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Abstract

This paper investigates the welfare effect of forming free trade agreements (FTAs) in an international oligopoly model with cost heterogeneity. To receive tariff-free treatment, firms must comply with the rules of origin (ROO) that require them to use a certain fraction of the parts and intermediates produced within the FTA. Firms producing outside of the FTA could undertake either market-oriented or export-platform foreign direct investment (FDIs). The presence of ROO has the following potential effects: (i) making an initially infeasible FTA become feasible by deterring outside firms from undertaking FDI, (ii) inducing an export-platform FDI of a less efficient firm to replace a market-oriented FDI of an efficient firm, or (iii) discharging FDIs made before the FTA was formed and deterring all possible FDIs. These potential effects complicate the welfare effect of FTAs and could decrease consumer surplus in member countries.

Keywords: Rules of origin; Free trade agreements; Foreign direct investment;
JEL classification: F12, F13, F15

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1 Introduction

Preferential trade agreements (PTAs) have remarkably increased throughout the world. As of November 2012, 352 PTAs were in effect and reported to the World Trade Organization (WTO), compared with 28 in 1990. By forming PTAs, member countries reciprocally remove their trade barriers while maintaining trade barriers with non-member countries. Broadly speaking, there are two types of PTAs, free trade agreements (FTA) and customs unions (CU). Each FTA member independently sets external tariffs on non-member countries, while CU members jointly set common external tariffs. Because the external tariffs of the FTA can differ, were it not for rules to distinguish between the products originating within an FTA and those produced outside an FTA, non-members would supply their goods to member countries through the members with the lowest tariff. To prevent such tariff circumvention, rules of origin (ROO) are indispensable for implementing FTAs. ROO condition goods to be certified as produced within an FTA only if a "substantial transformation" occurred there.[1]

There are three methods to check the substantial transformation within an FTA: (i) *changes in tariff-classification (CTC) criterion*, (ii) *value-content (VC) criterion*, and (iii) *specific-process (SP) criterion*.[2] The CTC criterion grant the origin if several imported intermediates of member countries are transformed into products with a different tariff-classification. The VC criterion requires producers to add more than a minimum percentage of value within the FTA. The SP criterion requires that certain production or processing be conducted within the FTA. Although the CTC criterion is commonly used in FTAs, the other two methods are frequently combined with the CTC criterion.

Although the primary purpose of ROO is to prevent tariff-circumvention, they can have many side effects. This paper focuses on the effects of ROO on the pattern of foreign

[1]Strictly speaking, ROOs are divided into two categories: non-preferential and preferential origin rules. The former is used for statistical purposes, while the latter is used to judge whether or not advantageous tariff treatments should be provided. The preferential origin rules are divided into two more categories: rules on general preferential treatment for developing countries (i.e. ROO for the Generalized System of Preferences) and rules relating to PTAs.

[2]See Falvey and Reed (1998) and WTO (2002) for details.

direct investments (FDIs). Because FTAs build free-trade zones among member countries, establishing a plant in one member country gives the investing firm an opportunity to make tariff-free exports to other member countries. Therefore, the formation of an FTA attracts FDIs from outside countries into member countries. This type of FDI is referred to as a *third-country export-platform FDI*.[3] Firms must meet the requirements of the ROO, however, to enjoy tariff-free exports within FTAs. Stricter ROO raises the cost of obtaining a certificate of "FTA-origin" and reduces outside firms' incentives to undertake export-platform FDIs (P-FDIs). For example, Estevadeordal, López-Córdova, and Suominen (2006) reported that FDI into Mexico after the implementation of North American Free Trade Agreement has flowed in sectors with less-stringent ROOs.

Among others, the VC criterion of ROOs has a similar property to local content requirements (LCRs) imposed on FDI. Both the VC criterion of ROO and LCRs require the investing firms to devote a certain amount of local parts or intermediates in the local production and has become an impediment to FDIs. An important difference is while LCRs are prohibited under WTO rules, the VC criterion of ROOs is a legitimate policy, despite distorting firms' location choices as LCRs do. The CTC and the SP criteria do not explicitly require the local sourcing of parts and intermediates, but they might have a similar property of LCRs because firms need a certain amount of them to change the tariff-classification of goods produced with imported inputs and undertake specific processes in local production.

Another important difference is that the investing firms have an option not to comply with ROOs and not to use tariff-free access within the FTA, but they are obliged to meet the content-rule in the case of LCRs. Hence, if the aim of undertaking an FDI is to serve the local market of the host country, which is referred to as a *market-oriented FDI* (M-FDI) in this paper, ROOs have no effect on that type of FDI. This means that ROOs only raise the cost of undertaking P-FDIs and do not affect that of undertaking M-FDIs. Knowledge of

[3] Export-platform FDIs include situations where the foreign affiliates export their products to the home country, which is referred to as home-country export-platform FDI. See Ekholm, Forsid, and Markusen (2007).

the different effects of ROOs on different types of FDIs is important toward understanding the effects of an FTA on FDIs.

The purpose of this paper is to explore new insights regarding the formation of FTAs in the presence of ROO. The main focus is on how the formation of an FTA changes the location choices made by firms in outside countries, and also how the changes are connected to the restrictiveness of the ROOs. In serving the markets of the inside countries, outside firms choose either exporting from the countries outside the FTA or establishing a plant in the FTA via FDIs. If the established plant serves only the local market, it is an M-FDI. In it serves the market of the other country in addition to serving the local market, it is a P-FDI.[4] Therefore, there are three options as an outside firm's location strategies: (i) **exporting**, (ii) **M-FDI**, and (iii) **P-FDI**. The formation of an FTA basically promotes P-FDI, but it is rather discouraged as the ROOs of the FTA become more stringent.

In addition, this paper considers the heterogeneity in production costs. In the real world, some firms choose FDIs while other firms in the same industry choose exporting to serve a foreign market. Although different location strategies among firms can be partly explained by strategic interactions among firms (see Yomogida, 2007, for instance), they could be also associated with differences in firms' productivity as suggested by Helpman, Melitz, and Yeaple (2004). We construct a simple three-country oligopoly model in which the production costs of firms in the country outside an FTA are heterogeneous and analyze how the cost heterogeneity is related to the welfare effects of an FTA if the FTA has a content-type ROO.

We found that the stringency of a content-type ROO is strongly related to the equilibrium locations of the outside firms. Specifically, an outside firm with a lower marginal cost is more likely to engage in P-FDI if the content-requirement is not so strict, but an outside firm with

[4]Thus, the P-FDI in our model is not a "pure" P-FDI but a mixture of M-FDI and P-FDI. M-FDI firms, however, have an advantage over P-FDI firms in serving a local market. Suppose the production process in one plant cannot be separated depending on the destination of the products. M-FDI firms can choose a production process that minimizes the cost of serving the local market, while P-FDI firms must adjust the production process optimally to serve both the local and the foreign market. Our model takes this difference into account, as discussed later.

a high marginal cost tends to choose P-FDI if the content-requirement is very stringent. The intuitive explanation is as follows. Suppose firms assemble parts and components to produce their products. A cost-efficient firm has a lower production cost than a less-efficient firm because the cost-efficient firm is able to assemble the parts and the inputs produced in its home country more effectively, or it has formed efficient production networks outside the FTA. Content-type ROOs increase the production costs of the firms undertaking P-FDIs by requiring them to use a certain amount of inputs made within the FTA. Given that both types of firms face the same price of input made within the FTA, the degree of an increase in the production cost of the efficient firm is larger than that of the less-efficient firm. Therefore, the content-type ROOs increase the efficient firm's cost of undertaking P-FDI .

The results suggest that there is a case where an FTA with a content-type ROO may deter FDIs or even "destroy" the market-oriented FDIs made before the FTA formation. There is also a case where it causes an "FDI-diversion effect" , which crowds out the M-FDI initially made by a cost-efficient firm while inviting P-FDI undertaken by a less-efficient firm. The FDI-diversion effect benefits member countries at the sacrifice of the welfare of the outside country and world welfare.

1.1 Related studies

This work is related to some previous studies that investigated the effects of PTAs on FDIs (see Motta and Norman, 1996; Donnenfeld, 2003; Raff, 2004; Ekholm, Forslid, and Markusen, 2007; and Blanchard, 2007, among others). Although these papers explored the emergence of P-FDIs in the PTAs, the present paper is distinct from these previous papers because it incorporates a content-type ROO and firm heterogeneity, both of which play key roles in the location choices of outside firms.

This paper also relates to existing theoretical works examining the location choices of heterogeneous firms. Qiu and Tao (2001) found that an LCR may promote FDI by a less efficient firm. Although the logic behind our results and their results is similar, our focus differs from theirs. In addition, these previous studies did not focus on strategic interactions between firms in their location choices by abstracting from the fixed cost for FDI. Ishikawa and Komoriya (2010) investigated strategic location decisions by heterogeneous firms. They showed that equilibrium location patterns are not monotonically changed as the trade costs change. Neither the effect of forming an FTA nor its interaction with ROOs was considered in those papers.

Some previous studies of ROOs investigated the effect of content-type ROOs. The main focus of those papers, however, was on the effect of the ROOs on intermediate-good markets.[5] In contrast, the present study focuses on the final-good market. Specifically, intermediate-good markets are assumed to be perfectly competitive and characterized by a perfectly elastic supply. With this setting, any effect of ROOs on the intermediate goods markets can be ruled out. The final-good market, on the other hand, is under an international oligopoly in which there are strategic interactions among firms. Although Ishikawa, Mukunoki, and Mizoguchi (2007) also used an international oligopoly model to investigate the effects of ROOs on the final-good market, their focus was on the market-segmentation effect of ROOs and they did not consider either content-type ROOs or FDIs.

The remainder of the paper is organized as follows. Section 2 presents the basic model. Sections 3 and 4 derive the pre-FTA equilibrium and the post-FTA equilibrium, respectively. Section 5 explores the effects of FTA-formation with ROOs on the pattern of FDI and on welfare. Section 6 concludes the paper.

2 Model

An international oligopoly model is constructed with three countries denoted by countries A, B, and C . Four firms produce a homogeneous good and compete in the product markets in countries A and B, and it is assumed that the good is not consumed in country C.[6] Unless

[5] See Krishna and Krueger (1995), Krueger (1999), Rosellón (2000), Rodriguez (2001), and Ju and Krishna (2005), among others.

[6] Even if we consider the market in country C, the main results of the paper would remain unchanged as long as the markets are segmented.

otherwise noted, countries A and B are indexed by $i \in \mathcal{N}_I = \{A, B\}$. The two markets are assumed to be segmented, and the inverse demand for this good in country i is given by $P_i(X_i) = a - X_i$ where $P_i(X_i)$ is the consumer price and X_i is the total consumption of the good in country i.

We consider the situation in which countries A and B form an FTA (A-B FTA). By forming an A-B FTA, the two member countries discriminately eliminate the tariffs, t_i, on the products traded between them. Each member keeps the tariff on imports from the rest of the world.

Regarding the production side, firm A and firm B are the firms of country A and country B, respectively. The two firms become inside firms if an A-B FTA is formed, and they are indexed by $j \in \mathcal{N}_I$. The other two firms are the firms of country C and denoted as firm H and firm L. These two firms are referred to as the outside firms if an A-B FTA is formed, and they are indexed by $k \in \mathcal{N}_O = \{H, L\}$ unless otherwise noted. Let $h \in \mathcal{N}_I \cup \mathcal{N}_O$ denote the index of all firms. Each firm assembles a set of parts, components, and intermediates to produce the final product. For expositional convenience, these are simply referred to as parts henceforth. The supply of parts is perfectly elastic in each country. It is assumed that each firm is able to utilize the parts supplied in all countries without incurring tariffs and trade costs.

