Optimal Tariffs and the Choice of Technology: Discriminatory Tariffs vs. the "Most Favored Nation" clause

by

Jay Pil Choi, Columbia University

1992

Discussion Paper Series No. 631

Optimal Tariffs and the Choice of Technology: Discriminatory Tariffs vs. the 'Most Favored Nation' Clause

by

Jay Pil Choi*
Columbia University

Abstract

We compare the effects of optimal tariffs on the technology choice of exporters under the discriminatory tariffs regime and the 'Most Favored Nation (MFN)" clause. It is shown that a lower marginal cost (MC) technology will be chosen in equilibrium under the "MFN" clause. As a result, importing country's long-run welfare increases with the adoption of "MFN" while exporting countries' welfare decreases in most cases. However, *ex post* technology choice, the importing country prefers discriminatory tariffs. This result, therefore, highlights the role of "MFN" as a commitment mechanism to resolve a time-inconsistency problem facing the importing country.

Correspondent:
Jay Pil Choi
Department of Economics
Columbia University
New York, NY 10027
U.S.A.

I. Introduction

This paper investigates the effect of rent-extracting strategic trade policy on the technology choice and henceforth long-run performance of the economy. We are especially interested in how the equilibrium technology choice can be affected by the uniform tariffs requirement mandated by an international agreement such as the "Most Favored Nation (MFN)" clause.

It has been relatively well known that import tariffs can improve domestic welfare by extracting rent if foreign firms are engaged in an oligopolistic competition [see, for example, Brander and Spencer (1984) and Krugman and Helpman (1989)]. Recently, Gatsios (1990) and Hwang and Mai (1991) investigated the optimal discriminatory tariffs if two foreign firms are located in two different countries. In a static context where cost structures of producers are given *exogenously*, they demonstrate that importing countries generally prefer to impose discriminatory or preferential tariffs across different countries rather than uniform tariffs.[1] The result is hardly surprising since importing countries are to have two instruments with discriminatory tariffs compared to one instrument with uniform tariffs. A more interesting result is that the tariff on the low-cost producer should be higher than that on the high-cost producer. Therefore, with discriminatory tariffs, the *effective* cost (production cost plus specific tariff) differential between producers will become smaller; the effect of optimal discriminatory tariffs is *ex post* reduction in comparative advantage for the cost-efficient firm. In terms of production efficiency, production is diverted from the more efficient to the less efficient firm. The consequences of mandated uniform tariffs such as the "Most Favored Nation" (MFN) principle will be an overall production efficiency with distributional effects favoring cost-efficient countries.

Rather than taking the technology as given, we endogenize the cost level by assuming that it is a result of costly investments, like R&D, by forward-looking and

[1]Uniform tariffs will have no welfare loss for the domestic country only when two producers have the same cost structure.

optimizing agents. We explore long-run consequences of active trade policy, namely, how the pursuit of rent-extraction can affect the long-run choice of technology by producers. We show that a lower marginal cost (MC) technology will be chosen under the MFN clause. The intuition is as follows. With the MFN clause, the effective cost differential remains the same as the production cost differential since importing countries are required to impose the same tariffs across countries. In contrast, under the discriminatory tariffs regime, we demonstrate that the importing country's tariff will respond more adversely against the rival firm in the other country when one firm's cost increases. Therefore, optimal tariffs in the discriminatory regime is an equalizer in the effective cost differential. In the symmetric equilibria that we focus on, two producers achieve the same MC and are treated equally even in the discriminatory tariffs regime. However, the mere possibility of different tariffs will affect the equilibrium MC they will reach under the discriminatory tariffs regime. It will be higher than the one they reach under the MFN clause. When the cost advantage is not exogenous, as in Gatsios (1990), and only is achieved by costly investment, the comparative advantage gap reducing effect of discriminatory tariffs will undermine the incentive of producers to cut the cost levels. Consequently, *ex ante,* the importing country will benefit from the uniform tariffs, even though, *ex post,* discriminatory tariffs are mostly preferred. Another way of paraphrasing this is that the importing country faces a time-inconsistency problem. An MFN clause can provide a natural way to precommit to uniform tariffs for the importing country. In contrast, the welfares of the exporting countries in most cases are reduced as a consequence of intense competition at the technology choice stage under MFN.

