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A "Reciprocal Dumping" Model of International Trade

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INTRODUCTION

It has long been known that the phenomenon of "dumping" in international trade can be explained in terms of the standard theory of monopolistic price discrimination.[1] If a profit-maximizing firm believes that it faces a higher price elasticity of demand abroad than at home, and it is able to discriminate between domestic and foreign markets, its f.o.b. export price will be less than its domestic price -- which is the technical definition of dumping. This may, although it need not, also involve an f.o.b. price below average cost and a c.i.f. price below domestic prices.

But why should the price elasticity of export demand be higher than that of domestic demand? Dumping might be a result of accidental differences in consumer behavior, which make market demand curves more elastic in some countries than in others. But there is probably more to it than mere accident. Even if the elasticity of market demand is the same abroad and at home, firms will usually have a larger share of the domestic market, and will therefore have more monopoly power in the domestic than in the foreign market. Dumping would arise not because of differences in the elasticity of market demand but because of differences in the elasticity of demand faced by individual firms.

If this is the underlying explanation of dumping, however, the use of models of pure monopoly begins to look inappropriate. The implicit model behind our argument seems to be one in which there are at least

two firms in the industry, one at home and one abroad, each of which could at least potentially take a significant share of the other's market. In a recent paper, Brander (1981) has considered such a model. That paper showed that noncooperative behavior by firms can indeed lead to dumping even when market demand schedules are the same in both countries. More surprisingly, the paper showed that one possible outcome is a situation in which firms in both countries dumped into the other's market, leading to "cross-hauling": two-way trade in identical products.[2] The flow of goods is shown schematically in Figure 1.

In this paper we examine some similar models and interpret such trade as "reciprocal dumping". In equilibrium each firm has a perceived elasticity of demand for exports which is larger than the perceived elasticity for domestic sales, because each has a smaller share of the other's home market than of its own. Thus each firm is price discriminating and "dumping" in the other's home market.

Section 1 develops a simple partial equilibrium model of Cournot duopoly, price discrimination, and trade which shows how reciprocal dumping can occur and describes the factors that affect it. Section 2 generalizes the model to the many firm case and considers entry. Section 3 is concerned with the welfare effects of reciprocal dumping. Section 4 generalizes the model to a fairly general specification of firms' behaviour and to arbitrary demand conditions, and gives it a general equilibrium interpretation. Finally, Section 5 considers the implications of the analysis.

