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Trade Integration, Welfare, and Horizontal Multinationals: A three-country model*

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Abstract

In this paper, we construct a three-country model with national and multinational (multi-plant) firms, in which oligopolistic firms in each country export their goods to other countries. We investigate the effects of trade liberalization between two countries on the third country. When the fixed costs of foreign direct investment (FDI) are sufficiently large, the firm does not conduct FDI, and trade liberalization always reduces the welfare level of the third country. When the fixed costs of FDI are small, trade liberalization may improve the welfare level of the third country. In addition, we observe cases under which trade liberalization between two of the countries improves the welfare of all three countries. In those cases, the two countries have incentives to join a free trade agreement (FTA), while the third country has no incentive to do so.

Keywords: FTA, Multinational firm, Trade costs
JEL classification: F13, F23

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1 Introduction

Bilateral and large regional free trade agreements (FTAs) have increased since the 1990s. It was reported that before 1990, only 16 FTAs were active worldwide. However, in the 1990s, 50 FTAs were enacted, and over 150 FTAs were signed from 2000 to 2011 (JETRO (2015)). Many countries have sought to sign FTAs, which generally help facilitate customs administration and trade. For example, the FTA between the United States and Korea tries to reduce not only tariff rates between the two countries but also non-tariff barriers between them. In parallel with the activities of bilateral and large regional FTAs, multinational firms have increased their volumes of foreign direct investment (FDI). JETRO data show that outward FDI stocks in Japan increased from 336 million dollars in 2003 to 684 million dollars in 2008 to 1,117 million dollars in 2013. These two trends show that an FTA affects the plant location strategy by multinational firms, which subsequently affects the welfare level of countries whether or not they sign an FTA. In this paper, we show that the location strategies of multinational firms influence the welfare level of not only the origin and host countries but also the third country.

In this paper, we construct a simple three-country model with national and multinational (multiplant) firms in the three countries. We assume that two of the three countries agree to an FTA. There is a firm in each country. One firm in one of the two countries under the FTA can become a multinational firm, as it can choose to export or conduct FDI in other countries. However, other firms exist as national firms that can only export to other countries. In this model, the firm that can conduct FDI has four strategies: Export to all other countries, conduct FDI in the FTA partner country (third country) and export to the third country (FTA partner country), and conduct FDI in all countries. To export goods, firms have to incur trade costs. Thus, when the potentially multinational firm conducts FDI, it has to incur fixed costs to construct its factory or logistics system in the other country and can then supply it goods without paying trade costs. Thus, this firm faces a trade-off between trade costs and fixed FDI costs.

The results of this paper are as follows. When the population of the third country is small and the fixed costs of FDI are medium-sized, the multinational firm does not have a plant in the third country and conducts FDI in the potential FTA partner country. When an FTA is set, the trade costs between the FTA countries are reduced. A reduction in trade costs induces the multinational firm to stop conducting FDI in the FTA partner country. Then, market competition in the FTA partner country becomes less intensive, which increases the profit gain of a national firm in the third country and has a positive effect on the welfare level of the third country. On the other hand, when the population of the third country is large and the fixed costs of having a factory in the foreign country are small, the multinational firm conducts FDI in all countries. A reduction in the trade costs for the FTA induces the multinational firm to shut down the plant in the FTA partner country. Then, the market competition in the FTA partner country becomes less intensive, which increases the profits of the national firm in the third country and subsequently raises the welfare of the

third country. Then, we show that the FTA agreement may increase the welfare level in the third country.

Some studies also construct a three-country model to investigate the effect of an FTA on the welfare level. Bagwell and Staiger (1997, 1998) construct a simple three-country and stationary dynamic model and investigate the effects of an FTA on the welfare level and on multilateral tariff cooperation. They show that trade liberalization between two countries decreases external tariff rates, which they term "tariff complementarity," which in turn increases the welfare level of the third country. Bond, Riezman, and Syropoulos (2004) construct a three-country static model. They investigate the effect of trade liberalization on the optimal tariff rates and the welfare level. They show that trade liberalization improves the third country's trade terms, which increases the welfare level of the third country. Although these papers study the welfare impacts of trade liberalization with three-country models, they do not consider the activities of multinational firms, which our paper focuses on.

Many studies have investigated the effects of trade liberalization on the behaviors of multinational firms and the welfare level using two- or three-country models. Motta and Norman (1996) construct a three-country oligopolistic model to investigate the effects of trade liberalization on multinational firms' activities and on the welfare level in the regional bloc. They show that economic integration between two of the three countries increases FDI from the third country, which raises the welfare level of these two countries. Raff (2004) constructs a three-country model and investigates the effects of a tariff rate on the location of FDI. Raff (2004) shows that a reduction in the tariff rate between two countries leads to FDI, which may increase the welfare level. Ekholm, Forslid, and Markusen (2007) also construct a three-country oligopolistic model to investigate the behavior of multinational firms. In their model, there are two large countries (United States and the European Union) and one small country (Mexico). They conclude that trade liberalization between a large and small country induces the firms in the third country to conduct FDI in the small country. Antras and Foley (2011) study the responses of multinational firms based on one country (West) to a reduction of trade barriers between two other countries (East and South) in the model. Their model predicts an increase in the number of Western firms engaging in FDI in the South-East area, which is consistent with an analysis of firm-level responses to the creation of the ASEAN FTA. These papers study the effects of trade liberalization on the behavior of multinational firms and welfare with three-country models. Our paper present different effects of trade liberalization from those studies and shows that FDI may raise the welfare of the third country. [1]

[1] Behrens and Picard (2007), Toulemonde (2008), and Cerina, Morita, and Yamamoto (2013) extend a theoretical two-country international trade model that allows monopolistically competitive firms to decide whether to serve the foreign market by exporting or opening a second plant in the foreign country. They show that a decrease in trade costs reduces the number of multinational firms with plants in both countries. Then, consumers in each country have to import consumption goods, which decreases the consumer surplus in both countries. The result that trade liberalization decreases the number of horizontal multinationals is sup-

Our paper shows that an FTA may increase the welfare level of the third country. Many theoretical and empirical studies analyze the effects of an FTA on the behavior of multinational firms and on the welfare level of the countries under FTA. We show the positive "externalities" of an FTA on a third country.[2]

The remainder of this paper is structured as follows. Section 2 describes the model, Section 3 conducts a welfare analysis on the third country, and Section 4 concludes.

2 The model

There are three countries, 1, 2, and 3. Variables referring to Country i ($i = 1, 2,$ or 3) have the subscript i. In this model, there are homogenous goods, and there is one firm in each country. [3] We name the firm in Country i Firm i. All firms compete strategically using their product quantities, that is, they engage in Cournot competition. We assume that Firms 2 and 3 have only one strategy, producing goods and exporting their goods to the other countries. On the other hand, Firm 1 chooses whether to become a national firm with a factory in only Country 1 or a multinational firm with factories in Country 1 and in other countries. We name the strategy where Firm 1 becomes a national firm Strategy E. When Firm 1 chooses to become a multinational firm with factories in both Countries 1 and 2 (3), we name this strategy Strategy M2 (Strategy M3). When Firm 1 chooses to become a multinational firm with factories in all countries, we term this strategy Strategy M. In this model, there are two steps. In the first step, the Firm 1 chooses whether to become a national firm or a multinational one. If the firm chooses to become a multinational, it chooses the number and location of its plants. In the second step, three firms produce goods to maximize their profits.

The inverse demand function in Country i is given by

$$p_i = 1 - \frac{Q_i}{s_i}, \tag{1}$$

where Q_i is the total supply of goods in Country i and s_i measures the market size in Country i. For simplicity, the marginal costs of the firms are zero. To become national firms, each firm does not have to incur fixed costs. The profits of Firms 2 and 3 become

$$\pi_2 = (p_1 - \tau_{12})q_1^2 + p_2 q_2^2 + (p_3 - \tau_{23})q_3^2,$$

$$\pi_3 = (p_1 - \tau_{13})q_1^3 + (p_2 - \tau_{23})q_2^3 + p_3 q_3^3,$$

ported by empirical research. Im (2013) splits two types of FDI, horizontal and vertical FDI, and he concludes that trade liberalization reduces horizontal FDI.

[2] Bagwell and Staiger (1999) are one of few studies that review the effects of an FTA on a third country.

