Tariffs and the extraction of foreign monopoly rents under potential entry

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Abstract. This paper examines the incentives for using tariffs to extract monopoly rents from imperfectly competitive foreign firms. Under imperfect competition price exceeds marginal cost, so that a country which imports such a good pays a rent to the foreign firm (unless the firm happens to earn only normal profits). Tariffs can be used to extract some of this rent. On the basis of a simple Stackelberg entry deterrence model, the paper shows that the rent-extracting policy is particularly attractive if the foreign firm faces a threat of domestic entry. In the special case in which a domestic entrant would produce only for its home market, some rent can be extracted without reducing the level of imports or domestic consumption of the good. Despite transportation costs, it is shown that the Stackelberg leader-follower model can lead to intra-industry trade in the same commodity. The rent-extracting tariff policy is then examined in the case that a potential domestic entrant may produce both for the home and export markets.

Tarifs douaniers et extraction de la rente monopolistique d'une firme étrangère quand il y a possibilité d'entrée sur le marché d'une firme domestique. Ce mémoire examine les incitations à utiliser les tarifs douaniers pour extraire la rente monopolistique de firmes étrangères opérant en situation de concurrence imparfaite. Dans une telle situation, le prix dépasse le coût marginal: alors le pays importateur paye une rente à la firme étrangère (sauf dans le cas où la firme étrangère ne gagne qu'un profit normal). Des tarifs douaniers peuvent être utilisés pour extraire une portion de cette rente. A partir d'un modèle simple du type de celui élaboré par Stackelberg pour analyser les méthode de prévention d'entrée de nouvelles firmes, le mémoire montre qu'une politique d'extraction de rente est particulièrement intéressante si la firme étrangère doit faire face à la menace de l'entrée d'une firme domestique sur le marché.

Pour le cas spécial où la firme domestique ne pourrait produire que pour le marché domestique, il est possible d'extraire une portion de la rente sans réduire le niveau des importations ou le niveau de consommation domestique du bien. Malgré l'existence de coûts de transport, on montre que le modèle de Stackelberg peut fort bien engendrer le commerce intra-indutriel du même bien. La politique tarifaire d'extraction de rente est aussi examinée dans le cas où la firme domestique qui pourrait entrer sur ce marché pourrait produire à la fois pour le marché d'exportation et pour le marché domestique.

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INTRODUCTION

There seems to be a growing belief that imperfect competition is important in international trade. Although the standard trade models assume perfect competition, there has been work incorporating imperfect competition, including Melvin and Warne (1973), Krugman (1979), and Markusen (1980). One important aspect of imperfect competition is that the price charged for a good exceeds the marginal cost of production. Thus, a country importing such a good usually pays a monopoly rent to the exporting firm. Tax policy is the standard instrument for extracting monopoly rents from imperfectly competitive firms in a domestic context. The first point of this paper is that under imperfect competition a country has an incentive to extract rent from foreign exporters by using tariffs.[1]

There is a difficulty with such a tariff policy. Since marginal benefit (price) exceeds marginal cost, an imperfectly competitive good is underconsumed from a world welfare point of view. Even for the domestic country alone, a tariff will drive a wedge between what consumers pay and the price foreign producers are willing to accept. If the foreign firms are concerned about the possibility of entry in the domestic country, however, their behaviour is constrained, and the domestic country will find the policy of using tariffs to extract rents more attractive than otherwise. This is the second point of the paper: potential entry has implications for tariff policy in the presence of imperfect competition.

A sufficiently high tariff will induce entry by a domestic firm. This may be in the interest (although not necessarily) of the domestic country, since rents will be transferred from the foreign firm to the entrant. The new entrant may even find it profitable to export to the foreign market and intra-industry trade could result.[2] A third point of the paper, then, is that imperfect competition can cause intra-industry trade. In addition, if a domestic entrant can earn foreign monopoly rents, protective tariffs become particularly attractive.

An outline of the paper is as follows. A model of entry deterrence in an international setting based on Dixit (1979)[3] is developed. Then the extraction of monopoly rent using tariffs without potential entry is examined. Next, the extraction of monopoly rent with potential entry in the case that a domestic entrant would produce only for its home market is considered, and the welfare

1 It has been suggested, for example, that western nations could use tariffs to extract oil rents from OPEC.

2 Intra-industry trade is trade in which a country imports and exports the same or similar goods. Intra-industry trade is now regarded as an important part of world trade, thanks largely to the work of Herbert Grubel. A standard reference is Grubel and Lloyd (1975). See also Giersch (1979) for some recent contributions on the subject. The inability of the standard models to explain intra-industry trade is one reason for recent interest in models that assume imperfect competition.

3 Entry deterrence is a topic of considerable recent interest. Other recent work includes Schmalensee (1978) and Spence (1979).

implications of an entry-inducing tariff are discussed. Next, the entrant is assumed to consider the possibility of exporting, and it is shown that the type of imperfect competition assumed in the Dixit model can lead to intra-industry trade. We then re-examine rent-extracting tariff policy under the threat of potential entry (by the domestic firm) in both domestic and foreign markets.