The production cost of each firm reflects the qualities of the parts as well as its technological condition of assembling parts. It is assumed that the contents of parts used in the production undertaken in the same plant are fixed. In other words, it is highly costly for each firm to adjust production process depending on the destination of the good produced in each plant. It is also assumed that the qualities of the parts supplied in countries A and B are of lower quality than those supplied in country C. This means that all firms use the parts supplied in country C without the restriction on the contents of parts in producing the good.

The outside firm j's unit cost of assembling parts produced in their home-country is given by c_j. Because it is assumed that firm L is more efficient than the other three firms in assembling the parts supplied in country C, $0 \leq c_L < c_H$ holds. Let $d = c_H - c_L > 0$ denote the unit-cost difference. Firm L achieves a lower cost because, for example, it develops a better technology to utilize domestic parts in production, it gains more experience in assembling the domestic parts, or it might be able to make a contract with suppliers that provide specific parts better suited to firm L's production. Regarding the parts supplied in countries A and B, on the other hand, all firms are assumed to face the same technological conditions in assembling them and their unit cost for the parts is constant and given by $\overline{c}$. The unit cost $\overline{c}$ might be the price of parts produced in countries A and B. The assumption implies that firm L cannot carry over its technologic advantage in the utilization of the parts produced in the foreign country. Even if firm L is still superior in assembling parts supplied in countries A and B, such that its marginal cost is given by $\overline{c}' \in (c_L, \overline{c})$, the basic insights of this model remain unchanged as long as $\overline{c} - \overline{c}' < d$, which means that firm L cannot fully transfer the technological advantage enjoyed in its home country.[7]

To simplify the analysis, it is assumed that the fixed costs for FDI that firms A and B incur is sufficiently large that they always locate in their home countries and supply their products from there. Firms H and L, on the other hand, might establish plants in country A and/or country B by undertaking FDIs. As explained in Section 1, two types of FDIs are considered: M-FDI by which the outside firm establishes plants in both countries A and B and supplies only the local market from each plant, and P-FDI, by which the outside firm supplies the product to both countries A and B from a single plant established in either A or B.[8] As long as the market sizes and the production costs are symmetric among the host countries, the firm chooses P-FDI only if the export costs to a particular country are lower

[7] Ishikawa and Komoriya (2010) consider the two cases where foreign production enlarges or shrinks the technological difference between a low-cost firm and a high-cost firm.

[8] Because the potential host countries are symmetric and the markets are segmented, if a firm has an incentive to undertake M-FDI for country A, it necessarily has an incentive to undertake the same FDI for country B. In addition, because it is assumed that firms cannot change the production structure within the same plant, and there are no direct benefits from FDIs to the host countries, the P-FDI in country A and that in country B are indifferent to the firms and to all countries. Thus, the name of the host country can be omitted from each FDI choice.

in the host country that those in the home country.

Firm j has three potential supply choices: exporting from the home country denoted by E, undertaking M-FDI denoted by I_M, and undertaking P-FDI denoted by I_P. Let $\Gamma = \{E, I_M, I_P\}$ denote the set of the choices, $\sigma_k \in \Gamma$ denote firm k's supply choice, and (σ_H, σ_L) represent the pair of the firms' choices. For example, (E, E) represents the case where both firms choose exporting and (E, I_P) represents the case where firm H chooses exporting while firm L undertakes P-FDI. There are nine possible cases. Irrespective of the type of FDI (M-FDI or P-FDI), the firm must incur a fixed cost for FDI, F, per plant they establish. The fixed cost is identical across the two outside firms, and it is not sunk and can be refundable if the firm withdraws the FDI.

The ROOs of an A-B FTA specify a criterion to grant firms located in the FTA tariff-free treatment within the FTA. To meet the ROO, firms need to use a certain fraction (denoted by γ) of parts that originate within the FTA in the production of the final good. The fraction, γ, is explicitly specified when the ROO are based on a VC criterion.[9] Even if the ROOs are based on CTC or SP criteria, firms must practically use a certain fraction of parts to meet their requirements. In this situation, if firm k chooses $\sigma_k = I_P$ whose aim is to utilize tariff-free access within the FTA, it must devote the parts supplied within the FTA up to γ per unit of output. The inside firms also need to adjust their production structure in the same manner to enjoy free trade. Thus, firm h's unit cost of production with P-FDI becomes $\gamma\overline{c} + (1-\gamma)\, c_h = c_h + \gamma\Delta c_h$ where $\Delta c_h \equiv \overline{c} - c_k > 0$. Note that $\Delta c_L > \Delta c_H = \Delta c_A = \Delta c_B$ holds.

[9] Two methods can be used to determine the value contents of products: (i) transaction value method and (ii) net-cost method. The transaction value method evaluates the total value of a product by the price of the product, while the net-cost method evaluates it by the total cost to produce the product. This paper considers the net-cost method. In practice, the net-cost method of ROO calculates the regional value-content of a good as a fraction of the net cost to the total cost to produce the good. The net cost is the total cost minus the cost associated with extra-FTA intermediates. In this framework, the value-content requirement of ROO requires η ($\eta \in [0,1]$) such that $\gamma\overline{c}/\{\gamma\overline{c} + (1-\gamma)c_k\} \geq \eta$ is satisfied. We can easily define a unique level of γ that satisfies this inequality.

The timing of the game is as follows. In the first stage, the outside firms simultaneously choose their respective supply modes. In the second stage, the firms engage in product market competition in countries A and B.

3 Equilibrium without an FTA

In this section, we derive the equilibrium in the absence of an A-B FTA where country i imposes a uniform tariff on imports from all foreign countries. Countries must set a uniform tariff without an FTA due to the Most-Favored-Nation principle of the General Agreement on Tariffs and Trade (GATT) and WTO. In this case, firm k faces the same tariff in exporting to country A (resp. country B) from country C and exporting from country B (resp. country A). Therefore, the outside firm has no incentive to undertake P-FDI and so it can be excluded from each firm's choice. Because the inside countries are symmetric, $t_A = t_B = t$ holds.

The operating profit (gross of the fixed cost for FDI) of firm $j \in \mathcal{N}_I$ and firm $k \in \mathcal{N}_O$ earned in country i are given by

$$\pi_{ji} = [P_i(X_i) - c_j - \lambda_{ji} t] x_{ji}, \quad (1)$$

$$\pi_{ki} = [P_i(X_i) - c_k - (1 - \eta_k) t] x_{ki} \quad (2)$$

where x_{ji} and x_{ki} are the sales of the good in country i by firm j and firm k, respectively. The total sales of the good is given by $X_i = \sum_h x_{hi}$. The parameter λ_{ji} takes $\lambda_{ji} = 0$ if $j = i$ and $\lambda_{ji} = 1$ if $j \neq i$, while $\eta_k = \phi_k(\sigma_k)$ is a function that maps firm k's location choice to parameter values $\eta_k = \{0, 1\}$. Specifically, $\phi_k(E) = \phi_k(I_P) = 0$ and $\phi_k(I_M) = 1$ hold.[10]

3.1 Product market competition

At the third stage, each firm chooses x_{hi} to maximize its profit given the amount of sales by rival firms.[11] By (1) and (2), the first-order conditions of the profit maximizations are given

[10]We let $\phi_k(I_P) = 0$ for analytical convenience.

[11]The main results of this paper would remain unchanged even if we consider a Bertrand competition, as long as the firms' products are differentiated.

by

$$
\begin{aligned}
\frac{\partial \pi_{ji}}{\partial x_{ji}} &= P_i(X_i) - c_j - \lambda_{ji} t + x_{ji} \frac{\partial P_i(X_i)}{\partial x_{ji}} = 0, \\
\frac{\partial \pi_{ki}}{\partial x_{ki}} &= P_i(X_i) - c_k - (1-\eta_k)\, t + x_{ki} \frac{\partial P_i(X_i)}{\partial x_{ki}} = 0.
\end{aligned}
$$

By solving these equations, the equilibrium sales become

$$
x_{ji}^N(\sigma_H, \sigma_L) = \frac{a + \sum_h c_h - 5c_j + (3 - 5\lambda_{ji} - \sum_k \eta_k)t}{5}, \tag{3}
$$

$$
x_{ki}^N(\sigma_H, \sigma_L) = \frac{a + \sum_h c_h - 5c_k - (2 + \sum_{m \in \mathcal{M}_O} \eta_m - 5\eta_k)t}{5}. \tag{4}
$$

Because η_k depends on σ_k, $x_{ji}^N(\sigma_H, \sigma_L)$ and $x_{ki}^N(\sigma_H, \sigma_L)$ are contingent on the supply modes of firms H and L. Because $x_{ii}^N(\sigma_H, \sigma_L) > x_{ji}^N(\sigma_H, \sigma_L)$ and $x_{ki}^N(\sigma_H, \sigma_L) \geq x_{ji}^N(\sigma_H, \sigma_L)$ $(i \neq j)$ hold, $x_{ji}^N(\sigma_H, \sigma_L) > 0$ is sufficient for positive sales of all firms in each market. We restrict our attention to the case where $x_{ji}^N(\sigma_H, \sigma_L) > 0$ holds irrespective of the outside firms' location choices. It can be confirmed that $x_{ji}^N(\sigma_H, \sigma_L) > 0$ holds for all $\{\sigma_H, \sigma_L\} \in \Gamma \backslash \{I_P\}$ if the following condition is satisfied:

$$
a > \widetilde{a} \equiv c_H + d + 4t. \tag{5}
$$

The equilibrium profits of firm $h \in \mathcal{N}_I \cup \mathcal{N}_O$ in country i are given by $\pi_{hi}^N(\sigma_H, \sigma_L) = \{x_{hi}^N(\sigma_H, \sigma_L)\}^2$ and the total profits of firm j and firm k are, respectively, given by $\Pi_j^N(\sigma_H, \sigma_L) = \sum_i \pi_{ji}^N(\sigma_H, \sigma_L) - 2\eta_k F$ and $\Pi_k^N(\sigma_H, \sigma_L) = \sum_i \pi_{ki}^N(\sigma_H, \sigma_L)$. The total supply in country i becomes $X_i^N(\sigma_H, \sigma_L) = \sum_h x_{hi}^N(\sigma_H, \sigma_L)$ and consumer surplus in country i is given by $CS_i^N(\sigma_H, \sigma_L) = \int_0^{X_i^N} P(s)ds = \{X_i^N(\sigma_H, \sigma_L)\}^2/2$. The social welfare of country i is the sum of the consumer surplus, the total profits of firm i, and tariff revenue. It is given by $W_i^N(\sigma_H, \sigma_L) = CS_i^N(\sigma_H, \sigma_L) + \Pi_i^N(\sigma_H, \sigma_L) + TR_i^N(\sigma_H, \sigma_L)$, where tariff revenue is calculated by $TR_i^N(\sigma_H, \sigma_L) = \sum_j t_i \lambda_{ji} x_{ji}^N(\sigma_H, \sigma_L) + \sum_k (1-\eta_k)\, t x_{ki}^N(\sigma_H, \sigma_L)$. The welfare of country C is equal to the total profits of the outside firms, $W_C^N(\sigma_H, \sigma_L) = \sum_k \Pi_k^N(\sigma_H, \sigma_L)$, and world welfare is given by $WW^N(\sigma_H, \sigma_L) = \sum_i W_i^N(\sigma_H, \sigma_L) + W^C(\sigma_H, \sigma_L)$.