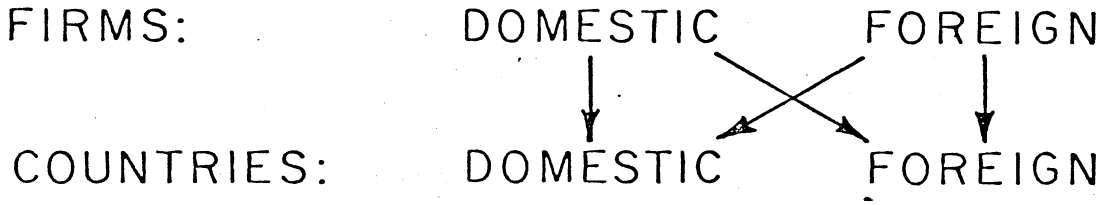

FIG. 1

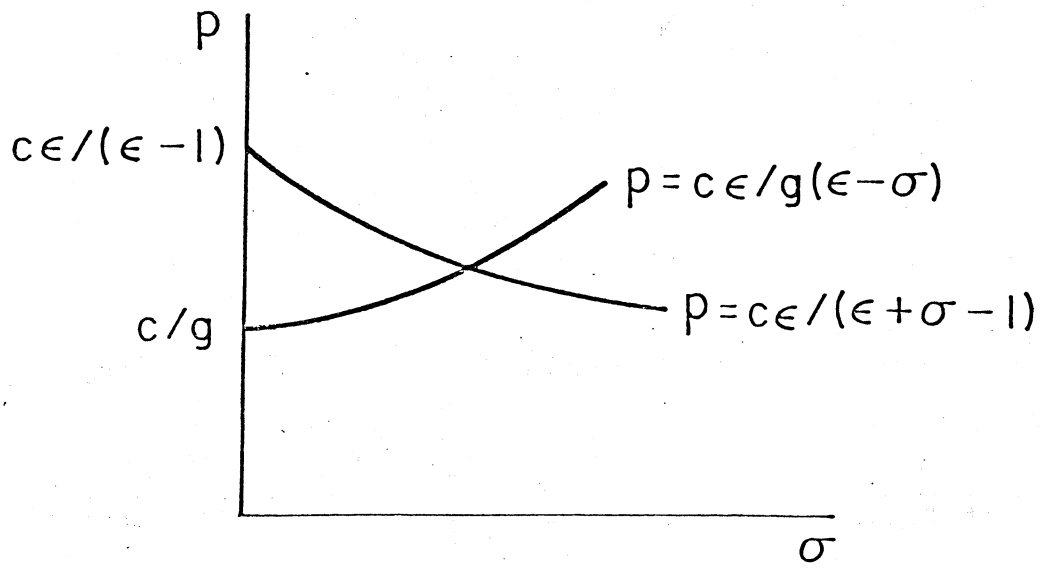

FIG. 2

1. A SIMPLE MODEL

Assume there are two identical countries and that each country has one firm producing commodity Z . There are transport costs incurred in exporting goods from one country to the other. The main idea is that each firm regards each country as a separate market and tries to choose the profit-maximizing quantity for each country separately. Each firm has a Cournot perception: it assumes the other firm will hold output fixed in each country. Two-way trade arises in this context. Each firm has a smaller market share of its export market than of its domestic market. Therefore, perceived marginal revenue is higher in the export market. The effective marginal cost of delivering an exported unit is higher than for a unit of domestic sales, because of transport costs, but this is consistent with the higher marginal revenue. Thus marginal revenue can equal marginal cost in both markets at positive output levels. This is true for firms in both countries which gives rise to two-way trade in identical products. Each firm has a smaller markup over cost in its export market than at home: reciprocal dumping.

The following notation will be useful:

x = output of the domestic firm for domestic consumption

x^* = output of the domestic firm consumed abroad

y = output of the foreign firm consumed in the domestic country

y^* = output of the foreign firm consumed in the foreign country

Z = total consumption in the domestic country

Z^* = total consumption in the foreign country

$p = p(Z)$ domestic price

$p^* = p^*(Z^*)$ foreign price

c = (constant) marginal cost

$\varepsilon = -p/Zp'$ = elasticity of domestic demand

$\sigma = y/Z$ = share of foreign firm in domestic market

We use the "iceberg" formulation of transport costs. It is as if quantity y/g begins the trip but only y actually survives the voyage, with $0 < g < 1$. The letter g is an inverse measure of transport costs.

The domestic firm maximizes profit assuming y and y^* are fixed.

$$\pi = xp(Z) + x^*p^*(Z^*) - c(x + x^*/g)$$

$$\partial\pi/\partial x = 0 \text{ implies } xp' + p - c = 0 .$$

where primes denote derivatives. In elasticity form this becomes:

$$p(\varepsilon - x/Z) = c\varepsilon$$

or
$$p = c\varepsilon/(\varepsilon + \sigma - 1) \qquad (1)$$

This is the implicit reaction function for the domestic firm in its home market. Only y, and not y^*, enters (1) so the two countries can be considered separately. By symmetry we need consider only one country.

The first order condition for the foreign firm is:

$$yp' + p = c/g$$

or
$$p(\varepsilon - y/Z) = c\varepsilon/g$$

so
$$p = c\varepsilon/g(\varepsilon - \sigma) \qquad (2)$$

This is the implicit reaction function for the foreign firm.

Equations (1) and (2) are two equations that can be solved for p and σ. The solutions are:

$$\sigma = (\varepsilon(g-1) + 1)/(1+g)$$

$$p = c\varepsilon(1+g)/g(2\varepsilon-1)$$

These solutions are meaningful only if they are positive and if the second order conditions are satisfied. A necessary and sufficient condition for a positive solution is:

$$\varepsilon < 1/(1-g)$$

If we assume that demand is constant elasticity: $p = AZ^{-1/\varepsilon}$, the equilibrium can be shown nicely on a diagram as in Figure 2. For the domestic firm price is declining in σ (foreign market share) and for the foreign firm price is increasing in σ. The intercepts on the price axis are, respectively, $c\varepsilon/(\varepsilon-1)$ and c/g so provided $c\varepsilon/(\varepsilon-1) > c/g$ (or $\varepsilon < 1/(1-g)$) the intersection must be at a positive foreign market share. Thus a very simple condition concerning the elasticity of demand and price determines whether or not reciprocal dumping will occur. Furthermore this condition has a natural economic interpretation, since $c\varepsilon/(\varepsilon-1)$ is the price which one would obtain if there were no trade, while c/g is the marginal cost of imports. What the condition says is that reciprocal dumping will occur if monopoly markups in its absence would exceed transport costs.