[3] We can construct a model in which there exist multiple firms in each country. In that model, we obtain qualitatively similar results to the current version of the model.

where p_i is the price in Country i, q_i^j is the supply of goods in Country i produced in Country j, and τ_{ij} is the trade cost between Countries i and j, which includes the non-tariff barrier and transportation costs. In this model, we define trade liberalization between Countries 1 and 2 as a reduction in τ_{12}. From the profit-maximization problem (1), the profit-maximizing quantities produced by Firms 2 and 3 can be obtained as follows:

$$q_i^2 = \frac{s_i(1-\tau_{i2})}{2} - \frac{q_i^1 + q_i^3}{2}, \tag{2}$$

$$q_i^3 = \frac{s_i(1-\tau_{i3})}{2} - \frac{q_i^1 + q_i^2}{2}, \tag{3}$$

where τ_{ii} is zero. When Firm 1 chooses Strategy E, the profit of Firm 1 is given by

$$\pi_1^E = p_1 q_1^1 + (p_2 - \tau_{12}) q_2^1 + (p_3 - \tau_{13}) q_3^1.$$

From the profit maximization problem, the profit-maximizing quantity produced by Firm 1 as a national firm becomes as follows:

$$q_i^1 = \frac{s_i(1-\tau_{1i})}{2} - \frac{q_i^2 + q_i^3}{2}, \tag{4}$$

In the equilibrium, we can obtain the following equilibrium quantity and price in each country:

$$q_i^i = \frac{s_1(1+\tau_{ij}+\tau_{ij'})}{4}, \tag{5}$$

$$q_i^j = \frac{s_i(1-3\tau_{ij}+\tau_{ij'})}{4}, \tag{6}$$

$$p_i = \frac{1+\tau_{ij}+\tau_{ij'}}{4}, i, j, j' \in \{1,2,3\}, i \neq j \neq j'. \tag{7}$$

Substituting the quantity and prices into the profits of Firm 1, the profits of Firm 1 choosing Strategy E are obtained as follows:

$$\pi_1^E = s_1(\frac{1+\tau_{12}+\tau_{13}}{4})^2 + s_2(\frac{1-3\tau_{12}+\tau_{23}}{4})^2 + s_3(\frac{1-3\tau_{13}+\tau_{23}}{4})^2. \tag{8}$$

When Firm 1 chooses to become a multinational firm, Firm 1 has to pay fixed costs $f > 0$. When the strategy of Firm 1 is Strategy M2, profits are given by

$$\pi_1^{M2} = p_1 q_1^1 + p_2 q_2^1 + (p_3 - \hat{\tau}_{12}) q_3^1 - f,$$

where $\hat{\tau}_{12} \equiv \min\{\tau_{13}, \tau_{23}\}$. From the profit maximization problem of Firm 1, the profit-maximizing quantities produced by Firm 1 become as follows:

$$q_1^1 = \frac{s_1}{2} - \frac{q_1^2 + q_1^3}{2}, \tag{9}$$

$$q_2^1 = \frac{s_2}{2} - \frac{q_2^2 + q_2^3}{2}, \tag{10}$$

$$q_3^1 = \frac{s_3(1-\hat{\tau}_{12})}{2} - \frac{q_3^2 + q_3^3}{2}. \tag{11}$$

Because the equilibrium condition in Country 1 is the same as the case where Firm 1 chooses Strategy E, the quantities of goods in Country 1 and the price of goods in Country 1 are (5), (6), and (7). We obtain the following equilibrium quantities of goods and prices in Countries 2 and 3:

$$q_2^1 = \frac{s_2(1+\tau_{23})}{4}, q_2^2 = \frac{s_2(1+\tau_{23})}{4}, q_2^3 = \frac{s_2(1-3\tau_{23})}{4}, p_2 = \frac{1+\tau_{23}}{4}, \tag{12}$$

$$q_3^1 = \frac{s_3(1-3\hat{\tau}_{12}+\tau_{23})}{4}, q_3^2 = \frac{s_3(1+\hat{\tau}_{12}-3\tau_{23})}{4},$$

$$q_3^3 = \frac{s_3(1+\hat{\tau}_{12}+\tau_{23})}{4}, p_3 = \frac{1+\hat{\tau}_{12}+\tau_{23}}{4}. \tag{13}$$

Substituting the equilibrium quantities and prices into the profits of Firm 1, the profits of Firm 1 choosing Strategy M2 can be obtained as follows:

$$\pi_1^{M2} = s_1(\frac{1+\tau_{12}+\tau_{13}}{4})^2 + s_2(\frac{1+\tau_{23}}{4})^2 + s_3(\frac{1-3\hat{\tau}_{12}+\tau_{23}}{4})^2 - f. \tag{14}$$

When the strategy of Firm 1 is Strategy M3, Firm 1 also has to pay fixed costs $f > 0$, and the profit is given by

$$\pi_1^{M3} = p_1 q_1^1 + (p_2 - \hat{\tau}_{13}) q_2^1 + p_3 q_3^1 - f,$$

where $\hat{\tau}_{13} \equiv \min\{\tau_{12}, \tau_{23}\}$. Because the equilibrium condition in Country 1 is the same as the economy where Firm 1 chooses Strategy M3, the profit-maximizing quantity and price of goods in Country 1 are given by (5), (6), and (7). We then obtain the following equilibrium quantities of the goods and prices in Countries 2 and 3:

$$q_2^1 = \frac{s_2(1-3\hat{\tau}_{13}+\tau_{23})}{4}, q_2^2 = \frac{s_2(1+\hat{\tau}_{13}+\tau_{23})}{4},$$

$$q_2^3 = \frac{s_2(1+\hat{\tau}_{13}-3\tau_{23})}{4}, p_2 = \frac{1+\hat{\tau}_{13}+\tau_{23}}{4}, \tag{15}$$

$$q_3^1 = \frac{s_3(1+\tau_{23})}{4}, q_3^2 = \frac{s_3(1-3\tau_{23})}{4}, q_3^3 = \frac{s_3(1+\tau_{23})}{4}, p_3 = \frac{1+\tau_{23}}{4}. \tag{16}$$

Substituting the equilibrium quantities and prices into the profits of Firm 1, the profit when Firm 1 chooses Strategy M3 can be obtained as follows:

$$\pi_1^{M3} = s_1(\frac{1+\tau_{12}+\tau_{13}}{4})^2 + s_2(\frac{1-3\hat{\tau}_{13}+\tau_{23}}{4})^2 + s_3(\frac{1+\tau_{23}}{4})^2 - f. \tag{17}$$

When the strategy of Firm 1 is Strategy M, Firm 1 has to pay fixed costs $2f$ because Firm 1 has two plants in Countries 2 and 3, and the profit is given by

$$\pi_1^M = p_1 q_1^1 + p_2 q_2^1 + p_3 q_3^1 - 2f.$$

Because the equilibrium condition in Country 1 is the same as the economy where Firm 1 chooses Strategy E, the demand function for goods in Country 1 and the price of goods in Country 1 are given by (5), (6), and (7). We obtain the following equilibrium quantities of goods and prices in Countries 2 and 3:

$$q_2^1 = \frac{s_2(1+\tau_{23})}{4}, q_2^2 = \frac{s_2(1+\tau_{23})}{4},$$

$$q_2^3 = \frac{s_2(1-3\tau_{23})}{4}, p_2 = \frac{1+\tau_{23}}{4}, \tag{18}$$

$$q_3^1 = \frac{s_3(1+\tau_{23})}{4}, q_3^2 = \frac{s_3(1-3\tau_{23})}{4}, q_3^3 = \frac{s_3(1+\tau_{23})}{4}, p_3 = \frac{1+\tau_{23}}{4}. \tag{19}$$

Substituting the equilibrium quantities and prices into the profits of Firm 1, the profits of Firm 1 when it chooses Strategy M are obtained as follows:

$$\pi_1^M = s_1(\frac{1+\tau_{12}+\tau_{13}}{4})^2 + s_2(\frac{1+\tau_{23}}{4})^2 + s_3(\frac{1+\tau_{23}}{4})^2 - 2f. \tag{20}$$

The conditions under which Firm 1 chooses to become a national firm are $\pi_1^E > \pi_1^{M2}$, $\pi_1^E > \pi_1^{M3}$, and $\pi_1^E > \pi_1^M$. Then, substituting for the profits of Firm 1, we obtain the following conditions:

$$\frac{16}{3}f > s_2(2+2\tau_{23}-3\tau_{12})\tau_{12} + s_3(2+2\tau_{23}-3(\hat{\tau}_{12}+\tau_{13}))(\tau_{13}-\hat{\tau}_{12}), \tag{21}$$

$$\frac{16}{3}f > s_3(2+2\tau_{23}-3\tau_{13})\tau_{13} + s_2(2+2\tau_{23}-3(\hat{\tau}_{13}+\tau_{12}))(\tau_{12}-\hat{\tau}_{13}), \tag{22}$$

$$2\times\frac{16}{3}f > s_2(2-3\tau_{12}+2\tau_{23})\tau_{12} + s_3(2-3\tau_{13}+\tau_{23})\tau_{13}. \tag{23}$$

The left-hand side (LHS) and right-hand side (RHS) of the equations represent the costs and benefits, respectively, of becoming a multinational firm. The first term on the RHS of (21) and (22) represents the gain from having a plant in Countries 2 or 3. The second term on the RHS of (21) and (22) represents the gain as a multinational firm of choosing to export to a country with lower trade costs. The first and second terms of the RHS (23) represent the gains from having a plant in Countries 2 and 3, respectively. For simplicity, we assume that $\tau_{12} = \tau_{13} = \tau_{23} \equiv \tau$ before the FTA is signed. In addition, because we focus on the equilibrium that all firms export goods to all countries in which they have no plants, we assume that $\tau < \frac{1}{3}$.