Our paper also relates to the work of DeGraba (1990) who addressed the same issues in the domestic context. He explored the long-run consequences of an upstream monopolist's third-degree price discrimination in input markets on the downstream producers' technology choice using linear demand and quadratic relationship between marginal cost and fixed cost.

Section II presents a three stage game where an active tariffs policy and a subsequent Cournot output game are preceded by the long-run technology choice by producers, thus endogenizing the cost of producers. We analyze the effect of the MFN clause on the technology choice and resulting welfare for importing and exporting countries. Section III applies the general model of section II to the linear demand case to get an analytical solution. Concluding comments follow.

II. The Model

There are two firms located in two different foreign countries, 1 and 2. They can produce a homogeneous product intended to sell in the Home market. For simplicity, we assume that there is no producer of this product in the Home market and there is no consumption of this product in foreign countries. Demand for this product in the Home market is given by P(Q), where $Q = q_1+q_2$. We assume that P(.) is a decreasing and twice continuously differential function, with $P''(Q)\, Q + P'(Q) < 0$.

We analyze the following three-stage game. In the first stage, each firm chooses its technology, which determines its constant marginal cost c_i. There is a tradeoff between marginal cost and sunk fixed cost. The relationship is represented by $F = \Phi(c)$. We assume that $\Phi'<0$ and $\Phi''>0$. That is, a lower marginal cost is achieved at the expense of a higher sunk cost. We can think of F as an irreversible investment in cost reducing R&D. In the second stage, after observing the choice of technology by each producer, the importing country pursues an active trade policy of imposing tariffs on imports. Finally, each firm competes in the domestic market in the Cournot fashion, given the cost level and tariff in place. The timing structure reflects the fact that technology choice is largely irreversible and the importing government cannot precommit to the specific level of tariffs. We search for a subgame perfect equilibrium in this game. As usual, we apply backwards induction and start with the third stage subgame.

Treating marginal cost $\mathbf{c}= (c_1, c_2)$ and tariff $\mathbf{t} = (t_1, t_2)$ as parameters, each firm maximizes the following.

$$\pi_i(q_1, q_2 ; \mathbf{c}, \mathbf{t}) = [P(q_1 + q_2) - c_i - t_i]\, q_i, \quad i=1,2 \tag{1}$$

The first order conditions are given by:

$$\partial\pi_i/\partial q_i = P'q_i + P - c_i - t_i = 0, \quad i=1,2 \tag{2}$$

By solving (2) simultaneously, we can derive the Cournot-Nash equilibrium outputs as functions of **c** and **t**, $q_1(\mathbf{c}, \mathbf{t})$ and $q_2(\mathbf{c}, \mathbf{t})$. By totally differentiating (2), we get the following comparative statics result.

$$\frac{\partial q_i}{\partial c_i} = \frac{\partial q_i}{\partial t_i} = \frac{P''q_j + 2P'}{M} < 0, \quad \frac{\partial q_j}{\partial c_i} = \frac{\partial q_j}{\partial t_i} = -\frac{P''q_j + P'}{M} > 0, \ i \neq j, \tag{3}$$

where $M = (P''q_1 + 2P')(P''q_2 + 2P') - (P''q_1 + P')(P''q_2 + P') = P'P''Q + 3(P')^2 > 0$.
The increase in tariff imposed on products from country i (firm i) will induce a reduction in the output from the targeted country and an increase in output from the other country. However, the effect on total output is negative, with the tariff's own effect dominating its cross effect.

$$\frac{\partial Q}{\partial t_i} = \frac{\partial q_i}{\partial t_i} + \frac{\partial q_j}{\partial t_i} = \frac{P'}{M} = \frac{1}{P''Q + 3P'} < 0 \tag{4}$$