The extent of cross-hauling is given by σ and we can easily see that $d\sigma/d\varepsilon < 0$. That is, if ε is low so that the domestic firm has substantial monopoly before trade, there will be extensive reciprocal dumping after trade. Monopoly power induces cross-hauling in this model.

2. *RECIPROCAL DUMPING WITH MANY FIRMS AND ENTRY*

First, the model is generalized to the many firm case. Assume there are n^* identical foreign firms and n identical domestic firms. Then $Z = nx + n^*y$ and $\sigma = n^*y/Z$. The first order conditions yield the following analogues to (1) and (2).

$$p = nc\varepsilon/(n\varepsilon + \sigma - 1) \tag{3}$$

$$p = n^*c\varepsilon/g(n^*\varepsilon - \sigma) \tag{4}$$

Equations (3) and (4) are implicit reaction functions for typical domestic and foreign firms respectively. Solving (3) and (4) for p and σ gives

$$p = c\varepsilon(n^* + gn)/g(n^*\varepsilon + n\varepsilon - 1)$$

$$\sigma = (nn^*\varepsilon(g - 1) + n)/(n + gn^*)$$

The necessary and sufficient condition for a positive solution is:

$$\varepsilon < 1/n^*(1 - g)$$

Setting $g = 1$ yields the standard many firm Cournot model and setting $n = n^* = 1$ yields the model of Section 1. The point being made here is that the reciprocal dumping result holds for the many firm case.

This analysis takes the number of firms in each country as given. Generally, however, the number of firms should be regarded as endogenous. In particular we might wonder whether a reciprocal dumping equilibrium is stable with free entry. (We require positive fixed costs to avoid competitive limit outcome.) Figure 3 shows that reciprocal dumping is stable subject to some quite reasonable regularity conditions. The

vertical and horizontal axes represent the number of foreign based and home based firms respectively. There is a locus of n^*,n combinations that yield zero profits for home firms, labelled $\pi = 0$. Similarly there is a zero profit locus for foreign firms, $\pi^* = 0$. By symmetry the curves intersect at a point like s, where $n^* = n$. Normally, each locus will be downward sloping, and $\pi = 0$ will be more steeply sloped than $\pi^* = 0$. Points below $\pi = 0$ involve positive profits for domestic firms and points below $\pi^* = 0$ involve positive profits for foreign firms.

In region D, for example, foreign firms are making positive profits so n^* tends to rise, while domestic firms make losses and n tends to fall moving the system toward equilibrium. All regions except B and E lead directly back to equilibrium, while regions B and E lead to stable regions so the system as a whole is stable.

There are three possible sources of instability: (1) if regions below a zero profit locus represents losses rather than profits, (2) if zero profit lines are upward sloping, or (3) if $\pi^* = 0$ is steeper than $\pi = 0$.

Possibilities (1) and (2) are ruled if the market is quasi-competitive,[3] that is, if entry increases output in each country and possibility (3) is ruled out if entry in a firm's home market affects profits more than entry in the foreign market. Focussing on a firm in the home country we have $dn^*/dn\big|_{\pi=0} = -\frac{d\pi/dn}{d\pi/dn^*}$ where

$$d\pi/dn = xp'dZ/dn + (p-c)dx/dn + x^*p^{*\prime}\frac{dZ^*}{dn} + (p^*-c/g)dx^*/dn$$

and $d\pi/dn^* = xp'dZ/dn^* + (p-c)dx/dn^* + x^*p^{*\prime}dZ^*/dn^* + (p-c/g)dx^*/dn^*$

Provided dZ/dn and dZ/dn^* are positive, $d\pi/dn$ and $d\pi/dn^*$ are both negative. Therefore regions below the zero profit locus represent positive profits and $dn^*/dn < 0$. Similar results hold for a typical foreign firm. Also, provided $|d\pi/dn| > |d\pi/dn^*|$, $|dn^*/dn| > 1$ along $\pi = 0$. Reasoning symmetrically for a foreign firm implies that along $\pi^* = 0$, $|dn^*/dn| < 1$ so possibility (3) is ruled out. Therefore, free entry will normally support a stable reciprocal dumping equilibrium.

