

TARIFF-JUMPING DIRECT FOREIGN INVESTMENT AND OPTIMAL TARIFFS: A THREE-COUNTRY THREE-FIRM MODEL

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With a three-country (one home and two foreign countries) three-firm model, this paper investigates an optimal import tariff set by a home government subject to tariff-jumping direct foreign investment (DFI) by foreign firms. It is shown that, unlike the existing two-country two-firm model, DFI occurs in equilibrium for some parameterizations of cost and demand conditions. We also show that the host country can be better off with the inflow of tariff-jumping DFI than in the benchmark case where the foreign firms are not allowed to conduct DFI and the home government can set an unconstrained optimal tariff.

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I. INTRODUCTION

This paper investigates an optimal import tariff set by the government of a home country subject to tariff-jumping direct foreign investment (DFI) by foreign firms. We also address the implications of tariff-jumping DFI for the welfare of the home country.

The structure of a market where gigantic multinational firms hold large market shares is generally characterized as oligopoly. The strategic aspects of trade policies in the oligopolistic markets have been greatly emphasized in the recent theory of international trade.¹ For example, in a perfectly competitive market, firms' profits are driven down to zero. Consequently, a country's import tariff only does harm to its national welfare by reducing consumption, which domin-

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¹ See, among others, Brander and Spencer (1984), Dixit (1984) and Helpman and Krugman (1985).

ates the tariff revenues. However, in oligopolistic markets, the tariff brings some of the oligopolistic rents to domestic firms and so, in some circumstances, it can be welfare-improving, compensating the tariff-created loss of consumer surplus.

However, when the import tariff of a country is high enough to more than offset the advantage of exporting over DFI, foreign firms may turn to foreign production and diffuse high tariffs.² That is, tariff-jumping DFI by foreign firms can be an obstacle thwarting the effort by the home government to maximize its national welfare by choosing an optimal tariff.

The optimal tariff set by a home government when a foreign firm can jump the tariff via DFI is the theme of Levinsohn (1989). With a two-country two-firm model, Levinsohn (1989) shows that the optimal tariff is constrained by the difference in the foreign firm's marginal costs of production in two countries since any tariff greater than that induces DFI and hence raises no revenue. As a consequence, DFI never occurs in equilibrium and the presence of DFI is an indication that the home country's tariff is suboptimal.

With an extension to a three-country (one home and two foreign countries) three-firm model, this paper shows that tariff-jumping DFI may arise in equilibrium. The home government sets an optimal tariff with which one of the two foreign firms directly invests into the home country for some parameterizations of underlying cost and demand conditions. With a relatively higher tariff inducing DFI, the home country can be better off than with a DFI-constrained optimal tariff in the sense of Levinsohn (1989) since the sum of incremental local firm's profits and a possible increase in tariff revenues from the exporting firm can more than compensate the loss of consumer surplus and the foregone tariff revenues from the firm which turns to DFI from exporting. However, the home government never sets a tariff that induces both foreign firms to produce abroad.

Furthermore, this paper also shows that, in some circumstances, the host country is even better off with the inflow of tariff-jumping DFI than in the benchmark case where the foreign firms are not allowed to conduct DFI and the home government can set an unconstrained optimal tariff. For a given tariff, the home government can gain from tariff-jumping DFI when the increase in consumer surplus dominates the loss of a domestic firm's profits and the foregone tariff. When this net welfare gain ("a DFI effect") is large enough to more than compensate for the loss of welfare ("a tariff effect") due to the deviation of tariff from its unconstrained optimal level, tariff-induced DFI can in fact help the home country to increase its national welfare.

These findings also have some bearings on the literature with regard to

² This type of tariff-jumping motive for DFI is unarguably one of the major determinants of DFI and is supported by many empirical studies, as summarized by Caves (1996). Non-tariff barriers such as quota and voluntary export restraints also motivate firms to conduct DFI, which can be analyzed in a similar fashion.

so-called "immiserizing growth"³ based on a standard two-commodity two-factor model of international trade. For example, Brecher and Diaz-Alejandro (1978) argue that, in small countries importing capital intensive goods, tariff created distortions in consumption and production and the profits accruing to foreign capitals always render the host economy worse off with additional incoming foreign capitals induced by tariffs. Recently, however, Dehejia and Weichenrieder (2001) argue that the host country can gain from tariff-jumping DFI when it can recoup foregone tariff revenues through taxation of foreign capitals. This paper shows that, in oligopoly markets, the host country may gain from tariff-induced inflow of foreign capitals without relying on additional policy measures such as capital tax.