Domestic consumers are assumed to have utility functions that are quasi-linear in a competitive numeraire good, enabling us to ignore any income effects. The government, considering the effect of its tariff choices on the equilibrium output, sets tariffs to maximize

$$W(\mathbf{t}; \mathbf{c}) = u[Q(\mathbf{c}, \mathbf{t})] - P[Q(\mathbf{c}, \mathbf{t})]Q(\mathbf{c}, \mathbf{t}) + t_1 q_1(\mathbf{c}, \mathbf{t}) + t_2 q_2(\mathbf{c}, \mathbf{t}) \tag{5}$$

where $u[Q(\mathbf{c}, \mathbf{t})] = \int_0^{Q(c,\,t)} P(z)dz.$

Using the fact that $u' = P$, the first order conditions for the maximization problem under the *discriminatory tariff system* are given by

$$\frac{\partial W}{\partial t_i} = -P'(Q)\,Q\,\frac{\partial Q}{\partial t_i} + q_i + t_1\frac{\partial q_1}{\partial t_i} + t_2\frac{\partial q_2}{\partial t_i} = 0, \quad i = 1,2 \tag{6}$$

Under *MFN,* the home government is required to set $t_1 = t_2$. By writing a

Lagrangian function $\pounds = W(t: c) + \lambda(t_1 - t_2)$, the first order conditions are given by

$$\begin{aligned} \pounds_1 &= W_1(t: c) + \lambda = 0 \\ \pounds_2 &= W_2(t: c) - \lambda = 0 \qquad (7) \\ \pounds_\lambda &= t_1 - t_2 = 0 \end{aligned}$$

It will be assumed that appropriate second order conditions are satisfied under both regimes. Let $t_1^*(c)$ and $t_2^*(c)$ be the optimal tariffs under the preferential regime and $t_1^{**}(c) = t_2^{**}(c) = t^{**}(c)$ be the optimal tariffs under the MFN regime.

Finally, each firm makes its technology choice taking into account the future imposition of tariffs and its effect on the final stage output game. By substituting derived optimal tariffs $\mathbf{t}(\mathbf{c})$ above and resulting Cournot-Nash outputs $q_i[\mathbf{c}, \mathbf{t}(\mathbf{c})]$ into equation (1), we get the reduced form profit function, $\pi_i[\mathbf{c}; \mathbf{t}(\mathbf{c})]$, as a function of marginal costs $\mathbf{c}=(c_1, c_2)$. At the technology adoption stage, each firm maximizes

$$\begin{aligned} \Pi_i[\mathbf{c}; \mathbf{t}(\mathbf{c})] &= \pi_i[\mathbf{c}; \mathbf{t}(\mathbf{c})] - \Phi(c_i) \\ &= [P(q_1[\mathbf{c}; \mathbf{t}(\mathbf{c})] + q_2[\mathbf{c}; \mathbf{t}(\mathbf{c})]) - c_i - t_i]\, q_i[\mathbf{c}; \mathbf{t}(\mathbf{c})] - \Phi(c_i) \qquad (8) \end{aligned}$$

Note that Π_i denotes firm i's profit *net* of sunk investment cost. Since two firms are symmetric ex ante, we will subsequently concentrate on the symmetric solutions. The reduced profit functions, $\pi_i[\mathbf{c}; \mathbf{t}(\mathbf{c})]$, are assumed to be concave in its own cost c_i, which, in turn, implies that $\Pi_i[\mathbf{c}; \mathbf{t}(\mathbf{c})]$ are also concave in c_i due to the convexity of $\Phi(c_i)$. We further assume that there exists a pure strategy equilibrium in the choice of technologies.

