Spillover Effects of Economic Integration in a Three-Country Model*

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Abstract

Using a simple monopoly model, we examine the effects of economic integration. We show that the number of markets and the shape of marginal revenue curves are crucial to evaluate economic integration when the marginal cost is not constant. The effects of tariff-reductions in a three-country model are in contrast with those in a two-country model. The effects also depend on what trade policy the non-member country adopts. When both importing countries simultaneously lower their tariffs, the Metzler paradox may arise.

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1 Introduction

The analysis of economic integration has been a hot issue in international trade theory since Viner's classical work (1950). With a parallel development of the theory of industrial organization, the number of studies on regional trade agreements (RTAs) conducted under imperfect competition has increased in the last two decades.[1] Many of those studies assume segmented markets and constant marginal cost (MC). The assumption of constant MC is imposed to eliminate the complication that firm's choices in different markets are connected through the dependence of MC on the total output. That is, the assumption of constant MC plays a role to shut the spillover effects among markets.

The purpose of this paper is to explicitly incorporate the spillover effects in the analysis of economic integration. We particularly point out that the number of markets and the shapes of the demand curves (or, the marginal revenue (MR) curves) could be crucial in the presence of the spillover effects. To accomplish this purpose, using a simple monopoly model, we examine the effects of tariff-reductions on economies when MC is not constant.[2] We first present a two-country model where the monopolist, which is located in country 1, serves the two markets (i.e., countries 1 and 2). Then we consider a three-country model (countries 1, 2 and 3) where the monopolist serves all the markets. In the three-country model, we examine two cases: the case of economic integration between only countries 1 and 2 and the case of economic integration among all three countries.

We show that in the three-country model, the effects of tariff-reductions could be different from those in the two-country model. For example, in the two-country model, the tariff-reduction in country 2 benefits the consumers in country 2 but harms those in country 1 when MC is increasing. In the three-country model, however, this may not hold. The consumers in country 1 could also gain from country 2's tariff-reduction. As far as we know, the differences obtained in our study have not been pointed out in the existing literature. Moreover, we show that the effects of country 2's tariff-reduction depend on trade policies adopted by country 3.

Not only the presence of the third country but also the shape of the MR curves is the key to our results. The upward-sloping MR curve particularly plays a crucial role. Although one may think that the increasing MR is peculiar, it has been recognized by a number of studies as an important possibility.[3] These works show that the conditions giving rise to the upward-sloping MR curve are not stringent: any convex demand function that is consistent with the law of demand can have upward-sloping MR curve (see Formby et al., 1982). In addition, Walters

[1] See Venables (1987), Long and Soubeyran(1997), Krishna (1998), and Freund (2000), among others.

[2] To make our point as clearly as possible, we present a monopoly model. We can obtain the similar results even in the framework of oligopoly. See the last section.

[3] A classical work by Robinson (1933) pointed out the possilbility and its importance. However, it was in the 1980's when the analysis of upward-sloping MR curve was actually developed. See Formby et al. (1982), Coughlin (1984), Beckman and Smith (1993), for example. In particular, using the elasticity of the slope of the demand curve, Coughlin (1984) shows that the MR function is increasing with respect to quantity if and only if the value of the elasticity is greater than two.

(1980) shows the evidence of positively sloping marginal revenue in the pricing of the Port of Singapore.

These suggest that there should be no theoretical and empirical reasons that rule out the possibility of upward MR curve, and, in fact, new results have been obtained by incorporating the possibility in various topics such as dual equilibria in monopolistic competition (Ireland, 1984), cartel and anti-trust (Smith et al., 1987), and third-degree price discrimination (Nahata et al., 1990). The theory of international trade is not an exception, and the slope of MR curve influences the magnitudes of the spillover effects as we shall see later.

The spillover effect of a tariff under perfect competition has been pointed out by Ikema (1984) by using a three-country, partial-equilibrium model. He shows that by reducing the world price, an increase in the tariff by an importing country affects the third country as well as the exporting country.[4] In contrast to his model, an increase in the tariff by an importing country may NOT lower the prices of the exporting country and the third country. Moreover, the presence of the third country is crucial to our result in the sense that it may reverse the effects on the exporting country.

We also show that when both importing countries simultaneously decrease their tariffs, the consumer price in one of these importing countries may rise. That is, the Metzler paradox may arise in our analysis. There are only a few studies that explore the Metzler paradox in the presence of imperfect competition.[5] Moreover, those existing literature focuses on the imperfect competition in the *importing* country. Our analysis provides another possibility. That is, the Metzler paradox could arise when there is a monopolist in the exporting country.

The rest of the paper is organized as follows. Section 2 provides our bench mark. We examine the effects of economic integration (i.e., decreases in tariffs) in a two-country model. The analysis in this section is basically the same as Ishikawa (2000b) which investigates various trade policies when the MC of the monopolist is not constant. Section 3 extends the analysis into a three-country model. We examine the effects of economic integration in the presence of a non-member country. Section 4 considers economic integration among three countries, that is, the case where both importing countries simultaneously lower their tariffs. Section 5 analyzes the case of quotas instead of tariffs. Section 6 concludes the paper.

2 Economic Integration in a Two-country Model

We consider a world where there exist only two countries (countries 1 and 2) or where the good in question is traded between only two countries. A single monopolist produces a good with a

[4] Ikema's (1984) point is that an increase in the tariff in an importing country may lead other importing countries to raise their tariffs.

[5] Panagariya (1982) shows in a general equilibrium model that the existence of monopoly in the domestic import competing industry increases the likelihood of the Metzler paradox. Benston and Hartigan (1983) show that an import tariff may induce the domestic firm to lower its price in a spatial duopoly model.

single plant in country 1 and serves both markets.[6] The demand function in country i ($i = 1, 2$) is given by

$$x_i = D_i(p_i); \quad D_i' < 0, \tag{1}$$

where x_i and p_i are, respectively, the demand and consumer price of the good in country i. We define the elasticity of the slope of the inverse demand function for the following analysis:

$$\epsilon_i \equiv \frac{D_i D_i''}{(D_i')^2}.$$

The (inverse) demand curve is concave if $\epsilon_i \leq 0$ and convex if $\epsilon_i \geq 0$. We assume that the markets are segmented.

There exist tariffs. Letting t_{ji} (≥ 0) denote a specific tariff when the good is exported from country j to country i,[7] the profit function of the monopolist is defined by

$$\Pi(P; T) = \sum_{i=1}^{n}(p_i - t_{1i})D_i(p_i) - C(\sum_{i=1}^{n} D_i(p_i)), \tag{2}$$

where P and T, respectively, denote the vectors of consumer prices and tariffs; and n is the number of countries. In this section, $P = (p_1, p_2)$, $T = (t_{11}, t_{12}, t_{21}, t_{22})$ and $n = 2$.[8] $C(\cdot)$ is the cost function with $C' > 0$ and $C'' \neq 0$.

The first-order conditions of the profit maximization are ($i = 1, 2$)

$$\frac{\partial \Pi}{\partial p_i} = D_i + (p_i - t_{1i} - C')D_i' = 0. \tag{3}$$

We assume that the second-order sufficient conditions are satisfied ($i, j = 1, 2$):

$$D_i'(2 - \epsilon_i) - C''(D_i')^2 < 0, \tag{4}$$

$$\begin{aligned} \Omega_{ij} &= [D_i'(2 - \epsilon_i) - C''(D_i')^2][D_j'(2 - \epsilon_j) - C''(D_j')^2] - (C'' D_i' D_j')^2 \\ &= \left[D_i'(2 - \epsilon_i) - C''(D_i')^2\right] D_j'(2 - \epsilon_j) - (2 - \epsilon_i)C'' D_i'(D_j')^2 > 0 \quad (i \neq j). \end{aligned} \tag{5}$$

Solving the first-order conditions, we have

$$p_i = \frac{\theta_i(p_i)}{\theta_i(p_i) - 1}[C'(\cdot) + t_{1i}],$$

where θ_i denotes the price elasticity in country i.[9] Substituting these prices into the demand functions, the supply to each market can be obtained.