The remainder of this paper is organized as follows. Section II presents a model. We examine an optimal tariff set by the home government and the foreign firms' optimal choice between exporting and DFI in section III. Section IV provides welfare implications. Finally, Section V concludes.

II. A MODEL

We construct a simple model of a single-period, three-stage game. Consider an economy consisting of three countries: a home country (Country *X*) and two foreign countries (Country *Y* and *Z*, respectively). We assume that there is potentially one firm in each country (denoted by Firm *X*, *Y* and *Z* respectively) and that the firms are Cournot-Nash competitors with identical products.

For simplicity of exposition, it is also assumed that the product in question is consumed only in Country *X*⁴. At the beginning, Country *X* is entirely supplied by Firm *X* located in Country *X*. The size of the market is not large enough to attract profitable entry by foreign firms.

Now, suppose there is an exogenous boost in the demand for the product in Country *X*. The boost can be attributed to a sharp increase in income, a major drop in the price of complementary products and so on. The inverse demand of the product after the boost is characterized by the following linear function:

$$P(Q) = a - bQ, \quad (1)$$

where *P* and *Q* represent price and quantity, respectively, and *a*, *b* > 0 are constants.

Foreign firms then see a new business opportunity in Country *X*. In order to serve Country *X*, a foreign firm can set up a production plant either in its

³ See Bhagwati and Srinivasan (1983) and Ruffin (1984) for surveys of this literature.

⁴ As pointed out by one of the referees of this journal, this may be a rather strong assumption. If we allow consumption of the product in foreign countries, the home government should consider the effect of its tariff on the home firm's profit from exporting to the foreign countries.

national territory or in Country X .⁵ Domestic production by Firm i requires a fixed setup cost, F_i , and a marginal cost, c_i , for $i = X, Y, Z$. Here and in what follows, the subscripts, X, Y and Z , refer to Country (or Firm)⁶ X, Y and Z , respectively. We assume that both fixed and marginal costs are country-specific.⁷ In case the foreign firms operate in Country X , they incur the same amount of fixed and marginal costs as Firm X .

Letting $F_i = 0$ ⁸ for $i = X, Y, Z$ for simplicity of exposition, we make the following assumptions:

$$c_X > c_Y > c_Z, \quad (\text{A.1})$$

$$a > 3c_X - c_Y - c_Z. \quad (\text{A.2})$$

First, if $c_X \leq c_i$ for $i = Y, Z$, Firm i always sets up a plant in Country X regardless of the size of the tariff set by the government of Country X . In this case tariff-jumping DFI is not an issue. Define $k_i = c_X - c_i > 0$ for $i = Y, Z$ representing a measure of a competitive advantage of Country i over Country X . The competitive advantage can be attributed to the differences in interest rates, wages, etc. of the two countries concerned. Second, (A.2) ensures that firms produce a positive amount of output in the absence of an import tariff where a represents the size of the market for the product.

The time sequence of events proceeds as follows. In stage 1 (*Policy-Making Stage*), the government of Country X announces a tariff, t , for a unit of the product imported. Then, given the tariff, foreign firms decide where to locate their production plants in stage 2 (*Plant-Building Stage*). Finally, in stage 3 (*Production Stage*), each firm produces an optimal amount of output to maximize its own profit and the government of Country X collects tariffs from a foreign exporter(s).

⁵ We simply rule out DFI between two foreign countries. Alternatively, it could be modeled as an endogenous outcome by incorporating some match-specific advantages associated with domestic production such as a smoother relationship between labor and management, better understanding of supply conditions of various inputs, and so on.

⁶ The reference would be clear from the context.

⁷ Certainly, production costs consist of both firm-specific and country-specific portions. Incorporation of firm-specific portion of costs would not change the main result of this paper.