Under discriminatory tariffs regime, the first order conditions for Nash equilibrium technology choice are given by

$$\frac{\partial \Pi_i}{\partial c_i} = \frac{\partial \pi_i}{\partial c_i} + \frac{\partial \pi_i}{\partial t_i}\frac{\partial t_i^*}{\partial c_i} + \frac{\partial \pi_i}{\partial t_j}\frac{\partial t_j^*}{\partial c_i} - \Phi'(c_i) = 0 \qquad (9)$$

Then, equation (9) defines continuous reaction functions $R_i(c_j)$. To ensure uniqueness of Nash equilibrium in the technology choice, we assume that $\left|\frac{\partial^2 \Pi_i}{\partial c_i^2}\right| > \left|\frac{\partial^2 \Pi_i}{\partial c_i \partial c_j}\right|$.

Similarly, under MFN regime, the first order conditions are given by

$$\frac{\partial \Pi_i}{\partial c_i} = \frac{\partial \pi_i}{\partial c_i} + \frac{\partial \pi_i}{\partial t_i}\frac{\partial t^{**}}{\partial c_i} + \frac{\partial \pi_i}{\partial t_j}\frac{\partial t^{**}}{\partial c_i} - \Phi'(c_i) = 0 \qquad (10)$$

Since two firms are assumed to be identical *ex ante*, the unique equilibrium is necessarily symmetric in the choice of technology. Therefore, optimal tariffs will be the same across countries, even in the discriminatory regime. However, it will be shown that the possibility of different tariffs *off the equilibrium* under preferential tariffs regime will alter strategic incentives for technology choices and will induce exporting producers to adopt a different symmetric equilibrium from the one they adopt under MFN.

Proposition 1. Let c* and c** be the symmetric Nash equilibrium technology choices under the discriminatory tariffs and the MFN clause, respectively. Then, c*>c**. That is, a lower MC technology is adopted under the MFN clause. As a result, the MFN clause increases the welfare of the importing country.

Proof. By comparing two first order conditions (9) and (10), it is immediate that at a symmetric equilibrium, the condition for the firms to adopt to a lower MC technology is given by

$$\frac{\partial \pi_i}{\partial t_i}\frac{\partial t_i^*}{\partial c_i}+\frac{\partial \pi_i}{\partial t_j}\frac{\partial t_j^*}{\partial c_i}>\frac{\partial \pi_i}{\partial t_i}\frac{\partial t^{**}}{\partial c_i}+\frac{\partial \pi_i}{\partial t_j}\frac{\partial t^{**}}{\partial c_i} \qquad (11)$$

We prove this by demonstrating that condition (11) is equivalent to $\frac{\partial t_1^*}{\partial c_1}-\frac{\partial t_2^*}{\partial c_1}<0$.

First, we claim that $\frac{\partial t_i^*}{\partial c_i}+\frac{\partial t_j^*}{\partial c_i}=2\frac{\partial t^{**}}{\partial c_i}$. That is, the sum of changes of tariffs in response to changes in the choice of technology is the same under both regimes. However, in general, the distribution of the tariffs change will be uneven in the preferential tariffs regime.

Since two firms are symmetric, ex ante, without loss of generality, we will take firm 1 as a representative firm. We totally differentiate (6) to get $\frac{\partial t_1^*}{\partial c_1}$ and $\frac{\partial t_2^*}{\partial c_1}$.

$$\begin{pmatrix} \frac{\partial^2 W}{\partial t_1^2} & \frac{\partial^2 W}{\partial t_1 \partial t_2} \\ \frac{\partial^2 W}{\partial t_2 \partial t_1} & \frac{\partial^2 W}{\partial t_2^2} \end{pmatrix} \begin{pmatrix} \frac{\partial t_1^*}{\partial c_1} \\ \frac{\partial t_2^*}{\partial c_1} \end{pmatrix} = \begin{pmatrix} -\frac{\partial^2 W}{\partial t_1 \partial c_1} \\ -\frac{\partial^2 W}{\partial t_2 \partial c_1} \end{pmatrix}$$