A MODEL OF ENTRY DETERRENCE

We use a slight modification of Dixit's (1979) model of entry barriers.[4] The model used by Dixit is essentially a Stackelberg leader-follower model in which the leader considers producing the 'limit' output: that output which prevents entry. This approach was developed by Sylos-Labini (1957) and Bain (1956) and exposited by Modigliani (1958). There are two countries, the domestic (or home) country and the foreign country. In each country demands are assumed to arise from a utility function of the form

$$U = u(z) + m, \tag{1}$$

where z is the level of consumption of good Z, which is produced under imperfect competition, and m is consumption of a competitive numeraire good. Imports of Z are paid for with exports of the competitive good. This utility function is useful for welfare comparisons since there are no income effects and the inverse demand function for Z is simply the derivative of u:[5]

$$p = u'(z). \tag{2}$$

In the initial situation the home country imports all its consumption of Z from a monopolist in the foreign country.[6] There is a potential entrant in the home country but initially the foreign monopolist finds it profitable to deter entry. The potential entrant takes the output of the existing firm as given and, if it enters, will produce the corresponding profit-maximizing output. The existing firm knows that the entrant would follow this Cournot rule and either accepts the Stackelberg leader-follower solution[7] or deters entry, depending on which course is more profitable.

4 This paper is not concerned with mathematical generality. We make the 'usual' convenient assumptions about demand functions, profit functions, and reaction functions, except where otherwise noted. Differentiability is assumed where useful, and existence and uniqueness of solutions to maximization problems are also assumed. Although there are dangers in this approach, the pathological properties associated with the models in this paper are well enough understood and sufficiently complicated that further discussion here would be inappropriate.

5 Using a utility function of this form amounts to the partial equilibrium assumptions that the good under consideration uses only a small part of the budget of any particular household, and that cross elasticities of demand are negligible.

6 We are not considering subsidiary investment and multi-national corporations. The entrant must be a different firm from the existing firm.

7 Fellner (1949) remains an excellent reference on simple reaction function models, including the Stackelberg leader-follower model. A more modern discussion can be found in Friedman (1977). A recent paper which uses Stackelberg and Cournot models in an international context is Robson (1980).

One problem with leader-follower models is that the asymmetry in firms' strategy is often hard to explain. In this model the asymmetry has a natural explanation in that one firm is in the market while the other is not. (See Spence, 1979 for further comments in this vein.) Although the Stackelberg model represents only one specific market structure, it seems a reasonable starting point for analysis of entry deterrence.

Unlike Dixit, we assume that the two firms produce (or would produce) the same product. The total output of the (established) foreign firm is $x + x^*$, where x is the quantity exported to the domestic country and x^* is the quantity sold in the foreign country. (Asterisks will generally denote variables associated with the foreign country.) The output of the domestic entrant (if it enters) is denoted by y. Initially it is assumed that entrant would sell only in its domestic market. In the absence of a tariff an expression for the profit of the existing firm is

$$\pi^*(x^*, x, y) = V^*(x^*) + V(x, y) - F^* \tag{3}$$

where $V^*(x^*) = x^*p^*(x^*) - c^*x^*$, and $V(x, y) = xp(x + y) - k^*x^*$,

F^* = fixed cost,

c^* = constant marginal cost of production,

$k^* = c^*$ + transport cost,

$V^*(x^*)$ = variable profit from sales in the foreign firm's home market,

$V(x, y)$ = variable profit from exports.

In other words, decreasing costs of a simple form are assumed: fixed cost plus constant marginal cost. The assumption that marginal cost is constant is convenient, since it allows the two markets to be considered independently, and in particular it ensures that the profit maximizing level of sales in the foreign market is unaffected by the values of x and y. It does not affect the nature of our results.

If the home-based firm enters, its profit is

$$\pi(x, y) = yp(x + y) - cy - F, \tag{4}$$

where again for simplicity marginal cost is assumed constant. The entrant chooses its level of output to maximize profit assuming x is fixed. Let $\pi_2(x, y)$ be the partial derivative of π with respect to y. Then the entrant sets

$$\pi_2(x, y) = 0 \tag{5}$$

This implicitly defines the reaction function $y = f(x)$ of the home-based firm, given that it enters. Assuming that the home firm enters only if it anticipates strictly positive profits, the reaction function of the potential domestic firm is

$$y(x) = \begin{cases} f(x) \text{ if } \pi(x, f(x)) > 0 \\ 0 \text{ if } \pi(x, f(x)) \leqq 0 \end{cases} \tag{6}$$

To prevent entry, the foreign monopoly must choose a level of exports such that the maximum profit of the entrant is zero. Let $\bar{b}$ be the lowest export level that prevents entry:

$$\pi(\bar{b}, f(\bar{b})) = 0. \tag{7}$$

If the unconstrained monopoly level of exports by the foreign firm, denoted x_m, is greater than or equal to $\bar{b}$, entry is blockaded and the foreign firm does not need to actively consider entry deterrence. We examine the implication of a tariff where entry deterrence is not a consideration in the next section. However, for our purposes the case in which $x_m < \bar{b}$, so that domestic entry is a possibility, is of more interest. In this case the established firm has a maximum profit under entry deterrence of $V^*(x^*_m) + V(\bar{b}, 0) - F^*$, where x^*_m is its profit maximizing level of sales in its own market (that is, in the foreign country).