We assume that Countries 1 and 2 agree to create an FTA. When the FTA is agreed on, the trade cost between Countries 1 and 2 decreases and becomes $\tau_F < \tau$. In this case, $\hat{\tau}_{12} = \tau$ is constant and $\hat{\tau}_{13} = \tau_F < \tau$ holds. We study the choice of Firm 1 with τ_F. The condition of $\pi_1^{M3} > \pi_1^M$ equals that of $\pi_1^E > \pi_1^{M2}$. This is because both conditions represent that the profits gained in Country 2 through exporting are larger than those gained in Country 2 by placing a plant in Country 2. In addition, the condition of $\pi_1^{M2} > \pi_1^M$ equals that of $\pi_1^E > \pi_1^{M3}$. This is because both conditions represent that the profits gained in Country 3

through exporting are larger than those gained in Country 3 by placing a plant in Country 3. (21) shows that the condition $\pi_1^E > \pi_1^{M2}$ or $\pi_1^{M3} > \pi_1^M$ is given by

$$\frac{16}{3}f > A(\tau_F), \tag{24}$$

where

$$A(\tau_F) \equiv s_2(2 + 2\tau - 3\tau_F)\tau_F. \tag{25}$$

$A(\tau_F)$ represents the profits gained from having a plant in Country 2 compared to exporting. Differentiating $A(\tau_F)$ with respect to τ_F, we can obtain the following equation:

$$A'(\tau_F) = s_2(2 + 2\tau - 6\tau_F) > 0, \tag{26}$$

because $\tau < \frac{1}{3}$. The second derivative of $A(\tau_F)$ is negative. When the trade costs between Countries 1 and 2 increase, the profits gained from having a plant in Country 2 increases. (22) implies that the condition of $\pi_1^E > \pi_1^{M3}$ or $\pi_1^{M2} > \pi_1^M$ becomes

$$\frac{16}{3}f > s_3(2 - \tau)\tau, \tag{27}$$

where the RHS of this equation represents the profits gained from having a plant in Country 3 compared to exporting. From (23), the condition under which the profits of Firm 1 with Strategy E are larger than those with Strategy M becomes

$$\frac{16}{3}f > \frac{A(\tau_F) + s_3(2 - \tau)\tau}{2} \equiv B(\tau_F), \tag{28}$$

where $B(\tau_F)$ represents the profits gained from having plants in Countries 2 and 3 compared to exporting. The condition under which the profits of Firm 1 with Strategy M2 is larger than that with Strategy M3 becomes

$$s_2(2 + 2\tau - 3\tau_F) = A(\tau_F) > s_3(2 - \tau)\tau. \tag{29}$$

When $s_2 > s_3$, we can depict $A(\tau_F)$ and $B(\tau_F)$ in Figure 1. When $s_2 < s_3$, we can depict $A(\tau_F)$ and $B(\tau_F)$ in Figure 2. From (26), (27), (28), and (29), we obtain the following proposition.

Proposition 1 *Suppose that $s_2 > s_3$. (1)When $\frac{16}{3}f > A(\tau)$, the strategy of Firm 1 is Strategy E. A decrease in τ_F does not affect the behavior of Firm 1.*

(2)When $s_3(2 - \tau)\tau < \frac{16}{3}f < A(\tau)$, the strategy of Firm 1 is Strategy E in $0 < \tau_F < \tau_F^A$ and Strategy M2 in $\tau_F^A < \tau_F < \tau$.

(3)When $\frac{16}{3}f < s_3(2 - \tau)\tau$, the strategy of Firm 1 is Strategy M3 in $0 < \tau_F < \tau_F^A$ and Strategy M in $\tau_F^A < \tau_F < \tau$.

Suppose that $s_2 < s_3$. Then, (4) When $\frac{16}{3}f > s_3(2 - \tau)\tau$, the strategy of Firm 1 is Strategy E. A decrease in τ_F does not affect the behavior of Firm 1.

(5) When $A(\tau) < \frac{16}{3}f < s_3(2 - \tau)\tau$, the strategy of Firm 1 is Strategy M3.

(6) When $\frac{16}{3}f < A(\tau)$, Firm 1 chooses Strategy M3 in $\tau_F < \tau_F^A$ and Strategy M in $\tau_F^A < \tau_F < \tau$. τ_F^A is given by

$$\tau_F^A = \frac{1 + \tau}{3} - \frac{1}{3}\sqrt{(1 + \tau)^2 - \frac{16f}{s_2}}. \tag{30}$$

We explain this proposition intuitively. Suppose that the population size in Country 3 is smaller than that in Country 2. In this case, the profit gained from placing a plant in Country 2 is larger than that in Country 3. We can distinguish three cases. In Case (1), the fixed costs of becoming a multinational firm are large. Firm 1 does not become a multinational firm and it chooses to export its goods to other countries. In Case (2), the profit gained from placing a plant in Country 2 (3) compared to exporting is larger (smaller) than the fixed costs of exporting. In this case, Strategy M2 is profitable, whereas Strategy M3 is not. Thus, when τ_F is low, Firm 1 chooses to supply its goods to Countries 2 and 3 by exporting, whereas when τ_F becomes large, it places its plant in Country 2. In Case (3), the fixed costs of constructing a plant are low, and both Strategies M2 and M3 are profitable. In this case, when τ_F is low, the multinational places its plant only in Country 3. When τ_F becomes high, the multinational firm places its plant in all countries.

Suppose that the population size in Country 3 is larger than that in Country 2. In this case, the profit gained from placing a plant in Country 3 is larger than that in Country 2. We also distinguish three cases here: (4), (5), and (6). In Case (4), the fixed costs of becoming a multinational firm are large, and thus, Firm 1 does not become a multinational and chooses to export its goods to other countries. In Case (5), the profit gained from placing a plant in Country 3 compared to exporting is larger than the fixed costs of the multinational, whereas the profit gained from placing a plant in Country 2 compared to exporting is smaller than the fixed costs of the multinational. In this case, Strategy M3 is profitable, while Strategy M2 is not profitable. Firm 1 then chooses to place a plant in Country 3. In Case (6), the fixed costs of constructing a plant are low, and both Strategy M2 and Strategy M3 are profitable. Here, when τ_F is low, the multinational places the plant only in Country 3. When τ_F becomes sufficiently high, the multinational firm places plants in all countries.

Differentiating τ_{12}^A with respect to τ and f/s_2, we can obtain the following equations:

$$\frac{d\tau_F^A}{d\tau} = -\frac{\tau_F^A}{2+\tau-3\tau_F^A} < 0,$$

$$\frac{d\tau_F^A}{df/s_2} = \frac{1}{3}\frac{8}{\sqrt{(1+\tau)^2-\frac{16f}{s_2}}} > 0,$$

because $\tau_F^A < \tau < 1/3$. In Cases (2), (3), and (6) when $\tau_F^A < \tau_F < \tau$, the firm has a plant in Country 2. When the trade costs between Countries 1 and 3 are large (τ_F^A is small), the market competition in Country 2 becomes less intensive and the incentive of Firm 1 to have a plant in Country 2 becomes large. When the country size in Country 2 is small (τ_F^A is large), the incentive of Firm 1 to have a plant in Country 2 shrinks.