⁸ Since the model in this paper is a single period game, we do not consider a strategic switchover of optimal policies over time, such as increasing tariff after the foreign firm has already made sunk investment in its country. Dispensing with this imposition does not change the qualitative aspects of the equilibrium but only affects the firms' participation conditions.

III. AN EQUILIBRIUM

We are interested in a subgame-perfect Nash equilibrium. In order to solve for an equilibrium, we examine the last stage first given the possible decisions made in the previous stages and then move backward up to stage 1.

Production Stage

A firm chooses the level of output to maximize its worldwide profit Π_i , for $i = X, Y, Z$, given the levels of outputs set by its competitors:

$$\begin{aligned}\Pi_X(X) &= (a - bQ - c_X)X \\ \Pi_Y(Y_e, Y_d) &= (a - bQ - t - c_Y)Y_e + (a - bQ - c_X)Y_d \\ \Pi_Z(Z_e, Z_d) &= (a - bQ - t - c_Z)Z_e + (a - bQ - c_X)Z_d,\end{aligned}\tag{2}$$

where X, Y_i, Z_i , for $i = e, d$ represent the output of Firm X, Y, Z , respectively, and subscripts e, d stand for the mode of supplying Country X : e for exporting and d for DFI. Therefore, $Q = X + Y + Z$ with $Y = Y_d + Y_e$ and $Z = Z_d + Z_e$.

It is easy to see that a firm either exports or makes DFI but it never does both at the same time when the marginal costs of production are constant.⁹ Intuitively, with constant marginal costs, production in one country is always more efficient than in the other regardless of the amount of outputs produced. Therefore, firms do not operate multiplants and simply choose the most efficient place for production.

Therefore, we can identify four possible market structures ensuing from the plant-building decisions (I_i) made by two foreign firms: (E, E) , (E, D) , (D, E) and (D, D) , where the first (second) arguments in parentheses represent Firm $Y(Z)$'s decisions, respectively, with $I_i = D$ for DFI and $I_i = E$ for exporting for $i = Y, Z$.

For a given tariff, t , the equilibrium outputs, $X(t)$, $Y(t)$, $Z(t)$, and the resulting profits, $\Pi_i(t)$ for $i = X, Y, Z$, can be easily obtained from maximization of (2) subject to the constraint of the nonnegativity of $X(t)$, $Y(t)$ and $Z(t)$ and the participation condition that $\Pi_i(t) \geq 0$ for $i = X, Y, Z$.¹⁰ For given t , equilibrium outputs and profits under each market structure are given in Table 1 and 2, respectively. If the nonnegativity constraint is violated,

⁹ See also Rowthorn (1992).

¹⁰ The participation condition is always satisfied since the fixed cost is assumed to be zero. If the fixed cost is sufficiently large, firms may not enter the market invalidating three firm model of this paper.

a firm would not build a plant at the outset. In order to avoid unnecessary complications, we focus on t satisfying the above constraint for the time being and see to it that firms produce nonnegative outputs in equilibrium.

[Table 1]

	$X(t)$	$Y(t)$	$Z(t)$
(E, E)	$\frac{1}{4b}(a+2t-3c_X+c_Y+c_Z)$	$\frac{1}{4b}(a-2t+c_X-3c_Y+c_Z)$	$\frac{1}{4b}(a-2t+c_X+c_Y-3c_Z)$
(E, D)	$\frac{1}{4b}(a+t-2c_X+c_Y)$	$\frac{1}{4b}(a-3t+2c_X-3c_Y)$	$\frac{1}{4b}(a+t-2c_X+c_Y)$
(D, E)	$\frac{1}{4b}(a+t-2c_X+c_Z)$	$\frac{1}{4b}(a+t-2c_X+c_Z)$	$\frac{1}{4b}(a-3t+2c_X-3c_Z)$
(D, D)	$\frac{1}{4b}(a-c_X)$	$\frac{1}{4b}(a-c_X)$	$\frac{1}{4b}(a-c_X)$

[Table 2]