We now examine the effects of economic integration under which t_{12} falls. We first consider the case with $C''' > 0$. To find the effects of a decrease in t_{12} on profits, consumer prices, trade flows, and welfare, we totally differentiate (3) and obtain:

$$\begin{pmatrix} D_1'(2 - \epsilon_1) - C''(D_1')^2 & -C'' D_1' D_2' \\ -C'' D_1' D_2' & D_2'(2 - \epsilon_2) - C''(D_2')^2 \end{pmatrix} \begin{pmatrix} \frac{dp_1}{dt_{12}} \\ \frac{dp_2}{dt_{12}} \end{pmatrix} = \begin{pmatrix} 0 \\ D_2' \end{pmatrix}$$

[6] We assume away the possibility of multi plants. This may be because it is too costly for the monopolist to operate multi plants.

[7] Even if the tariffs are an ad valorem type, the essence of our results would not change.

[8] $t_{ii} = 0$ holds.

[9] θ_i is not necessarily assumed constant in our analysis. If it is constant, however, $\epsilon_i = 1 + 1/\theta_i$ holds.

with the solution

$$\begin{pmatrix} \frac{dp_1}{dt_{12}} \\ \frac{dp_2}{dt_{12}} \end{pmatrix} = \frac{1}{\Omega_{12}} \begin{pmatrix} D_2'(2-\epsilon_2) - C''(D_2')^2 & C'' D_1' D_2' \\ C'' D_1' D_2' & D_1'(2-\epsilon_1) - C''(D_1')^2 \end{pmatrix} \begin{pmatrix} 0 \\ D_2' \end{pmatrix}.$$

In view of (4) and (5), therefore, the effects of a change in t_{12} on consumer price in each market are given by

$$\frac{dp_1}{dt_{12}} = \frac{C'' D_1'(D_2')^2}{\Omega} < 0, \quad \frac{dp_2}{dt_{12}} = \frac{[D_1'(2-\epsilon_1) - C''(D_1')^2]D_2'}{\Omega} > 0. \tag{6}$$

Noting $C'' > 0$, a decrease in t_{12} lowers the consumer price in country 2; and raises the price in country 1. Thus, a decrease in t_{12} benefits the consumers in country 2 but harms those in country 1.[10] Obviously, the volume of trade increases.

The effect of a decrease in t_{12} can be seen with the aid of Figure 1. In the figures, panel (a) shows the MC curve of the plant, whereas panel (b) shows the MR curve in country 1, MR_1. Since the slope of the MR curve is given by $D_i'(2-\epsilon_i)$, the following lemma (Couglin, 1984) is straightforward:

Lemma 1 *The MR curve in country i is downward-sloping if and only if $\epsilon_i < 2$.*

Moreover, it can be seen from the second-order conditions (4) and (5) that if $\epsilon_j \geq 2$, then $\epsilon_i < 2$ $(i \neq j)$ is necessary and vice versa. Thus, we obtain the following lemma.

Lemma 2 *The MR curve can be upward-sloping or horizontal at most in one country.*

Since $C'' > 0$, the MC rises if and only if the total supply rises. The effect of a decrease in t_{12} on the total supply $X(\equiv \sum_{i=1}^{n} x_i)$ is given by

$$\frac{dX}{dt_{12}} = D_1' \frac{dp_1}{dt_{12}} + D_2' \frac{dp_2}{dt_{12}} = \frac{D_1'(D_2')^2(2-\epsilon_1)}{\Omega}. \tag{7}$$

A reduction of t_{12} increases the total supply and hence the MC if and only if $\epsilon_1 < 2$. We can easily verify that a decrease in t_{12} lowers the supply to country 1 in both cases in Figure 1.

[Figure 1 around here]

The following should be noted. The decrease in the supply to country 1 caused by a decrease in t_{12} in turn generates another spillover effect. That is, the decrease in the supply to country 1 lowers the MC and hence the supply to country 2 rises. The above equation shows that the original spillover effect dominates the second one if and only if $\epsilon_1 < 2$.

The reason why $\epsilon_1 = 2$ is critical can be seen from Figure 1. In panel (b), an increase in MC due to a tariff-reduction corresponds to a shift of the MC curve from MC to MC'. We can easily confirm that the effect of the shift of the MC curve on the supply in country 1 is mitigated

[10] We can verify that a decrease in t_{12} does not affect the price in country 1 (i.e., there is no spillover effect) if $C'' = 0$.

when the MR curve is downward-sloping, but is magnified when the MR curve is upward-sloping. Thus, even if the change in the MC is small, its effect on country 1's supply could be large when $\epsilon_1 > 2$. The following lemma is useful to analyze a three-country model.

Lemma 3 *The effect of a change in the MC on the supply to country i is mitigated if* $\epsilon_i < 2$ *but is magnified if* $\epsilon_i > 2$.

The effect of a decrease in t_{12} on profits can be obtained by using the envelop theorem:

$$\frac{d\Pi}{dt_{12}} = \frac{\partial \Pi}{\partial t_{12}} = -D_2 < 0. \tag{8}$$

The monopolist gains from a decrease in t_{12}. Thus, the effect on the welfare of country 1, which is measured by the sum of the profits and consumers' surplus:

$$W_1 \equiv \Pi(P;T) + \int_{p_1}^{\infty} D_1(z)dz \tag{9}$$

is generally ambiguous.[11]

The effect on the welfare of country 2, which is measured by the sum of consumers' surplus and tariff revenue:

$$W_2 \equiv \int_{p_2}^{\infty} D_2(z)dz + t_{12}D_2(p_2) \tag{10}$$

is also ambiguous. As shown by Brander and Spencer (1984), using a tariff, the country 2 could extract some of the monopoly rent and hence raise welfare. That is, there exists the optimal level of the tariff. A small decrease in the tariff raises welfare if the initial tariff is higher than the optimal level but reduces welfare if it is lower than the optimal level. Differentiating (10) with respect to t_{12} and evaluating it at $t = 0$, we obtain

$$\left.\frac{dW_2}{dt_{12}}\right|_{t_{12}=0} = D_2(1 - \frac{dp_2}{dt_{12}}) \tag{11}$$

Thus, the optimal tariff is positive if and only if $(dp_2/dt_{12})|_{t_{12}=0} < 1$, that is, an increase in the consumer price caused by a tariff is less than the size of the tariff. Since we have

$$1 - \frac{dp_2}{dt_{12}} \equiv \widetilde{\Gamma} = \frac{D_2'D_1'[(1-\epsilon_2)\,\Psi_1 - (2-\epsilon_1)\,C''D_2']}{\Omega} \tag{12}$$

where $\Psi_i \equiv (2-\epsilon_i) - C''D_i'$ which is positive from (4), a sufficient condition under which a small tariff enhances country 2's welfare is $\epsilon_1 < 2$ and $\epsilon_2 < 1$.[12]

Next we consider the case with $C'' < 0$. From (6), $dp_1/dt_{12} > 0$ and $dp_2/dt_{12} > 0$. When MC is decreasing, the increase in supply to country 2 by a decrease in t_{12} lowers MC of the monopolist. Hence, a tariff reduction lowers the consumer price in all countries. In this case, welfare of country 1 necessarily improves.