3 Welfare analysis

In this section, we focus on the welfare level in Country 3 when the FTA between Countries 1 and 2 is created. When Firm 1 chooses Strategy E, the welfare level in Country 3 becomes as follows:

$$W_3^E(\tau_F) = \frac{s_3}{32}(3-2\tau)^2 + \frac{1}{16}\left[(s_1+s_2)(1+\tau_F-3\tau)^2 + s_3(1+2\tau)^2\right], \quad (31)$$

The first term represents the consumer surplus in Country 3 and the second term represents the profits of Firm 3. The welfare levels in Country 3 when Firm 1 chooses Strategies M3, M2, and M are given by

$$W_3^{M3}(\tau_F) = \frac{s_3}{32}(3-\tau)^2 + \frac{1}{16}\left[(s_1+s_2)(1+\tau_F-3\tau)^2 + s_3(1+\tau)^2\right], \quad (32)$$

$$W_3^{M2}(\tau_F) = \frac{s_3}{32}(3-2\tau)^2 + \frac{1}{16}\left[s_1(1+\tau_F-3\tau)^2 + s_2(1-3\tau)^2 + s_3(1+2\tau)^2\right], \quad (33)$$

$$W_3^{M}(\tau_F) = \frac{s_3}{32}(3-\tau)^2 + \frac{1}{16}\left[s_1(1+\tau_F-3\tau)^2 + s_2(1-3\tau)^2 + s_3(1+\tau)^2\right]. \quad (34)$$

Differentiating (31), (32), (33), and (34) with respect to τ_F, the following equations can be obtained:

$$\frac{\partial W_3^E(\tau_F)}{\partial \tau_F} = \frac{\partial W_3^{M3}(\tau_F)}{\partial \tau_F} = \frac{(s_1+s_2)(a+\tau_F-3\tau)}{8} > 0, \quad (35)$$

$$\frac{\partial W_3^{M2}(\tau_F)}{\partial \tau_F} = \frac{\partial W_3^{M}(\tau_F)}{\partial \tau_F} = \frac{s_1(a+\tau_F-3\tau)}{8} > 0. \quad (36)$$

A reduction in the trade costs between Countries 1 and 2 makes the competition in these countries intensive. Therefore, the FTA between Countries 1 and 2 reduces the profits of Firm 3 and decreases the welfare level in Country 3. We focus on the case when the population size in Countries 1 and 2 are the same and the population in Country 3 is smaller than that in Countries 1 and 2. We obtain the following lemma (See the Appendix for proof):

Lemma 1 Suppose that $s_1 = s_2 = s$. We assume that $s > max(s_3, T)$, where $T \equiv s(2+2\tau-3\hat{\tau}_F)\hat{\tau}_F$.

(1)When $\frac{16}{3}f > A(\tau)$, the FTA between Countries 1 and 2 decreases the welfare level in Country 3.

(2) When $T < \frac{16}{3}f < A(\tau)$, the FTA between Countries 1 and 2 increases the welfare level in Country 3 when $\hat{\tau}_F < \tau_F < \tau_F^A$ and decreases it when $0 < \tau_F < \hat{\tau}_F$ and $\tau_F^A < \tau_F < \tau$.

(3) When $\frac{16}{3}f < T$, the FTA between Countries 1 and 2 decreases the welfare level in Country 3.

$\hat{\tau}_F$ is given by

$$\hat{\tau}_F = -(1-3\tau) + \frac{\sqrt{2}\sqrt{13\tau^2-10\tau+2}}{2}.$$

In this lemma, we focus on the case that $s > max(s_3, T)$. In this case, Proposition 1 implies that when the fixed costs are sufficiently large ($\frac{16}{3}f > A(\tau)$), Firm 1 chooses Strategy E. In this range, a reduction in the trade costs between Countries 1 and 2 reduces the welfare level in Country 3 monotonically. When the fixed costs are medium ($T < \frac{16}{3}f < A(\tau)$), the FTA induces Firm 1 to change her strategy from Strategy M to Strategy M3 or from Strategy M2 to Strategy E. In both cases, the number of plants of the multinational firm decreases, which lowers intensity of the market competition among firms. Then, the profit gain of Firm 3 becomes large. This increase in the profit of the national firm improves the welfare level in Country 3 in $\hat{\tau}_F < \tau_F < \tau_F^A$. When the fixed costs are sufficiently low ($\frac{16}{3}f < T$), Proposition 1 shows that Firm 1 chooses Strategy M or Strategy M2. When the FTA is agreed on, Firm 1 may change her strategy to Strategy M3 (E). When the fixed costs are low, the value of the trade costs under which Firm 1 changes its strategy from M (M2) to M3 (E), τ_F^A, is low, because the fixed costs of having an additional plant are low. In the case of $\tau_F^A < \hat{\tau}_F$, when Firm 1 changes its strategy with an FTA, the welfare in the third country becomes lower than that without an FTA.

Next, we investigate the case when the population size in Country 3 is large compared to that in Countries 1 and 2. We obtain the following lemma (See the Appendix for proof):

Lemma 2 Suppose that $T < s < s_3$.

(1) When $\frac{16}{3}f > s_3(2-\tau)\tau$, *an FTA between Countries* 1 *and* 2 *decreases the welfare level in Country* 3.

(2) When $A(\tau) < \frac{16}{3}f < s_3(2-\tau)\tau$, *an FTA between Countries* 1 *and* 2 *decreases the welfare level in Country* 3.

(3) When $T < \frac{16}{3}f < A(\tau)$, *an FTA between Countries* 1 *and* 2 *increases the welfare level in Country* 3 *when* $\hat{\tau}_F < \tau_F < \tau_F^A$ *and decreases it when* $0 < \tau_F < \hat{\tau}_F$ *and* $\tau_F^A < \tau_F < \tau$.

(4) When $\frac{16}{3}f < T$, *an FTA between Countries* 1 *and* 2 *decreases the welfare level in Country* 3.

We explain this lemma intuitively. When the fixed costs of having a plant is sufficiently large, Proposition 1 implies that Firm 1 always chooses Strategy E. Then, the FTA decreases the profits of Firm 3 earned in Countries 1 and 2 and reduces the welfare level in Country 3. When $A(\tau) < \frac{16}{3}f < s_3(2-\tau)\tau$, Firm 1 always chooses Strategy M3. Then, an FTA between Countries 1 and 2 decreases the profits of Firm 3 earned in Countries 1 and 2 and decreases the welfare level in Country 3. When $T < \frac{16}{3}f < A(\tau)$ holds, Proposition 1 implies that Firm 1 chooses Strategies M3 and M. When the FTA between Countries 1 and 2 induces Firm 1 to shut down its factory in Country 2, the market competition becomes less intensive and the profits gained by Firm 3 become large. Then, the FTA between Countries 1 and 2 increases the welfare level in Country 3 in $\hat{\tau}_F < \tau_F < \tau_F^A$. When the fixed costs are low ($\frac{16}{3}f < T$), Proposition 1 implies that Firm 1 chooses Strategy M in the case without an FTA. When an FTA is agreed on, Firm 1 may change its strategy to Strategy M3. When the fixed costs are low, the value of trade costs with which Firm 1 changes its strategy from M (M2) to M3 (E), τ_F^A, is low, because the fixed

costs of having an additional plant are low. In the case of $\tau_F^A < \hat{\tau}_F$, when Firm 1 changes its strategy with an FTA, the welfare in the third country becomes lower than that without an FTA.

From Lemma 1 and Lemma 2, we can obtain the following proposition:

Proposition 2 *When* $T < \frac{16}{3}f < A(\tau)$ *and* $\hat{\tau}_F < \tau_F < \tau_F^A$*, an FTA between Countries* 1 *and* 2 *increases the welfare level in Country* 3*. Otherwise, it decreases the welfare level in Country* 3*.*

This proposition shows that there exists a case where the FTA formation improves welfare in the third country. When this occurs, the multinational firm shuts down its plants once the FTA takes effect. If a multinational firm operates with the same number of plants after the FTA is agreed on, the FTA reduces the welfare of the third country. The competition among firms intensifies, because the FTA reduces the trade costs between Countries 1 and 2. The profit of the national firm in the third country is lowered with this intensive competition effect. However, there are cases where a multinational firm shuts down its plants under an FTA, because the FTA reduces the proximity benefit of plants in the countries under the FTA. The reduction of plants of multinational firms makes competition among firms weak, which raises the profit of the national firm in the third country.