The entry deterrence solution is illustrated in figure 1 for the case $x_m < \bar{b}$. The curve $f(x)$ is the reaction function of the home-based firm, disregarding fixed costs. Because of fixed costs, the segment of the function $f(x)$ below point d would involve losses for the potential home-based firm, so that it will not enter. The minimum output of the foreign firm which prevents entry is thus $\bar{b}$. The threat of entry prevents the foreign firm from exporting at the monopoly level, x_m.

The foreign firm compares the profitability of the entry deterrence solution with the profitability of the Stackelberg solution that would occur if the domestic firm were to enter. In defining the Stackelberg solution there are two cases to consider. First, as in figure 1, an isoprofit contour can be tangent to $f(x)$ to the left of $\bar{b}$. (The isoprofit contours are combinations of x and y which yield the same variable profit for the foreign firm from its export market.) In this case, which is the interesting case, the Stackelberg solution is easily defined: the foreign firm chooses x to maximize $\pi^*(x^*, x, f(x))$. The output y chosen by the entrant is then positive. The level of exports by the foreign firm, denoted x_s, is the tangency solution and must be strictly less than $\bar{b}$. Lower isoprofit contours correspond to higher levels of profit. Therefore, as drawn, the entry-preventing level of exports, $\bar{b}$, is more profitable than the Stackelberg point, s, for the foreign firm, and it will choose to deter entry. (See Dixit, 1979 for a fuller description of the model.)

It is also possible that the tangency between an isoprofit contour and $f(x)$ could occur to the right of $\bar{b}$. However, the possibility that x_s could exceed $\bar{b}$ is an empty box: the domestic firm would not enter. Also, if the tangency does occur to the right of $\bar{b}$, the foreign firm will deter entry, either by selling x_m if $x_m \geqq \bar{b}$ or, if $x_m < \bar{b}$ as we assume, by selling $\bar{b}$. (This can be seen from a little experimentation with figure 1.) Any tariff that would induce entry must, therefore, first shift the isoprofit contours so that the tangency moves to the left of $\bar{b}$. Consequently, if we assume entry is possible, we can assume $x_s < \bar{b}$ without loss of generality.

We have $y(x_s)$ as the output of the domestic firm given export level x_s by the

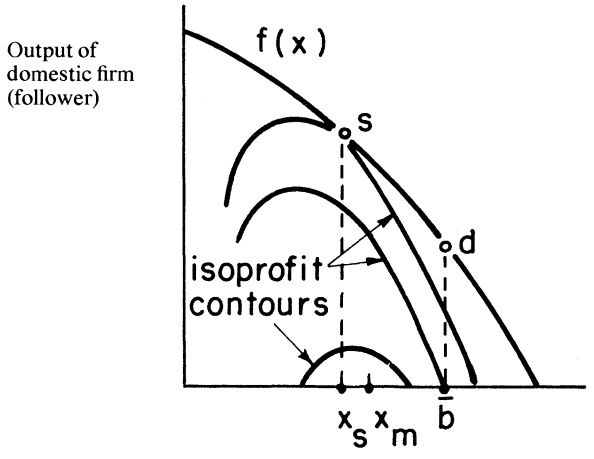

FIGURE 1 Entry deterrence in a Stackelberg leader-follower model

foreign firm, so the maximum profit of the foreign firm at the Stackelberg solution is

$$\pi^{*s} = V^*(x_m) + V(x_s, y(x_s)) - F^*.$$

We assume that entry deterrence is profitable in the pre-tariff situation so that $V(\bar{b}, 0) > V(x_s, y(x_s))$. For this to be the case it is not necessary that the existing firm have lower costs than the entrant. Even if $c < k^*$, there is some level of fixed cost F at which the existing firm would profit from entry deterrence. Higher levels of F reduce the output $\bar{b}$ required to prevent entry and increase the profit associated with entry deterrence. The level of F does not affect the profit associated with the Stackelberg tangency solution x_s. For some sufficiently high value of F the foreign firm would find entry deterrence more profitable than the Stackelberg solution. The level of F at which entry deterrence is profitable may be less than F^*, which has been incurred by the foreign firm and which is defrayed, at least in part, by variable profits from its home market.[8] Note that there is nothing to rule out the possibility that prices could be different in the two markets, which raises the possibility of arbitrage. We assume that arbitrage is not possible. Since treating arbitrage explicitly would complicate the algebra and restrict the behaviour of firms in a fairly obvious way without contributing additional insights, it seems appropriate to ignore it.

8 However, at $F = 0$ and $c \leq k^*$, it is not profitable for the established firm to deter entry.

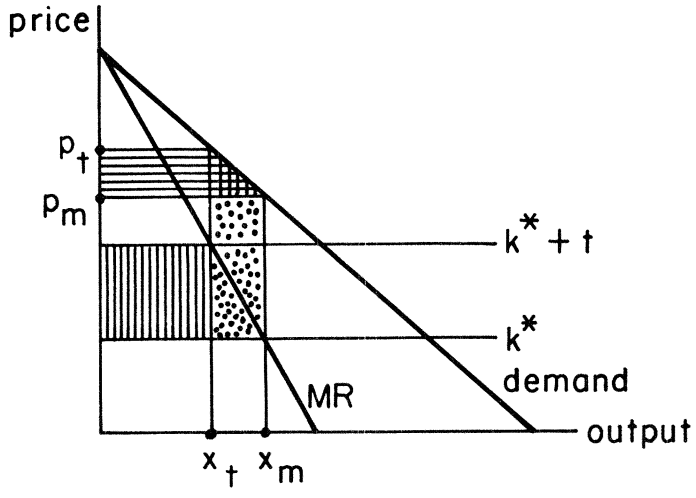

FIGURE 2

A RENT-EXTRACTING TARIFF WITHOUT ENTRY

We now consider the effects of a linear tariff placed on imports of good Z from the foreign monopoly firm.[9] Assume, for this section, that domestic entry is not feasible (Entry is and remains blockaded.) From the demand function (2), the net gain to the home country from imports of Z given tariff t per unit is:

$$G_0(t) = u(x(t)) - p(x(t))x(t) + tx(t), \tag{8}$$

where $u - px$ is the consumer surplus[10] from quantity $x(t)$ of good Z imported at tariff t and $tx(t)$ is tariff revenue. From differentiation of (8) and the fact that marginal revenue is set equal to marginal cost, $k^* + t$, by the foreign firm,

$$G_0'(t) = (p - (k^* + t))x'(t) + x(t) + tx'(t), \tag{9}$$

where primes are used to denote derivatives. An increase in the tariff allows an additional $x(t) + tx'(t)$ of the foreign monopoly rent to be extracted as tariff revenue but consumer surplus is reduced by $(p - (k^* + t))x'(t)$. The home country may gain by charging a tariff to extract some of the foreign monopoly rent but this gain is at least partially offset by the loss in consumer surplus.

The gains and losses from the tariff are illustrated in figure 2. The total tariff

9 Two-part or other non-linear tariffs might be superior for extracting rent. However linear (ad valorem) tariffs are much easier to administer and are so commonly observed in practice that it seems reasonable to restrict attention to them.

10 The inverse demand is $p = u'(z)$ and there are no income effects, so consumer surplus is

$$\int_0^x (u'(z) - p)\, dz$$

which equals $u(x) - p \cdot x$ assuming $u(0) = 0$.

revenue is shown by the vertically hatched area and the loss in consumer surplus by the horizontally shaded area, including the double-hatched small triangle.[11]

This analysis is very similar to the standard analysis in public finance of the effect of a per unit tax on a domestic monopoly. In the case of domestic monopoly the monopoly rent accrues to residents. Since an increase in the tax reduces profits at rate $x(t)$, the marginal gain, $G_0'(t)$ is $(p - k^*)x'(t)$ which is negative. The net loss is shown by the dotted area plus the small hatched triangle in figure 2.[12] Such a tax is obviously not an attractive way of collecting revenue in a purely domestic context. In the absence of potential entry, a tariff is attractive only because income is taken from foreigners rather than domestic residents.

EXTRACTION OF RENT UNDER POTENTIAL ENTRY

The possibility of domestic entry substantially modifies the reaction of the foreign monopoly to the imposition of a tariff. Recall that we are assuming that the entrant would produce for its home market only.

Proposition 1
If the foreign monopoly deters entry, a tariff can extract some monopoly rent at no cost in reduced consumption to the domestic country. The entire tariff revenue is a net gain to the domestic country.

Proposition 1 follows directly from expressions (5) and (7), which imply that the entry-deterring level of exports $\bar{b}$, is unaffected by the tariff.

The amount of monopoly rent that can be extracted is constrained by two requirements. First the variable profit from exports must remain positive to the foreign firm:

$$0 \leqslant V(\bar{b}, 0; t) \equiv [p(\bar{b}) - k^*]\bar{b} - t\bar{b}. \tag{10}$$

Second, the variable profit from entry deterrence must continue to exceed the variable profit from the Stackelberg leader-follower equilibrium:

$$V(\bar{b}, 0; t) \geqslant V^s(t) \equiv (p(z_s) - k^*)x_s - tx_s, \tag{11}$$

where $z_s = x_s + y(x_s)$: consumption of Z by the domestic country at the Stackelberg equilibrium.

If constraint (11) is never binding, the home country can set the tariff so as to extract the entire monopoly rent from exports at no cost in consumer surplus. Constraint (10) would then hold with equality. Moreover, since x^*_m, the output sold in the foreign firm's home market, is unaffected by the tariff,

11 These areas are obtained from (8) or alternatively by integrating the corresponding terms in (9). The optimum tariff is found by setting $G'_0(t) = 0$.

12 Under perfect competition in the domestic country, so that price equals marginal cost, the loss would be the small triangle alone: the familiar deadweight loss triangle.

this transfer of rent is achieved with no reduction in world welfare. (This interesting result still holds in the more general case where marginal costs are not constant.)

On the other hand, if constraint (11) is binding, the total tariff revenue is limited by the requirement that the foreign monopoly earn at least $V^s(t)$ from its policy of entry deterrence. Since proposition 1 ensures that $\bar{b}$ is constant, the tariff revenue increases with the tariff until one of the constraints is binding. This leads to the following remark.

Remark 1
The optimum tariff in the entry deterrence regime is a tariff just marginally below the minimum tariff that will induce the foreign firm to abandon entry deterrence.

Remark 2
An increase in the tariff increases the relative attractiveness of the Stackelberg solution to the foreign firm. That is, as t rises, $V(\bar{b}, 0, t) - V^s(t)$ falls.

