of demand in the small and large countries, identical prices are charged in both markets, just as we would expect if a monopoly with no transaction cost were price discriminating between these markets. Also, since identical prices are charged in both markets, there must be greater sales in the large country due to its higher population. From equation (10) we find that under the special case in which the transaction cost of exporting to the external country is the same as the transaction cost between the large and small countries, the price would be higher in the external country than in the other two countries. This is perhaps due to the fact that the bulk of the sales in the small and large countries involve no transaction costs at all in this model.

### D. Effect of Change in Tariffs on Sales, Prices, and Profits Under Rising Marginal Cost

#### Effect of a Change in Tariffs on Sales

With the help of this model, we can examine the impact of changes in transaction costs on imports into the external country on each firm's profits and sales in each market. We can then say something about what happens when, for instance, a new member is allowed into a preferential trading agreement.

Taking the first derivative of the Nash equilibrium quantities found in Appendix I with respect to  $t_E$ , we find the following relations:

$$\frac{dQ_{SS}^*}{dt_E} = \frac{dQ_{LS}^*}{dt_E} = B_S[m^2 B_E(B_S + B_L + B_E) + B_E m]/D > 0, \quad (11)$$

$$\frac{dQ_{SL}^*}{dt_E} = \frac{dQ_{LL}^*}{dt_E} = B_L[m^2 B_E(B_S + B_L + B_E) + B_E m]/D > 0, \quad (12)$$

$$\frac{dQ_{SE}^*}{dt_E} = \frac{dQ_{LE}^*}{dt_E} = -B_E[m^2(B_S B_E + 2B_S B_L + B_L B_E + B_S^2 + B_L^2) + m(4B_S + 4B_L + 3B_E) + 3]/D < 0, \quad (13)$$

$$\text{and } \frac{dQ_{ST}^*}{dt_E} = \frac{dQ_{LT}^*}{dt_E} = \frac{dQ_{SS}^*}{dt_E} + \frac{dQ_{SL}^*}{dt_E} + \frac{dQ_{SE}^*}{dt_E} = -3B_E[m(B_S + B_L + B_E) + 1]/D < 0, \quad (14)$$

where  $D \equiv 3(m(B_S + B_L + B_E) + 3)(m(B_S + B_L + B_E) + 1)$ .

Since all of the variables are positive, the derivatives in (11) and (12) are positive, and those in (13) and (14) are negative. Also, we know that:

$$\frac{dQ_{SS}^*}{dt_E} = \frac{dQ_{LS}^*}{dt_E} < \frac{dQ_{SL}^*}{dt_E} = \frac{dQ_{LL}^*}{dt_E}, \quad (15)$$

since  $B_S < B_L$ .

Thus, as tariffs on imports into the external country are reduced, we expect sales in both the small and the large countries to decrease and those in the external country to increase—and these sales increases or decreases to be split evenly between the two firms in each country.<sup>11</sup> Further, we expect the resulting sales decrease in the small country to be less than that in the large country in absolute terms. We also expect the total quantity sold by each firm to rise as tariffs on imports into the external country are reduced. The results from equations (6)–(8) and (11)–(13), are shown graphically in Figures 2a, 2b, and 2c. These equations are only valid in the range of  $t_E < t_E^M$ , where  $t_E^M$  is the maximum  $t_E$  for which the large-country firm would sell to the external country (if  $t_E \geq t_E^M$ , we would not have an internal solution).

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<sup>11</sup> Note that a drop in sales resulting from a reduction in tariffs is signified by a positive first derivative and an increase in sales from a reduction in tariffs by a negative first derivative. It might seem a bit confusing to the reader since our experiment involves a decrease rather than a rise in  $t_E$ .