[11] For details, see Ishikawa (2000b).

[12] This condition is the same with one obtained in Brander and Spencer (1984). However, the value of $[1-(dp/dt)]$ in our model is different from theirs, because the monopolist in their model serves only country 2. See Ishikawa (2000b), for details.

Therefore, we can summarize the effects of economic integration in our two-country model as follows: the monopolist and the consumers in country 2 gain; the consumers in country 1 lose if MC is increasing but gain if MC is decreasing; and welfare of each country may or may not improve. It is possible that both countries lose when MC is increasing.

3 A Three-Country Model: Economic Integration in the presence of a Non-Member Country

In this section, we introduce a third country (country 3) into the model and examine the effects of economic integration between only countries 1 and 2. In the process of economic integration, country 2 lowers its tariff (i.e. t_{12}), while country 3, which is the non-member country, does not alter its tariff (i.e. t_{13}). We show that the effects of a change in the tariff could be different in the presence of a non-member country.

The demand function of country i ($i = 1, 2, 3$) is given by (1). A monopolist based in country 1 serves all the countries. The profit function (2) and the first-order conditions (3) remain unchanged. However, the second-order conditions require another condition in addition to (4) and (5). Defining the following matrix:

$$A \equiv \begin{pmatrix} D_1'(2-\epsilon_1) - C''(D_1')^2 & -C'' D_1' D_2' & -C'' D_1' D_3' \\ -C'' D_2' D_1' & D_2'(2-\epsilon_2) - C''(D_2')^2 & -C'' D_2' D_3' \\ -C'' D_3' D_1' & -C'' D_3' D_2' & D_3'(2-\epsilon_3) - C''(D_3')^2 \end{pmatrix},$$

the condition is $|A| < 0$.

We now examine the effects of changes in tariffs. Totally differentiating (3), we obtain:

$$\begin{pmatrix} dp_1 \\ dp_2 \\ dp_3 \end{pmatrix} = A^{-1} \begin{pmatrix} 0 \\ D_2' dt_{12} \\ D_3' dt_{13} \end{pmatrix}.$$

We first analyze the effects of a change in t_{12} on p_i ($i = 1, 3$) and p_2. They are given by

$$\frac{dp_2}{dt_{12}} = \frac{D_2'\{[D_1'(2-\epsilon_1) - C''(D_1')^2][D_3'(2-\epsilon_3) - C''(D_3')^2] - (C'' D_1' D_3')^2\}}{|A|} > 0, \tag{13}$$

$$\frac{dp_i}{dt_{12}} = \frac{C''(D_2')^2 D_1' D_3'(2-\epsilon_k)}{|A|}; \quad (i, k = 1, 3; : i \neq k). \tag{14}$$

Suppose $C'' > 0$. Then we have

$$\frac{dp_i}{dt_{12}} \gtrless 0 \iff 2 - \epsilon_k \lesseqgtr 0; \ (i, k = 1, 3; : i \neq k). \tag{15}$$

When MC is increasing, a decrease in t_{12} necessarily lowers the consumer price in country 2, but may NOT raise the consumer price in country 1. The consumer price in country 1 rises if and

only if $\epsilon_3 < 2$. The effect of a decrease in t_{12} on the consumer price in country 1 is in contrast to that in the two-country model. The presence of the non-member country could drastically change the effect on country 1. Similarly, the consumer price in country 3 rises if and only if $\epsilon_1 < 2$. We should note that Lemma 2 is still valid and hence $\epsilon_1 > 2$ and $\epsilon_3 > 2$ do not hold at the same time.

An interesting feature is that the change in the consumer price in country 1 (country 3) depends on the shape of the MR curve in country 3 (country 1). To see why, we need to clearly recognize that there are two kinds of spillover effects in the three-country model and how they work. The first spillover effect is caused by a change in the supply to country 2 due to a change in the tariff. When the tariff in country 2 lowers, the supply to country 2 and hence the MC rise. This decreases the supply to both countries 1 and 3. The magnitude of the decrease in country i ($i = 1, 3$) depends on ϵ_i. The decrease is relatively small if $\epsilon_i < 2$, but is relatively large if $\epsilon_i > 2$ (recall Lemma 3). The supply changes in countries 1 and 3 in turn generate the second spillover effects. The decrease in the supply to country 3 increases that to country 1. Obviously, the second spillover effect on country 1 becomes larger as the change in the supply to country 3 which is caused by the first spillover effect becomes larger. Thus, the first spillover effect on country 1 depends on ϵ_1, while the second one on country 1 depends on ϵ_3. If $\epsilon_3 > 2$ (which implies $\epsilon_1 < 2$ and $\epsilon_2 < 2$ from Lemma 2), the second spillover effect dominates the first one and hence the supply to country 1 actually rises. In the two-country model, the spillover effect from country 3 to country 1 does not exist. Thus, a decrease in t_{12} necessarily reduces the supply to country 1.

We can confirm the above result with the aid of Figure 2. In Case 1, $\epsilon_1 < 2$ and $\epsilon_3 < 2$ holds while in Case 2, $\epsilon_i < 2$ and $\epsilon_k > 2$ ($i = 1, 3$; $i \neq k$). In the figures, panels (a), (b) and (c), respectively, show the MC curve of the plant, the MR curve in country i, and the MR curve in country k. Since t_{13} reduces the marginal revenue in country 3 by the same amount, the MR curve in country 3 is depicted to include the tariff burden. Recall that the MR curve in country i is downward-sloping if and only if $\epsilon_i < 2$ (Lemma 1).

[Figure 2 around here]

As in the two-country model, the MC rises if and only if the total output rises. We first obtain the condition under which the total output increases. The effect of a decrease in t_{12} on the total supply is given by

$$\frac{dX}{dt_{12}} = D_1' \frac{dp_1}{dt_{12}} + D_2' \frac{dp_2}{dt_{12}} + D_3' \frac{dp_3}{dt_{12}} = \frac{(D_2')^2 \{D_1' D_3' (2 - \epsilon_1)(2 - \epsilon_3)\}}{|A|}. \tag{16}$$

A decrease in t_{12} increases the total supply if and only if $(2 - \epsilon_1)(2 - \epsilon_3) > 0$. Thus, a decrease in t_{12} increases the MC in Case 1 but decreases it in Cases 2. In panels (a) and (b), the first spillover effect corresponds to a shift of the MC curve from MC to MC', and the second spillover effect corresponds to a shift from MC' to MC''. As a result, a decrease in t_{12} shifts the equilibrium from E to E' in the figures. We can easily verify the changes in the prices in countries 1 and 3

in each case. In Case 2, for example, the MC decreases due to the smaller total output. Since MR_i is downward-sloping but MR_k is upward-sloping, p_i falls but p_k rises. In other words, the first spillover effect (the second spillover effect) dominates the second spillover effect (the first spillover effect) in country k (country i).

Next we consider the case with $C'' < 0$. In view of (4), the MR curves must be downward sloping in all the countries (i.e., $\epsilon_i < 2$; $i = 1, 2, 3$). From (14) and (16), $dp_1/dt_{12} > 0$ and $dp_3/dt_{12} > 0$. A tariff reduction benefits consumers in all countries as in the two-country case. Table 1 summarizes the direction of price changes.