Proof
An increase in the tariff makes both entry deterrence and the Stackelberg leader-follower solution less profitable for the foreign firm.
By the envelope theorem,[13]

$$dV^s/dt = -x_s,$$

and

$$dV(\bar{b}, 0, t)/dt = -\bar{b}$$

From the definition of x_s, $x_s < \bar{b}$ so V^s, the variable profit under the Stackelberg solution, falls by less than V, the variable profit under entry deterrence.

An implication of remark 2 is that a high, but not prohibitive, tariff may induce entry by making the Stackelberg solution more profitable than entry deterrence to the foreign firm.[14] It is of interest to examine the conditions under which a tariff will have this entry-inducing effect.

Proposition 2
The following condition is necessary for the foreign firm to change its policy from entry deterrence to the Stackelberg outcome: $p(z_s) > p(\bar{b})$.

13 A presentation of the envelope theorem can be found in Varian (1978).

14 This paper does not consider quotas. Nevertheless, an interesting point made by Paul Krugman seems worth reporting. The domestic government can induce entry by setting a quota level slightly below the entry-preventing output $\bar{b}$, but above x_s. The foreign firm's best strategy would then involve producing the Stackelberg output x_s. Thus the quota would apear to be inactive, even though it was having an important effect.

Proof
To accept the Stackelberg outcome the foreign firm requires that

$$V^s(t) \geq V(\bar{b}, 0, t), \text{ or}$$

$$(p(z_s) - (k^* + t))x_s \geq [p(\bar{b}) - (k^* + t)]\bar{b}$$

Since $\bar{b} > x_s$ and since, for positive variable profit, $p(z_s) > k^* + t$ and $p(\bar{b}) > k^* + t$, it is necessary that $p(z_s)$ exceed $p(b)$ as was to be shown.

Proposition 2 implies that the domestic country can induce domestic entry only if this action increases the price of the good.

THE ENTRY-INDUCING TARIFF AND WELFARE

Since a tariff may induce the Stackelberg solution (and entry), the question immediately arises of whether the domestic country could gain from such a tariff. One would like to compare the optimum tariff under each of the two regimes; entry deterrence and the Stackelberg solution. Unfortunately there is very little that one can say in the general case (without specific functional forms). However, a related question of some interest is whether a marginal increase in the tariff from just below the entry-inducing level to the entry-inducing level will increase or decrease the domestic country's welfare. Although there is perfect information in our model, in a more realistic context policy-makers might have only local information about demand and cost and might therefore be interested in this marginal change.

Suppose that at tariff t_0, $V^s(t_0) = V(\bar{b}, 0, t_0) > 0$ so that the foreign monopoly is indifferent between entry deterrence and the Stackelberg solution. As already shown (remark 1) a tariff just marginally below t_0 is the home country's best tariff under the entry deterrence regime. The following proposition indicates the importance of the relative costs of production.

Proposition 3
The following condition is necessary for the welfare of the domestic country to be improved by a slight increase in the tariff from just below the entry-inducing level to the entry-inducing level:

$$cy(x_s(t_0)) + F < k^* y(x_s(t_0)),$$

where t_0 is the entry-inducing tariff and $y(x_s(t_0))$ is the corresponding output of the domestic firm.

Proof
See Appendix.

From proposition 2, total consumption z_s under entry is always less than $\bar{b}$, the consumption under entry-deterrence. Consequently, the consumer surplus associated with good Z is always less after entry. Furthermore, tariff revenue also declines as imports fall from $\bar{b}$ to $x_s(t_0)$. Therefore a net gain can occur only if the profits earned by the domestic firm more than offset these

losses. It transpires that the entrant's profits can be sufficiently high only if the cost condition of proposition 3 holds. If transport costs are low and cost conditions are similar in the two countries so that k^* and c would be similar, significant fixed costs make it unlikely that inducing entry could be welfare-improving at the margin for the home country.

Nevertheless, it is possible that a discrete increase in the tariff to some level significantly above t_0 could improve welfare. The additional rent extracted from the foreign firm, if any, and the additional profits earned by the domestic firm would have to be weighed against the loss in consumer surplus from reduced consumption of Z. (See the appendix for further analysis.)

At the extreme, the domestic country could charge a prohibitive tariff so that the domestic entrant would act as a monopolist. Given the assumption that the entrant does not export, such a policy is unlikely to be advantageous for the home country unless domestic costs of production are much lower than foreign costs. Note that a domestic firm may be deterred from entry even if it has lower costs than the foreign firm. The lower its costs, the 'harder' it is for the foreign firm to prevent entry (i.e., $\bar{b}$ is higher), and a sufficiently large decline in domestic costs would, of course, induce domestic entry without the imposition of a tariff.

POTENTIAL ENTRY IN BOTH COUNTRIES

Intra-industry Trade

So far we have assumed that the entrant considers producing only for its home market. Another possibility is that the entrant might produce for both markets. This raises the possibility of intra-industry trade: each country may import and export the imperfectly competitive good. We shall see that imperfect competition in itself can cause intra-industry trade. This result is of some interest since trade within commodity groups is now accepted as an important part of world trade. The intra-industry trade result in this paper may seem rather odd, since the good is homogeneous and transport costs exist, but it does follow from the standard, although specific, assumptions made concerning the behaviour of firms.