By noting that $\frac{\partial^2 W}{\partial t_1 \partial c_1} = \frac{\partial^2 W}{\partial t_1^2} - \frac{\partial q_1}{\partial t_1}$, $\frac{\partial^2 W}{\partial t_2 \partial c_1} = \frac{\partial^2 W}{\partial t_1 \partial t_2} - \frac{\partial q_1}{\partial t_2}$, we have

$$\frac{\partial t_1^*}{\partial c_1} = \frac{1}{H}\left[\frac{\partial^2 W}{\partial t_1 \partial t_2}\left(\frac{\partial^2 W}{\partial t_1 \partial t_2} - \frac{\partial q_1}{\partial t_1}\right) - \frac{\partial^2 W}{\partial t_1^2}\left(\frac{\partial^2 W}{\partial t_1 \partial t_2} - \frac{\partial q_1}{\partial t_2}\right)\right]$$

$$= -1 + \frac{1}{H}\left[\frac{\partial^2 W}{\partial t_2^2}\frac{\partial q_1}{\partial t_1} - \frac{\partial^2 W}{\partial t_1 \partial t_2}\frac{\partial q_1}{\partial t_2}\right] \quad (12)$$

$$\frac{\partial t_2^*}{\partial c_1} = \frac{1}{H}\left[\frac{\partial^2 W}{\partial t_1^2}\frac{\partial^2 W}{\partial t_2^2} - \frac{\partial^2 W}{\partial t_1 \partial t_2}\frac{\partial^2 W}{\partial t_2 \partial t_1}\right] \quad (13),$$

where H (the determinant of the Hessian matrix) $= \frac{\partial^2 W}{\partial t_1^2}\frac{\partial^2 W}{\partial t_2^2} - \frac{\partial^2 W}{\partial t_1 \partial t_2}\frac{\partial^2 W}{\partial t_2 \partial t_1} > 0$, by the second order condition for the maximization. Note that the signs of $\frac{\partial t_1^*}{\partial c_1}$ and $\frac{\partial t_2^*}{\partial c_1}$ are, in general, ambiguous. However, we can prove that the effect of MC increase on the effective cost (production cost + specific tariff) is always positive.

$$\frac{\partial(c_1 + t_1^*)}{\partial c_1} = \frac{1}{H}\left[\frac{\partial^2 W}{\partial t_2^2}\frac{\partial q_1}{\partial t_1} - \frac{\partial^2 W}{\partial t_1 \partial t_2}\frac{\partial q_1}{\partial t_2}\right] > 0 \quad (14)$$

Similarly, we totally differentiate (7) to get $\frac{\partial t_1^{**}}{\partial c_1} = \frac{\partial t_2^{**}}{\partial c_1} = \frac{\partial t^{**}}{\partial c_1}$.

$$\begin{pmatrix} \frac{\partial^2 W}{\partial t_1^2} & \frac{\partial^2 W}{\partial t_1 \partial t_2} & 1 \\ \frac{\partial^2 W}{\partial t_2 \partial t_1} & \frac{\partial^2 W}{\partial t_2^2} & -1 \\ 1 & -1 & 0 \end{pmatrix} \begin{pmatrix} \frac{\partial t_1^{**}}{\partial c_1} \\ \frac{\partial t_1^{**}}{\partial c_1} \\ \frac{\partial \lambda}{\partial c_1} \end{pmatrix} = \begin{pmatrix} -\frac{\partial^2 W}{\partial t_1 \partial c_1} \\ -\frac{\partial^2 W}{\partial t_2 \partial c_1} \\ 0 \end{pmatrix}$$

Then,

$$\frac{\partial t_1^{**}}{\partial c_1} = \frac{\partial t_2^{**}}{\partial c_1} = \frac{1}{\overline{H}} \left[\left(\frac{\partial^2 W}{\partial t_1^2} \cdot \frac{\partial q_1}{\partial t_1} \right) + \left(\frac{\partial^2 W}{\partial t_2 \partial t_1} \cdot \frac{\partial q_1}{\partial t_2} \right) \right] \tag{15}$$

where $\overline{H}$ (the determinant of bordered Hessian) $= -\left(\frac{\partial^2 W}{\partial t_1^2} + \frac{\partial^2 W}{\partial t_2^2} + 2\frac{\partial^2 W}{\partial t_1 \partial t_2} \right) > 0$, by the second order condition for the constrained maximization.