[Table 1 around here]

Thus, noting that (8) remains to hold, we can obtain the following proposition.

Proposition 1 *A decrease in the tariff imposed by country 2 necessarily benefits the monopolist in country 1 and the consumers in country 2. When MC is increasing, the consumers in country 1 gain if and only if $\epsilon_3 > 2$ and those in country 3 gain if and only if $\epsilon_1 > 2$. When MC is decreasing, the consumers in all three countries gain.*

We next examine the welfare effects. From Proposition 1, when $C'' > 0$, country 1 gains if $\epsilon_3 > 2$ and country 3 gains if and only if $\epsilon_1 > 2$. When $C'' < 0$, both countries 1 and 3 gain. With respect to country 2, since (10) is not affected by the presence of other countries, (11) remains valid in the three-country model. Thus, we investigate under what condition $dp_2/dt_{12} < 1$ holds. In the following, to make a comparison between the two-country and the three country models, we assume $t_{13} = 0$. In the three-country model with $t_{13} = 0$, we have

$$1 - \frac{dp_2}{dt_{12}} \equiv \widehat{\Gamma} = \frac{D_1' D_2' D_3' [(1-\epsilon_2)(2-\epsilon_3)\Psi_1 - (2-\epsilon_3)(2-\epsilon_1) C'' D_2' - (1-\epsilon_2)(2-\epsilon_1) C'' D_3']}{|A|}. \tag{17}$$

When MC is increasing, a sufficient condition under which a small tariff improves country 2's welfare is $\epsilon_1 < 2$, $\epsilon_2 < 1$ and $\epsilon_3 < 2$; and when MC is decreasing, a necessary condition is $\epsilon_2 < 1$.[13] On the contrary, a sufficient condition under which free trade maximizes country 2's welfare is $\epsilon_1 > 2$ and $1 \leq \epsilon_2 < 2$ when MC is increasing, and $1 \leq \epsilon_2 < 2$ when MC is decreasing.[14]

Comparing $\widetilde{\Gamma}$ and $\widehat{\Gamma}$, we have

$$\widetilde{\Gamma} - \widehat{\Gamma} = \frac{D_2' [(2-\epsilon_1) D_1' D_2' D_3' C''']^2}{\Omega |A|} > 0. \tag{18}$$

This implies that the increase in p_2 caused by a tariff is greater in the three-country model than in the two-country model. Thus, a small import tariff is more likely to improve welfare of country 2 in the two-country model.

We should note that (8) remains to hold. Thus, if $C'' > 0$ and $\epsilon_3 > 2$, or if $C'' < 0$, a decrease in t_{12} benefits country 1 because the monopolist as well as the consumers in countries

[13] Recall that $\epsilon_i < 2$ $(i = 1, 2, 3)$ is necessary when $C'' < 0$.

[14] Since $t_{ji} \geq 0$, welfare of country 2 is maximized with $t_{12} = 0$.

1 and 2 gains. In addition, if the initial tariff in country 2 is greater than the optimal level, the tariff-reduction enhances welfare of both countries 1 and 2. In this case, however, country 3 loses when $C'' > 0$ because $\epsilon_3 > 2$ implies $\epsilon_1 < 2$ (recall Lemma 2).

In sum, we can make various claims with respect to the welfare effects of economic integration depending on the values of ϵ_i in the three-country model. The following proposition is immediate:

Proposition 2 *Economic integration between two countries (i.e., countries 1 and 2) benefits the non-member country (i.e., country 3) if $C'' > 0$ and $\epsilon_1 > 2$, or if $C'' < 0$. It may benefit only non-member country if $C'' > 0$, $\epsilon_1 > 2$, and $\epsilon_3 < 2$ hold. Neither member nor non-member countries may gain from economic integration if $C'' > 0$, $\epsilon_1 < 2$, $\epsilon_2 > 2$ and $\epsilon_3 < 2$ hold.*

The latter two results in the above proposition are related to (17), because it is providing conditions under which the economic integration hurts country 2. Since (17) is derived under $t_{13} = 0$, the following reinterpretation is possible: country 1 and 3 are already integrated and country 2 becomes the new member, or country 1 that has the free trade agreement with country 3 concludes the overlapping trade agreement with country 2.[15] Hence, our results also suggest that new membership of importing countries to a trading bloc may benefit only other importing member countries, rather than benefit exporting member countries or new participants. The result also indicates that welfare effects of forming a hub-and-spoke trading system are not straightforward. For instance, it may hurt the hub country and benefit only spoke countries.

4 A Three-Country Model: Economic Integration among All Three Countries

In Section 3, we have examined the economic integration between countries 1 and 2. This section analyzes the economic integration among all countries under which both countries 2 and 3 simultaneously decrease their tariffs. Since there are many cases depending on the tariff sizes, here we focus on the case where the tariffs imposed by countries 2 and 3 are the same and both countries change their tariffs by the same amount.[16] That is, we assume $t \equiv t_{12} = t_{13}$ and examine the effects of a change in t.

[15] We thank an anonymous referee for pointing out the interpretation.

[16] For example, this could be the case when countries 2 and 3 form a costoms union and set a common external tariff. We examine the case in which the tariff rates could be different across countries elsewhere (Ishikawa and Mukunoki, 2004).

The effects of changes in t on Π and p_i $(i = 1, 2, 3)$ are given by

$$\frac{d\Pi}{dt} = \frac{\partial \Pi}{\partial t} = -(D_2 + D_3) < 0, \tag{19}$$

$$\frac{dp_1}{dt} = \frac{C'' D_1' D_2' D_3' [D_3'(2-\epsilon_2) + D_2'(2-\epsilon_3)]}{|A|}, \tag{20}$$

$$\frac{dp_2}{dt} = \frac{D_1' D_2' D_3' (2-\epsilon_3)\Psi_1}{|A|} \gtreqless 0 \Longleftrightarrow \epsilon_3 \lesseqgtr 2, \tag{21}$$

$$\frac{dp_3}{dt} = \frac{D_1' D_2' D_3' (2-\epsilon_2)\Psi_1}{|A|} \gtreqless 0 \Longleftrightarrow \epsilon_2 \lesseqgtr 2, \tag{22}$$

$$\frac{dX}{dt} = D_1' \frac{dp_1}{dt} + D_2' \frac{dp_2}{dt} + D_3' \frac{dp_3}{dt} = \frac{D_1' D_2' D_3' (2-\epsilon_1)\{D_2'(2-\epsilon_3) + D_3'(2-\epsilon_2)\}}{|A|}, \tag{23}$$

where $\Omega_{1j} = \left[\Psi_1 \Psi_j - (C'')^2 D_1' D_j'\right] D_1' D_j' > 0$ $(j = 2, 3)$.

Suppose $C'' > 0$. From (20), a decrease in t lowers p_1 if and only if $[D_3'(2-\epsilon_2) + D_2'(2-\epsilon_3)] > 0$. Whereas D_3' (D_2') is related to the spillover effect due to a change in t_{13} (t_{12}), $(2-\epsilon_2)$ $((2-\epsilon_3))$ is related to the spillover effect from county 2 (country 3) to country 1. When $\epsilon_2 < 2$ and $\epsilon_3 < 2$, we have $dp_1/dt < 0$, $dp_2/dt > 0$, and $dp_3/dt > 0$ from (20), (21) and (22). When $\epsilon_2 > 2$ $(\epsilon_3 > 2)$, we have $dp_2/dt > 0$ $(dp_2/dt < 0)$; $dp_3/dt < 0$ $(dp_3/dt > 0)$; and $dp_1/dt > 0$ if and only if $[D_3'(2-\epsilon_2) + D_2'(2-\epsilon_3)] > 0$.