	$\pi_X(t)$	$\pi_Y(t)$	$\pi_Z(t)$
(E, E)	$\frac{1}{16b}(a+2t-3c_X+c_Y+c_Z)^2$	$\frac{1}{16b}(a-2t+c_X-3c_Y+3c_Z)^2$	$\frac{1}{16b}(a-2t+c_X+c_Y-3c_Z)^2$
(E, D)	$\frac{1}{16b}(a+t-2c_X+c_Y)^2$	$\frac{1}{16b}(a-3t+2c_X-3c_Y)^2$	$\frac{1}{16b}(a+t-2c_X+c_Y)^2$
(D, E)	$\frac{1}{16b}(a+t-2c_X+c_Z)^2$	$\frac{1}{16b}(a+t-2c_X+c_Z)^2$	$\frac{1}{16b}(a-3t+2c_X-3c_Z)^2$
(D, D)	$\frac{1}{16b}(a-c_X)^2$	$\frac{1}{16b}(a-c_X)^2$	$\frac{1}{16b}(a-c_X)^2$

Plant-Building Stage

Under the given tariff set by the government of Country X in *Policy-Making Stage*, foreign firms decide where to build production plants in order to maximize their profits.

Again, we look for a Nash equilibrium of this subgame. From Table 2, we can see that it is a dominant strategy for a foreign firm to produce in Country X when the home country's tariff is larger than the difference between the marginal costs of domestic and foreign productions¹¹, i.e., $t > k_i$ for $i = Y, Z$. Otherwise, the dominant strategy for the foreign firm is to build a production plant in its national territory.

Therefore, the optimal plant-building decisions, I_i^* , by Firm i for $i = Y, Z$, can be summarized as follows:

- (i) when $t \leq k_Y$, both firms export ($I_Y^* = I_Z^* = E$),
- (ii) when $k_Y < t \leq k_Z$, Firm Y chooses DFI and Firm Z exports, ($I_Y^* = D$,

¹¹ We assume that firms decide to export to Country X when they are indifferent to the two modes of serving the market of Country X .

$$I_Z^* = E),$$

(iii) when $t > k_Z$, both firms choose DFI ($I_Y^* = I_Z^* = D$).

Policy-Making Stage

In *Policy-Making Stage*, the government of Country X selects an optimal tariff, t^* , to maximize its national welfare, $W(t)$, which is defined as the sum of profits of Firm X , consumer surplus and tariff revenues as shown below:

$$W(t) = \begin{cases} W_1(t) = (a - bQ - c_X)X + \frac{bQ^2}{2} + t(Y_e + Z_e), & t \leq k_Y \\ W_2(t) = (a - bQ - c_X)X + \frac{bQ^2}{2} + tZ_e, & k_Y < t \leq k_Z \\ W_3(t) = (a - bQ - c_X)X + \frac{bQ^2}{2}, & t > k_Z. \end{cases} \quad (3)$$

Substitution of the appropriate optimal outputs given in Table 1 into $W_i(t)$ for $i=1,2,3$ shows that $W_1(t)$ and $W_2(t)$ are strictly concave downward while $W_3(t)$ is independent of t . We also note that the following inequalities hold due to the assumptions, (A.1) and (A.2):

$$W_1|_{t=k_Y} - W_2|_{t=k_Y} = \frac{1}{4b}(c_X - c_Y)(a - c_X - c_Y + c_Z) > 0, \quad (4.a)$$

$$W_2|_{t=k_Z} - W_3 = \frac{1}{4b}(a - c_X)(c_X - c_Z) > 0. \quad (4.b)$$

Let t_i^* be an unconstrained optimal tariff for $W_i(t)$ for all t which is obtained from $\frac{dW_i(t)}{dt}|_{t=t_i^*} = 0$:

$$t_1^* = \frac{3a - c_X - c_Y - c_Z}{10} \quad \text{and} \quad t_2^* = \frac{a + 2c_X - 3c_Z}{7}. \quad (5)$$