3. *WELFARE EFFECTS*

So far the analysis has been entirely positive. The reciprocal dumping model also has some interesting welfare properties. Clearly, the reciprocal dumping solution is not Pareto-optimal. Some monopoly distortion persists even after trade, and there are socially pointless transportation costs incurred in cross-hauling. What is less clear is whether, given the existence of imperfect competition in each country, free trade is superior to autarky.

This is a question with an uncertain answer, because there are two effects. On one hand, allowing trade in this model leads to waste in transport, tending to reduce welfare. On the other hand, international competion leads to lower prices, reducing the monopoly distortion.

If consumer welfare can be represented by a utility function of the form $U = u(Z) + K$ where K represents consumption of a numeraire competitive good, then the welfare effects of trade are measured exactly by the change in producer plus consumer surplus.

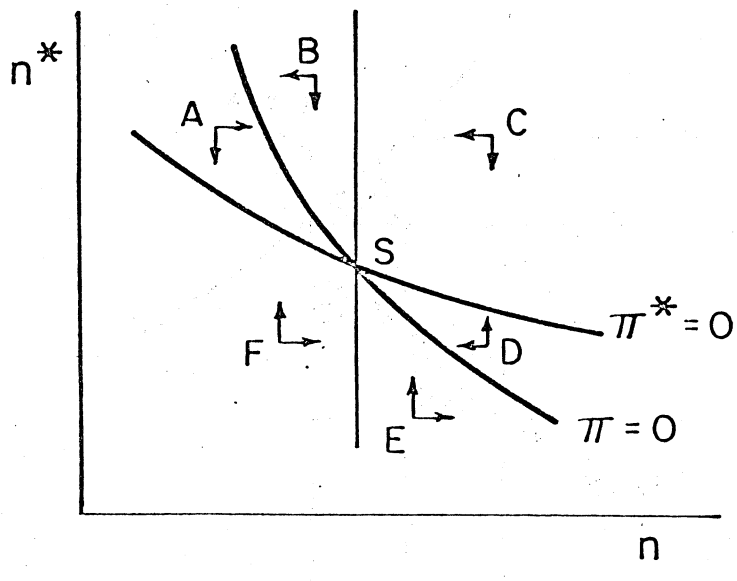

FIG. 3

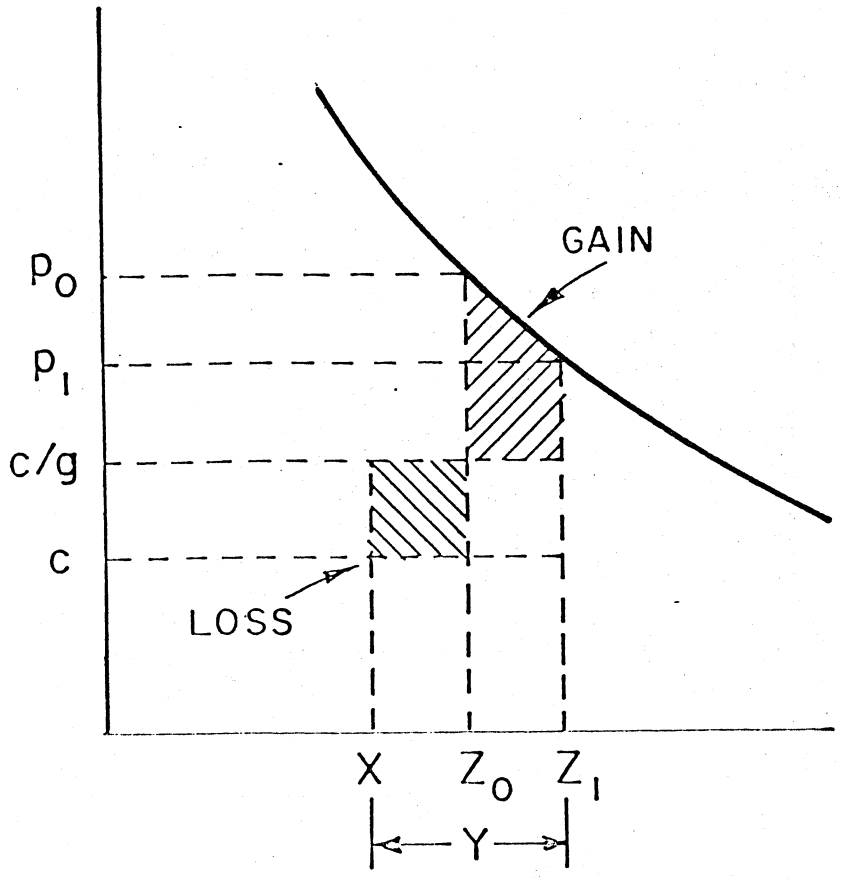

FIG. 4

Figure 4 illustrates the point that there are conflicting effects on welfare. In the figure Z_0 is the pre-trade output of the monopolized good, p_0 is the pre-trade price, and c is the marginal cost. After trade consumption rises to Z and price falls to p_1. But output for domestic consumption falls to X (=mx), with imports Y. As the figure shows there is a gain from the "consumption creation" $Z_1 - Z_0$, but a loss from the "consumption diversion" $Z_0 - X$. The relative size of these two effects depends in a complex way on the elasticity of demand and the size of transport costs. As transport costs become small, however, trade definitely increases welfare. In the limit with transport costs equal to zero, the cross-hauling, though pointless, is also costless and the pro-competitive effect insures that there will be gains from trade: countries gain by taking in each other's washing.