It should be remarked that $dp_i/dt < 0$ $(i = 2, 3)$ implies the Metzler paradox in country i. That is, when an importing country decreases (increases) its tariff, its consumer price rises (falls). We should note that the Metzler paradox arises only if both importing countries simultaneously change their tariffs.

Alternatively, suppose $C'' < 0$. From (4), it is necessary that $\epsilon_i < 2$ $(i = 1, 2, 3)$. From the above equations, we have $dp_1/dt > 0$, $dp_2/dt > 0$, $dp_3/dt > 0$, and $dX/dt < 0$. When MC is decreasing, therefore, the economic integration among all three countries necessarily benefits consumers in all countries.

We thus obtain the following proposition.

Proposition 3 *Suppose that $t_{12} = t_{13}$ and that countries 2 and 3 simultaneously decrease their tariffs by the same amount. The monopolist in country 1 gains. When MC is increasing, the consumers in country 1 gain only if either $\epsilon_2 > 2$ or $\epsilon_3 > 2$, those in country 2 gain if and only if $\epsilon_3 < 2$, and those in country 3 gain if and only if $\epsilon_2 < 2$. When MC is decreasing, consumers in all three countries gain.*

The comparison between Propositions 1 and 3 implies that the effects of multilateral trade liberalization may be quite different from those of bilateral trade liberalization when MC is increasing (see Table 2). In particular, multilateral trade liberalization may harm consumers in the tariff-reducing country though bilateral trade liberalization always benefits them. To ensure consumer gains, importing countries may prefer bilateral trade agreement to multilateral trade agreement.

[Table 2 around here]

It is also interesting to compare the sequential tariff-reduction with the simultaneous one. Without the loss of generality, we assume that country 2 moves first and then country 3 if the tariff cut is sequential. It is obvious that the sequential tariff decreases and the simultaneous tariff decreases eventually lead to the same effects on the prices. However, the paths of price changes could be different between them. Figure 3 summarizes the paths. The panels (a), (b) and (c) show the paths of price changes in countries 1, 2 and 3, respectively. For example, in Case 1 where all countries have the downward-sloping MR curves, a decrease in t_{12} raises p_1 and p_3 and lowers p_2 and then a decrease in t_{13} raises p_1 and p_2 and lowers p_3. Comparing the final levels with the initial ones, p_1 becomes higher but p_2 and p_3 become lower. The figures show that if either $\epsilon_2 > 2$ (i.e., Case 3) or $\epsilon_3 > 2$ (i.e., Case 4) holds, the directions of price changes are reversed in all countries.[17]

[Figure 3 around here]

In Cases 3 and 4, sequential trade liberalization may serve as a device to attain multilateral trade liberalization. When $\epsilon_2 > 2$ (i.e., Case 3), economic integration among all three countries raises p_3 and hence country 3 may oppose the simultaneous tariff reduction. By the bilateral trade liberalization between country 1 and country 2, p_3 becomes higher than in the case of multilateral trade liberalization. Then, subsequent bilateral liberalization between country 1 and country 3 (i.e., the reduction of t_{13}) lowers p_3, which results in multilateral trade liberalization. When $\epsilon_3 > 2$ (i.e., Case 4), on the other hand, economic integration among all three countries raises p_2 and country 2 may oppose the simultaneous tariff reduction. Even if the final level of p_2 is higher than the initial level, however, sequential trade liberalization leads to lower p_2 temporally. If consumers have high discount rates, the short-run gain can outweigh the long-run loss and hence country 2 may liberalize trade. Therefore, sequential tariff reductions may be superior to simultaneous tariff reductions in our model.

In this section, (17) is modified as follows:

$$1-\frac{dp_i}{dt} = \frac{D_1' D_2' D_3' [(1-\epsilon_i)(2-\epsilon_j)\Psi_1 - (2-\epsilon_j)(2-\epsilon_1) C'' D_i' - (2-\epsilon_i)(2-\epsilon_1) C'' D_j']}{|A|}; \quad (i,j=2,3; i \neq j).$$

The difference appears only in the last term. Thus, when MC is increasing, a sufficient condition for country i's welfare improvement by a small tariff is $\epsilon_1 < 2$, $\epsilon_i < 1$ and $\epsilon_j < 2$ $(i,j=2,3; i \neq j)$; and when MC is decreasing, a necessary condition is $\epsilon_i < 1$. On the other hand, a sufficient condition under which free trade maximizes country i's welfare is $\epsilon_1 > 2$ and $1 \leq \epsilon_i < 2$ when MC is increasing, and $1 \leq \epsilon_i < 2$ when MC is decreasing.

5 Economic Integration in the Presence of Quotas

We have been focusing on tariffs as trade policy. This section investigates economic integration between countries 1 and 2 when country 2 and/or country 3 set import quotas. We let q_i denote

[17] When either $\epsilon_2 > 2$ or $\epsilon_3 > 2$ holds, the final level of p_1 may or may not be higher than the initial level.

the quota level of country i $(= 2, 3)$.

We first consider the case where country 2 sets a quota and country 3 sets a tariff. We assume that the quota is initially binding. The profit function of the monopolist becomes

$$\Pi(P; q_2; t_{13}) = p_1 D_1(p_1) + p_2^q q_2 + (p_3 - t_{13}) D_3(p_3) - C(D_1(p_1) + q_2 + D_3(p_3)), \tag{24}$$

where $p_i^q \equiv D_i^{-1}(q_i)$.

The effects of a change in q_2 is as follows. Differentiating (24) with respect to q_2 and using the envelope theorem, we obtain

$$\frac{d\Pi}{dq_2} = \frac{\partial \Pi}{\partial q_2} = p_2^q - \frac{q_2}{(D_2')^2} - C' \geq 0,$$

where equality holds when the quota is set at the free-trade level. Totally differentiating the first-order conditions with respect to q_2, we have the effects of a change in the quota level:

$$\frac{dp_i}{dq_2} = \frac{D_1' D_3' C''(2 - \epsilon_j)}{\Omega_{13}}; \quad (i, j = 1, 3; i \neq j).$$

Therefore, $dp_i/dq_2 < 0$ when $C'' < 0$, and

$$\frac{dp_i}{dq_2} \gtreqless 0 \iff 2 - \epsilon_j \gtreqless 0 \tag{25}$$

when $C'' > 0$. This condition is similar to (15) which is obtained in the case of the tariff-change. Obviously, $dp_2/dq_2 < 0$. Thus, the effects of weakening country 2's quota on prices are the same as those of lowering country 2's tariff.

Next we consider the case where country 2 sets a tariff while country 3 sets a quota. When country 3 employs a quota, the effects of a change in t_{12} may be different from those in section 3. We have two cases. The quota remains binding in one case while it becomes unbinding in the other. In the former case, it is obvious that a change in t_{12} has no effect on p_3. Thus, the effects of a change in t_{12} are the same as those in the two-country model.

From Proposition 1, a decrease in t_{12} reduces the profit-maximizing level of the supply to country 3 if and only if $\epsilon_1 < 2$. In this case, the initially binding quota q_3 may no longer be binding. If the quota becomes unbinding as t_{12} falls, $dp_3/dt_{12} < 0$ holds.

[Table 3 around here]

We can establish the following proposition (see Table 3).