Figure 2a: Quantities Sold in Small Country

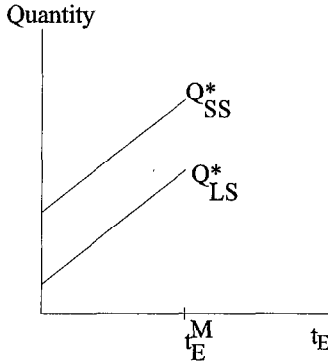


Figure 2b: Quantities Sold in Large Country

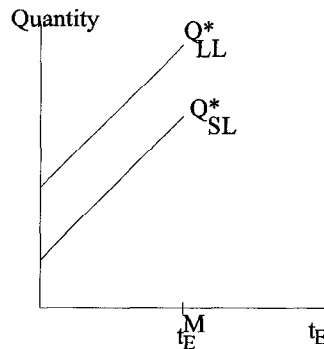
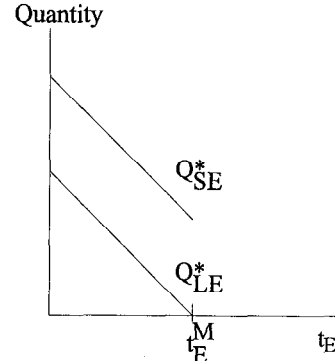


Figure 2c: Quantities Sold in External Country



Since we know that the S-firm has more sales in its own market and in the external country than the L-firm, and that the L-firm has more sales in its own market than the S-firm, these equal increases or decreases by both firms in the markets will result in changes in market shares. In other words, in response to a reduction in the external country tariff, the foreign firm will lose market share to the domestic firm in both the small country and the large country, and the large country will gain market share within the external country.<sup>12</sup>

### Effect of a Change in Tariffs on Prices

Given our knowledge about how quantities change in each market as  $t_E$  changes, we can also say something about how price changes. As  $t_E$  decreases, the quantities sold in the small and large countries fall, while the quantity sold in the external country rises. This implies that with a decrease in  $t_E$ , prices rise in the small and large countries, and they fall in the external country. Prices increase by the same amount in both the small and large countries, as the price level must be the same before and after the  $t_E$  change (see equation (9)). This relationship is symbolically written as:

<sup>12</sup> Note that if internal solutions are not compared, a fall in the external country tariff could lead to the small country gaining market share within the external country. If  $t_E$  is low enough for the small-country firm to sell in the external country after a decrease in  $t_E$ , and if  $t_E > t^M_E$ , then the fall in  $t_E$  will cause only the small-country firm to increase its sales to the external country. Thus, the small country will increase its market share in the external country as a result of the reduction in  $t_E$ .

$$\frac{dP_S^*}{dt_E} = \frac{dP_L^*}{dt_E} < 0. \quad (16)$$

From equation (10), we can also determine how much the price differential between the external country and the other countries will change when  $t_E$  changes. In particular,

$$\frac{d(P_E^* - P_L^*)}{dt_E} = \frac{d(P_E^* - P_S^*)}{dt_E} = 2/3. \quad (17)$$

Therefore when  $t_E$  decreases, the differential between the external country price and the price in the other countries will be reduced by 2/3 of the fall in  $t_E$ .

If the price increases by the same amount in each country, it must be the case that the total quantity sold in the large country decreases more than it does in the small country. This result is true because demand has the same elasticity in both countries (both countries face the same percent increase in price resulting in the same percent fall in quantity, and this requires a greater absolute decrease in quantity in the large country than in the small country). This finding is consistent with our earlier conclusions about how sales in the two countries would change when  $t_E$  falls.

### Effect of a Change in Tariffs on Profits

Who gains more from a drop in tariffs on imports of the external country? That was the primary policy issue in Casella's paper. We can calculate the difference in the change in profits for both firms with respect to a change in  $t_E$ .