3.1 Incentive to sign an FTA

Next, we investigate the incentive to sign an FTA between Countries 1 and 2. We derive the sum of the welfare levels in Countries 1 and 2. If the sum of the welfare levels in Countries 1 and 2 with an FTA is larger than that without an FTA, Countries 1 and 2 have an incentive to sign an FTA. [4] We focus our attention on the case of $T < \frac{16}{3}f < A(\tau)$.[5] Then, Proposition 1 shows that Firm 1 chooses Strategy E or Strategy M3 in $\hat{\tau}_F < \tau_F < \tau_F^A$ and Strategy M2 or Strategy M in $\tau_F^A < \tau_F \leq \tau$. Before Countries 1 and 2 agree on an FTA, Firm 1 chooses Strategy M2 (M). If $\hat{\tau}_F < \tau_F < \tau_F^A$, Firm 1 changes its strategy and chooses Strategy E (M3) after the FTA. The sum of the welfare levels in Countries 1 and 2 when Firm 1 chooses Strategy E and M2 is given by

$$W_1^E(\tau_F)+W_2^E(\tau_F) = \frac{s}{16}\left[5\tau^2 - 6\tau\tau_F + 2\tau + 21\tau_F^2 - 14\tau_F + 13\right] + \frac{s_3}{8}(1-2\tau)^2, \tag{37}$$

$$W_1^{M2}(\tau_F)+W_2^{M2}(\tau_F) = \frac{s}{32}\left[10\tau^2 - 6\tau\tau_F + 4\tau + 21\tau_F^2 - 14\tau_F + 26\right] + \frac{s_3}{8}(1-2\tau)^2 - f. \tag{38}$$

[4] Even if the welfare of one of the two countries decreases with an FTA, the welfare loss can be compensated for by the welfare gain of the other country.

[5] In this parameter range, there is a case where an FTA improves the welfare of the third country.

Differentiating (37) and (38) with respect to τ_F, we can obtain the following equation:

$$\frac{\partial(W_1^E(\tau_F)+W_2^E(\tau_F))}{\partial\tau_F}=2\frac{\partial(W_1^{M2}(\tau_F)+W_2^{M2}(\tau_F))}{\partial\tau_F}=-\frac{s}{8}(7-21\tau_F+3\tau)<0,$$

because $\tau_F<1/3$. If Firm 1 do not change its strategy ($\tau_F^A<\tau_F\leq\tau$), the FTA improves the sum of the welfare of Countries 1 and 2. We see that $\frac{\partial(W_1^E(\tau_F)+W_2^E(\tau_F))}{\partial\tau_F}<\frac{\partial(W_1^{M2}(\tau_F)+W_2^{M2}(\tau_F))}{\partial\tau_F}$ holds. We observe that $W_1^E(\tilde{\tau}_F)+W_2^E(\tilde{\tau}_F)=W_1^{M2}(\tau)+W_2^{M2}(\tau)$ holds where $\tilde{\tau}_F$ is given by[6]

$$\tilde{\tau}_F=\frac{3\tau+7}{21}-\frac{\sqrt{2}}{42}\sqrt{333\tau^2-210\tau+98-672\frac{f}{s}}. \tag{39}$$

When $\tau_F<(>)\tilde{\tau}_F$, the sum of the welfare level in Countries 1 and 2 when Firm 1 chooses Strategy E is larger (smaller) than that when Firm 1 chooses Strategy M2. Therefore, when $\tau_F^A<\tilde{\tau}_F$, an FTA between Countries 1 and 2 always increases the sum of the welfare level in Countries 1 and 2. When $\tilde{\tau}_F<\tau_F^A$, an FTA between Countries 1 and 2 decreases the sum of the welfare level in Countries 1 and 2 in $\tilde{\tau}_F<\tau_F<\tau_F^A$.

The sums of the welfare levels in Countries 1 and 2 when Firm 1 chooses Strategies M3 and M are respectively given by

$$W_1^{M3}(\tau_F)+W_2^{M3}(\tau_F)=\frac{s}{16}\left[5\tau^2-6\tau\tau_F+2\tau+21\tau_F^2-14\tau_F+13\right]+\frac{s_3}{16}\left[10\tau^2-4\tau+2\right]-f, \tag{40}$$

$$W_1^{M}(\tau_F)+W_2^{M}(\tau_F)=\frac{s}{32}\left[10\tau^2-6\tau\tau_F+4\tau+21\tau_F^2-14\tau_F+26\right]+\frac{s_3}{16}\left[10\tau^2-4\tau+2\right]-2f. \tag{41}$$

Differentiating (40) and (41) with respect to τ_F, we obtain the following equation:

$$\frac{\partial(W_1^{M3}(\tau_F)+W_2^{M3}(\tau_F))}{\partial\tau_F}=2\frac{\partial(W_1^{M}(\tau_F)+W_2^{M}(\tau_F))}{\partial\tau_F}=-\frac{s}{8}(7-21\tau_{12}+3\tau)<0,$$

because $\tau_F<1/3$. If Firm 1 does not change its strategy ($\tau_F^A<\tau_F\leq\tau$), $\frac{\partial(W_1^{M3}(\tau_F)+W_2^{M3}(\tau_F))}{\partial\tau_F}<\frac{\partial(W_1^{M}(\tau_F)+W_2^{M}(\tau_F))}{\partial\tau_F}$ holds. When $\tau_F=\tilde{\tau}_F$ holds, $W_1^{M3}(\tilde{\tau}_F)+W_2^{M3}(\tilde{\tau}_F)=W_1^{M}(\tau)+W_2^{M}(\tau)$. When $\tau_F<(>)\tilde{\tau}_F$, the sum of the welfare level in Countries 1 and 2 when Firm 1 chooses Strategy M3 is larger (smaller) than that when Firm 1 chooses Strategy M. Therefore, when $\tau_F^A<\tilde{\tau}_F$ holds, an FTA between Countries 1 and 2 always increases the sum of the welfare level in Countries 1 and 2. When $\tilde{\tau}_F<\tau_F^A$ holds, an FTA between Countries 1 and 2 decreases the sum of the welfare level in Countries 1 and 2

[6] When $\tau_F=\frac{3\tau+7}{21}+\frac{\sqrt{2}}{42}\sqrt{333\tau^2-210\tau+98-672\frac{f}{s}}$, $W_1^E(\tau_F)+W_2^E(\tau_F)=W_1^{M2}(\tau)+W_2^{M2}(\tau)$ holds. However, $\frac{3\tau+7}{21}+\frac{\sqrt{2}}{42}\sqrt{333\tau^2-210\tau+98-672\frac{f}{s}}>\frac{1}{3}$ and $\tau_F<\frac{1}{3}$.

when $\tilde{\tau}_F < \tau_F < \tau_F^A$. Therefore, when $\tau_F^A < \tilde{\tau}_F$, Countries 1 and 2 always have the incentive to sign an FTA.

Lemma 3 Suppose that $T < \frac{16}{3}f < A(\tau)$. *When* $\tilde{\tau}_F < \tau_F < \tau_F^A$, *an FTA decreases the sum of the welfare level in Countries* 1 *and* 2. *Otherwise, it improves the sum of the welfare level in these countries.*

In the former subsection, we saw that when $T < \frac{16}{3}f < A(\tau)$ and $\hat{\tau}_F < \tau_F < \tau_F^A$, an FTA improves the welfare of the third country. Then, we obtain the following proposition:

Proposition 3 *Suppose that* $T < \frac{16}{3}f < A(\tau)$ *and* $\tau_F^A < \tilde{\tau}_F$. *An FTA between Countries* 1 *and* 2 *increases the welfare level of all countries when* $\hat{\tau}_F < \tau_F < \tau_F^A$.

This proposition points out that there exists a case in which Countries 1 and 2 have an incentive to agree to an FTA, which raises the welfare in the third country. We show that if the multinational firm decreases its number of plants, there exists a case where the FTA improves the welfare of the third country. When $T < \frac{16}{3}f < A(\tau)$ and $\tau_F^A < \tilde{\tau}_F$, the sum of the welfare in Countries 1 and 2 increases with an FTA. Such an FTA has three effects on the sum of the welfare in the two countries. First, because an FTA reduces the trade costs between Countries 1 and 2, the price of consumption in Countries 1 and 2 decreases, improving welfare. Second, the decline in trade costs increases competition among firms and reduces the profits of multinational and national firms, which lowers welfare. Third, when the multinational firm reduces its number of plants, the competition intensity is lowered and the profits of the multinational and national firms are raised, which improves welfare. When $T < \frac{16}{3}f < A(\tau)$ and $\tau_F^A < \tilde{\tau}_F$, the first and third effects overcome the second effect, and the FTA improves the sum of the welfare in Countries 1 and 2.