Since the tariffs across two countries will be also equalized at a symmetric equilibrium, with $c_1 = c_2$ even under preferential tariffs regime [see Gatsios (1991)], $\frac{\partial^2 W}{\partial t_1^2} = \frac{\partial^2 W}{\partial t_2^2}$. It is straightforward to derive that

$$\frac{\partial t_1^*}{\partial c_1} + \frac{\partial t_2^*}{\partial c_1} = 2\frac{\partial t^{**}}{\partial c_1} \tag{16}$$

Using (16), we can rewrite condition (11) as follows.

$$\frac{1}{2}\left(\frac{\partial t_1^*}{\partial c_1} - \frac{\partial t_2^*}{\partial c_1} \right)\left(\frac{\partial \pi_1}{\partial t_1} - \frac{\partial \pi_1}{\partial t_2} \right) > 0$$

It can be easily verified that $\frac{\partial \pi_1}{\partial t_1} < 0$ and $\frac{\partial \pi_1}{\partial t_2} > 0$ by using the envelope theorem. Therefore, the expression in the second parenthesis is negative. We complete the proof by showing that the sign of the first parenthesis is also negative.

We note that

$$\frac{\partial t_1^*}{\partial c_1} - \frac{\partial t_2^*}{\partial c_1} = -1 + \frac{\frac{\partial q_1}{\partial t_1} - \frac{\partial q_1}{\partial t_2}}{\frac{\partial^2 W}{\partial t_1^2} - \frac{\partial^2 W}{\partial t_1 \partial t_2}} \tag{17}$$

Since both numerator and denominator of (17) are negative, it suffices to show that

$$\frac{\partial^2 W}{\partial t_1^2} - \frac{\partial^2 W}{\partial t_1 \partial t_2} < \frac{\partial q_1}{\partial t_1} - \frac{\partial q_1}{\partial t_2}.$$

$$\frac{\partial^2 W}{\partial t_1^2} - \frac{\partial^2 W}{\partial t_1 \partial t_2} = -P'Q\left[\frac{\partial^2 Q}{\partial t_1^2} - \frac{\partial^2 Q}{\partial t_1 \partial t_2}\right] + \left(\frac{\partial q_1}{\partial t_1} - \frac{\partial q_1}{\partial t_2}\right) + \left(\frac{\partial q_1}{\partial t_1} - \frac{\partial q_2}{\partial t_1}\right)$$

$$+ t_1\left[\frac{\partial^2 q_1}{\partial t_1^2} - \frac{\partial^2 q_1}{\partial t_1 \partial t_2}\right] + t_2\left[\frac{\partial^2 q_2}{\partial t_1^2} - \frac{\partial^2 q_2}{\partial t_1 \partial t_2}\right]$$

By utilizing the fact that optimal tariffs across countries are equal ($t_1 = t_2$) at the symmetric equilibrium, even under discriminatory tariffs, and $\frac{\partial^2 Q}{\partial t_1^2} = \frac{\partial^2 Q}{\partial t_1 \partial t_2}$ (to see this, differentiate equation (4)), $[\frac{\partial^2 W}{\partial t_1^2} - \frac{\partial^2 W}{\partial t_1 \partial t_2}] - [\frac{\partial q_1}{\partial t_1} - \frac{\partial q_1}{\partial t_2}] = \frac{\partial q_1}{\partial t_1} - \frac{\partial q_2}{\partial t_1} < 0.$ Q.E.D.

Even though we can not say, a priori, the signs of $\frac{\partial t_1^*}{\partial c_1}$ and $\frac{\partial t_2^*}{\partial c_1}$ in isolation, we have shown that the responses of discriminatory tariffs to one firm's MC increase have a relatively more adverse effect on the rival firm. Consequently, when the importing country cannot precommit to set tariffs equally across countries, exporting firms generally choose a technology that has a higher marginal production cost, implying less output and a higher price in the market place.