The profit function for the S-firm is

$$\pi_S = P_S Q_{SS} + P_L Q_{SL} + P_E Q_{SE} - t_W Q_{SL} - t_E Q_{SE} - fc - 0.5m(Q_{ST})^2 - a_m Q_{ST}. \quad (18)$$

Taking the first derivative of the S-firm's profits in equilibrium with respect to  $t_W$ , we get

$$\begin{aligned} \frac{d\pi_S^*}{dt_E} = & \frac{dP_S^*}{dt_E} Q_{SS}^* + P_S^* \frac{dQ_{SS}^*}{dt_E} + \frac{dP_L^*}{dt_E} Q_{SL}^* + P_L^* \frac{dQ_{SL}^*}{dt_E} + \frac{dP_E^*}{dt_E} Q_{SE}^* + P_E^* \frac{dQ_{SE}^*}{dt_E} \\ & - t_W \frac{dQ_{SL}^*}{dt_E} - Q_{SE}^* - t_E \frac{dQ_{SE}^*}{dt_E} - m Q_{ST}^* \frac{dQ_{ST}^*}{dt_E} - a_m \frac{dQ_{ST}^*}{dt_E}. \end{aligned} \quad (19)$$

Now we can use the fact that  $P_L^* = P_S^*$  (equation (9)) and  $\frac{dP_S^*}{dt_E} = \frac{dP_L^*}{dt_E}$  (equation (16)) to simplify equation (19) and obtain the following:

$$\begin{aligned} \frac{d\pi_S^*}{dt_E} = & \frac{dP_S^*}{dt_E} (Q_{SS}^* + Q_{SL}^*) + P_S^* \left( \frac{dQ_{SS}^*}{dt_E} + \frac{dQ_{SL}^*}{dt_E} \right) \\ & + \left( \frac{dP_E^*}{dt_E} - 1 \right) Q_{SE}^* + (P_E^* - t_E) \frac{dQ_{SE}^*}{dt_E} - t_W \frac{dQ_{SL}^*}{dt_E} - m Q_{ST}^* \frac{dQ_{ST}^*}{dt_E} - a_m \frac{dQ_{ST}^*}{dt_E}. \end{aligned} \quad (20a)$$

By analogy, we can find a similar equation for the change in profits of the L-firm with respect to a change in  $t_E$ :

$$\begin{aligned} \frac{d\pi_L^*}{dt_E} = & \frac{dP_S^*}{dt_E} (Q_{LS}^* + Q_{LL}^*) + P_S^* \left( \frac{dQ_{LS}^*}{dt_E} + \frac{dQ_{LL}^*}{dt_E} \right) \\ & + \left( \frac{dP_E^*}{dt_E} - 1 \right) Q_{LE}^* + (P_E^* - t_E) \frac{dQ_{LE}^*}{dt_E} - t_W \frac{dQ_{LS}^*}{dt_E} - m Q_{LT}^* \frac{dQ_{LT}^*}{dt_E} - a_m \frac{dQ_{LT}^*}{dt_E}. \end{aligned} \quad (20b)$$

Now we can find the difference between equations (20b) and (20a), and take advantage of

$$\frac{dQ_{SS}^*}{dt_E} = \frac{dQ_{LS}^*}{dt_E}, \frac{dQ_{SL}^*}{dt_E} = \frac{dQ_{LL}^*}{dt_E}, \frac{dQ_{SE}^*}{dt_E} = \frac{dQ_{LE}^*}{dt_E}, \text{ and } \frac{dQ_{ST}^*}{dt_E} = \frac{dQ_{LT}^*}{dt_E} \text{ (from (11)–(14))}$$

to cancel out or combine some terms. The result is:

$$\begin{aligned} \frac{d\pi_L^*}{dt_E} - \frac{d\pi_S^*}{dt_E} = & \frac{dP_S^*}{dt_E} (Q_{LS}^* + Q_{LL}^* - Q_{SS}^* - Q_{SL}^*) + \left( \frac{dP_E^*}{dt_E} - 1 \right) (Q_{LE}^* - Q_{SE}^*) \\ & - t_W \left( \frac{dQ_{LS}^*}{dt_E} - \frac{dQ_{SL}^*}{dt_E} \right) + m (Q_{ST}^* - Q_{LT}^*) \frac{dQ_{LT}^*}{dt_E}, \end{aligned} \quad (21)$$

which has four terms showing us four different effects of an increase in  $t_E$ .