4 Conclusion

In this paper, we construct a simple three-country model with national and multinational (multiplant) firms in which oligopolistic firms in each country export. We investigate the effects of trade liberalization between two countries on the third country. In each country, there is a firm. For simplicity, we assume that a single firm in a country that signs an FTA can have two strategies: One strategy is exporting their goods to the other countries, and the other strategy is conducting FDI in the other countries and supplying goods without paying transportation costs. To conduct FDI, the firm has to incur fixed costs. The two other firms only export their goods and do not conduct FDI. When the FDI fixed costs are sufficiently large, the firm does not choose to conduct FDI, and trade liberalization reduces the welfare level in the third country. When the FDI fixed costs are small, the firm conducts FDI and trade liberalization may increase the welfare level of the third country.

Analyzing the incentive of the third country to join the FTA as well as studying tariff revenues are of interest. These are left for future studies.

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5 Appendix

5.1 Proof of Lemma 1

1. When $\frac{16}{3}f > A(\tau)$, Proposition 1 implies that Firm 1 chooses Strategy E. Then, from (35), the welfare level in Country 3 is increasing in the trade costs between Countries 1 and 2. Therefore, an FTA between Countries 1 and 2 always reduces the welfare level in Country 3.

2. Suppose that $s_3(2-\tau)\tau < T$. When $s_3(2-\tau)\tau < \frac{16}{3}f < A(\tau)$, Proposition 1 shows that Firm 1 chooses Strategy E in $0 < \tau_F < \tau_F^A$ and Strategy M2 in $\tau_F^A < \tau_F < \tau$. When $\tau_F = 0$, $W_3^E(0) = W_3^{M2}(0)$. From (35), the slope of $W_3^E(\tau_F)$ is steeper than $W_3^{M2}(\tau_F)$. Figure 3 represents the relationship between $W_3^E(\tau_F)$ and $W_3^{M2}(\tau_F)$. We show that when $\tau_F > \hat{\tau}_F$, the welfare level in Country 3 when Firm 1 chooses Strategy E is larger than that when Firm 1 chooses Strategy M2. Subtracting $W_3^{M2}(\tau)$ from $W_3^E(\tau_F)$, we obtain the following equation:

$$W_3^E(\tau_F) - W_3^{M2}(\tau) = 2(1+\tau_F-3\tau)^2 - (1-2\tau)^2 - (1-3\tau)^2. \tag{42}$$

$W_3^E(\tau_F) - W_3^{M2}(\tau)$ is increasing in τ_F. Substituting $\hat{\tau}_F$ into (42), we obtain the following equation:

$$W_3^E(\hat{\tau}_F) - W_3^{M2}(\tau) = 2(\frac{\sqrt{2}\sqrt{13\tau^2-10\tau+2}}{2})^2 - (1-2\tau)^2 - (1-3\tau)^2 = 0.$$

Therefore, when $\tau_F > \hat{\tau}_F$, the welfare level in Country 3 when Firm 1 chooses Strategy E is larger than that when Firm 1 chooses Strategy M2. When $\hat{\tau}_F > \tau_F^A$ in Figure $3-2$, an FTA between Countries 1 and 2 always reduces the welfare level in Country 3. When $\hat{\tau}_F < \tau_F^A$ holds in Figure $3-1$, an FTA between Countries 1 and 2 may increase the welfare level in Country 3. The condition that $\hat{\tau}_F < \tau_F^A$ is given by

$$\frac{16}{3}f > s(2+2\tau-3\hat{\tau}_F)\hat{\tau}_F = T.$$

Therefore, when $s_3(2-\tau)\tau < T < \frac{16}{3}f$ holds, an FTA between Countries 1 and 2 increases the welfare level of Country 3 in $\hat{\tau}_F < \tau_F < \tau_F^A$.

Suppose that $s_3(2-\tau)\tau > T$. When $s_3(2-\tau)\tau < \frac{16}{3}f < A(\tau)$, from Proposition 1, Firm 1 chooses Strategy E in $0 < \tau_F < \tau_F^A$ and Strategy M2 in $\tau_F^A < \tau_F < \tau$. As discussed previously, an FTA between Countries 1 and 2 increases the welfare level of Country 3 when $\hat{\tau}_F < \tau_F < \tau_F^A$. When $T < \frac{16}{3}f < s_3(2-\tau)\tau$ holds, Proposition 1 shows that Firm 1 chooses Strategy M3 in $0 < \tau_F < \tau_F^A$ and Strategy M in $\tau_F^A < \tau_F < \tau$. When $\tau_F = 0$, $W_3^{M3}(0) = W_3^M(0)$. From (35), the slope of $W_3^{M3}(\tau_F)$ is steeper than $W_3^M(\tau_F)$. Figure 4 represents the relationship between $W_3^{M3}(\tau_F)$ and $W_3^M(\tau_F)$. We show that when $\tau_F > \hat{\tau}_F$, the welfare level in country 3 when Firm 1 chooses Strategy M3 is larger than that when Firm 1 chooses Strategy M. Subtracting $W_3^M(\tau)$ from $W_3^{M3}(\tau_F)$, we can show that $W_3^{M3}(\tau_F)$ is larger than $W_3^M(\tau)$ when $\tau_F > \hat{\tau}_F$.

Therefore, when $T < \frac{16}{3}f < s_3(2-\tau)\tau$ holds, an FTA between Countries 1 and 2 increases the welfare level of Country 3 in $\hat{\tau}_F < \tau_F < \tau_F^A$.

3. When $\frac{16}{3}f < T$, Proposition 1 shows that Firm 1 chooses Strategy M3 or Strategy E in $0 < \tau_F < \tau_F^A$ and Strategy M or Strategy M2 in $\tau_F^A < \tau_F < \tau$. From (35), the slope of $W_3^{M3}(\tau_F)$ or $W_3^E(\tau_F)$ is steeper than $W_3^M(\tau_F)$ or $W_3^{M2}(\tau_{12})$. Figures 3 and 4 represent the relationship between $W_3^{M3}(\tau_F)$ and $W_3^M(\tau_F)$, and $W_3^E(\tau_F)$ and $W_3^{M2}(\tau_F)$. When $\tau_F = \hat{\tau}_F$, $W_3^{M3}(\hat{\tau}_F) = W_3^M(\tau)$ or $W_3^E(\hat{\tau}_F) = W_3^{M2}(\tau)$ holds. Then, when $T > \frac{16}{3}f$ holds, $\hat{\tau}_F > \tau_F^A$ and the FTA between Countries 1 and 2 decreases the welfare level of Country 3.

5.2 Proof of Lemma 2

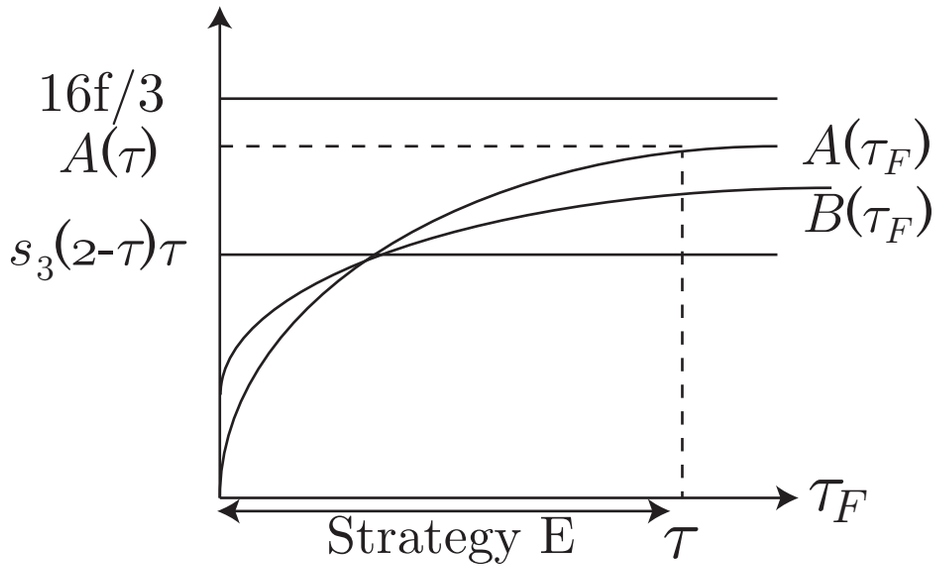
1. When $\frac{16}{3}f > s_3(2-\tau)\tau$, Proposition 1 implies that Firm 1 chooses Strategy E. (35) shows that the welfare level in Country 3 is increasing in the trade costs between Countries 1 and 2. Therefore, an FTA between Countries 1 and 2 always decreases the welfare level in Country 3.