Proposition 4 *Suppose that country 2 decreases its tariff when country 3 is imposing a quota. The tariff reduction makes the quota unbinding only if MC is increasing. When the quota remains binding, the consumers in countries 1 lose (gain) if MC is increasing (decreasing), those in country 2 gain, and those in country 3 are indifferent. When the quota becomes unbinding, however, the consumers in countries 1 may gain if $\epsilon_3 > 2$, those in country 2 gain, and those in country 3 lose.*

Proof. See Appendix. ■

Contrary to the tariff case, a quota shuts the spillover effects as long as the quota is binding. Hence, any policy change in country 2 that increases its imports never raises country 1's supply as long as the MC is increasing and the quota remains binding in country 3. Moreover, it is obvious that when both importing countries impose binding quotas, simultaneous changes in quota levels never lead to the Metzler paradox, which is in contrast to the tariff case.

6 Concluding Remarks

We have examined the effects of economic integration in the framework of monopoly. It has been shown that the presence of a third country could drastically change the effects. In particular, it is possible that the consumer price falls not only in the country which lowers its tariff but also in another country; and that the consumers in the country which lowers its tariff lose. The non-constant MC and MR are the key to our results. The non-constant MC leads to spillover effects, while the increasing MR magnifies the spillover effects.

In the case of quotas, however, the spillover effects are shut down. The effects of a tariff-reduction in an importing country differ if the other importing country employs a quota instead of a tariff. This result has an important implication. The WTO bans, in principle, all quantitative restrictions. Thus, the members are obligated to replace all quantitative restrictions with tariffs and then lower the tariffs. This replacement may lead to different outcomes in economic integration.

To make our point as clearly as possible, we present a monopoly model. It is possible to extend our analysis to an oligopoly framework. For example, introducing local firms into our model, we can still verify the existence of a Cournot equilibrium without the declining MR and obtain similar results as long as the local firms serve only their own markets.

Although we have dealt with the case where both importing countries decrease their tariffs, we have not considered any strategic interactions between the governments. It is certainly worthwhile to examine this kind of strategic interactions. This is left for future research.

Appendix

Proof of Proposition 4

We let $\widetilde{p}_k$ and $\widetilde{x}_k$ denote the optimal price and supply in country k ($k = 1, 2, 3$) in the absence of the quota (i.e., $\widetilde{x}_k \equiv D_k(\widetilde{p}_k)$). We also let x_k denote the actual level of supply to country k. Suppose that country 3's quota is initially binding (i.e., $\widetilde{x}_3 \geq x_3 = q_3$) but a change in t_{12} makes it unbinding. Note that $\Delta\widetilde{x}_3 = (D_3')^{-1}(d\widetilde{p}_3/dt_{12})\Delta t_{12}$. From (15), $d\widetilde{p}_3/dt_{12} > 0$ when $C'' < 0$, and $d\widetilde{p}_3/dt_{12} \gtreqless 0$ if and only if $\epsilon_1 \gtreqless 2$ when $C'' > 0$. Hence, the quota becomes unbinding (i.e., $\Delta\widetilde{x}_3 < 0$) if $C'' > 0$, $\epsilon_1 < 2$, and $\Delta t_{12} < 0$, or if $C'' > 0$, $\epsilon_1 > 2$, and $\Delta t_{12} > 0$, or if $C'' < 0$, $\Delta t_{12} > 0$. Since the quota is initially binding, we have $d\widetilde{x}_3/dt_{12} \leq dx_3/dt_{12} \leq 0$ or $0 \leq dx_3/dt_{12} \leq d\widetilde{x}_3/dt_{12}$. We define $\beta \equiv (dx_3/dt_{12})/(d\widetilde{x}_3/dt_{12})$, where $\beta \in [0, 1]$, $\beta = 0$ if the quota remains binding, and $\beta = 1$ if the quota is initially set at the free-trade level. We have

$$\frac{dp_1}{dt_{12}} = \beta\frac{d\widetilde{p}_1}{dt_{12}} + (1-\beta)\frac{D_1'(D_2')^2 C''}{\Omega_{12}}.$$

When $C'' < 0$, $d\widetilde{p}_1/dt_{12} > 0$ and so $dp_1/dt_{12} > 0$. Suppose $C'' > 0$. If q_3 remains binding, $dp_1/dt_{12} = D_1'(D_2')^2 C''/\Omega_{12} < 0$. If the quota becomes unbinding and $\epsilon_3 < 2$, $d\widetilde{p}_1/dt_{12} < 0$. If the quota becomes unbinding and $\epsilon_3 > 2$, on the other hand, $d\widetilde{p}_1/dt_{12} > 0$. In this case, dp_1/dt_{12} takes the minimum value at $\beta = 0$, which is negative, and maximum value at $\beta = 1$, which is positive. Hence, dp_1/dt_{12} has an ambiguous sign. As for p_3, we have

$$\frac{dp_3}{dt_{12}} = \beta\frac{d\widetilde{p}_3}{dt_{12}}.$$

Hence, $dp_3/dt_{12} = 0$ when the quota remains binding; $dp_3/dt_{12} > 0$ when it becomes unbinding and $C'' < 0$; and $dp_3/dt_{12} \gtreqless 0$ if and only if $\epsilon_1 \gtreqless 2$ when it becomes unbinding and $C'' > 0$. Finally,

$$\frac{dp_2}{dt_{12}} = \beta\frac{d\widetilde{p}_2}{dt_{12}} + (1-\beta)\frac{D_2'\left[D_1'(2-\epsilon_1) - C''(D_1')^2\right]}{\Omega_{12}} > 0.$$

Note that $d\widetilde{p}_2/dt_{12} > 0$ from (13). Q.E.D.

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Tables and Figures

Table 1 : Bilateral tariff changes

	dp_1/dt	dp_2/dt	dp_3/dt
$C'' > 0$			
$\epsilon_k < 2$ $(k = 1, 2, 3)$	$-$	$+$	$-$
$\epsilon_1 > 2$	$-$	$+$	$+$
$\epsilon_2 > 2$	$-$	$+$	$-$
$\epsilon_3 > 2$	$+$	$+$	$-$
$C'' < 0$	$+$	$+$	$+$

Table 2 : Simultaneous tariff changes

	dp_1/dt	dp_2/dt	dp_3/dt
$C'' > 0$			
$\epsilon_k < 2$ $(k = 1, 2, 3)$	$-$	$+$	$+$
$\epsilon_1 > 2$	$-$	$+$	$+$
$\epsilon_2 > 2$	$+$ or $-$	$+$	$-$
$\epsilon_3 > 2$	$+$ or $-$	$-$	$+$
$C'' < 0$	$+$	$+$	$+$