The first term,  $\frac{dP_S^*}{dt_E} (Q_{LS}^* + Q_{LL}^* - Q_{SS}^* - Q_{SL}^*)$ , is negative. It shows us that as  $t_E$  increases, the resulting price reduction in the small and large countries will reduce profits more for

the L-firm than for the S-firm, because the L-firm sells more than the S-firm in the small and large countries combined. We know this, since the L-firm must sell more than the S-firm (from (5)) and the S-firm must export more to the E-country (from (8)).

The second term,  $(\frac{dP_E^*}{dt_E} - 1)(Q_{LE}^* - Q_{SE}^*)$ , is positive. It shows us that as  $t_E$  increases, the resulting fall in net revenue per unit sold will reduce profit more for the S-firm than for the L-firm, since the S-firm exports more to the external country than the L-firm. The first part of this term,  $(\frac{dP_E^*}{dt_E} - 1)$ , must be negative, as we do not expect the external country price to rise more than the increase in  $t_E$ , since such an increase would imply that the exporting firms have a negative tax burden.

The third term,  $(-t_w)(\frac{dQ_{LS}^*}{dt_E} - \frac{dQ_{SL}^*}{dt_E})$ , is positive. It shows us that as  $t_E$  increases, the S-firm will face a greater increase in transactions costs on trade between the small and large countries than the L-firm. This is because the S-firm will increase its exports to the large country more than the L-firm will to the small country. We know this from equation (15).

The fourth term,  $m(Q_{ST}^* - Q_{LT}^*)\frac{dQ_{LT}^*}{dt_E}$ , is positive. It takes into account the fact that as  $t_E$  increases, the cost of production should fall more for the large firm than for the small firm. This difference results from the fact that both firms would cut production by the same amount  $(\frac{dQ_{LT}^*}{dt_E} = \frac{dQ_{ST}^*}{dt_E} < 0)$  in reaction to an increase in  $t_E$ . Since there is increasing marginal cost in the cost function and the large firm produces more, the large firm saves more when production is cut. Therefore, as  $t_E$  increases, the impact of the cost savings on the difference between the profits of the two firms is to increase the profits of the large firm more than those of the small firm.

In sum, the first term is negative, and the last three terms are positive, so the sign of

$\frac{d\pi_L^*}{dt_E} - \frac{d\pi_S^*}{dt_E}$  is not clear from this equation.

However, we can write:

$$\frac{dP_C^*}{dt_E} = \frac{d(a_d - (1/B_C)Q_{TC}^*)}{dt_E} = \frac{-1}{B_C} \left( \frac{dQ_{TC}^*}{dt_E} \right), \quad (22)$$



so we can replace  $\frac{dP_S^*}{dt_E}$  with  $\frac{-1}{B_S} \left( \frac{dQ_{TS}^*}{dt_E} \right)$  and  $\frac{dP_E^*}{dt_E}$  with  $\frac{-1}{B_E} \left( \frac{dQ_{TE}^*}{dt_E} \right)$ , and we can let

$$B_S = RB_L, \quad (23)$$

where  $0 < R < 1$ . We then obtain:

$$\frac{d\pi_L^*}{dt_E} - \frac{d\pi_S^*}{dt_E} = \frac{(1-R)B_L B_E m t_w [(2/3) + 1/(mB_E + (1+R)mB_L + 1)]}{(mB_E + (1+R)mB_L + 3)} > 0. \quad (24)$$

The right-hand side of this equation must be positive because of the restriction on  $R$  in equation (23). Therefore, as  $t_E$  increases, the difference between the L-firm's profits and the S-firm's profits increases; the first effect noted above is overwhelmed by the second, third, and fourth effects. Since each firm's profits fall (rise) when  $t_E$  rises (falls) (see Appendix II), the small-country firm's profits must fall more than the large-country firm's profits as a result of an increase in  $t_E$ . By the same token, if  $t_E$  falls, the small-country firm's profits will rise more than the large-country firm's profits.