3.2 Location decisions

Now we investigate the location choices of firms H and L in the first stage. We only need to consider firm k's choice between exporting and M-FDI because the outside firms never choose P-FDI in equilibrium. Let $\Omega_H^{NM}(\sigma_L) \equiv \Pi_H^N(I_M, \sigma_L) + 2F - \Pi_H^N(E, \sigma_L)$ denote the changes in firm H's profits, gross of the fixed cost for M-FDI (i.e., $2F$), by switching its supply mode from exporting to M-FDI. Similarly, let $\Omega_L^{NM}(\sigma_H) \equiv \Pi_L^N(\sigma_H, I_M) + 2F - \Pi_L^N(\sigma_H, E)$ denote the same changes in firm L's profits from M-FDI.

Given σ_L, firm H chooses M-FDI if $\Omega_H^{NM}(\sigma_L) > 2F$ holds and chooses exporting otherwise. Similarly, firm L chooses M-FDI if $\Omega_L^{NM}(\sigma_H) > 2F$ holds and chooses exporting otherwise, given σ_H. We have the following lemma.

Lemma 1 *(i) $\Omega_L^{NM}(E) > \Omega_H^{NM}(E)$ and $\Omega_L^{NM}(I_M) > \Omega_H^{NM}(I_M)$ hold, (ii) $\Omega_k^{NM}(E) > \Omega_k^{NM}(I_M) > 0$ holds, and (iii) $\Omega_L^{NM}(I_M) > \Omega_H^{NM}(E)$ holds if $d > t/5$, and $\Omega_L^{NM}(I_M) \leq \Omega_H^{NM}(E)$ holds otherwise.*

Proof. See Appendix. ■

This lemma suggests that (i) firm L's gain from M-FDI is higher than firm H's gain if evaluated at the same supply mode of the rival firm, because firm L produces with lower unit cost, (ii) each firm's gain from undertaking M-FDI becomes smaller if the rival firm also undertakes M-FDI, meaning that the two firms' FDIs are strategic substitutes, (iii) firm L's best response to firm H's M-FDI is always undertaking M-FDI if the technology gap between firm L and firm H is large and the tariff is small, whereas it might be exporting otherwise.

Given the rival's supply mode, $s \in \Gamma \backslash \{I_P\}$, firm k undertakes M-FDI if $\Omega_k^{NM}(s) > 2F$ holds. Let $\widetilde{F}_L(s)$ and $\widetilde{F}_H(s)$ denote the cut-off fixed costs, which respectively satisfies $\Omega_L^{NM}(s) = 2\widetilde{F}_L(s)$ and $\Omega_H^{NM}(s) = 2\widetilde{F}_H(s)$ for $s \in \Gamma \backslash \{I_P\}$. By the above lemma, we have the following proposition, which characterizes the Nash equilibrium of the two firm's location choices.

Proposition 1 *There exist unique values of the fixed cost for FDI,* $\widetilde{F}_L(E)$, $\widetilde{F}_L(I_M)$, $\widetilde{F}_H(E)$, *and* $\widetilde{F}_H(I_M)$, *such that the equilibrium supply strategies of the firms become: (i)* (E, E) *if* $\widetilde{F}_L(E) \leq F$ *holds, (ii)* (E, I_M) *if* $\widetilde{F}_H(E) \leq F < \widetilde{F}_L(E)$ *holds, (iii)* (E, I_M) *or* (I_M, E) *if* $\widetilde{F}_L(I_M) < \widetilde{F}_H(E)$ *and* $\widetilde{F}_L(I_M) \leq F < \widetilde{F}_H(E)$ *hold, (iv)* (E, I_M) *if* $\widetilde{F}_H(I_M) \leq F < \min[\widetilde{F}_H(E), \widetilde{F}_L(I_M)]$ *holds, and (v)* (I_M, I_M) *if* $0 \leq F < \widetilde{F}_H(I_M)$ *holds.*

Proof. See Appendix. ■

Before the A-B FTA is formed, firm L is more likely to undertake M-FDI in the sense that the M-FDI of firm L can be the unique equilibrium outcome under certain parameterization. This is because, given that the rival firm does not undertake M-FDI, firm L can gain more by making the M-FDI than firm H does (i.e., $\widetilde{F}_L(E) > \widetilde{F}_H(E)$). Because M-FDI by the rival firm decreases each firm's gains from M-FDI (i.e., $\widetilde{F}_L(E) > \widetilde{F}_L(I_M)$ and $\widetilde{F}_H(E) > \widetilde{F}'_L$), however, (I_M, E) also becomes an equilibrium outcome if $\widetilde{F}_L(I_M) \leq F < \widetilde{F}_H(E)$ holds. It cannot be the unique equilibrium outcome, however, because $\widetilde{F}_H(I_M) < F \leq \widetilde{F}_L(E)$ always holds in this case, which means that (E, I_M) is also an equilibrium outcome. If the fixed cost of FDI is sufficiently low (i.e., $F < \widetilde{F}_H(I_M)$), (I_M, I_M) becomes the unique equilibrium outcome, which means that both firms undertake M-FDIs.

4 Equilibrium with an FTA

In this section, we investigate equilibrium in the presence of an A-B FTA. By the FTA, countries A and B reciprocally remove the tariff, t, on the partner country while keeping the tariff on the outside countries at the pre-FTA level. For simplicity, inside firms are assumed to always choose to comply with the ROO and export freely to the partner country. The operating profits of the inside firm j and the outside firm k in county i are given by

$$\pi_{ji} = [P_i(X_i) - c_k - \gamma \Delta c_k] x_{ji}, \tag{6}$$

$$\pi_{ki} = [P_i(X_i) - c_k - (1 - \eta_k) \{\mu_k \gamma \Delta c_k + (1 - \mu_k) t_i\}] x_{ki}, \tag{7}$$

where η_k is the same parameter defined in the previous section and $\mu_k = \psi(\sigma_k)$ is a function that maps firm k's supply strategies σ_k ($\sigma_k \in \Gamma$) to parameter values $\mu_k = \{0, 1\}$. We have $\psi_k(E) = \psi_k(I_M) = 0$ and $\psi_k(I_P) = 1$.

4.1 Product market competition

In the second stage, the four firms compete in the product market given the location decisions of the outside firms and the level of external tariffs. By (6) and (7), the first-order conditions of profit maximizations are given by

$$\begin{aligned}\frac{\partial \pi_{ji}}{\partial x_{ji}} &= P_i(X_i) - c_k - \gamma \Delta c_k + x_{ji} \frac{\partial P_i(X_i)}{\partial x_{ji}} = 0, \\ \frac{\partial \pi_{ki}}{\partial x_{ki}} &= P_i(X_i) - c_k - (1 - \eta_k)\{\mu_k \gamma \Delta c_k + (1 - \mu_k) t_i\} + x_{ki} \frac{\partial P_i(X_i)}{\partial x_{ki}} = 0.\end{aligned}$$

By solving these equations, the equilibrium sales of each firm in country i become:

$$x^F_{ji}(\sigma_H, \sigma_L) = \frac{a - 3(c_j + \gamma \Delta c_j) + \sum_m [c_m (1 - \eta_m)\{\mu_m \gamma \Delta c_m + (1 - \mu_m) t_i\}]}{5}, \tag{8}$$

$$x^F_{ki}(\sigma_H, \sigma_L) = \frac{a + 2(c_j + \gamma \Delta c_j) + \sum_m (5\beta_m - 4)[c_m + (1 - \eta_m)\{(\gamma \mu_m \Delta c_m + (1 - \mu_m) t_i)\}]}{5}, \tag{9}$$

where β_m is the parameter that takes $\beta_m = 0$ if $m = k$ ($m \in \mathcal{N}_O$) and $\beta_m = 1$ if $m \neq k$. We can verify that $x^F_{ki}(\sigma_H, \sigma_L) > 0$ holds as long as (5) holds. We focus on the case where $x^F_{ji}(\sigma_H, \sigma_L) > 0$ holds for any $\{\sigma_H, \sigma_L\} \in \Gamma \backslash \{I_P\}$, meaning that all firms always supply the good to both markets. The necessary and sufficient condition for $x^F_{ji}(\sigma_H, \sigma_L) > 0$ is given by

$$a > \widehat{a} \equiv \overline{c} + \sum_k \Delta c_k. \tag{10}$$

By comparing (5) and (10), we can verify that $\widetilde{a} > \widehat{a}$ is satisfied if $t > \widetilde{t} \equiv 3\Delta c_H/4$ holds and $\widetilde{a} \leq \widehat{a}$ otherwise.

As in the previous section, the equilibrium profits of firm j are given by $\Pi^F_j(\sigma_H, \sigma_L) = \sum_i \{x^F_{ji}(\sigma_H, \sigma_L)\}^2$ and those of firm k are given by $\Pi^F_k(\sigma_H, \sigma_L) = \sum_i \{x^F_{ki}(\sigma_H, \sigma_L)\}^2 - (2\eta_k + \mu_k) F$. The consumer surplus and the tariff revenue in country i are respectively given by $CS_i^F(\sigma_H, \sigma_L) = \{\sum_h x_{hi}^F\}^2/2$ and $TR_i^F(\sigma_H, \sigma_L) = \sum_k (1-\eta_k)(1-\mu_k) t_i x_{ki}^F(\sigma_H, \sigma_L)$. The social welfare of country i is given by $W_i^F(\sigma_H, \sigma_L) = CS_i^F(\sigma_H, \sigma_L) + \Pi_i^F(\sigma_H, \sigma_L) + TR_i^F(\sigma_H, \sigma_L)$. The welfare of country C is given by $W_C^F(\sigma_H, \sigma_L) = \sum_k \Pi_k^F(\sigma_H, \sigma_L)$ and world welfare is given by $WW^F(\sigma_H, \sigma_L) = \sum_i W_i^F(\sigma_H, \sigma_L) + W_C^F(\sigma_H, \sigma_L)$.

4.2 Location decisions

Now we investigate the location choices of firms H and L in the first stage. Let $\Omega_H^{FM}(\sigma_L) \equiv \Pi_H^F(I_M, \sigma_L) + 2F - \Pi_H^F(E, \sigma_L)$ and $\Omega_L^{FM}(\sigma_H) \equiv \Pi_L^F(\sigma_H, I_M) + 2F - \Pi_L^F(\sigma_H, E)$ denote the changes in firm H's profits and those in firm L's profits, gross of the fixed cost for FDI, by switching its supply mode from exporting to M-FDI given the other outside firm's choice. Similarly, let $\Omega_H^{FP}(\sigma_L) \equiv \Pi_H^F(I_P, \sigma_L) + F - \Pi_H^F(E, \sigma_L)$ and $\Omega_L^{FP}(\sigma_H) \equiv \Pi_L^F(\sigma_H, I_P) + F - \Pi_L^F(\sigma_H, E)$ denote those changes by switching the supply mode from exporting to P-FDI given the other outside firm's choice. We have the following lemma

Lemma 2 *At $\gamma = 0$, (i) $\Omega_k^{FP}(s) = \Omega_k^{FM}(s)$ and $\Omega_L^{FP}(s) > \Omega_H^{FP}(s)$ hold for any $s \in \Gamma$, (ii) $\Omega_k^{FP}(E) > \Omega_k^{FP}(I_P)$ holds, and (iii) $\Omega_L^{FP}(I_P) > \Omega_H^{FP}(E)$ holds if $d > t/5$ and $\Omega_L^{FP}(I_P) \leq \Omega_H^{FP}(E)$ holds otherwise.*

Proof. See Appendix. ■

This lemma implies that, when firms do not need to use local inputs to meet ROOs, the outside firms always prefer P-FDI to M-FDI. Both types of FDIs make the investing firm avoid the external tariffs without incurring additional costs to meet ROOs, but the fixed cost is lower in P-FDI than in M-FDI because the two markets are supplied by a single local plant in P-FDI. Therefore, the outside firms have no incentive to choose M-FDI at $\gamma = 0$. It also suggests that gains from P-FDI for firm L are larger than those for firm H if evaluated with the rival's same strategy. This means that whenever it is profitable for firm H to choose P-FDI given that firm L chooses exporting, it is also profitable for firm L to choose P-FDI though the reverse does not hold. This is because the firm with the lower marginal cost can gain more from undertaking FDI than the firm with the higher marginal cost, as long as the

ROO do not require the parts to be sourced locally. This means that, if (I_P,E) becomes an equilibrium outcome, (E, I_P) is also an equilibrium outcome at the same level of fixed cost. In other words, (I_P,E) cannot be a unique equilibrium outcome when $\gamma = 0$ holds.