Constructing examples in which there is a welfare loss is not straightforward, but the following fairly extreme case shows that welfare loss can occur and indicates the kind of circumstances that might lead to welfare loss. Figure 5 illustrates the welfare loss. Suppose demand is perfectly elastic up to point Z' then perfectly inelastic, as shown in the figure. Before trade quantity Z' will be supplied and total surplus will equal the area of rectangle PABC minus fixed costs, if any. After trade, because of the kinked demand curve, there are many possible outcomes, specifically, any combination of x + y which leaves $Z = Z^1$ will be an equilibrium. This is because each firm will have a marginal revenue of p for reductions in the quantity supplied, marginal revenue of zero for increases in the quantity supplied. All of these outcomes involve a welfare loss compared with free trade, since there is no reduction in the price of the monopolized good and there is a socially pointless transportation cost, as indicated by the shaded rectangle.

4. A MORE GENERAL MODEL

The Cournot oligopoly model of Section 1 is very special. However, the reciprocal dumping result is robust in more general models. Assume that demand conditions in either country can be represented by a utility function of the form:

$$U = u(Z) + K$$

where K represents consumption of a numeraire competitive good. Then $p = u'$. (This utility function allows a simple general equilibrium interpretation.) Assume, as before, that there are n identical domestic firms and n^* identical foreign firms. Then $Z = nx + n^*y$ and $\sigma = n^*y/Z$.

Relaxing the Cournot assumption, the first order condition for a domestic firm in the domestic country is

$$p + xp'\lambda = c$$

where λ (following Seade, 1980) is the conjectural variation, dZ/dx. The Cournot model is the case in which $\lambda = 1$. In elasticity form this is written $p(\varepsilon - x\lambda/Z) = c\varepsilon$

but $x/Z = (1 - \sigma)/n$

so $$p = nc\varepsilon/(n\varepsilon + \sigma\lambda - \lambda) \qquad (5)$$

Similarly, we can derive the implicit reaction function for a representative foreign firm:

$$p + yp'\lambda^* = c/g$$

where λ^* is the conjectural variation for a foreign firm.

This yields $p(\varepsilon - \sigma\lambda^*/n^*) = c\varepsilon/g$

or $$p = n^*c\varepsilon/g(n^*\varepsilon - \sigma\lambda^*) \qquad (6)$$

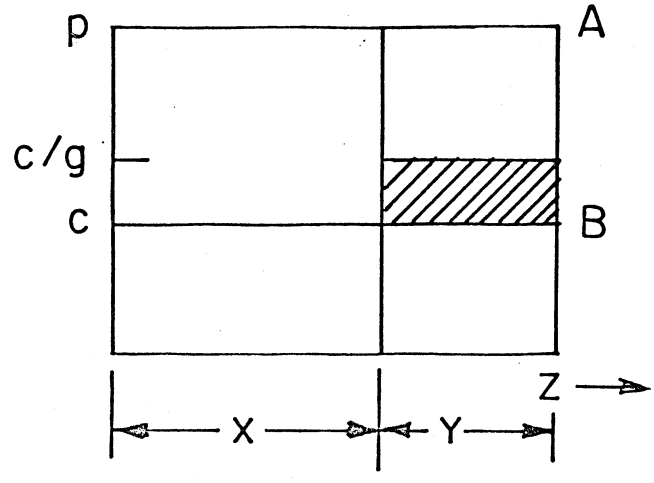

FIG. 5

Solving (5) and (6) for p and σ yields

$$p = c\varepsilon(n^*\lambda + ng\lambda^*)/g(n^*\lambda\varepsilon + n\lambda^*\varepsilon - \lambda\lambda^*)$$