The long-run welfare effects of the MFN clause on the importing country can be easily seen by the envelope theorem,

$$\frac{dW(t;c,c)}{dc} = \frac{\partial W(t;c,c)}{\partial c_1} + \frac{\partial W(t;c,c)}{\partial c_2}$$

$$= \sum_{i=1}^{2} [\, - P'(Q)\, Q \frac{\partial Q}{\partial c_i} + t_1 \frac{\partial q_1}{\partial c_i} + t_2 \frac{\partial q_2}{\partial c_i}\,] = - (q_1 + q_2) < 0$$

As a consequence, the importing country's welfare increases with the adoption of MFN as a result of lower cost technology adoption by exporting countries.

The effect of the MFN clause on the welfare of exporting countries is ambiguous at the most general level. However, in most cases, it is expected that MFN reduces the profit by inducing more intense competition in the technology choice stage. Let $J(c) = \Pi_1(c,c) + \Pi_2(c,c)$ be the joint profit by firm 1 and 2 when both choose the same technology c. It is assumed that J(c) is strictly concave. Let c^0 be the maximizer of J(c). Then, c^0 satisfies the following first order condition.

$$[\frac{\partial \pi_i}{\partial c_i} + \frac{\partial \pi_i}{\partial t_i}\frac{\partial t_i^*}{\partial c_i} + \frac{\partial \pi_i}{\partial t_j}\frac{\partial t_j^*}{\partial c_i}] + [\frac{\partial \pi_j}{\partial c_i} + \frac{\partial \pi_j}{\partial t_i}\frac{\partial t_i^*}{\partial c_i} + \frac{\partial \pi_j}{\partial t_j}\frac{\partial t_j^*}{\partial c_i}] - \Phi'(c_i) = 0 \quad (17)$$

The expression in the first square bracket is the effect of MC increase on its own operating profit. The expression in the second bracket is the effect on the other firm's profit that is not taken into account in the calculation of the noncooperative Nash equilibrium. Whether MFN clause will be preferred or not by the exporting countries will depend on the sign of this externality. If MC increase of one firm has a total effect of positive externality on the other firm, then $c^0 > c^*$ ($>c^{**}$). In this case, the MFN clause will induce the technology choice further from the joint-profit maximizing level and hurt the exporting countries. Since the direct effect of MC increase on the other firm's profit, $\frac{\partial \pi_j}{\partial c_i}$, is positive, the sufficient condition for this is that the direct effect, $\frac{\partial \pi_j}{\partial c_i}$, dominates the induced effect from tariffs changes, $\frac{\partial \pi_j}{\partial t_i}\frac{\partial t_i^*}{\partial c_i} + \frac{\partial \pi_j}{\partial t_j}\frac{\partial t_j^*}{\partial c_i}$.

Proposition 2. If $\frac{\partial t_j^*}{\partial c_i} < 0$, the exporting countries' profits decrease with the MFN clause.

Proof.

$$\frac{\partial \pi_j}{\partial c_i} + \frac{\partial \pi_j}{\partial t_i}\frac{\partial t_i^*}{\partial c_i} + \frac{\partial \pi_j}{\partial t_j}\frac{\partial t_j^*}{\partial c_i} = \frac{\partial \pi_j}{\partial c_i}\,[\,1 + \frac{\partial t_i^*}{\partial c_i}\,] + \frac{\partial \pi_j}{\partial t_j}\frac{\partial t_j^*}{\partial c_i} \quad (18)$$

Since $\frac{\partial \pi_j}{\partial c_i} > 0$, $\frac{\partial \pi_j}{\partial t_j} < 0$, and the expression in the square bracket is positive by (14), the sufficient condition for the whole expression to be negative is $\frac{\partial t_j^*}{\partial c_i} < 0$. Q.E.D.

In a static model where technologies are given, Gatsios (1990) focuses on the conflicting interests between developing and developed countries in the adoption of the MFN clause. However, in his model, it is hard to see why the importing country will adopt the MFN clause voluntarily without any side payments from the developed countries, since the importing country suffers from the adoption of the MFN clause. By introducing prior investment in R&D, we can resolve the apparently paradoxical phenomenon of why an importing country accepts the MFN clause in spite of being in favor of a preferential tariff system, given the cost levels of exporters.