An increase in γ changes the situation considerably. We first examine the effects of an increase in γ on firms' gains from FDI. We have the following lemma.

Lemma 3 *For any* $\gamma \in [0,1]$*, (i)* $\partial\{\Omega_L^{FP}(I_P)\}/\partial\gamma < 0$ *and* $\partial\{\Omega_L^{FP}(s)\}/\partial\gamma < 0$ *hold for* $s \in \Gamma\backslash\{I_P\}$*, (ii)* $\partial\{\Omega_L^{FP}(s)\}/\partial\gamma < \partial\{\Omega_H^{FP}(s)\}/\partial\gamma$ *holds for* $s \in \Gamma$*, (iii)* $\partial\{\Omega_k^{FM}(s)\}/\partial\gamma > 0$ *holds for* $s \in \Gamma$*, and (iv)* $\partial\{\Omega_H^{FM}(I_P)\}/\partial\gamma \geq \partial\{\Omega_L^{FM}(I_P)\}/\partial\gamma > \partial\{\Omega_k^{FM}(s)\}/\partial\gamma$ *holds for* $s \in \Gamma\backslash\{I_P\}$*.*

Proof. See Appendix. ■

This lemma means that a stricter content-requirement of ROOs reduces firm L's gains from P-FDI more than firm H's gains from P-FDI if evaluated at the same supply mode of the other outside firm. Although an increase in γ raises the cost of all P-FDI firms, it raises the cost of the efficient firm (firm L) disproportionately and narrows the cost-gap between firm L and the other firms. The latter effect hurts firm L but benefits the other firms. Consequently, firm L becomes less willing to make P-FDI than firm H does as the content-requirement of ROOs becomes stricter. It is worth noting that, although the production cost of firm L and those of other firms cannot be reversed, the ranking between $\Omega_L^{FP}(s)$ and $\Omega_H^{FP}(s)$ $(s \in \Gamma)$ can be reversed when γ is high enough under a particular parameterization range. As for M-FDI, on the other hand, both outside firms become more willing to undertake M-FDI as γ becomes higher because the firm that undertakes M-FDI is free from the cost of meeting the ROOs while the inside firms and the firm that makes P-FDI must incur the cost.

Because a stricter content-requirement of ROOs in general increases the relative attractiveness of M-FDI to P-FDI, the outside firm may prefer M-FDI to P-FDI when γ is sufficiently high. Let $\widehat{F}_L(s)$ and $\widehat{F}_H(s)$ denote the fixed costs, making $\widehat{F}_L(s) = \max[\Omega_L^{NP}(s),$ $\Omega_L^{NM}(s)/2]$ and $\widehat{F}_H(s) = \max[\Omega_L^{NP}(s),\ \Omega_L^{NM}(s)/2]$ for $s \in \Gamma$. We have the following lemma.

Lemma 4 *If* $\Omega_L^{NP}(s) < \Omega_L^{NM}(s)/2$ *holds at* $\gamma = 1$*, there exists a unique level of* γ*,* $\widehat{\gamma}_k(s) \in (0,1)$*, such that* $\Omega_L^{NP}(s) \geq \Omega_L^{NM}(s)$ *holds for* $\gamma \in [0, \widehat{\gamma}_k(s)]$ *and* $\Omega_L^{NP}(s) < \Omega_L^{NM}(s)$ *holds for* $\gamma \in (\gamma_k(s), 1]$*. Otherwise,* $\Omega_L^{NP}(s) \geq \Omega_L^{NM}(s)$ *always holds.*

Firm k prefers P-FDI to M-FDI under $\gamma \in [0, \widehat{\gamma}_k(s)]$ and it prefers M-FDI to P-FDI under $\gamma \in (\gamma_k(s), 1]$. For expositional convenience, we set $\widehat{\gamma}_k(s) = 1$ if $\Omega_L^{NP}(s)$ is always greater than $\Omega_L^{NM}(s)/2$ for all $\gamma \in [0,1]$. Let $\sigma_k = \varphi_k(\sigma_{-k})$ be the best response function of firm k's choice of supply mode to the action of the other outside firm, σ_{-k}. We have

$$\varphi_k(\sigma_{-k}) = \begin{cases} E & \text{if } F > \widehat{F}_k(\sigma_{-k}) \\ I_M & \text{if } F < \widehat{F}_k(\sigma_{-k}) \text{ and } \gamma \in (\widehat{\gamma}_k(\sigma_{-k}), 1] \\ I_P & \text{if } F < \widehat{F}_k(\sigma_{-k}) \text{ and } \gamma \in [0, \widehat{\gamma}_k(\sigma_{-k})] \end{cases}.$$

Figure 1 depicts how the level of F and that of γ are related to the best response of firm k when $\widehat{\gamma}_k(\sigma_{-k}) < 1$ holds.

[Insert Figure 1 around here]

By combining the best responses of the two firms, we can derive the possible location equilibria in the presence of an A-B FTA. The full characterization of the equilibrium is, however, highly complicated because it depends on six cut-off levels of fixed costs and each cut-off level depends on the restrictiveness of the ROOs, γ. The level of γ changes each firm's gains from P-FDI and M-FDI, and the magnitudes (and possibly the directions) of those changes are different between the two outside firms. Therefore, the strategic interactions between the outside firms in determining their location choices become more diversified.[12]

The following proposition summarizes the conditions under which each location outcome becomes the equilibrium outcome of the game.

[12]Specifically, we cannot determine the ranking between any combinations of $\widehat{F}_H(\sigma_L)$ and $\widehat{F}_L(\sigma_H)$ for $\{\sigma_{H,}\sigma_{H,}\} \in \Gamma$ as well as the ranking between $\widehat{\gamma}_H(s)$ and $\widehat{\gamma}_L(s)$ for $s \in \Gamma$.

Proposition 2 *The equilibrium location choices become*

(i) (E, E) *if* $F \geq \max[\widehat{F}_H(E), \widehat{F}_L(E)]$ *holds,*

(ii) (E, I_P) *if* $\gamma \leq \widehat{\gamma}_L(E)$ *and* $\widehat{F}_L(E) > F \geq \widehat{F}_H(I_P)$ *hold,*

(iii) (I_P, E) *if* $\gamma \leq \widehat{\gamma}_H(E)$ *and* $\widehat{F}_H(E) > F \geq \widehat{F}_L(I_P)$ *hold,*

(iv) (I_P, I_P) *if* $\gamma \leq \min[\widehat{\gamma}_L(I_P), \widehat{\gamma}_L(I_P)]$ *and* $F < \min[\widehat{F}_H(I_P), \widehat{F}_L(I_P)]$ *hold,*

(v) (E, I_M) *if* $\gamma > \widehat{\gamma}_L(E)$ *and* $\widehat{F}_L(E) > F \geq \widehat{F}_H(I_M)$ *hold,*

(vi) (I_M, E) *if* $\gamma > \widehat{\gamma}_H(E)$ *and* $\widehat{F}_H(E) > F \geq \widehat{F}_L(I_M)$ *hold,*

(vii) (I_P, I_M) *if* $\widehat{\gamma}_L(I_P) < \gamma \leq \widehat{\gamma}_H(I_M)$ *and* $F < \min[\widehat{F}_H(I_M), \widehat{F}_L(I_P)]$ *hold,*

(viii) (I_M, I_P) *if* $\widehat{\gamma}_H(I_P) < \gamma \leq \widehat{\gamma}_L(I_M)$ *and* $F < \min[\widehat{F}_H(I_P), \widehat{F}_L(I_M)]$ *hold, and*

(viiii) (I_M, I_M) *if* $\gamma > \min[\widehat{\gamma}_L(I_M), \widehat{\gamma}_L(I_M)]$ *and* $F < \min[\widehat{F}_H(I_M), \widehat{F}_L(I_M)]$ *hold.*

The proposition means that all possible combinations of the two firms' location choices can be the equilibrium outcome in the presence of an A-B FTA. To assess the effects of a content-requirement of ROOs, we should first focus on the possible equilibrium outcomes when complying with ROOs does not require the parts to be sourced locally (i.e., $\gamma = 0$).

Corollary 1 *At* $\gamma = 0$*, the equilibrium locations of the outside firms with an A-B FTA become: (i)* (E, E) *if* $\widehat{F}_L(E) < F$ *holds, (ii)* (E, I_P) *if* $\widehat{F}_H(E) < F \leq \widehat{F}_L(E)$ *holds, (iii)* (E, I_P) *and* (I_P, E) *if* $\widehat{F}_L(I_P) < \widehat{F}_H(E)$ *and* $\widehat{F}_L(I_P) < F \leq \widehat{F}_H(E)$ *hold, (iv)* (E, I_P) *if* $\widehat{F}_H(I_P) < F \leq \min[\widehat{F}_H(E), \widehat{F}_L(I_P)]$ *holds, (v)* (I_P, I_P) *if* $0 < F \leq \widehat{F}_H(I_P)$ *holds.*

Proof. See Appendix. ■

If $\gamma = 0$, the outside firms never choose M-FDI because P-FDI realizes the same operating profits as M-FDI, while P-FDI saves the fixed cost. According to the same reasoning that holds for the pre-FTA situation, (I_P, E) cannot be the unique equilibrium outcome because $\widehat{F}_H(I_P) < F < \widehat{F}_L(E)$ always holds whenever $\widehat{F}_L(I_P) < F < \widehat{F}_H(E)$ holds at $\gamma = 0$.

Figure 2 depicts a numerical example of the cut-off level of fixed costs where the parameters are set at $a = 60$, $t = 7$, $\overline{c} = 5$, $.c_H = 4$, and $c_L = 0$. Under the parameterization, $\Omega_H^{FP}(s) > \Omega_H^{MP}(s)$ holds for all $s \in \Gamma$ and for all $\gamma \in [0, 1]$ so that firm H always prefers P-FDI to M-FDI.

[Insert Figure 2 around here]

By considering the best responses of each firm in all regions of Figure 3, the possible equilibria with the A-B FTA under the parameterization are depicted in Figure 3. Possible equilibria without the A-B FTA are also shown in the figure.

[Insert Figure 3 around here]

It is worth noting that, as depicted in the figure, (I_P, E) may become the unique equilibrium outcome with an FTA when $\gamma > 0$. We have another corollary.