2. When $A(\tau) < \frac{16}{3}f < s_3(2-\tau)\tau$ holds, Proposition 1 implies that Firm 1 chooses Strategy M3. (35) indicates that the welfare level in Country 3 when Firm 1 chooses Strategy M3 is increasing in the trade costs between Countries 1 and 2. Therefore, an FTA between Countries 1 and 2 always decreases the welfare level in Country 3.

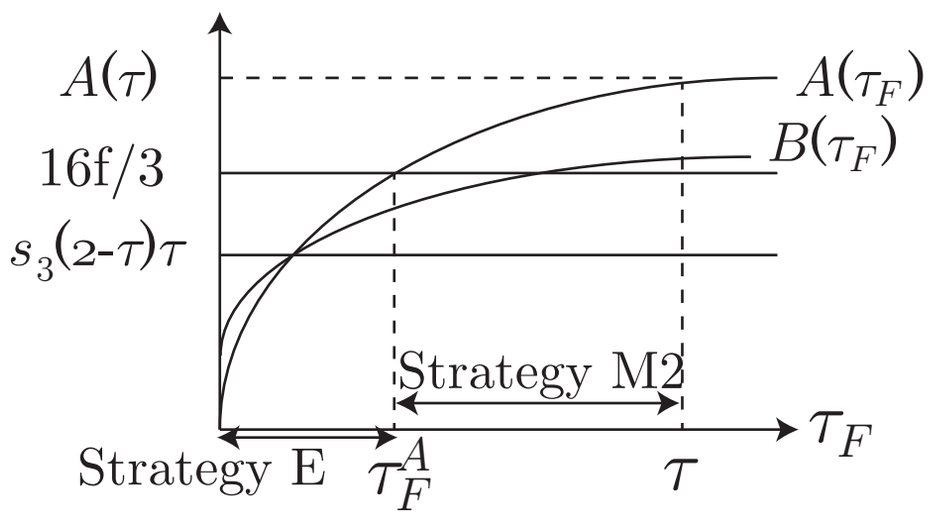
3. When $\frac{16}{3}f < A(\tau)$, Proposition 1 indicates that Firm 1 chooses Strategy M3 in $0 < \tau_F < \tau_F^A$ and Strategy M in $\tau_F^A < \tau_F < \tau$. When $\tau_F = \hat{\tau}_F$, $W_3^{M3}(\hat{\tau}_F) = W_3^M(\tau)$ holds in Figure 4. When $T < \frac{16}{3}f < A(\tau)$ holds, $\hat{\tau}_F < \tau_F^A$ in Figure $4-1$. Thus, an FTA between Countries 1 and 2 increases the welfare level of Country 3 in $\hat{\tau}_F < \tau_F < \tau_F^A$ and decreases the welfare level of Country 3 in $0 < \tau_F < \hat{\tau}_F$.

4. When $\frac{16}{3}f < T < A(\tau)$, Proposition 1 shows that Firm 1 chooses Strategy M3 in $0 < \tau_F < \tau_F^A$ and Strategy M in $\tau_F^A < \tau_F < \tau$. In addition, when $\frac{16}{3}f < T$ holds, $\hat{\tau}_F$ is larger than τ_F^A in Figure $4-2$. Therefore, an FTA between Countries 1 and 2 always decreases the welfare level of Country 3.

(1) 16f/3>A(τ)



(2)$s_3(2-\tau)\tau$<16f/3<A(τ)



(3)$s_3(2-\tau)\tau$>16f/3

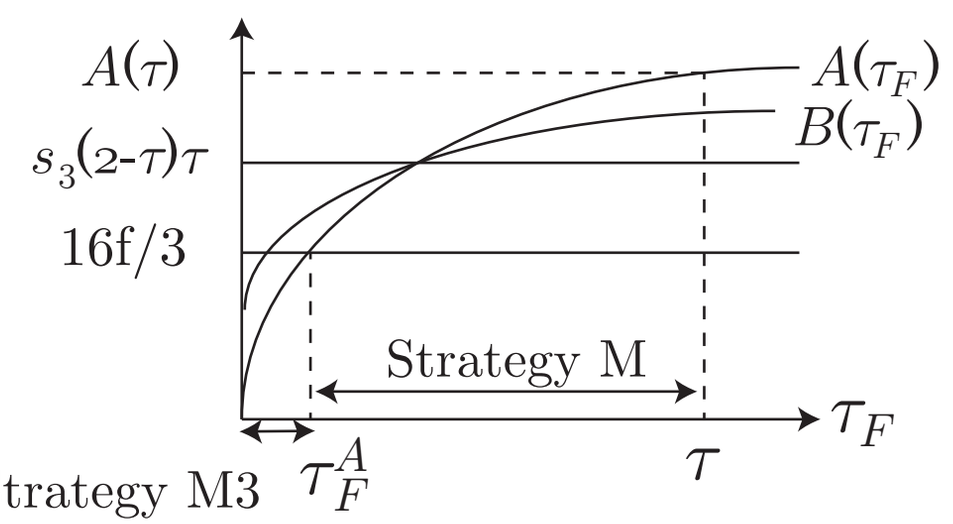
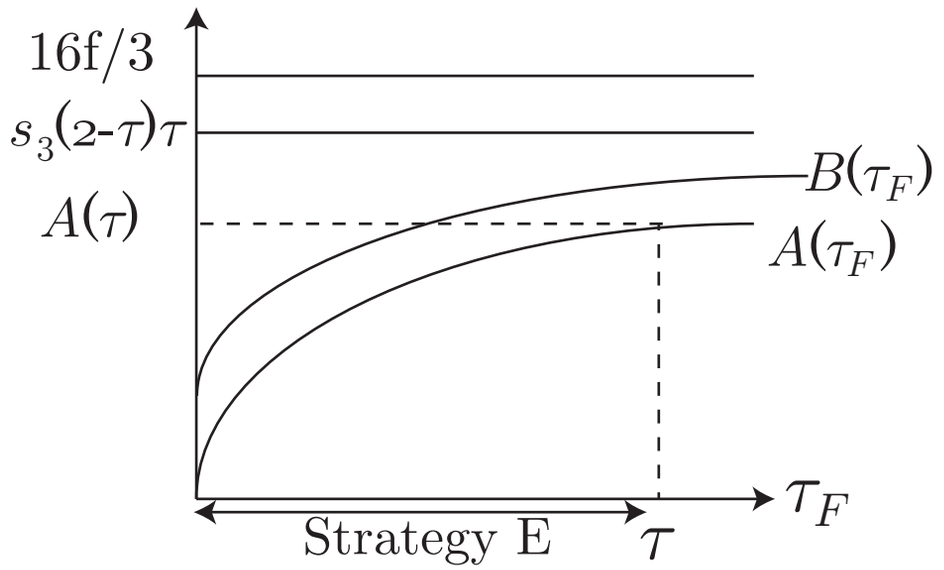
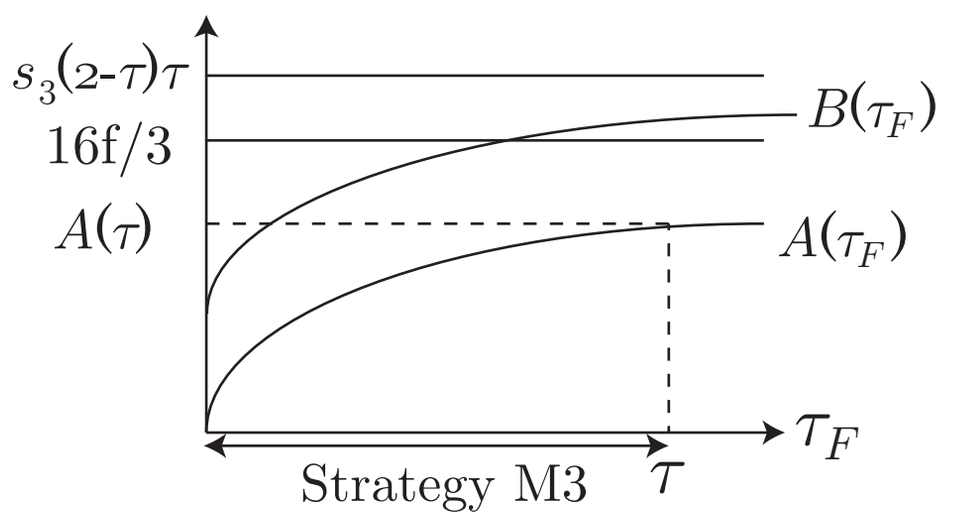