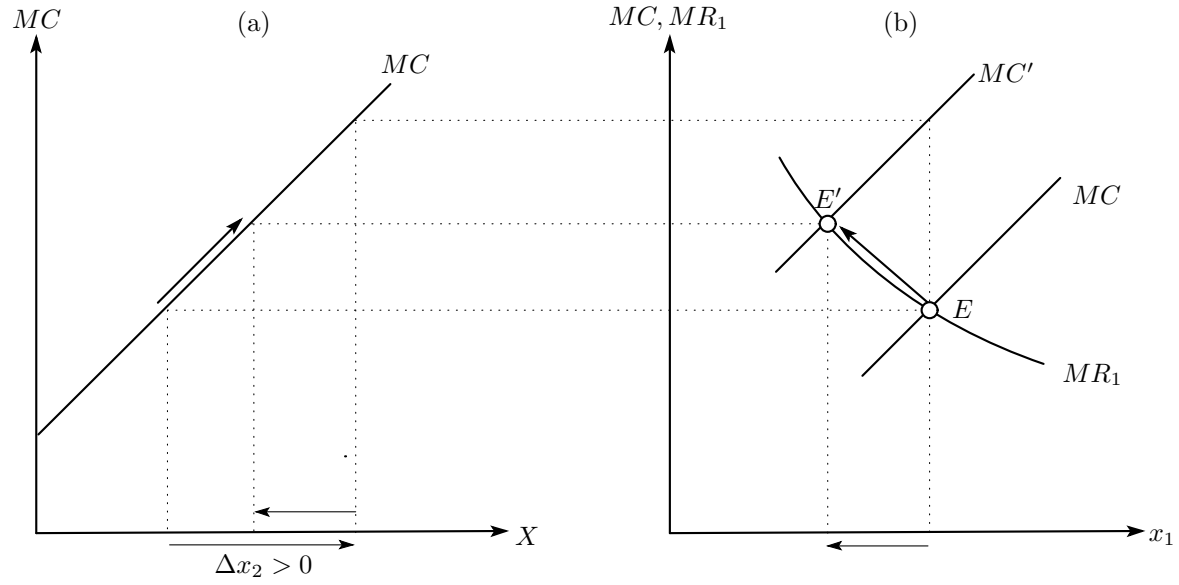
Table 3 : Country 2's tariff-changes when country 3 employs a quota

	dp_1/dt	dp_2/dt	dp_3/dt
The quota remains binding			
$C'' > 0$	$-$	$+$	no effect
$C'' < 0$	$+$	$+$	no effect
The quota becomes unbinding (only if $C'' > 0$)			
$\epsilon_k < 2$ $(k = 1, 2, 3)$	$-$	$+$	$-$
$\epsilon_1 > 2$ or $\epsilon_2 > 2$	$-$	$+$	$-$
$\epsilon_3 > 2$	$+$ or $-$	$+$	$-$

Figures

Figure 1: The two-country model

Case 1: $\varepsilon_1 < 2$



Case 2: $\varepsilon_1 > 2$

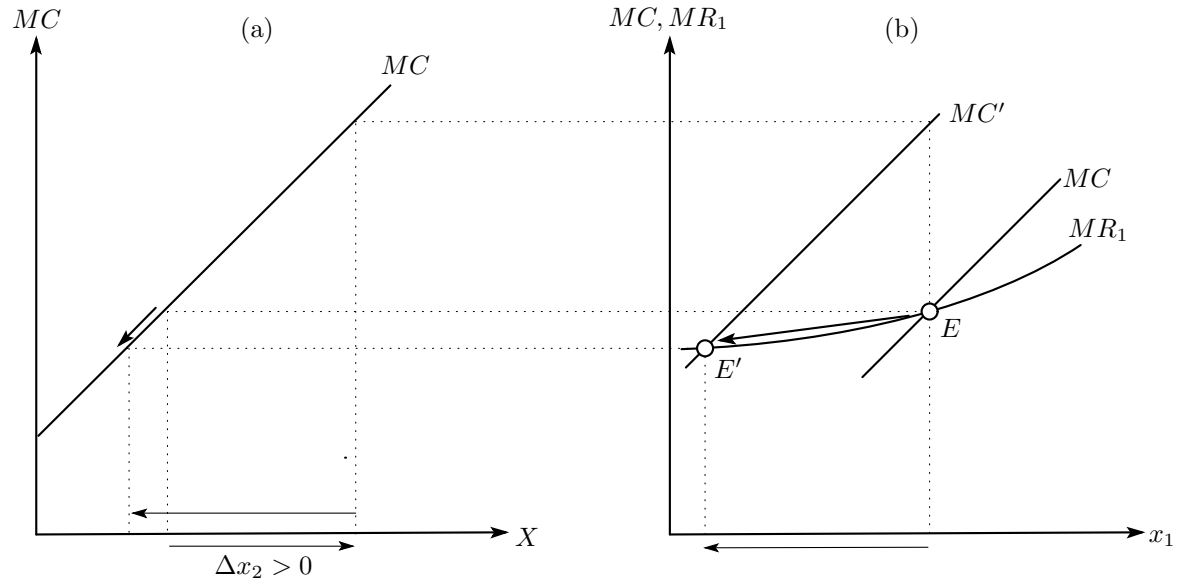
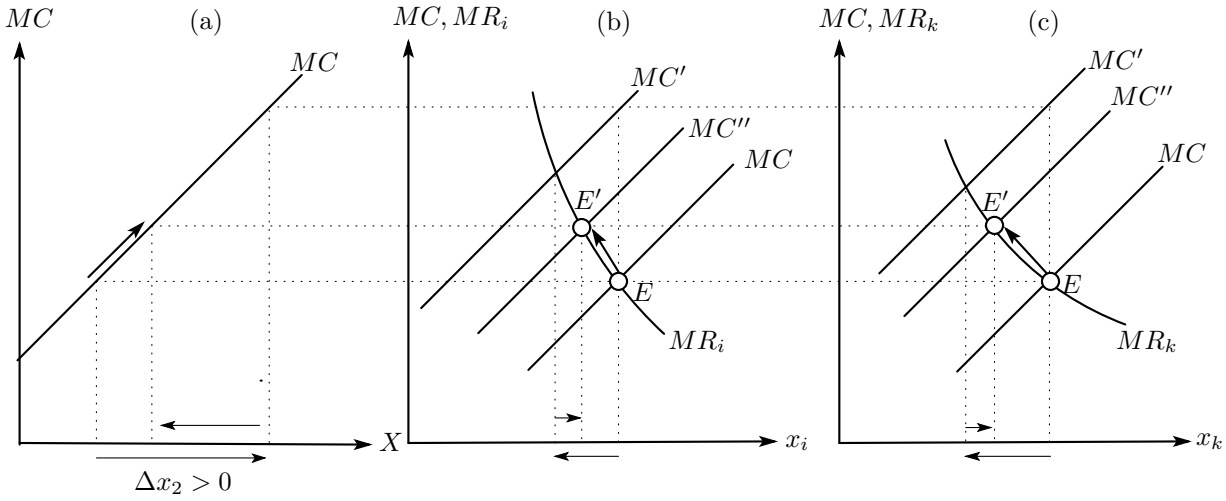