Corollary 2 *With the A-B FTA,* (I_P, E) *becomes the unique equilibrium outcome if* $0 < \gamma \leq \widehat{\gamma}_H(E)$ *and* $\widehat{F}_H(E) > F \geq \max[\widehat{F}_L(E), \widehat{F}_L(I_P)]$ *hold.*

The corollary indicates that an FTA with ROOs may promote P-FDI by a less-efficient firm rather than P-FDI by an efficient firm.

5 Effects of FTA formation and ROO

Here, we investigate the effects of the A-B FTA on the locations of firms and how the effects are connected to the restrictiveness of the ROOs. We also discuss the welfare effects of the A-B FTA in the presence of FDI and ROO. For clarification, we assume $d > t/5$ holds hereafter so that (I_M, E) cannot be the equilibrium outcome without the A-B FTA and also (I_P, E) cannot be the equilibrium outcome with the A-B FTA and $\gamma = 0$.

5.1 Effects of FTA formation on equilibrium locations

Four effects of the FTA formation on the outside firms' FDIs are explored below.

First, the formation of the A-B FTA may induce an FDI of the outside firm without crowding out the FDI by the other firm made before the A-B FTA, which is called the *FDI creation effect*. Second, the firm that initially undertook the M-FDI may shut down one of the two plants due to the formation of the A-B FTA and change its supply mode to P-FDI, which is called the *FDI consolidation effect*. Third, the FTA formation may induce the firm that made the M-FDI before the A-B FTA to withdraw the FDI without inducing any FDI by the other firm, which is called the *FDI destruction effect.* Finally, there is the case where the formation of the A-B FTA crowds out the M-FDI initially made by the efficient firm (firm L) and instead induces P-FDI by the less-efficient firm (firm H), which is called the *FDI diversion effect.*

By Lemma 2, we can verify that $\widetilde{F}_k(E) < \widehat{F}_k(E)$ and $\widetilde{F}_k(I_M) < \widehat{F}_k(I_P)$ hold at $\gamma = 0$. We can observe the FDI creation effects when the fixed cost for FDI satisfies $\widetilde{F}_L(E) \leq F < \widehat{F}_L(E)$, because the M-FDI is unprofitable before the A-B FTA, but P-FDI is profitable after the A-B FTA. If the fixed cost of the FDI satisfies $F < \widetilde{F}_L(E)$, FTA formation is accompanied by the FDI consolidation effect as long as γ is not very large. This is because M-FDI is profitable before the FTA and P-FDI is also profitable after the FTA. Because a ROO with a stricter content requirement reduces gains from P-FDI, it reduces both the FDI creation effect and the FDI consolidation effect.

Regarding M-FDI, we can easily verify that $\Omega_k^{NF}(s) < \Omega_k^{NM}(s)$ holds for all $s \in \Gamma \backslash \{I_P\}$. This means that FTA formation makes M-FDI less attractive for each outside firm. This is because tariff elimination between the member countries increases the degree of competition in each inside market, and thereby reduces the gains from undertaking M-FDI. Hence, if γ is high enough to deter P-FDIs by both firms, FTA formation may have an FDI destruction effect.

As we have seen, ROOs with a stricter content requirement narrow and even reverse the ranking of the gains from P-FDI between firm L and firm H. Therefore, (I_P, E) can be a unique equilibrium outcome under the FTA when γ is high (see Corollary 2). In this case, FTA formation comes with an FDI diversion effect. Specifically, the FDI diversion effect emerges if $\gamma \leq \widehat{\gamma}_H(E)$ and $\min[\widetilde{F}_L(E), \widehat{F}_H(E)] > F \geq \max[\widehat{F}_L(E), \widehat{F}_L(I_P)]$ hold.

5.2 Effects of FTA formation on welfare

Here, we discuss how FTA formation and FTA-induced changes in firms' locations affect consumer surplus and welfare. The welfare effects of FTA formation can be decomposed into the following three effects: (i) the direct effect of internal tariff elimination, (ii) the effect due to the location changes of the outside firms, and (iii) the effect of an increase in production costs due to the content-requirement of ROOs. For clarity, this paper provides numerical examples to investigate the welfare effects of FTA formation.

Before showing the numerical examples, we first examine as a benchmark the welfare effect of the FTA formation holding the pre-FTA locations of outside firms fixed and firms do not need to use the local inputs to meet the ROO (i.e., $\gamma = 0$). By Proposition 1 and with the assumption that $d > 5/t$ holds, possible pre-FTA locations are (E, E), (E, I_M), and (I_M, I_M). We have the following proposition.

Proposition 3 *If the formation of an A-B FTA does not change the firm's locations and its ROOs do not require firms to use local inputs, it necessarily increases consumer surplus and improves the welfare of member countries and worsens the welfare of non-member countries. It improves world welfare if the cost-difference between the outside firms is small and otherwise worsens it.*

Proof. See Appendix. ■

Note that world welfare can be decreased with FTA formation due to the conventional trade-diversion effect. With the formation of an A-B FTA, a part of sales by the efficient firm (i.e., firm L) is replaced by an increase in exports of the less-efficient inside firms (i.e, firms A and B).

It is also useful to consider how the diversion of FDIs from the low-cost firm's FDI to the high-cost firm's FDI affects the welfare of member countries.

Proposition 4 *Given γ, the FDI diversion from firm L's FDI to firm H's FDI improves the welfare of each member country.*

Proof. We have $W_i^F(I_P, E) - W_i^F(E, I_P) = [2(5-2\gamma)t + \gamma(\{(2-\gamma)d + 2\gamma\Delta c_H)\}]d/10 > 0$ and $W_i^F(I_M, E) - W_i^F(E, I_M) = td > 0$. ■

The proposition implies that, if an infinitesimal change of γ causes the FDI diversion effect by which the equilibrium location changes from (E, I_P) to (I_P, E) or from (E, I_M) to (I_M, E), the member countries benefit from the change. The intuitive explanation is as follows. Although a tariff-jumping FDI by an outside firm increases consumer surplus, it reduces tariff revenue of each member country as well as the profits of the inside firms. Because the latter two effects always dominate the former, if one of the two outside firms were to undertake P-FDI or M-FDI, each inside country would prefer the FDI by the less efficient firm. In other words, member countries may strategically use a content-type ROO to prevent the FDI by the efficient firm and accommodate the FDI by the less efficient firm.

In the numerical examples presented below, we focus on three important cases. The basic parameters are the same as those used in Figure 3: $a = 50$, $t = 7$, $\overline{c} = 5$, $c_H = 4$, and $c_L = 0$. Note that $d > t/5$ is satisfied under this parameterization. We can calculate that $\widetilde{F}_L(E) = 138.88 > \widetilde{F}_L(I_M) = 123.2 > \widetilde{F}_H(E) = 94.08 > \widetilde{F}_H(I_M) = 78.4$. By Proposition 1, the equilibrium outcome before the FTA-formation is (E, E) if $F > \widetilde{F}_L(E)$, (E, I_M) if $F \in (\widetilde{F}_H(I_M), \widetilde{F}_L(E)]$, and (I_M, I_M) if $F \in [0, \widetilde{F}_H(I_M)]$. We can also calculate that $\widehat{F}_L(E) = 246.4 > \widehat{F}_L(I_P) = 215.04 > \widehat{F}_H(E) = 156.8 > \widehat{F}_H(I_P) = 125.44$ at $\gamma = 0$. By Corollary 1, the equilibrium outcome after FTA-formation is (E, E) if $F > \widehat{F}_L(E)$, (E, I_P) if $F \in (\widehat{F}_H(I_P), \widehat{F}_L(E)]$, and (I_P, I_P) if $F \in [0, \widehat{F}_H(I_P)]$ when $\gamma = 0$ holds.

5.2.1 Case 1: ROOs deter the FDI creation effect

Suppose $F = 150$ ($> \widetilde{F}_L(E)$) holds such that both outside firms choose exporting before the formation of an A-B FTA. In this case, the equilibrium outcome after FTA formation becomes (E, I_P) if γ is small. This means that the FDI creation effect is observed when γ is small. If γ is large enough to satisfy $\gamma \geq \gamma_1' = 0.48329$, on the other hand, the equilibrium outcome becomes (E, E).

Figure 4 shows how the A-B FTA changes the welfare of each member, the consumer surplus of each member country, the welfare of the outside country, and world welfare. At $\gamma = 0$, we have $\Delta W_i < 0$, $\Delta CS > 0$, $\Delta W_C < 0$ $\Delta WW < 0$. If the ROOs of the FTA do not require the local sourcing of parts, the FTA induces P-FDI by the efficient firm (firm L). The FDI creation effect of an FTA, however, reduces each member's welfare gain because a decrease in the profits of the domestic firms and in their tariff revenues outweigh the consumers' gains. Although the FTA with the FDI creation effect benefits consumers and firm L, it also decreases the overall profits of the non-member firms and world welfare. This is because the FTA significantly decreases the profit of firm H and a part of the tariff revenues, which works as a transfer from the non-member country to member countries, is absorbed as fixed costs for FDI. Because $\Delta W_i < 0$ holds, the A-B FTA would not be formed given $\gamma = 0$.

[**Insert Figure 4 around here**]

Next, consider the case with $\gamma > 0$. An increase in γ from $\gamma = 0$ is harmful to consumers and worsens world welfare. At $\gamma = \gamma_1'$, the equilibrium location changes from (E, I_P) to (E, E), and the welfare of members and world welfare jump up while consumer surplus and the welfare of the non-members falls. Because the welfare of each member is maximized at $\gamma = \gamma_1'$ in (E, E), if the member countries are able to choose the level of γ, they will set $\gamma = \gamma_1'$, which is the smallest level that deters P-FDI by firm L.

At $\gamma = \gamma_1'$, $\Delta W_i > 0$ holds while $\Delta W_i < 0$ holds at $\gamma = 0$. This implies that a content-type ROO has a role to deter the FDI creation effect of FTA, and may make an initially infeasible FTA feasible. As shown in Figure 4, however, the FTA formation may reduce world welfare ($\Delta WW_i = -1.7919$ at $\gamma = \gamma_1'$) when the level of γ_1' is high and the negative welfare impact of the content-requirement of ROOs is sufficiently large. We obtain the following proposition.

Proposition 5 *A content-requirement of ROOs may make an infeasible FTA feasible by deterring the FDI creation effect, but FTA formation with ROOs may worsen world welfare if the content-requirement is very strict.*

5.2.2 Case 2: ROOs cause the FDI diversion effect

Suppose $F = 130$ holds such that $\Omega_L^{FP}(E) = \Omega_H^{FP}(E)/2 = F$ holds at some $\gamma \in (0,1)$. The equilibrium location outcome before FTA formation is given by (I_M, E). Because $F \in (\widehat{F}_H(I_P), \widehat{F}_L(E)]$ holds, the equilibrium location outcome after the FTA formation changes to (I_P, E) if γ is small. This means that the FDI consolidation effect is obtained with a small γ, with which firm L changes its FDI from M-FDI to P-FDI.

As the content requirement of the ROOs becomes stricter, the equilibrium location outcomes after the A-B FTA become (E, I_P) for $0 \leq \gamma < \gamma_2' = 0.488\,70$, (I_P, E) or (E, I_P) for $\gamma_2' \leq \gamma < \gamma_2'' = 0.59179$, (I_P, E) for $\gamma \in [\gamma_2'', 1]$. Because (I_P, E) can be the equilibrium outcome and it is actually the unique equilibrium outcome for $\gamma \in [\gamma_2'', 1]$, an FTA with ROO content-requirements may cause the FDI diversion effect.