### E. Results of the Model Under Constant or Declining Marginal Cost

The mathematical equalities found in the previous two subsections are general—they apply to all cases of linear marginal cost functions, whether they are rising, falling, or constant. The inequalities in those subsections were, however, based upon the assumption of rising marginal cost. In this subsection, we will discuss how these inequalities change when we consider constant or declining marginal cost. The results under declining marginal cost depend on how negative the additional marginal cost,  $m$ , is with respect to other parameters. In particular, what is important is  $m$ 's relation to  $B_S$ ,  $B_L$ , and  $B_E$  (the absolute values of the demand-curve slopes<sup>13</sup> for the small, large, and external countries) and especially their sum:  $B_T = B_S + B_E + B_L$ . Table 1 shows various cases.

As Table 1 shows, the situation when the marginal cost slope is negative is complicated and ambiguous. For all of the values, the sign changes at least once in the range where  $m$  is negative. In the last row the sign changes many times when we observe the effect on profit differentials that results from the change in transaction cost to the external country.

The case of constant marginal cost is as clear as the case of rising marginal cost, although it is trivial: each firm would treat its sales in each country independently and transaction costs would have no sales-diversion impact. Thus, both firms in this situation always sell

<sup>13</sup> These are the slopes when the quantity demanded is represented on the vertical axis and price on the horizontal axis.

identical amounts to the external country, and changes in transaction costs to that country affect them in the same way.

Table 1 does not report on price levels explicitly, but that information is easily obtainable from the table. Since price levels are inversely related to the quantity sold, changes in price levels with respect to  $t_E$  may be garnered from the rows on  $dQ_{FS}^*/dt_E$ ,  $dQ_{FL}^*/dt_E$ , and  $dQ_{FE}^*/dt_E$ . Also note that equations (9), (10), and (17) hold for all values of  $m$ .

The implication of these results is that having information about the presence of economies of scale and/or declining marginal cost is not sufficient to provide us with unambiguous answers to the questions considered in this paper. However, if the marginal cost is known to be rising or known to be constant, then we can obtain unambiguous answers.

Table 1: Signs Under Alternative Assumptions for Slope of Marginal Cost (m) in Relation to Sum of Slopes of Demand Curves ( $B_T$ )<sup>a,b</sup>

	$m < -3/B_T$	$-3/B_T \leq m < -2.5/B_T$	$-2.5/B_T \leq m < -1/B_T$	$-1/B_T < m < 0$	$m = 0$	$m > 0$
$Q_{LT}^* - Q_{ST}^*$	-	-	-	+	+	+
$Q_{SS}^* - Q_{LS}^*$	+	+	+	c	+	+
$Q_{LL}^* - Q_{SL}^*$	d	d	d	-	+	+
$Q_{SE}^* - Q_{LE}^*$	+	+	+	-	0	+
$\frac{dQ_{FC}^*}{dt_E}$ Here $F \in \{S, L\}$ , $C \in \{S, L\}$	+	(undetermined at $m = -3/B_T$ )	-	-	0	+
$\frac{dQ_{FE}^*}{dt_E}$ Here $F \in \{S, L\}$	e	(undetermined at $m = -3/B_T$ )	-	-	-	-
$\frac{dQ_{FT}^*}{dt_E}$ Here $F \in \{S, L\}$	+	(undetermined at $m = -3/B_T$ )	-	-	-	-
$\frac{dQ_{FL}^*}{dt_E} - \frac{dQ_{FS}^*}{dt_E}$ Here $F \in \{S, L\}$	+	(undetermined at $m = -3/B_T$ )	-	-	0	+
$\frac{d\pi_L^*}{dt_E} - \frac{d\pi_S^*}{dt_E}$	+	(undetermined at $m = -3/B_T$ )	+	-	0	+

Note: All values are undefined for  $m = -1/B_T$ .

a: Note that the second order conditions,  $m > -2/B_C$  (additional marginal cost > additional marginal revenue) may prevent the model from being applicable in some cases when  $m < 0$ , but it is impossible to tell which cases are inapplicable without knowing what  $B_S$ ,  $B_E$ , and  $B_L$  are.

b: The signs in this table are determined in a relatively straightforward manner from equations (5)-(8), (11)-(13), and (24), but the following knowledge is helpful.