Figure 1: Proof of Propostion 1 when $s_2 > s_3$

(4)16f/3>$s_3(2-\tau)\tau$



(5)A(τ)<16f/3<$s_3(2-\tau)\tau$



(6)A(τ)>16f/3

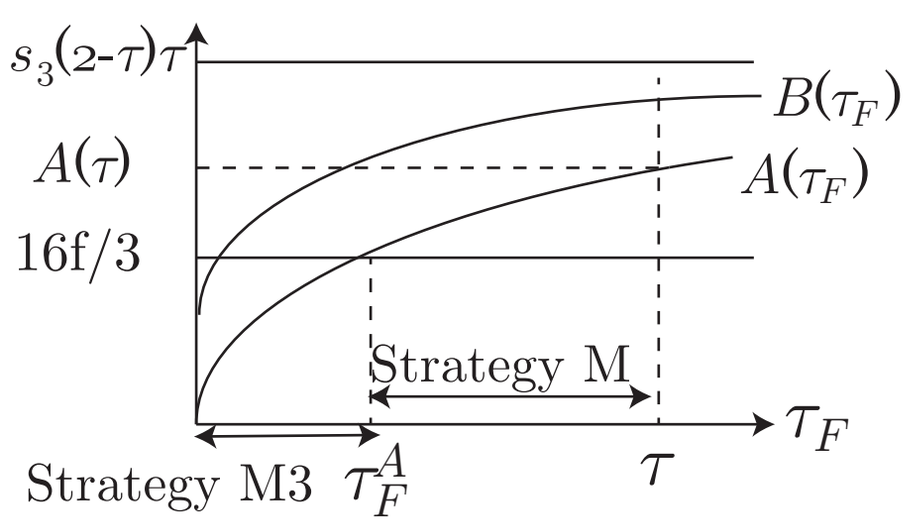
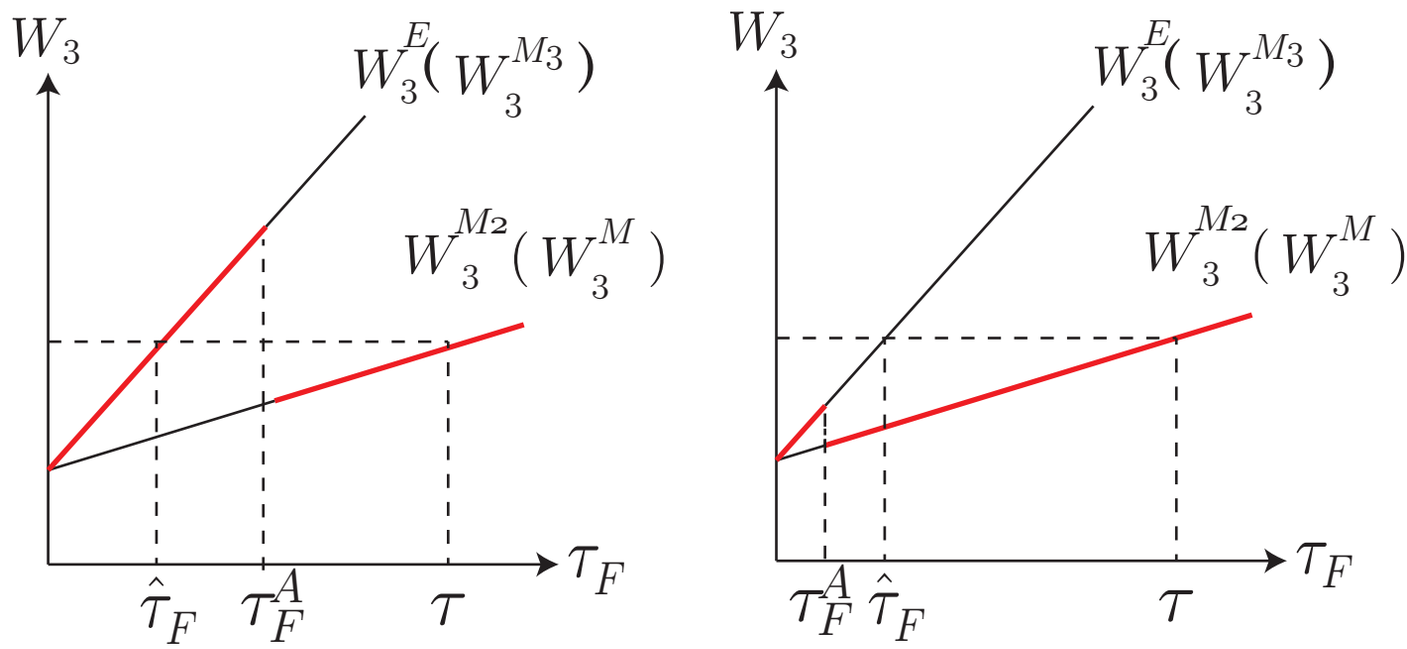
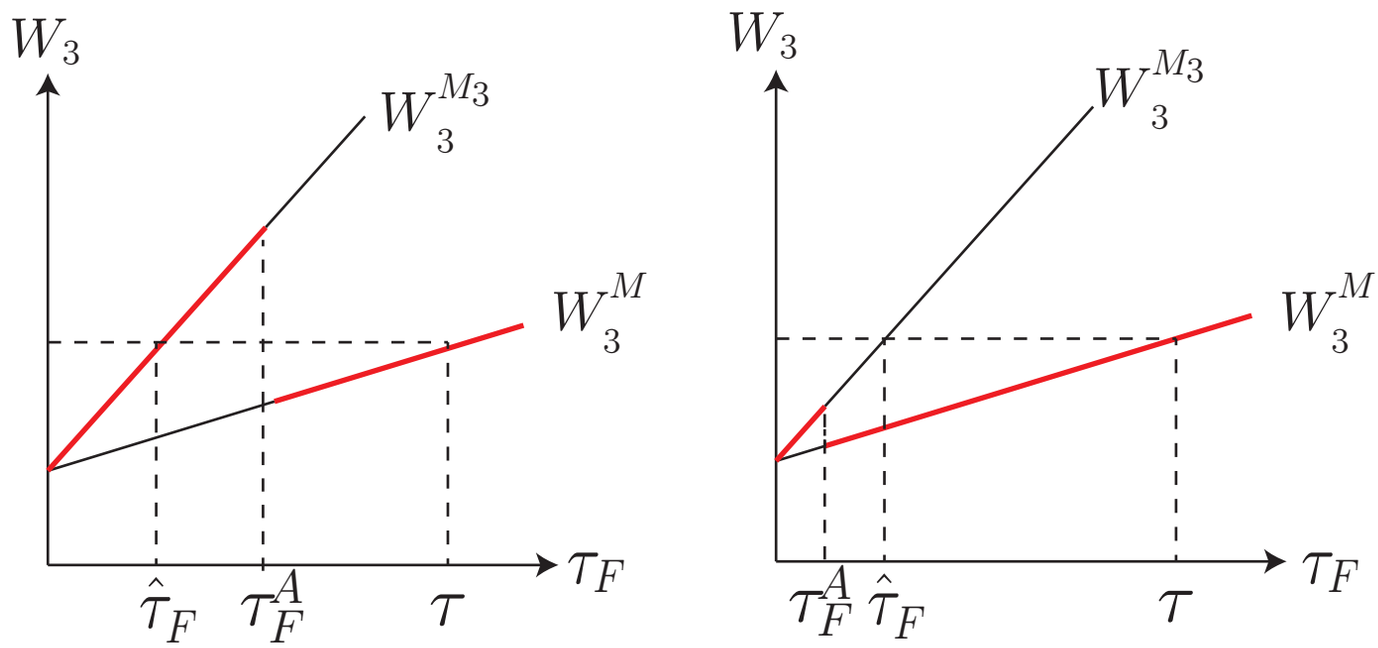


Figure 2: Proof of Propostion 1 when $s_2 < s_3$



3-1: $T<16f/3<A(\tau)$ 3-2: $T>16f/3$

Figure 3: Proof of Lemma 1



4-1: $T<16f/3<A(\tau)$

4-2: $T>16f/3$

Figure 4: Proof of Lemmas 1 and 2