Figure 5 shows how the FTA changes the welfare of each member, the consumer surplus of each member, the welfare of the outside country, and world welfare. At $\gamma = 0$, $\Delta W_i > 0$, $\Delta CS > 0$, $\Delta W_C > 0$, and $\Delta WW > 0$ hold. If the ROOs of the FTA do not require local sourcing of parts, an FTA with the FDI consolidation effect benefits consumers, and improves the welfare of all countries, as well as the world.

[Insert Figure 5 around here]

With a content-type ROO, however, the welfare of each member is maximized at the smallest γ that attains (I_P, E) as the equilibrium outcome. At this level of γ , however, the FTA formation makes non-member countries worse off ($\Delta W_C < 0$). Although consumer surplus and world welfare are still increased by the FTA formation, the gains from the FTA become smaller compared to the case when the FTA formation has the FDI-consolidation effect.

This numerical example suggests that ROO can be used as a strategic tool to deter FDI by an efficient firm and instead promote FDI by a less efficient firm. From the viewpoint of an outside country, consumers, and world welfare, the FDI by the efficient firm should be promoted because it increases the degree of product market competition more and the gains from the FDI are larger for the non-member country. The following proposition summarizes the effect of ROOs.

Proposition 6 *An FTA with a content-requirement of ROO may divert FDI made by an efficient firm to an FDI by a less-efficient firm. An FTA with the FDI diversion effect shifts rents from the non-member to the member countries, while reducing the gains from the FTA formation for consumers and world welfare.*

5.2.3 Case 3: ROOs have an FDI destruction effect

Suppose the fixed cost is set at $F = 138$, so that $F \in (\widehat{F}_H(I_P), \widehat{F}_L(E)]$ holds. The pre-FTA location equilibrium is (E, I_M). As in Case 2, a stricter ROO from $\gamma = 0$ changes the equilibrium locations after the FTA formation into (E, I_P) for $\gamma \in [0, \gamma_3')$, (I_P, E) or (E, I_P) for $\gamma \in [\gamma_3', \gamma_3'')$, (I_P, E) for $\gamma \in [\gamma_3'', \gamma_3''')$, where $\gamma_3' = 0.43997$, $\gamma_3'' = 0.548\,00$, and $\gamma_3''' = 0.83929$. If γ is high enough to satisfy $\gamma \in [\gamma_3''', 1]$, the equilibrium outcome becomes (E, E). At $\gamma = 0$, the A-B FTA has an FDI consolidation effect, which increases the welfare of all the countries, consumer surplus, and world welfare.

An FTA formation with ROOs having a strict content requirements ($\gamma \geq \gamma_3'''$) may lead to an FDI destruction effect, and the member countries would be willing to set $\gamma = \gamma_3'''$ to maximize their welfare. Even if ROOs with a stricter content requirement raise the costs of the inside firms, the negative welfare effect is dominated by the strategic effect by which the FDIs are squeezed out from the FTA.

If the formation of A-B FTA is accompanied by an FDI destruction effect, $\Delta CS < 0$ and $\Delta W_C < 0$ hold. This means that the A-B FTA harms consumers and worsens the welfare of non-member countries. It improves world welfare, however, and the level of world welfare is higher than that attained at $\gamma = 0$. The FDI destruction effect eliminates the fixed cost for M-FDI, and the elimination positively affects world welfare. This numerical example shows that the positive effect of the fixed-cost elimination is greater than the negative welfare effects from a stricter ROO and from the weaker market competition.

Proposition 7 *An FTA with a content-requirement of ROOs may lead to the withdrawal of the FDI made before the FTA formation and deter any FDI after the FTA formation. The FDI destruction effect shifts rents from non-member to member countries, while reducing or even eliminating the consumer gains from the FTA formation, though it may improve world welfare.*

6 Conclusion

This paper constructs an international oligopoly model with cost heterogeneity and investigates the welfare effect of the formation of FTAs. Outside firms can take advantage of free trade within the FTA by undertaking a P-FDI by establishing a single plant to serve all of the markets in the FTA. Outside firms can also undertake an M-FDI by establishing a plant in each country. The ROOs of the FTA specify a content requirement for granting tariff-free treatment within the FTA.

An FTA with ROOs may deter P-FDIs by outside firms, and it can also have an effect in which an FDI by an efficient firm is replaced with an FDI by a less efficient firm (the FDI diversion effect). Although stricter ROOs are basically harmful to consumers and worsen the welfare of all countries holding the firms' location choices fixed, each member country may use stricter ROOs as a strategic tool to manipulate the location patterns by outside firms in favor of their welfare. The strategic use of a content-type ROO may improve the welfare of member countries, but it is harmful to consumers and worsens the welfare of non-member countries. World welfare is either decreased or increased by the presence of ROOs because the patterns of the outsiders' FDIs without ROOs might not be socially desirable. These effects of FTA formation with ROOs were overlooked in the previous studies.

To avoid the FDI diversion effect, the stringency of ROOs should be limited. For instance, Estevadeordal et al. (2007) proposes a WTO-led 'ROO cap' to limit the restrictiveness of ROOs. Besides that, the liberalization of FDI may help reduce the strategic effect of ROO because the FDI diversion effect does not occur if the fixed cost of FDI is sufficiently low.

There remains room for further research. This paper does not consider the endogenous determinations of the tariff level before or after FTA-formation. Previous analyses indicate that if each member country sets pre-FTA and post-FTA external tariffs optimally to increase its own welfare, the formation of an FTA allows each member country to reduce its external tariff from the pre-FTA level, which may also improve the welfare of the outside countries (see Ornelas, 2005, for example). Because the content-requirement of ROOs has similar effects as an increase in the internal tariff, stricter ROOs would lead to higher external tariffs if they are endogenously determined. Moreover, the presence of the FDI diversion effect raises the optimal external tariffs, which hurts non-member countries and worsens world welfare, because each country has an incentive to set a higher tariff on a firm with lower marginal cost. These topics, although worthy of further consideration, are beyond the scope of this paper and should be studied further.

Appendix

Proof of Lemma 1

(i) We have $\Omega_L^{NM}(E) - \Omega_H^{NM}(E) = \Omega_L^{NM}(I_M) - \Omega_H^{NM}(I_M) = 16dt/5 > 0$ and $\Omega_H^{NM}(E) - \Omega_H^{NM}(I_M) = \Omega_L^{NM}(E) - \Omega_L^{NM}(I_M) = 16t^2/25 > 0$. By using (5), we also have $\Omega_H^{NM}(I_M) = 16\left((a-\widetilde{a})+3t\right)t/25 > 0$. (ii) Because we have $\Omega_L^{NM}(I_M) - \Omega_H^{NM}(E) = 18\left(5d-t\right)t/25$, $\Omega_L^{NM}(I_M) > \Omega_H^{NM}(E)$ holds if $d > t/5$ and $\Omega_L^{NM}(I_M) \leq \Omega_H^{NM}(E)$ holds otherwise. ■

Proof of Proposition 1

By Lemma 1, $\widetilde{F}_L(E) > \widetilde{F}_H(E)$, $\widetilde{F}_L(I_M) > \widetilde{F}_H(I_M) > 0$, and $\widetilde{F}_H(E) > \widetilde{F}_H\ I_M)$ are satisfied. Let $\varphi_k\left(\sigma_{-k}\right)$ be the best response action of firm k to the action of the other outside firm, σ_{-k}.

(i) If $\widetilde{F}_L(E) \leq F$ holds such that $\Omega_H^{NM}(s) \leq 2F$ holds for $s \in \Gamma\backslash\{I_P\}$ and $\Omega_L^{NM}(E) \leq 2F$ holds, then we have $\varphi_H(E) = \varphi_H(I_M) = E$ and $\varphi_L(E) = E$. In this case, (E, E) is the unique Nash equilibrium.

(ii) If $\widetilde{F}_H(E) \leq F < \widetilde{F}_L(E)$ holds such that $\Omega_H^{NM}(I_M) < \Omega_H^{NM}(E) \leq 2F < \Omega_L^{NM}(E)$ holds, then we have $\varphi_H(E) = \varphi_H(I_M) = E$ and $\varphi_L(E) = I_M$. In this case, (E, I_M) is the unique Nash equilibrium.

(iii) Suppose $\widetilde{F}_H(I_M) \leq F < \widetilde{F}_H(E)$ holds such that $\Omega_H^{NM}(I_M) \leq 2F < \Omega_H^{NM}(E) < \Omega_L^{NM}(E)$ holds. If d is small enough to make $\widetilde{F}_L(I_M) < \widetilde{F}_H(E)$ and $\widetilde{F}_L(I_M) \leq F < \widetilde{F}_H(E)$ hold, we have $\Omega_H^{NM}(I_P) < \Omega_L^{NM}(I_M) \leq 2F < \Omega_H^{NM}(E) < \Omega_L^{NM}(E)$. Then, the best responses of each firm are $\varphi_H(I_M) = E$, $\varphi_L(E) = I_M$, $\varphi_H(I_M) = E$ and $\varphi_L(E) = I_M$. In this case, (E, I_M) is the unique Nash equilibrium.

(iv) If $\widetilde{F}_H(I_M) \leq F < \min[\widetilde{F}_H(E), \widetilde{F}_L(I_M)]$ holds such that $\Omega_H^{NM}(I_M) \leq 2F < \min[\Omega_H^{NM}(E), \Omega_L^{NM}(I_M)]$ holds, then $\varphi_L(E) = \varphi_L(I_M) = I_M$ and $\varphi_H(I_M) = E$ are the best responses of the firms. In this case, (E, I_M) is the unique equilibrium outcome.

(v) If $0 \leq F < \widetilde{F}_H(I_M)$ holds so that $2F < \Omega_H^{NM}(I_M) < \Omega_H^{NM}(E) < \min[\Omega_L^{NM}(E), \Omega_L^{NM}(I_M)]$ holds, undertaking M-FDI is the dominant strategy for both firms and (I_M, I_M) becomes the unique Nash equilibrium.

Proof of Lemma 2

(i) Because $\Pi_H^F(I_P, s) = \Pi_H^F(I_M, s)$ and $\Pi_H^F(s, I_P) = \Pi_H^F(s, I_M)$ hold at $\gamma = 0$ for $s \in \Gamma$, $\Omega_k^{FP}(s) = \Omega_k^{MP}(s)$ is satisfied for $s \in \Gamma$. We have $\left(\Omega_L^{FP}(s) - \Omega_H^{FP}(s)\right)\big|_{\gamma=0} = 16dt/5 > 0$ for $s \in \Gamma$. (ii) We have $\left(\Omega_k^{FP}(E) - \Omega_k^{FP}(I_P)\right)\big|_{\gamma=0} = 16t^2/25 > 0$.