In this paper, the raison d'etre for the MFN clause lies in the time-inconsistency problem facing the importing country. Even though the uniform tariff is better than the discriminatory one for the importing country before the choice of technology, it has incentive to switch to the discriminatory one after the choice of technology has been made. The discretionary power, *ex post*, actually hurts the importing country. The MNF clause provides a mechanism for the importing country to precommit to uniform tariffs and achieve a higher welfare.

III. An Example: Linear Demand

In this section, we demonstrate the general result of section II in a closed form by using a linear demand. Let the inverse demand be given by P = a - bQ. Then, the Cournot-Nash output and equilibrium profits in terms of costs and tariffs levels are given by:

$$q_i\ (c,\ t) = \frac{1 - 2c_i - 2t_i + c_j + t_j}{3b}$$

$$\pi_i\ (c,\ t) = \frac{(1 - 2c_i - 2t_i + c_j + t_j)^2}{9b}, \qquad i=1,\ 2 \text{ and } i \neq j$$

Optimal tariffs under preferential and uniform tariffs regimes are given by :

$$t_i^*(\mathbf{c}) = \frac{2a - 3c_i + c_j}{8}, \qquad i=1, 2 \text{ and } i \neq j$$

$$t^{**}(\mathbf{c}) = \frac{2a - c_1 - c_2}{8}$$

Therefore, Nash equilibrium choices in technology under the preferential tariff regime (c*), MFN (c**), and joint profit maximizing choice (c^0), satisfy the following first -order conditions, respectively:

$$\Phi'(c^*) = -3(a - c^*)/16b$$

$$\Phi'(c^{**}) = -5(a - c^{**})/16b$$

$$\Phi'(c^0) = -(a - c^0)/8b$$

Therefore, $c^{**} < c^* < c^0$.

With linear example, MFN is harmful for exporting countries[2].

IV. Concluding Remarks

We presented a simple model examining how rent-extracting tariff policy can affect exporting producers' choice of long-run technology. It was demonstrated that welfare implications for the importing country vis-à-vis exporting countries can be quite different from those derived in the static context treating the technology of exporters as given.

This paper also highlighted the dynamic inconsistency problem facing the country importing a good produced by international oligopolists. Gatsios (1990) and Hwang and Mai (1991) showed that given the cost level of producers, the importing country will have incentive to impose discriminatory tariffs against cost -efficient producers. However, if we analyze the effect of strategic tariff policy in the long-run time horizon in which cost level is determined as a consequence of technology choice through costly investment, the discriminatory tariffs will diminish the incentive to cut costs by exporters. Even though discriminatory tariffs is *ex post* optimal, it can be *ex ante* inferior. The MFN clause can

[2] Even though the condition in proposition 2 is violated in our example, it is a sufficient, not a necessary, condition for the adverse effect of MFN on exporting countries. Therefore, the example is not inconsistent with proposition 2.

be viewed as a precommitment mechanism to uniform tariffs by the importing country.

The result also provides a caution in the policy debate on the merits of the MFN. The discard of the MFN by an importing country can be beneficial in the short-run. The adverse long-run effect can be more grave, outweighing the short-run gain.

References

Brander, J. and B. Spencer, 1984, Tariff protection and imperfect competition, in: Monopolistic competition and international trade, ed. H. Kierzkowski (Clarendon Press, Oxford).

DeGraba, P., 1990, Input market price discrimination and the choice of technology, American Economic Review 80, 1246-1253.

Gatsios, K.,1990, Preferential tariffs and the 'Most Favored Nation' principle: a note, Journal of International Economics 28, 365-373.

Helpman, E. and P. Krugman, 1989, Trade policy and market structure (MIT Press, Cambridge).

Hwang, H. and C. Mai, 1991, Optimum discriminatory tariffs under oligopolistic competition, Canadian Journal of Economics 24, 693-702.