First, in determining the sign of the numerator in (11) and (12), it is useful to know that equation:  
 $Y = m^2 B_E (B_S + B_L + B_E) + B_E m$  (where  $B_S, B_L, B_E$  are constants) is a parabola in which  $Y$  is negative between the points  $m = 0$  and  $m = -1/B_T$ .

Second, in determining the sign of the numerator in (13), it is useful to know that equation:  
 $Y = m^2 (B_S B_E + 2B_S B_L + B_L B_E + B_S^2 + B_L^2) + m(4B_S + 4B_L + 3B_E) + 3$  is a parabola in which  $Y$  is negative between the points  $m = -1/B_T$  and  $m = -3/(B_S + B_L)$ .

Third, in determining the sign of the numerator in (24), it is useful to know that  $2/3 + 1/(mB_T + 1)$  is negative, if and only if  $-2.5/B_T < m < -1/B_T$ .

c: + if  $m < -1/(2B_L + B_E)$ , 0 if  $m = -1/(2B_L + B_E)$ , – if  $m > -1/(2B_L + B_E)$

d: + if  $m < -1/(2B_S + B_E)$ , 0 if  $m = -1/(2B_S + B_E)$ , – if  $m > -1/(2B_S + B_E)$

e: – if  $m < -3/(B_S + B_L)$ , 0 if  $m = -3/(B_S + B_L)$ , + if  $m > -3/(B_S + B_L)$

### III. CONCLUSIONS AND POLICY IMPLICATIONS

This paper has analyzed how an industry's activities and outcomes are affected by lowered transaction costs on the imports of new entrants wishing to join a preferential trading bloc. We have used a three-country duopoly model to examine the effects of a new entrant on the quantities produced and sold, prices charged, and profits earned by firms already within the bloc. There are two firms (one in the large country and the other in the small country), and three markets (two within the union and the other being that of the new entrant country). This topic is of great significance as new countries are allowed into the numerous trading blocs and economic unions in existence all over the world.

Our model is in the spirit of Casella (1996)'s model. Casella has developed an elegant model based on monopolistic competition with features such as economies of scale, Dixit-Stiglitz preferences, mobility of some types of labor within the trading bloc, and home market advantage for domestic firms. In contrast, the model in this paper only assumes duopoly in the product market and discusses primarily the case of rising marginal costs, which can be consistent with economies of scale. Moreover, we treat the factor market as given in our model. Some of the important results of our paper under rising marginal costs are as follows:

First, both the small- and large-country firms produce more for their domestic markets than the foreign firm, and the small-country firm will export more to the external country than the large-country firm. These results are consistent with the main findings of Casella (1996). Second, as the tariffs imposed by the external country are reduced, sales in both the small and large countries decrease, but sales in the external country increase. Moreover, the changes in sales to each country are split evenly between the two firms in each country. Since the small-country firm will initially export more to the external country than the large-country firm, this equal increase in sales by the two firms to the external country leads to a rise in the large-country firm's export share in the external country. This result is the opposite from Casella's. Third, the welfare of the small country improves more than the welfare of the large country as a result of a decline in the tariffs of the external country (in our model, the proxy for country welfare is the profit level of the firm located in that country). This finding again agrees with Casella's.

We contend that our duopoly model is simpler and clearer than Casella's monopolistic competition model for analyzing the expansion of a trade bloc in the short run (with barriers to entry). Nevertheless, under rising marginal cost we obtain results that are generally in accordance with her model. Among the weaknesses of our theoretical framework is that we have not accounted for the impact of per capita income levels on demand and marginal cost. The increase in each firm's profits due to trade bloc expansion can be expected to alter the demand and marginal cost schedules through changing income levels, resulting in secondary effects on profits. It is possible that the secondary

effects from trade bloc expansion may ultimately result in the small-country firm's profits *not* increasing more than those of the large-country firm (under rising marginal cost) as a consequence of lower tariffs on sales to the external country. We contend, however, that such a result should not arise if stability conditions hold. This is part of the more general problem that a partial equilibrium framework was used rather than a general equilibrium framework. Second, it is important to note that while Casella's model is more complicated, it is richer in the sense that labor markets are endogenized, and its assumption of monopolistic competition may be more appropriate in some cases when applying the theory to real-world phenomena. Finally, the assumption of linear marginal costs in our model for both the large-country and small-country firms with identical technologies may be considered to be rather restrictive, but it keeps the model tractable.