That is, t_1^* for $i=1,2$ denotes the optimal tariff of the home country for each plant-building strategy assuming that the foreign firms do not change their strategies for all t . First, we note that $t_i^* > 0$ for $i=1,2$ again due to (A.1) and (A.2). Under a given market structure, the home country maximizes its national welfare with a positive tariff. In addition, a simple arithmetic shows that the following relationships hold:

$$t_1^* \leq k_Y \quad \text{if} \quad a \leq a_1 \equiv \frac{11c_X - 9c_Y + c_Z}{3},$$

$$\begin{aligned} t_2^* &\leq k_Y \text{ if } a \leq a_2 \equiv 5c_X - 7c_Y + 3c_Z, \\ t_2^* &\leq k_Z \text{ if } a \leq a_3 \equiv 5c_X - 4c_Z, \end{aligned} \quad (6)$$

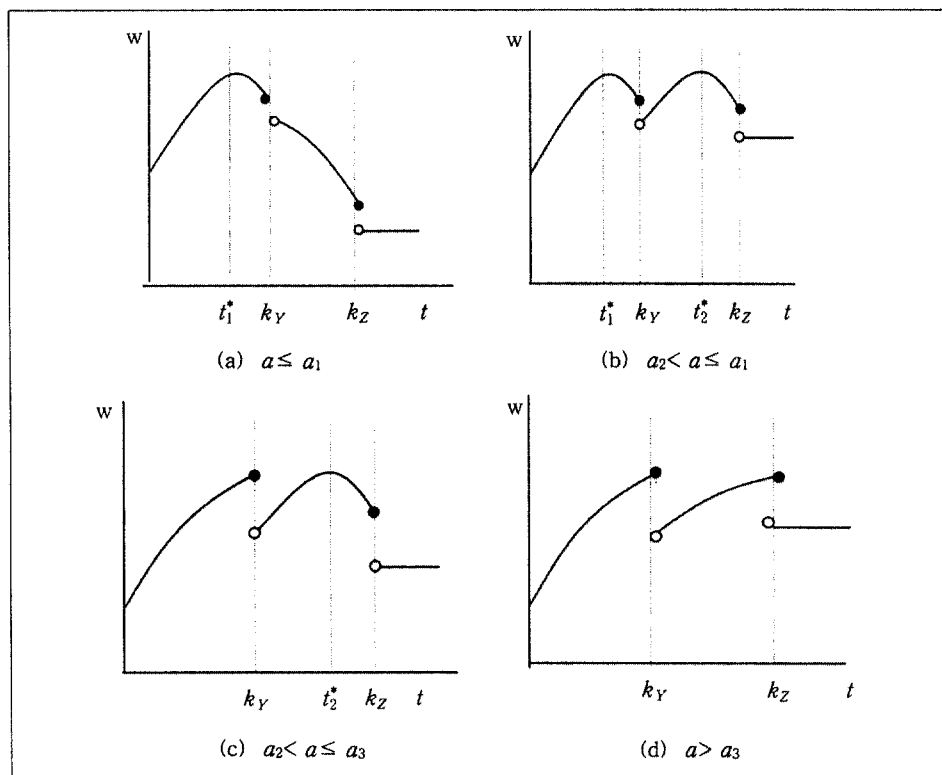
where a_i for $i=1,2,3$ are critical values of a leading home government to set a tariff such that foreign firms are indifferent between exporting and DFI with $a_3 > a_1$, a_2 . (6) shows that the home government sets an unconstrained optimal tariff so high that a foreign firm directly invests in the home country when the size of the home market (a) is sufficiently large. When $a > a_1$ ($a < a_2$), interior solution of tariff maximizing W_1 (W_2) does not exist. Finally, $a_1 > a_2$ if