The extrant is assumed to follow a Cournot strategy in each market, and the existing firm follows a Stackelberg strategy in each market unless it deters entry. If the domestic firm enters its profit is

$$\pi = W(x, y) + W^*(x^*, y^*) - F, \tag{12}$$

where

$$W(x, y) = yp(x + y) - cy \equiv \text{variable profit at home}$$

$$W^*(x^*, y^*) = y^*p^*(x^* + y^*) - ky^* \equiv \text{variable profit from export}$$

y^* = domestic firm's exports

$k = c$ + transport cost

p^* = foreign inverse demand.

The assumption of constant marginal costs ensures that the variable profit in each market depends only on the sales (of both firms) in that market. The entrant chooses y and y^* to maximize (12) given x and x^*. The first order conditions require that perceived marginal revenue equal marginal cost in each market:

$$p + yp' = c, \tag{13}$$

$$p^* + y^*p^{*\prime} = k. \tag{14}$$

Equation (13) is the same as equation (5) and implicitly defines the reaction function $y = f(x)$; similarly, equation (14) defines the reaction function $y^* = f^*(x)$. Corresponding to (6), we define $y(x) = f(x)$ provided π and W are positive and $y(x) = 0$ otherwise. Similarly $y^*(x^*) = f^*(x^*)$ if π and W^* are positive and $y^*(x^*) = 0$ otherwise. The maximum profit of the domestic firm (if it decides to enter) is

$$\pi = W(x, y(x)) + W^*(x^*, y^*(x^*)) - F. \tag{15}$$

The possibility of exporting can never reduce the domestic firm's profits. Entry is more likely because the domestic firm can use variable profit from both markets to cover fixed cost.

Under entry the profit of the existing firm is

$$\pi^* = V(x, y; t) + V^*(x^*, y^*) - F^*, \tag{16}$$

where $V(x, y; t) = xp(x + y) - (k^* + t)x,$

and $V^*(x^*, y^*) = x^*p^*(x^* + y^*) - c^*x^*.$

Equation (16) is similar to equation (3). If the existing firm accepts the Stackelberg leader-follower solution, it chooses x_s and x^*_s so as to maximize π^* subject to $y = y(x)$ and $y^* = y^*(x^*)$. The first order conditions require marginal revenue to be set equal to marginal cost in each market:

$$p + x_s p'[1 + y'(x_s)] = k^* + t, \tag{17}$$

$$p^* + x^*_s p^{*\prime}[1 + y^{*\prime}(x^*_s)] = c^*. \tag{18}$$

Equations (13), (14), (17), and (18) are four equations in four unknowns: x_s, x^*_s, y, y^*. Naturally, these equations may or may not have a positive solution, and the solution, if it exists, may or may not be unique. However, for many normal cases there will be a unique strictly positive solution at which profits are non-negative for both firms. This implies intra-industry trade. In a sense, intra-industry trade arises from a kind of discrimination: each firm sees each country as a separate market and tries to set marginal revenue equal to marginal cost in each. A referee suggested that one way of looking at the result is that intra-industry trade occurs because two firms share two national markets, while each firm happens to be located in a different country.

We assume that there is no arbitrage between the two markets. If arbitrage

were costless, the difference in prices would be constrained by $p^* \leqq p + r$ and $p \leqq p^* + r + t$, where r represents per unit transport costs. For many commodities produced under imperfect competition the need for a distribution network would make arbitrage very costly. If arbitrage is regarded as an important possibility, the suggested model of intra-industry trade is less likely to be empirically important.

The type of intra-industry trade arising here is described and analysed more fully in Brander (1981) and Brander and Krugman (1981). It relies on imperfect competition per se as an underlying cause of trade. Competing and perhaps more convincing explanations which rely on product differentiation are in Krugman (1979) and Lancaster (1980). It seems reasonable that actual intra-industry trade might arise from both sources.

Entry deterrence

The expectation that the entrant will produce for both markets changes the entry deterrence problem faced by the existing firm. The main point is that entry deterrence becomes more difficult; the entry deterring quantity is greater and the profit is lower than in the case in which the entrant cannot export.

To deter entry, the foreign firm must choose b and b^* such that

$$\pi \equiv W(b, y(b)) + W^*(b^*, y^*(b^*)) - F \leqslant 0, \tag{19}$$

where

b = entry-deterring output for domestic country,

and

b^* = entry-deterring output for foreign country.

Setting $\pi = 0$ defines b^* as an implicit function of b. We refer to $b^*(b)$ as the bb^* contour:

$$db^*/db = (-dW/db)/(dW^*/db^*) < 0. \tag{20}$$

Proposition 4

The possibility of potential entry in both markets cannot cause the entry-deterring firm to sell less in either market. On the contrary, the normal case is for sales to expand in both markets.

Proof

If $b < \bar{b}$ the potential entrant will enter its home market regardless of the export market. Therefore $b \geqq \bar{b}$ to deter entry so sales in the domestic market cannot fall. If $W^*[b^*, y^*(b^*)] \geq 0$, so that the entrant can make some variable profit from exports, then $b > \bar{b}$. Also the foreign firm will never produce less than the monopoly output in its home market.