Figure 2: The three-country model

Case 1: $\varepsilon_i < 2$ and $\varepsilon_k < 2$ $(i, k = 1, 3;\ i \neq k)$



Case 2: $\varepsilon_i < 2$ and $\varepsilon_k > 2$ $(i, k = 1, 3;\ i \neq k)$

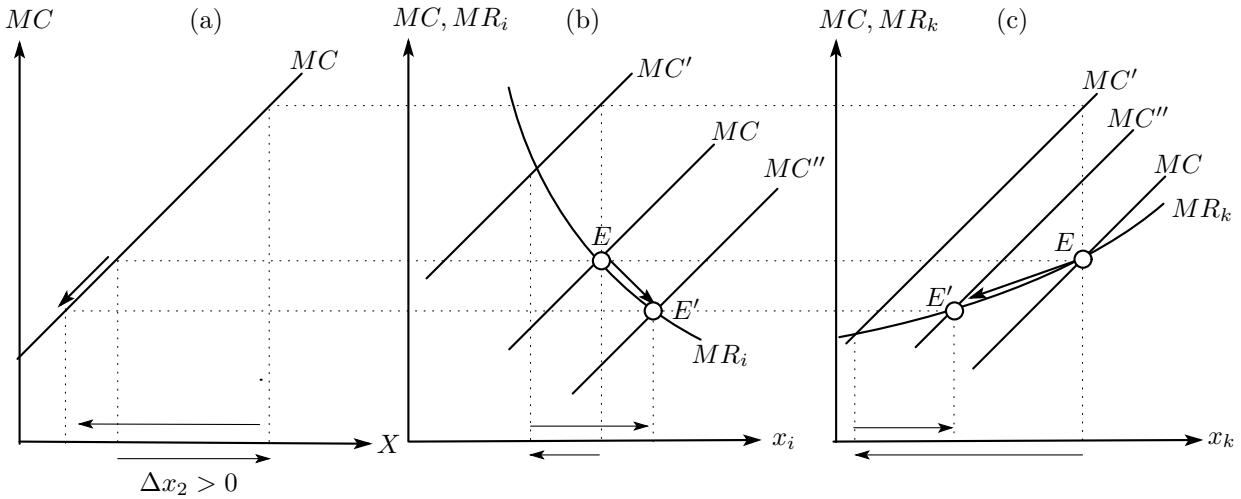
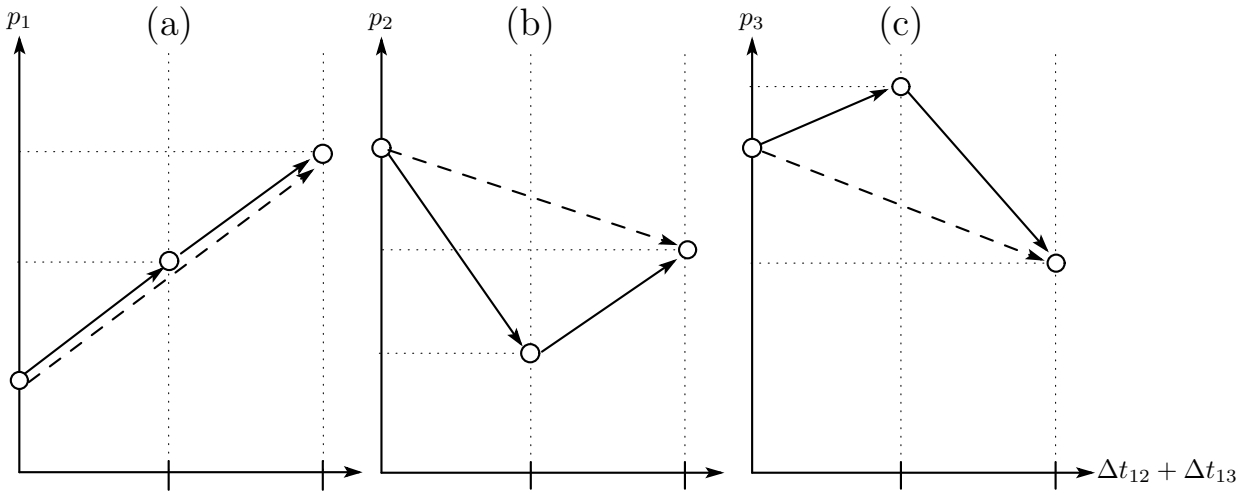
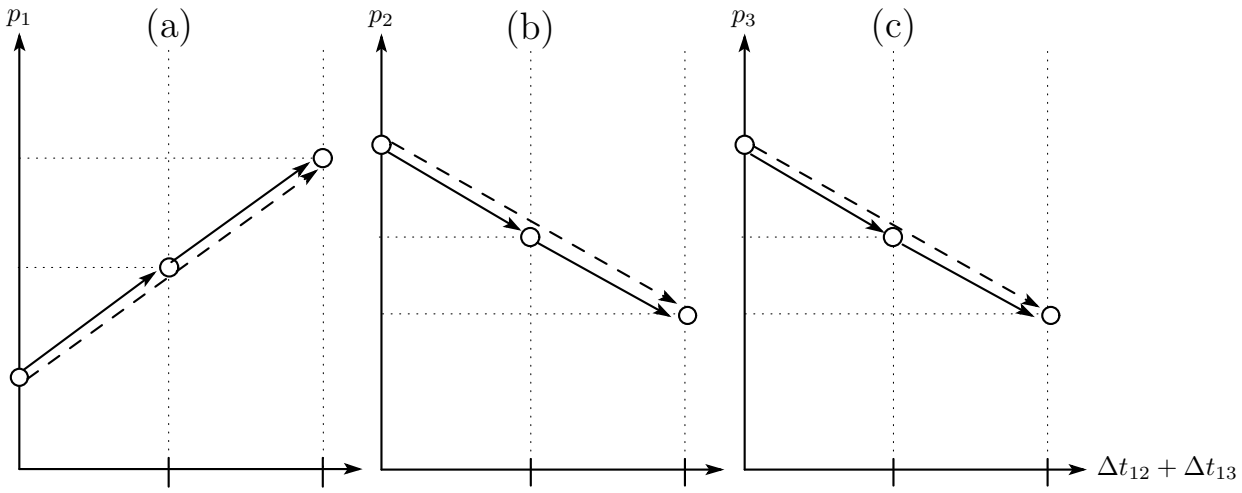


Figure 3: Sequential tariff reduction

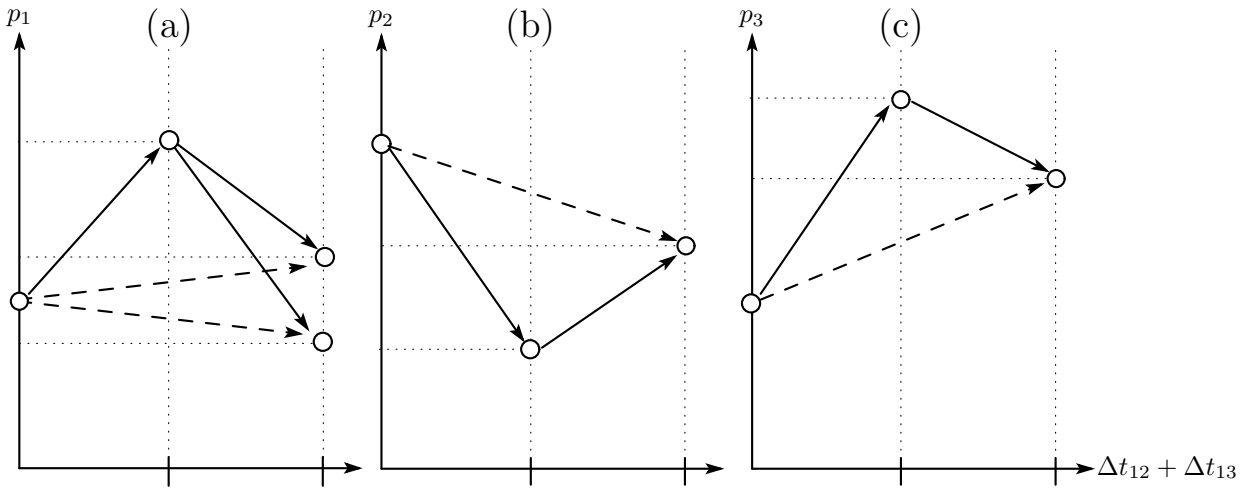
Case 1: All countries have downward-sloping MR curve



Case 2: Exporting country has upward-sloping MR curve



Case 3: Country 2 has upward-sloping MR curve



Case 4: Country 3 has upward-sloping MR curve