An important policy implication can be derived from our results. Firms in small countries such as Austria, Portugal, and Sweden, should not necessarily be apprehensive when the former communist countries join the European Union. This is especially true if these countries have firms with substantial market power in the output market relative to firms in large countries. For instance, it is quite likely that the Swedish firms, Volvo and Saab, may enjoy greater increases in profits than their German counterparts, Volkswagen and Mercedes-Benz, due to a reduction in the import tariffs levied by Poland or Estonia. The implication (also noted in Casella [1996]) is that the potential loss of voting power that larger members of the European Union may experience because of expansion<sup>14</sup> *cannot* be argued as a roughly equal exchange for their gaining more economically than small member countries. This paper and Casella's suggest that large member countries (or their firms) might instead gain *less* than their small member-country counterparts.

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<sup>14</sup> Casella (1996) summarizes the work of Widgrén (1994a, 1994b), which deals with the impact of the expansion of the European Union on power shifts within the Union's Council of Ministers. She states, "... in general the power of the larger countries is reduced by the entry of new members: the admission of new countries increases the number of possible coalitions of smaller economies that can impose their preferences in matters subject to qualified majority" (p. 390).

### The Nash Equilibrium

The implicit reaction functions, (4a)—(4f), can be written explicitly as follows:

$$\begin{aligned}
 (A1.a) \quad Q_{SS} &= (B_S(a_d - a_m) - Q_{LS} - mB_S(Q_{SL} + Q_{SE})) / (mB_S + 2), \\
 (A1.b) \quad Q_{SL} &= (B_L(a_d - a_m) - Q_{LL} - mB_L(Q_{SS} + Q_{SE}) - B_L t_w) / (mB_L + 2), \\
 (A1.c) \quad Q_{SE} &= (B_E(a_d - a_m) - Q_{LE} - mB_E(Q_{SS} + Q_{SL}) - B_E t_E) / (mB_E + 2), \\
 (A1.d) \quad Q_{LS} &= (B_S(a_d - a_m) - Q_{SS} - mB_S(Q_{LL} + Q_{LE}) - B_S t_w) / (mB_S + 2), \\
 (A1.e) \quad Q_{LL} &= (B_L(a_d - a_m) - Q_{SL} - mB_L(Q_{LS} + Q_{LE})) / (mB_L + 2), \text{ and} \\
 (A1.f) \quad Q_{LE} &= (B_E(a_d - a_m) - Q_{SE} - mB_E(Q_{LS} + Q_{LE}) - B_E t_E) / (mB_E + 2).
 \end{aligned}$$

The equilibrium quantities resulting from solving (A1.a)—(A1.f) simultaneously are given below:<sup>15</sup>

Let  $D \equiv 3(m(B_S + B_L + B_E) + 3)(m(B_S + B_L + B_E) + 1)$  and  $X \equiv 3a_d(mB_S + mB_L + mB_E + 1)$ .