Extracting monopoly rent
The extraction of monopoly rent is more complicated in the case of potential intra-industry trade because the existing firm now has some flexibility. The problem facing the established firm is to maximize its own profit subject to being on the bb^* contour defined in (20) and to compare it with the Stackelberg outcome. The profit of the existing firm under entry deterrence can be written

$$\pi^* = V(b, 0; t) + V^*(b^*, 0) - F^* \tag{21}$$

and, along an isoprofit contour,

$$db^*/db = (-\partial V/\partial b)/(\partial V^*/\partial b^*) < 0. \tag{22}$$

The effect of an increase in the tariff is to cause the existing firm to move along the bb^* contour, increasing b^* and reducing b. Its profits are also reduced.

Remark 3
An increase in the tariff decreases the established firm's exports and lowers the profit obtained under entry deterrence.

$$db/dt < 0 \quad \text{and} \quad d\pi^*/dt < 0$$

Proof
i) $db/dt < 0$.
The established firm chooses b to maximize π^* in equation (21). Substituting $b^* = b^*(b)$ the first order condition is

$$d\pi^*/db = 0$$

The comparative static result is obtained by totally differentiating the first order condition with respect to b and t

$$db/dt = 1/[d^2\pi^*/db^2] < 0 \text{ by the second order condition, } d^2\pi^*/db^2 < 0.$$

ii) $d\pi^*/dt = -b < 0$ by the envelope theorem.
In this case the domestic country cannot extract rent painlessly since the tariff causes a loss in consumer surplus as imports fall. Nevertheless, by proposition 4, for any tariff the domestic country is better off with the threat of entry in both markets than with the threat of entry into the domestic market only.

The possibility of entry in both markets also affects the domestic country's decision about whether to use the tariff to induce entry. As before, inducing entry with a tariff enables the domestic firm to earn profits from its domestic operation and reduces the rents going to the foreign firm. In addition the entrant can earn profits from its foreign operation. If the foreign market is very large, the profits earned there can swamp the welfare losses or gains in the domestic market. Protective tariffs insure that domestic firms can enter and survive, and these firms earn rent from foreign operations.

Finally, a prohibitive tariff is also more attractive in this case. Even though the entrant produces only the monopoly output at home, resulting in a loss of

consumer surplus, the entrant can earn rent from overseas which might more than compensate for the domestic welfare losses.

CONCLUDING REMARKS

As pointed out by a referee, the interest one attaches to this paper depends critically on how one views the limit output model of entry prevention. Since the dominant firm may not produce the limit output if entry should occur, there is some doubt as to whether the limit output is a credible entry-deterring threat. One approach is that the dominant firm 'commit' itself, through capital investment or whatever, to the limit output (see Dixit, 1980 and Eaton and Lipsey, 1980). This commitment approach seems more realistic. The cost is that the analysis must be made explicitly dynamic. The insights of the analysis in this paper would not seem to be changed by this approach, particularly if one thinks of the government acting ex ante in setting tariffs – before the dominant firm makes a final decision concerning its level of commitment. If commitment is required for entry prevention, then the range of cases in which entry deterrence is possible, and consequently, for which the analysis of this paper is relevant, is reduced.

A second caveat, also suggested by a referee, is that different strategies by firms and different tools by government are important possibilities. For example Katrak (1977) suggests profits taxes and consumption taxes as tools for dealing with foreign monopoly and DeMeza (1979) suggests price controls. See also Just et al. (1979) and Stegemann (1981) on state trading. (Clearly a maximum price equal to marginal cost is the best possible policy, from a national point of view, in a simple deterministic full information world. We would argue that such a policy tool is probably inferior to a tariff in a more realistic world and rarely feasible in any case.) Certainly, different behaviour by firms could lead to different results. There is a large number of competing models of market structure; the model here is a particular type of conjectural variation model. Other possibilities include price-setting models and collusive models. The model we have chosen seems like the natural starting point.

If one is to start considering different possible strategies by the firms and the government(s) involved, the possibility arises of modelling the interaction between agents as a game. Explicit game-theoretic modelling is beyond the scope of this paper, but a few useful preliminary remarks can be made. Consider first the simplest case, in which there are only two players: the domestic government and a foreign monopoly. The outcome suggested in the paper is clearly not in the core of a co-operative game with side payments. Specifically, if the monopoly were to set $p = MC$ the government could pay the monopoly slightly more than it earns under the optimum tariff regime, and in addition the domestic country would be better off. (No wedge would be driven between consumer and producer prices.) In more conventional economic

terms, the core contains first-best outcomes while the paper is strictly concerned with a second-best world. Consequently, there is room for direct negotiation between the firm and the government. Thus, by threatening to use a tariff the government might extract rents more efficiently than by actually using a tariff.

With potential entry there are three players and sorting out possible outcomes becomes very difficult. However, since the relative bargaining position of the foreign firm is made worse, presumably the domestic country could do better. If there is potential entry in both countries, we should perhaps recognize that there are two tariff-setting jurisdictions, with four players (two governments and two firms); once again it is hard to predict what would happen. At the very least, the prospect of retaliatory tariffs would reduce the ability of any one government to use rent-extracting tariffs. The government-government interaction here is rather like it is in the standard optimum tariff retaliation argument.

There are several points which should be summarized here. Our model is built around the idea that under imperfect competition price exceeds marginal cost, so that countries which import such goods usually pay rent to foreign firms. Some of this rent can be extracted by a tariff, and this kind of tariff policy can be particularly effective under the threat of domestic entry. In the special case in which the foreign firm expects the entrant to produce only for its home market, some rent can be extracted with no additional distortion.