(iii) Because $\Omega_L^{FP}(I_P) - \Omega_H^{FP}(E) = 16t\,(5d - t)/25$, $\Omega_L^{FP}(I_P) > \Omega_H^{FP}(E)$ holds if $d > t/5$ is satisfied and $\Omega_L^{FM}(I_P) \leq \Omega_H^{FM}(E)$ holds otherwise. ■

Proof of Lemma 3

(i) $\partial(\Omega_H^{FP}(E))/\partial\gamma = -16\Delta c_H\{(a - \widetilde{a}) + 3t\}/25 < 0$ holds. (ii) We can calculate that $\partial(\Omega_H^{FP}(E))/\partial\gamma - \partial(\Omega_L^{FP}(E))/\partial\gamma = 16d\,(a - c + 2\Delta c_H + 4\,(1-\gamma)\,\Delta c_L + t)\,/25 > 0$, $\partial(\Omega_H^{FP}(I_M))/\partial\gamma = -16\Delta c_H\{(a - \widetilde{a}) + 2t\}/25 < 0$ and $\partial(\Omega_H^{FP}(I_M))/\partial\gamma - \partial(\Omega_L^{FP}(I_M))/\partial\gamma = 16d\{a - c + 2\Delta c_H + 4\,(1-\gamma)\,\Delta c_L\}/25 > 0$ and $\partial(\Omega_H^{FP}(I_P))/\partial\gamma - \partial(\Omega_L^{FP}(I_P))/\partial\gamma = 16d\,(a - c + 2\Delta c_H + 4\,(1-\gamma)\,\Delta c_L + t)\,/25 > 0$. We also have $\partial(\Omega_L^{FP}(I_P))/\partial\gamma = -16[\{(a - \widetilde{a}) + 5d + 2\gamma\,(\Delta c_L - 3d)\}\Delta c_L + (\Delta c_L + 3d)\,t]/25$.

It is apparent that $\partial(\Omega_L^{FP}(I_P))/\partial\gamma < 0$ holds if $\Delta c_L \geq 3d$ is satisfied. If $\Delta c_L < 3d$ is satisfied, on the other hand, we have $\partial(\Omega_L^{FP}(I_P))/\partial\gamma < \partial(\Omega_L^{FP}(I_P))/\partial\gamma\big|_{\gamma=1} = -16[\{(a-\widetilde{a}) + \sum_{k\in\mathcal{M}_O}\Delta c_k\}\Delta c_L + (\Delta c_L + 3d)\,t]/25 < 0$.

(iii) We have $\partial(\Omega_H^{FM}(E))/\partial\gamma = \partial(\Omega_L^{FM}(E))/\partial\gamma = \partial(\Omega_H^{FM}(I_M))/\partial\gamma = \partial(\Omega_L^{FM}(I_M))/\partial\gamma = 32\Delta c_H t/25 > 0$. (iv) We can calculate that $\partial(\Omega_L^{FM}(I_P))/\partial\gamma - \partial(\Omega_H^{FM}(E))/\partial\gamma = 16\Delta c_H t/25 > 0$ and $\partial(\Omega_H^{FM}(I_P))/\partial\gamma - \partial(\Omega_L^{FM}(I_P))/\partial\gamma = 16dt/25 \geq 0$ hold. ■

Proof of Corollary 1

By Lemma 2, $\Omega_k^{FP}(s) > \Omega_k^{FM}(s)/2$ holds for $s \in \Gamma$ and then M-FDI will never be the best response for both firms. Let $\widehat{F}_L(E)$, $\widehat{F}_L(I_P)$, $\widehat{F}_H(E)$, and $\widehat{F}_H(I_P)$ be the fixed costs for FDI, which respectively make $\Omega_L^{FP}(E) = F$, $\Omega_L^{FP}(I_P) = F$, $\Omega_H^{FP}(E) = F$, and $\Omega_H^{FP}(I_P) = F$. By Lemma 1, $\widehat{F}_L(E) > \widehat{F}_H(E)$, $\widehat{F}_L(I_P) > \widehat{F}_H(I_P)$ and $\widehat{F}_H(E) > \widehat{F}_H(I_P) > 0$ are satisfied. Let $\varphi_k(\sigma_{-k})$ be the best response action of firm $k \in \mathcal{M}_O$ to the action of the other outside firm, σ_{-k}.

(i) If $\widehat{F}_L(E) \leq F$ holds so that $\Omega_H^{FP}(s) < F$ for $s \in \Gamma$ and $\Omega_L^{FP}(E) \leq F$ holds, then we have $\varphi_H(E) = \varphi_H(I_P) = E$ and $\varphi_L(E) = E$. In this case, (E, E) is the unique equilibrium outcome.

(ii) If $\widehat{F}_H(E) \leq F < \widehat{F}_L(E)$ holds so that $\Omega_H^{FP}(I_P) < \Omega_H^{FP}(E) \leq F < \Omega_L^{FP}(E)$ holds, then we have $\varphi_H(E) = \varphi_H(I_P) = E$ and $\varphi_L(E) = I_P$. In this case, (E, I_P) is the unique Nash equilibrium.

(iii) Suppose $\widehat{F}_H(I_P) \leq F < \widehat{F}_H(E)$ holds such that $\Omega_H^{FP}(I_P) \leq F < \Omega_H^{FP}(E) < \Omega_L^{FP}(E)$ holds. If d is small enough to make $\widehat{F}_L(I_P) < \widehat{F}_H(E)$ and $\widehat{F}_L(I_P) \leq F < \widehat{F}_H(E)$, we have $\Omega_H^{FP}(I_P) < \Omega_L^{FP}(I_P) \leq F < \Omega_H^{FP}(E) < \Omega_L^{FP}(E)$. The best responses of each firm are $\varphi_H(I_P) = E$, $\varphi_L(E) = I_P$, $\varphi_H(I_P) = E$ and $\varphi_L(E) = I_P$. Hence, (E, I_P) is the unique equilibrium outcome.

(iv) If $\widehat{F}'_H \leq F < \min[\widehat{F}_H(E), \widehat{F}_L(I_P)]$ holds such that we have$\Omega_H^{FP}(I_P) \leq F < \min[\Omega_H^{FP}(E),\, \Omega_L^{FP}(I_P)]$, then $\varphi_L(E) = \varphi_L(I_P) = I_P$ and $\varphi_H(I_P) = E$ hold. Hence, (E, I_P) is the unique equilibrium outcome.

(v) If we have $0 < F < \widehat{F}_H(I_P)$ such that $F < \Omega_H^{FP}(I_P) < \Omega_H^{FP}(I_P) < \min[\Omega_L^{FP}(E), \Omega_L^{FP}(I_P)]$ holds, then M-FDI is the dominant strategy for both firms and (I_P, I_P) becomes the unique equilibrium outcome. ■

Proof of Proposition 3

Given $\gamma = 0$, we have $CS_i^F(I_M, I_M) - CS_i^N(I_M, I_M) = \{8(a - \widetilde{a}) + 10d + 31t\}t/50 > CS_i^F(I_M, E) - CS_i^N(I_M, E) = CS_i^F(E, I_M) - CS_i^N(E, I_M) = \{8(a - \widetilde{a}) + 10d + 29t\}t/50 > CS_i^F(E, E) - CS_i^N(E, E) = \{8(a - \widetilde{a}) + 10d + 27t\}t/50 > 0$, $W_i^F(E, I_M) - W_i^N(E, I_M) = \{2(a - \widetilde{a}) + 2d + 9t\}t/10 > W_i^F(I_M, E) - W_i^N(I_M, E) = W_i^F(E, I_M) - W_i^N(E, I_M) = \{2(a - \widetilde{a}) + 2d + 7t\}t/10 > W_i^F(E, E) - W_i^N(E, E) = \{2(a - \widetilde{a}) + 2d + 5t\}t/10 > 0$, and $W_C^F(E, E) - W_C^N(E, E) = -4\{2(a - \widetilde{a}) + 5d + 9t\}t/25 < W_C^F(I_M, E) - W_C^N(I_M, E) = W_C^F(E, I_M) - W_C^N(E, I_M) = -4\{2(a - \widetilde{a}) + 5d + 6t\}t/25 < W_C^F(E, E) - W_C^N(E, E) = -4\{2(a - \widetilde{a}) + 5d + 3t\}t/25 < 0$ hold. Besides that, we have $WW^F(E, E) - WW^N(E, E) = \{2(a - c_H) + 5t - 12d\}t/25 \gtreqless 0 \Longleftrightarrow \{2(a - c_H) + 5t\}/12 \gtreqless d$, $WW^F(I_M, E) - WW^N(I_M, E) = WW^F(E, I_M) - WW^N(E, I_M) \gtreqless 0 \Longleftrightarrow \{2(a - c_H) + 3t\}/12 \gtreqless d$, and $WW^F(I_M, I_M) - WW^N(I_M, I_M) \gtreqless 0 \Longleftrightarrow \{2(a - c_H) + t\}/12 \gtreqless d$. ■