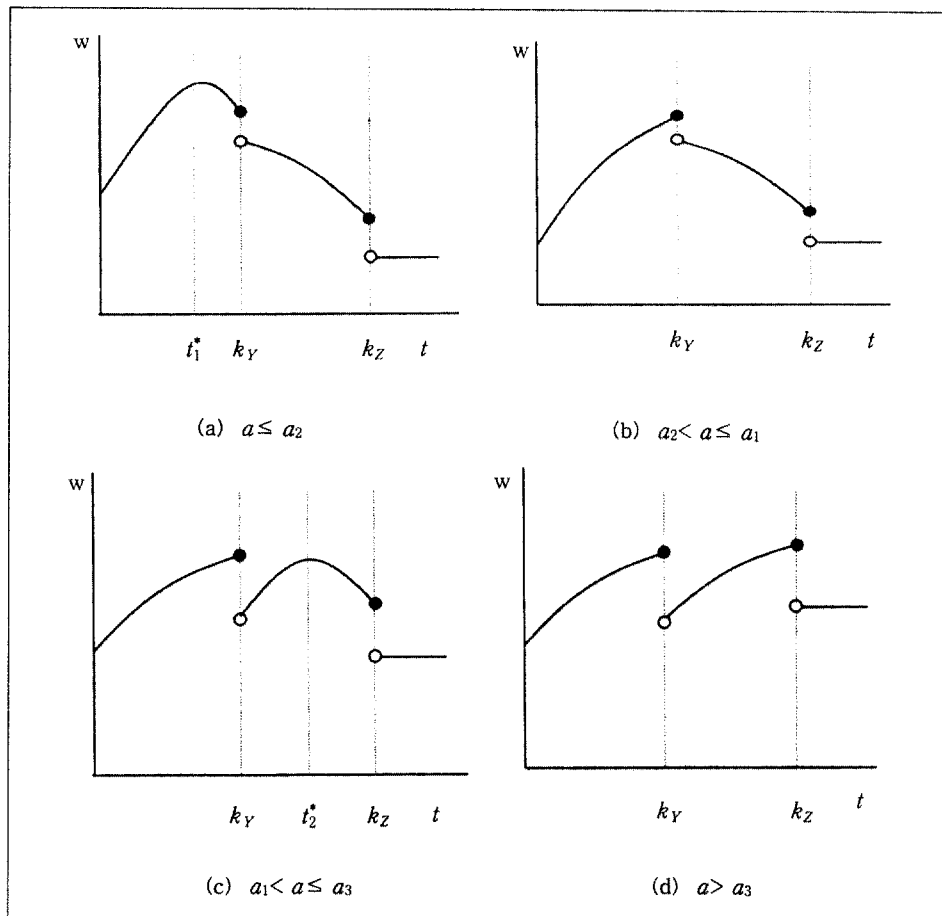
$$c_X - c_Y < 2(c_Y - c_Z). \quad (7)$$

When the relative cost advantage of Firm Y compared to Firm X is not too strong, interior solutions exist for both W_1 and W_2 when the size of home country market is in a medium range, or $a_2 < a < a_1$.

Discussions heretofore lead us to characterize the welfare function of Country X as in Figure 1 and 2 below.

[Figure 1] $a_3 > a_1 > a_2$



[Figure 2] $a_1 \leq a_2 < a_3$ 

Proposition 1. *In a three-country three-firm model, tariff-jumping DFI by the less efficient foreign firm (Firm Y) may occur in a subgame-perfect Nash equilibrium, $\{t^*, I_Y^*, I_Z^*, X^*, Y^*, Z^*\}$, for some parameterizations of cost and demand conditions.*

Proof) In order to prove the above proposition, it suffices to show a numerical example where $t^* \leq (\text{or } >) k_Y$ depending on the sizes of the underlying parameters.¹² In fact, when (7) holds and $a_2 < a \leq a_1$, $t^* = t_1^* (\leq k_Y)$ in Table 3 while $t^* = t_2^* (> k_Y)$ in Table 4.

The optimal outputs of three firms, X^*, Y^*, Z^* , can be obtained from

¹² For many cases, a condition for a t to be a subgame-perfect Nash equilibrium could not be obtained in a neat form. For all numerical examples we let $b=1$ since b does not change the relative sizes of welfare for different tariff levels.

substitution of t^* into Table 1 as shown in Table 5. We can see that $X^*, Y^*, Z^* > 0$ due to (A.1) and (A.2). Q.E.D.