The Nash equilibrium outcomes for *quantities* are

$$\begin{aligned}
 (A2.a) \quad Q_{SS}^* &= (B_S/D)[X + t_E(m^2 B_E(B_S + B_L + B_E) + mB_E) \\
 &\quad + t_w(m^2(4B_L B_E + 3B_L B_S + 3B_L^2 + B_E^2 + B_S B_E) + m(9B_L + 4B_E + 3))], \\
 (A2.b) \quad Q_{SL}^* &= (B_L/D)[X + t_E(m^2 B_E(B_S + B_L + B_E) + mB_E) \\
 &\quad - t_w(m^2(2B_L B_E + 3B_L B_S + 3B_L^2 + 2B_E^2 + 5B_S B_E) + m(12B_S + 3B_L + 8B_E + 6))], \\
 (A2.c) \quad Q_{SE}^* &= (B_E/D)[X - t_E(m^2(B_S B_E + 2B_S B_L + B_L B_E + B_S^2 + B_L^2) + m(4B_S + 4B_L + 3B_E) + 3) \\
 &\quad + t_w(m^2(2B_L B_E + B_L B_S + 2B_L^2 - B_S B_E - B_S^2) + m(5B_L - 4B_S))], \\
 (A2.d) \quad Q_{LS}^* &= (B_S/D)[X + t_E(m^2 B_E(B_S + B_L + B_E) + mB_E) \\
 &\quad - t_w(m^2(2B_S B_E + 3B_L B_S + 3B_L^2 + 2B_E^2 + 5B_L B_E) + m(12B_L + 3B_S + 8B_E + 6))], \\
 (A2.e) \quad Q_{LL}^* &= (B_L/D)[X + t_E(m^2 B_E(B_S + B_L + B_E) + mB_E) \\
 &\quad + t_w(m^2(4B_S B_E + 3B_L B_S + 3B_S^2 + B_E^2 + B_L B_E) + m(9B_S + 4B_E + 3))], \text{ and} \\
 (A2.f) \quad Q_{LE}^* &= (B_E/D)[X - t_E(m^2(B_S B_E + 2B_S B_L + B_L B_E + B_S^2 + B_L^2) + m(4B_S + 4B_L + 3B_E) + 3) \\
 &\quad + t_w(m^2(2B_S B_E + B_L B_S + 2B_S^2 - B_L B_E - B_L^2) + m(5B_S - 4B_L))].
 \end{aligned}$$

The Nash equilibrium outcomes for *prices* are

$$\begin{aligned}
 (A3.a) \quad P_S^* &= P_L^* = (1/3)[X - 2t_E mB_E + t_w(3 + mB_E)] / [(m(B_S + B_L + B_E) + 3)], \text{ and} \\
 (A3.b) \quad P_E^* &= (1/3)[X + t_E(6 + 2mB_S + 2mB_L) - t_w(mB_S + mB_L)] / [(m(B_S + B_L + B_E) + 3)]
 \end{aligned}$$

<sup>15</sup> The equations were solved using a computer package called Mathcad.

### Effect of Tariffs on Profits of Each Firm

The following experiment (under rising marginal costs) demonstrates that each firm's profits must fall as the tariff,  $t_E$ , rises. Let us call the initial situation before the increase in  $t_E$ , situation A, and after the increase, situation B. When  $t_E$  rises, each firm decreases sales in the external country. The amount of reduced sales in the external country of each firm is matched by the increase in sales in the large and small countries of each firm plus the decrease in output of each firm.

Suppose we force the two firms to increase their sales to both the small and large countries by the same amount, as in situation B (under this experiment). However, in this experiment the firms are required to keep both their production levels and the tariff the same as in situation A. For each firm, the marginal revenue net of transaction cost is equal across countries in situation A. But (under the experiment) it is now higher in the external country and lower in the small and large countries. Since marginal cost will not change in this experiment, the two firms must have lower profits than in situation A; each firm will sell too much in the small and large countries (marginal revenue net of transaction cost is less than marginal cost) and too little in the external country (marginal revenue net of transaction cost is greater than marginal cost). Compared with our experiment, situation B has each firm producing lower output (as is totally reflected in the lower sales to the external country in situation B, compared with the experimental situation). Whatever is still sold to the external country is subject to the higher cost from the increased  $t_E$ . We do not expect the price rise resulting from the firms reducing sales to the external country to be greater than the increase in  $t_E$ , since that would imply a negative tax burden for the firms. Therefore, in comparison with the experimental situation, situation B cuts output that was previously sold profitably to the external country, and has lower price (net of tariff) on whatever the firms still sell to that country. Thus, situation B has smaller profits for each firm than the experimental situation, and since the experimental situation has smaller profits for each firm than situation A, it must be the case that situation B has lower profits for each firm than situation A. In other words, the profits of each firm fall as  $t_E$  rises.



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