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Figures

Figure 1: Best response in location choices

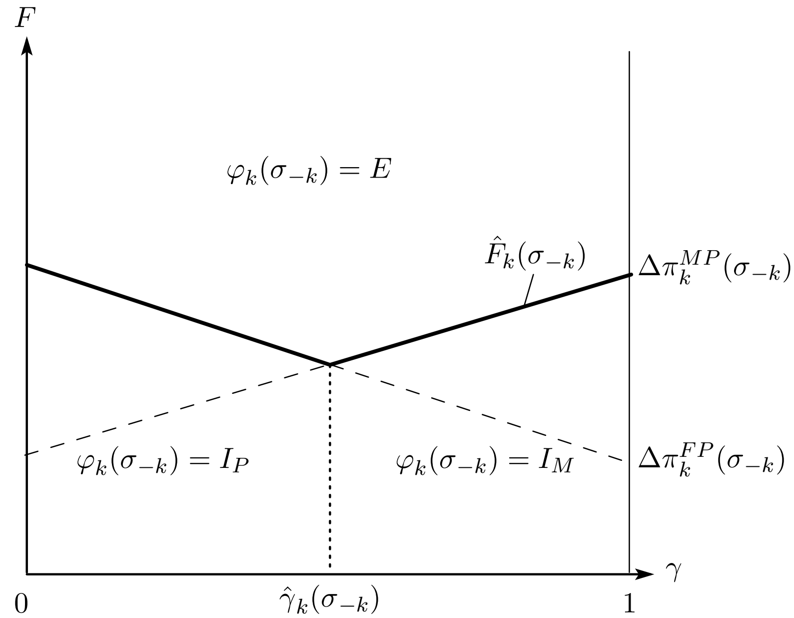

Figure 2: The cut-off fixed costs

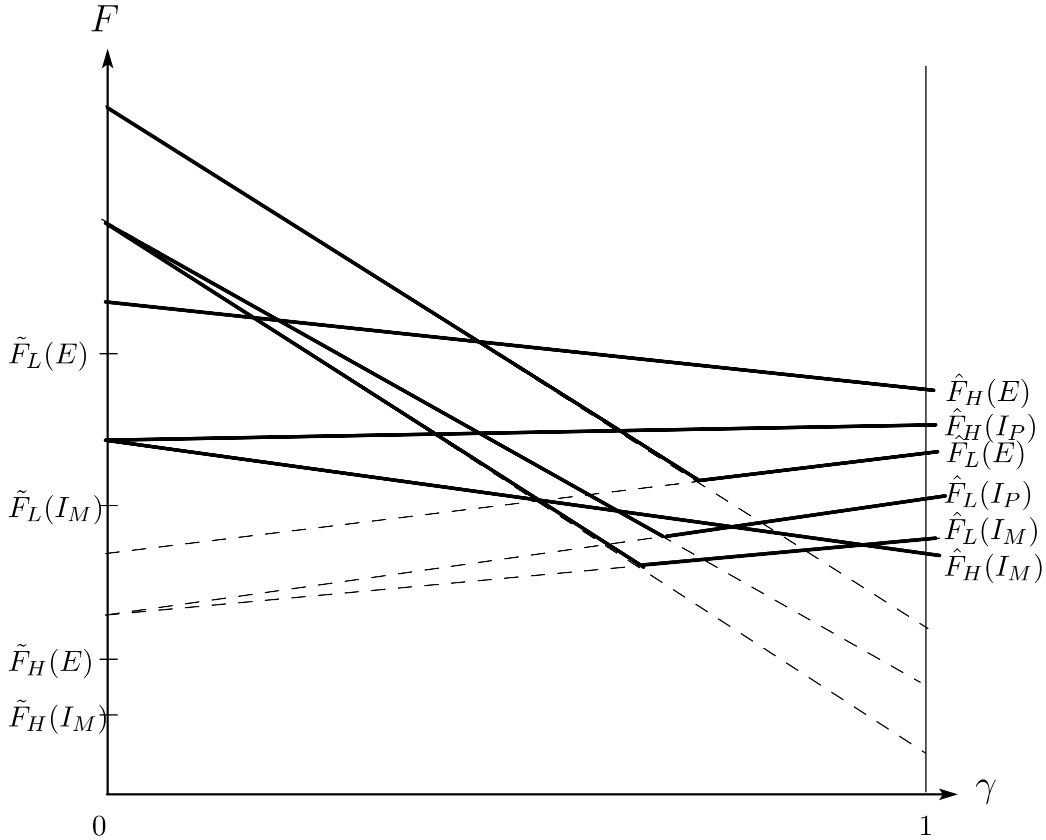

Figure 3: The equilibrium locations

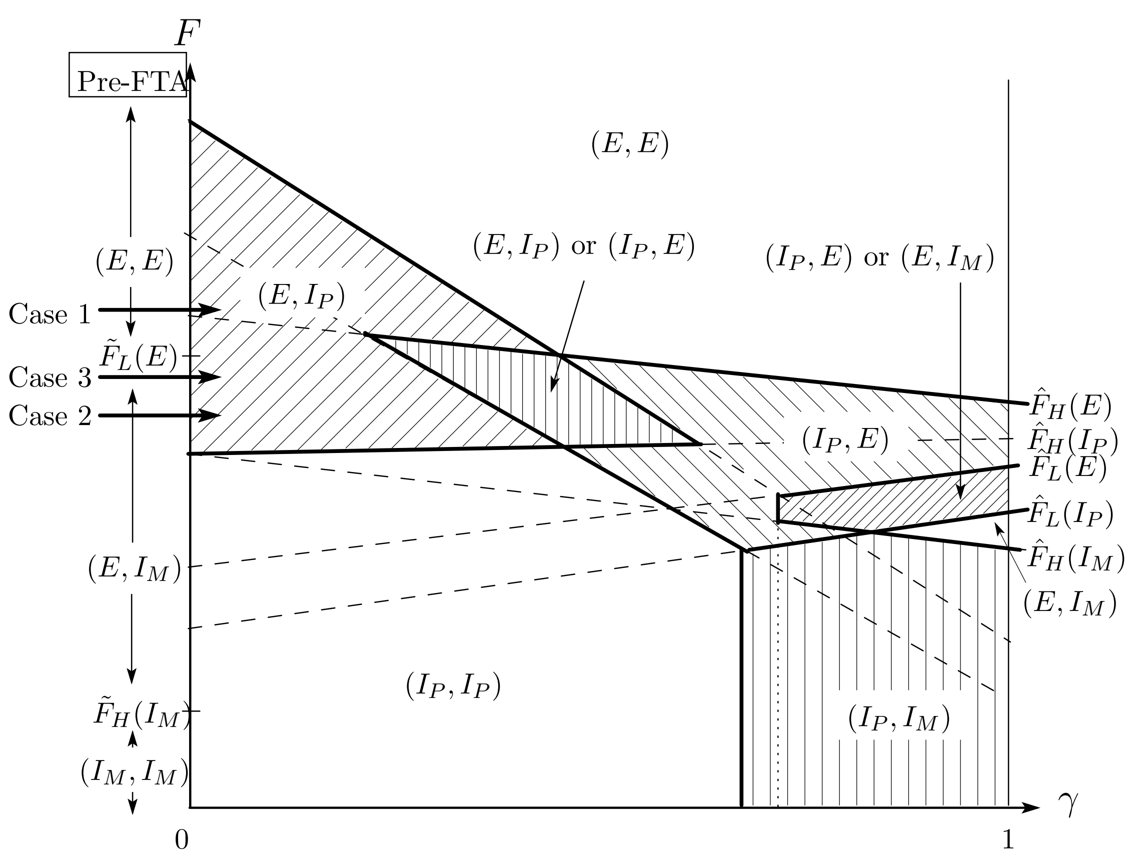

Figure 4: The effect of FTA when ROOs may deter the FDI-creation effect

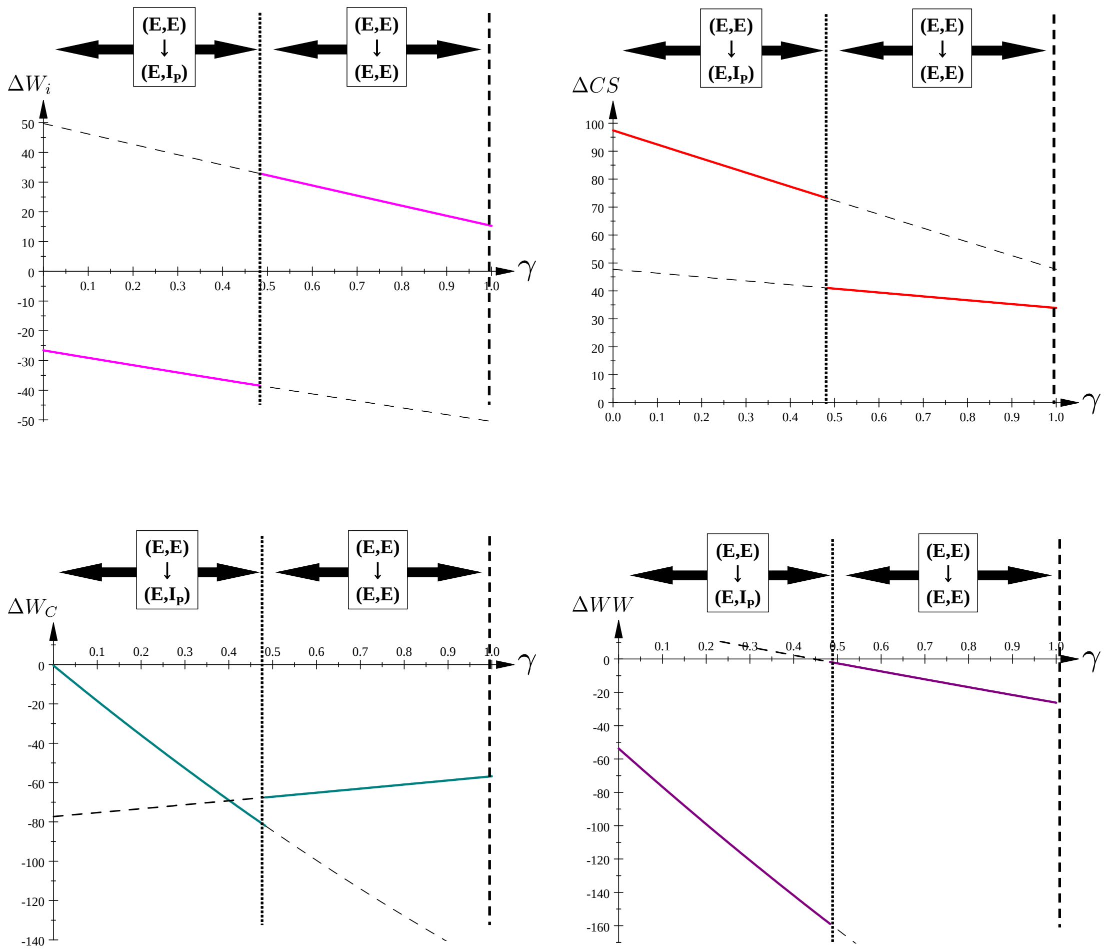

Figure 5: The effect of FTA with the FDI-Consolidation effect or the FDI-diversion effect

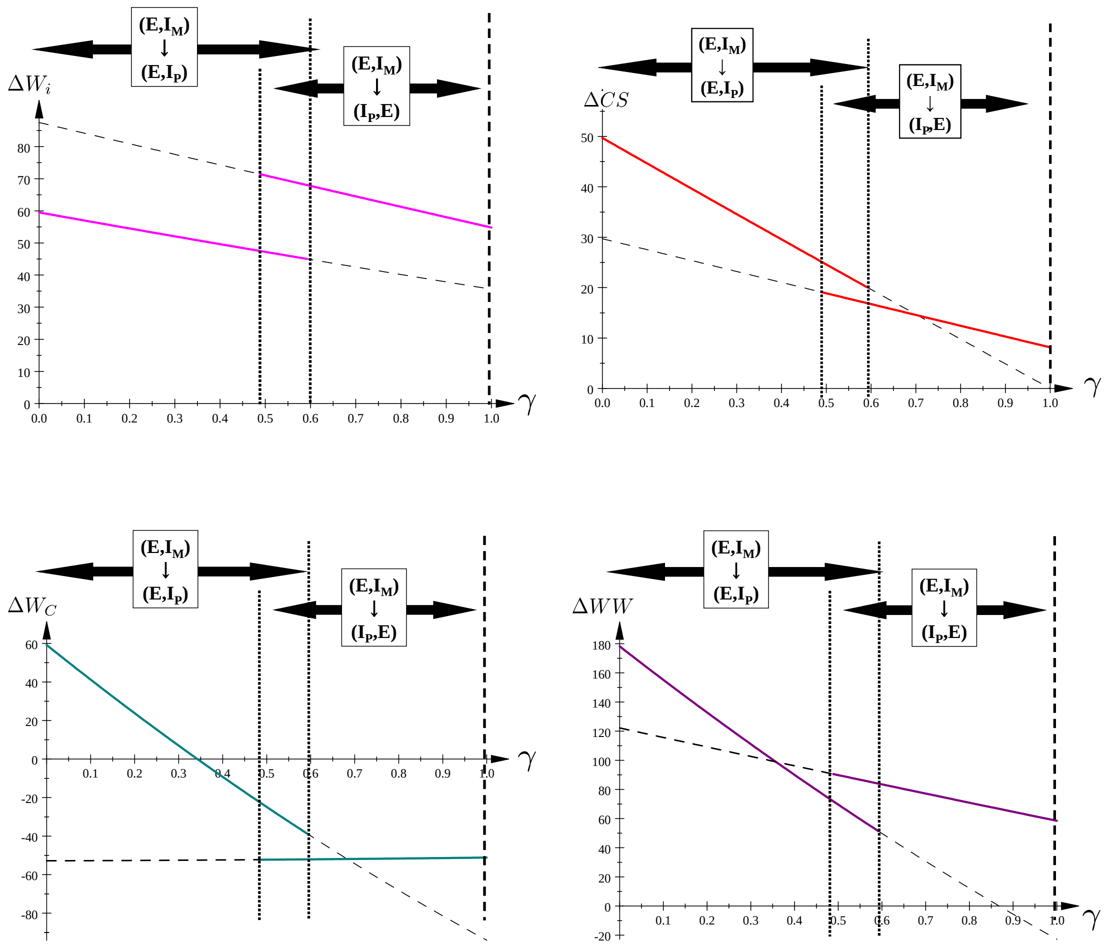

Figure 6: The effect of FTA when ROO may cause the FDI-destruction effect