[Table 3] $t^* = t_1^*, I_Y^* = I_Z^* = E$

t^*	a	c_X	c_Y	c_Z	π_X^*	Consumer Surplus	Tariff Revenue	Total Welfare
$t_1^* = 0.82$	9.7	7.9	7	6	0.0256	1.3448	1.2136	2.5840
$t_2^* = 1.0714$	9.7	7.9	7	6	0.0590	1.2123	1.1479	2.4192

[Table 4] $t^* = t_2^*, I_Y^* = D, I_Z^* = E$

t^*	a	c_X	c_Y	c_Z	π_X^*	Consumer Surplus	Tariff Revenue	Total Welfare
$t_1^* = 0.695$	9.35	7.9	7.2	6	0.0036	0.9660	0.9243	1.8940
$t_2^* = 1.0214$	9.35	7.9	7.2	6	0.0204	0.8543	1.0433	1.9180

[Table 5]

t^*	X^*	Y^*	Z^*
t_1^*	$\frac{1}{5b}(2a - 4c_X + c_Y + c_Z)$	$\frac{1}{10b}(a + 3c_X - 7c_Y + 3c_Z)$	$\frac{1}{10b}(a + 3c_X + 3c_Y - 7c_Z)$
t_2^*	$\frac{1}{7b}(2a - 3c_X + c_Z)$	$\frac{1}{7b}(2a - 3c_X + c_Z)$	$\frac{1}{7b}(a + 2c_X - 3c_Z)$
k_Y	$\frac{1}{4b}(a - c_X - c_Y + c_Z)$	$\frac{1}{4b}(a - c_X - c_Y + c_Z)$	$\frac{1}{4b}(a - c_X + 3c_Y - 3c_Z)$
k_Z	$\frac{1}{4b}(a - c_X)$	$\frac{1}{4b}(a - c_X)$	$\frac{1}{4b}(a - c_X)$

[Table 6] $t^* = k_Y, I_Y^* = I_Z^* = E$

t^*	a	c_X	c_Y	c_Z	π_X^*	Consumer Surplus	Tariff Revenue	Total Welfare
$k_Y = 1.000$	11	8	7	6	0.2500	3.1250	2.000	5.3750
$t_2^* = 1.2857$	11	8	7	6	0.3265	2.9490	1.6531	4.9240

[Table 7] $t^* = t_2^*, I_Y^* = D, I_Z^* = E$

t^*	a	c_X	c_Y	c_Z	π_X^*	Consumer Surplus	Tariff Revenue	Total Welfare
$k_Y = 1.000$	11	8	7	5	0.0625	3.7813	2.5000	6.3438
$t_2^* = 1.7143$	11	8	7	5	0.1837	3.3061	2.9388	6.4286
$t_1^* = 1.300$	11	8	7	5	0.1056	3.5778	3.0550	6.7384

Potential DFI causes discontinuities in the objective (welfare) function of the home country, which makes a DFI-constrained optimal tariff quite sensitive to the underlying economic conditions. Depending upon the demand and cost conditions, DFI-constrained optimal tariff may bring about one of the two different market structures: (i) both Firm Y and Z export to Country X , and (ii) Firm Z exports to Country X while Firm Y makes DFI. The relatively more efficient foreign firm opts to export to the home country under the higher tariff than the other foreign firm since it enjoys a stronger competitive advantage and, thus, it can sustain larger tariff burdens on its exports.

Unlike the two-country two-firm model [Levinsohn (1989)], the presence of DFI can possibly be an outcome of a DFI-constrained optimal tariff by the home government. However, it is not optimal for the home government to raise a tariff up to a level that induces both foreign firms to directly invest into its national territory. The home country gains nothing by raising its tariff over k_Z but only loses the tariff revenues from Firm Z .

With a relatively higher tariff inducing DFI by one of the foreign firms, the home country can be better off than with a DFI-constrained optimal tariff barring DFI altogether. The sum of incremental local firm's profits and a possible increase in tariff revenues from the exporting firm can more than compensate the loss of consumer surplus and the foregone tariff revenues from the firm which turns to DFI from exporting. We discuss more about the welfare effects of tariff-jumping DFI in section IV.