$$\sigma = (nn^*\varepsilon(g - 1) + n^*\lambda)/(n^*\lambda + ng\lambda^*)$$

The necessary and sufficient condition for a positive solution is:

$$\lambda\lambda^*/(n^*\lambda + n\lambda^*) < \varepsilon < \lambda/n^*(1 - g)$$

Setting $n = n^* = \lambda = \lambda^* = 1$ yields the result of section 1. But reciprocal dumping is possible as long as $\lambda > 0$. In effect $\lambda = 0$ is a situation in which firms view themselves as unable to affect total market supply and hence market price. As long as firms believe that by reducing their deliveries to the market they can raise their price, there exists the possibility that the domestic price in the absence of trade will exceed the marginal cost of imports, and that reciprocal dumping will result.

This is only one type of generalization of firms' behaviour, however. In the foregoing it was still the case that each firm took a separate view of each market. Firms might be concerned about how their behaviour in one market might influence their rival's behaviour in the other. For example, if firms believe that invading another firm's domestic market would induce retaliatory invasion, we might expect cross-hauling to be avoided, although this would depend on the exact perceptions that firms happened to hold.

Another area of generalization would involve considering price rather than quantity as the strategy variable. If firms play a Nash price game (each firm takes the other's price as given) undercutting

will occur until $p = c/g$, the limit price at which no cross-hauling would take place. The point remains, however, that reciprocal dumping is possible in fairly general circumstances.

An easily developed special case is the Stackelberg leader-follower model in which each firm is a leader in its home market and a follower abroad.[4] Letting $n = n^* = 1$ and $\lambda^* = 1$, we have only to establish λ. If demand is linear $\lambda = 1/2$. (Any reduction is output by the leader induces the follower to make up exactly half the reduction in extra output.) If $p = a - bZ$ the explicit solution is $x = (a+c/g-2c)/2b$, $y = (a+2c-3c/g)/4b$. Once again we have reciprocal dumping, this time in a (symmetric) Stackelberg model.

5. *CONCLUSIONS*

This paper has examined international trade under conditions of oligopoly and price discrimination. We have shown that in these models the discriminatory pricing of imperfectly competitive firms can cause trade in the absence of any of the usual motivations for trade; neither cost differences nor economies of scale are necessary. And we find that there can, as a result of "reciprocal dumping", be cross-hauling of identical products. Moreover, the model is robust to free entry and fairly general specifications of demand and of firms' behaviour.

In reality, two-way trade in strictly identical products is probably rare. Rather, the motives which we have presented here in stark form probably lead to trade in commodities which are only slightly differentiated, and would not be traded in the absence of price discrimination; or at any rate lead to a larger volume of trade. What we have shown is that price-discriminating firms will tend to interpenetrate each others' markets -- and thus enlarge the volume of trade -- to a greater extent than would otherwise be the case.

Finally, we should briefly note another application of our basic analysis. Throughout this paper we have assumed that firms must produce in their home country. Given the assumed identity of production costs, however, firms clearly have an incentive to save transport costs by producing near the market, if they can. But if we allow them to do this, each firm will produce in both countries -- and we will have moved from a model of reciprocal dumping in trade to a model of two-way direct foreign investment.

Footnotes

*A version of this paper was presented at the 1980 Warwick Summer Economics Workshop.

1. For an exposition of dumping as monopolistic price discrimination see Caves and Jones (1977, pp 152-154).

2. Two-way trade in similar (but not necessarily identical) products is often referred to intra-industry trade. Standard references on the importance of intra-industry trade are Balassa (1966) and Grubel and Lloyd (1975).

3. The behaviour of Cournot models under free entry has been examined by Frank (1965), Ruffin (1971) and Seade (1980).

4. Brander and Spencer (1980) examine the implications for tariff policy of a market structure in which the foreign firm is an entry-deterring or potentially Stackelberg leader in both markets.

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