A sufficiently high tariff will force the foreign firm to abandon its strategy of entry deterrence and may therefore induce domestic entry. This is unlikely to be welfare-improving for the home country unless the domestic entrant can export and earn rent from its foreign operations. Despite transportation costs and tariffs the domestic entrant may indeed export with the result that intra-industry trade occurs. This is of some interest since intra-industry trade is an important part of world trade that is not well explained by standard competitive models. Furthermore, if the existing firm believes that the domestic firm may enter both domestic and foreign markets, its entry-deterring behaviour is affected. The domestic country can no longer extract rent from the foreign firm in a non-distorting way with a linear tariff. Nevertheless, at any tariff level, the domestic country is better off than it would be if the domestic firm threatened to enter only its home market.

The theme of the paper is that imperfect competition significantly changes the tariff-setting incentives facing a particular country. We are not advocating the use of tariffs to extract foreign rents and do not seriously address the issue of world welfare. We do, however, point out that a country may have an incentive to use tariffs under imperfect competition. Some of the points made seem fairly obvious, yet they rarely emerge in discussions concerning tariffs, perhaps because of the lack of emphasis that imperfect competition has received in international trade theory.

APPENDIX

Proposition 3
The following condition is necessary for the welfare of the domestic country to be improved by a slight increase in the tariff from just below the entry-inducing level to the entry-inducing level:

$$cy(x_s(t_0)) + F < k^*y(x_s(t_0)),$$

where t_0 is the entry inducing tariff and $y(x_s(t_0))$ is the output of the domestic firm.

Proof
If there is no entry, the gain to the home country from the consumption of good Z at tariff t_0 is

$$G_1(t_0) = u(\bar{b}) - p(\bar{b})\bar{b} + t_0\bar{b}. \tag{A-1}$$

$G_1(t_0)$ is the consumer surplus at t_0 plus the tariff revenue. By adding and subtracting $k^*\bar{b}$,

$$G_1(t_0) = u(\bar{b}) - k^*\bar{b} - V(\bar{b}, 0, t_0). \tag{A-2}$$

Similarly, the gain to the home country from the Stackelberg solution at a tariff t where $t \geqslant t_0$ is

$$G_2(t) = u(z_s) - p(z_s)z_s + \pi[x_s, y(x_s)] + tx_s, \tag{A-3}$$

where, for simplicity, $x_s(t)$ is written as x_s. $G_2(t)$ is the consumer surplus from z_s plus the profit of the domestic entrant and the tariff revenue. This reduces to

$$G_2(t) = u(z_s) - (k^*x_s + cy(x_s) + F) - V^s(t). \tag{A-4}$$

The welfare of the domestic country at a tariff just below t_0 exceeds its welfare at the entry inducing tariff if $G_1(t_0) - G_2(t_0) > 0$. From (A-2) and (A-4), since $V(\bar{b}, 0, t_0) = V^s(t_0)$,

$$G_1(t_0) - G_2(t_0) = u(\bar{b}) - u(z_s) - k^*\bar{b} + [k^*x_s + cy(x_s) + F] \tag{A-5}$$

$$= [u(\bar{b}) - u(z_s) - k^*(\bar{b} - z_s)] + [cy(x_s) + F - k^*y(x_s)]. \tag{A-6}$$

From proposition 2 we know $z_s < \bar{b}$ which implies $u(\bar{b}) > u(z_s)$. Also the value of the additional consumption, $\bar{b} - z_s$, under entry deterrence exceeds its additional cost of production, $k^*(\bar{b} - z_s)$ so that the first term (in square brackets) of (A-6) is positive. Therefore $G_1(t_0) - G_2(t_0) > 0$ if $cy(x_s) + F \geqslant k^*y(x_s)$. Therefore a necessary (but not sufficient) condition for $G_2(t_0)$ to exceed $G_1(t_0)$ is $cy(x_s) + F < k^*y(x_s)$. Q.E.D.

THE MARGINAL GAIN FROM AN INCREASE IN THE TARIFF AFTER ENTRY

From (A-3),

$$G_2(t) = u(z_s) - p(z_s)z_s + \pi[x_s, y(x_s)] + tx_s. \tag{A-7}$$

Since marginal revenue to the foreign firm equals $k^* + t$, differentiating (A-7) and rearranging terms, we obtain

$$G'_2(t) = [p - (k^* + t)]x'_s(t) + (p - c)y'(x_s)x'_s(t) + tx'_s(t) + x_s(t). \tag{A-8}$$

Expression (A-8) is the same as expression (9) of the text ($x_s(t)$ replaces $x(t)$) except for the extra term, $(p - c)y'(x_s)x'_s(t)$, which is the marginal net value of the additional output produced by the entrant with an increase in the tariff.

The sum of the first two terms of (A-8) represents the net change in consumer surplus and profit earned by the domestic firm from the reduction in imports, x_s, because of a rise in t. This sum could be positive or negative. If it is positive, and if raising the tariff increases tariff revenue, domestic welfare also increases. However, if foreign costs are less than or equal to domestic costs, normally the sum of the first two terms would be negative, since we expect $-1 < y'(x_s) < 0$, which implies that total consumption, $x_s + y(x_s)$, falls as t rises. Even in this case, if x_s is sufficiently inelastic in t, domestic welfare could improve.

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