IV. THE WELFARE IMPLICATIONS OF TARIFF-JUMPING DFI

In the numerical example shown in Table 4, the home country is better off with the inflow of foreign capitals than with an unconstrained optimal tariff. On the other hand, Table 7 gives an example for the case where (7) holds and $a_1 < a \leq a_3$ showing that the home country is better off with inflow of DFI than with a DFI-constrained optimal tariff but worse off than with a unconstrained optimal tariff. Again, tariff-jumping DFI may or may not occur depending on the sizes of parameters (see also Table 6).

In order to evaluate the effects of tariff-jumping DFI on the national welfare of Country X compared to the welfare level with unconstrained optimal tariff, we decompose the effects of tariff-jumping DFI into "a tariff effect" and "a DFI effect". A tariff effect refers to the effect of the deviation of the tariff from its unconstrained optimal level on the national welfare of the home country when both foreign firms can export only. On the other hand, a DFI effect occurs when a foreign firm translocates its production plant from its national territory to Country X for a given tariff.

Of course, a tariff effect is always negative. As regards to a DFI effect, we first note from Table 2 that DFI has a negative effect on the profits of Firm

X for a given tariff, $k_Y < t \leq k_Z$. With a tariff falling in the range, Firm Y produces in Country X at the marginal cost, c_X , which is lower than the effective marginal cost of domestic production $c_Y + t$, which includes tariff payments. As a result, the output and the profit of Firm X are lower when Firm Y produces in Country X .¹³

On the other hand, consumer surplus (or, total consumption) is positively influenced by DFI, which can be seen from Table 1. For a given $k_Y < t \leq k_Z$, translocation of a production plant by Firm Y leads to the increase in the output by Firm Y which more than compensates the decrease in the sum of the outputs by Firm X and Z .

Finally, the impact of the tariff-jumping DFI on the tariff revenues of the host country is twofold. The tariff revenues decrease, since (i) Firm Y 's output is no longer subject to the tariff and, (ii) Firm Z 's output decreases in response to the increase in the output by Firm Y .

Proposition 2. *When the positive effect of tariff-jumping DFI on the consumer surplus more than compensates the negative effects on producer surplus and tariff revenues and a tariff-created welfare loss (i.e., a tariff effect), the host country is better off with the inflow of tariff-jumping DFI than in the benchmark case where the foreign firms are not allowed to conduct DFI and the home government can set an unconstrained optimal tariff.*

Unlike the conventional wisdom, the host government can increase its national welfare by allowing a foreign firm to produce in its national territory. We also expect that the country with its national firm's market share being relatively small is more likely to benefit from a DFI-inducing import tariff since the gains in consumer surplus are more likely to dominate the loss of producer surplus and tariff created distortions.

So far we have focused on the comparison between the welfare with tariff-jumping DFI and the one with unconstrained optimal tariff. However, considering that there are few countries downrightly forbidding inflow of DFI by law, it is more of a practical importance to see if the home country can gain from DFI-inducing tariff compared to a DFI-constrained optimal tariff. Since there already exist tariff-created distortions in the DFI-constrained optimal tariff, the home country can find a welfare-improving tariff with tariff-jumping DFI for a wider range of parameterization of economic conditions. It is even possible that the tariff-created distortions are smaller with tariff-inducing tariff than with a DFI-constrained optimal tariff [e.g., t_2^* is closer to t_1^* than k_Y is in Figure 1(c)]. A DFI-inducing tariff may be an optimal choice for many governments.

¹³ This is a standard result in an oligopoly model of international trade. See, for example, Dixit(1984).

V. CONCLUDING REMARKS

Extension to a three-country three-firm model provides the possibility of tariff-jumping DFI and new insights for welfare implications of it. Moreover, a three-country three-firm model better depicts a real international economy. For example, US and Japanese multinational firms in the same industry are serving a European market competing with domestic firms.

The finding that a host country may gain from tariff-jumping DFI by multinational firms not only adds to academic literature on DFI but also have policy implications for many countries and blocs setting optimal trade policies. It is not always optimal to prevent all foreign firms from making DFI into the home market.

Traditional two-commodity two-factor model deals with imperfect factor market (models on immiserizing growth) while recent theoretical works (including this paper) pay more attention to imperfect competition in the product market. It would be an invaluable future research agenda to combine these two features in a model and see how they interact with each other and find optimal trade policies.

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