Competition and unilateral dumping

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This paper presents an analysis of the effects of market structure on the propensity of firms to dump goods. The analysis of Brander and Krugman is extended to show that in the presence of transportation costs, bilateral intra-industry trade is not possible without dumping. Contrary to the conventional wisdom, this paper finds that firms in markets with a large number of domestic competitors are more prone to dump unilaterally than firms in less competitive markets. This dumping is not predatory but may result in export prices being below average cost.

1. Introduction

Some traditional economic treatments of dumping have held that the phenomenon should arise when firms with fairly concentrated, protected home markets export into relatively competitive world markets. This paper demonstrates, however, that in the absence of trade barriers, we might expect the reverse flow. Using a framework similar to the one developed in Brander and Krugman (1983), it is possible to show that firms in relatively competitive markets are more likely to engage in unilateral dumping than firms operating out of concentrated domestic markets. Furthermore, in cases where fixed costs are high enough so that firms just break even, any firms that dump will do so at prices below average cost.

The ‘reciprocal dumping’ effect that Brander and Krugman first identified is actually quite a general result. In fact, whenever two countries engage in bilateral trade of a homogeneous good (‘cross-hauling’) in the presence of transportation costs, at least one of the countries must engage in dumping. The logic behind this statement flows directly from the definition of dumping. In order not to engage in dumping, a firm in any given country must set an

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1For example, Haberler (1937, p. 301) writes; 'The first necessary condition for successful dumping is that the goods are prevented from coming back again.... The second necessary condition is monopoly upon the home market.'
FOB\textsuperscript{2} price that is at least as high as the price for the goods destined for the domestic market.\textsuperscript{3} Hence, the landed price of the goods in the foreign market (inclusive of transportation costs) must be higher than the price in the domestic market. If firms in both countries sell domestically and export, then this means that the price in each domestic market must be lower than the price in each foreign market. Since it clearly is impossible to have lower prices in both markets, bilateral trade of a homogeneous good cannot possibly occur without dumping.

While this result must be true by definition, it is not a factor that is often considered in constructing trade policy. For example, U.S. trade policy toward Japan in the area of semiconductors has simultaneously sought increased U.S. market penetration of the Japanese market and cessation of alleged Japanese dumping. However, if Japanese firms export computer chips to the United States and U.S. firms export the same type of computer chip to Japan, then, provided that transportation costs are positive, firms in at least one of the two countries must be dumping. Furthermore, as the following analysis will show, this type of dumping may occur at prices below the 'less than fair value' standard used by the U.S. government.

2. Dumping and bilateral intra-industry trade

Before examining the effects of competition on dumping, a simple analytical framework must be constructed that can generate dumping and handle equilibria with several firms in each country. Consider two countries that trade with each other. Let the total quantity of a good sold in the domestic country be denoted by $Z$, and by $Z^*$ in the foreign country, and assume that the price in either country is determined solely by the total amount of the good available in that country's market.\textsuperscript{4} This implies that the price in the domestic market, $p(Z)$, is solely a function of the goods available in that market, and the price in the foreign market, $p^*(Z^*)$, does not have any relation to conditions in the domestic market. In addition, assume that the inverse demands are twice continuously differentiable and that

$$\lim_{Z \to \infty} p(Z) = \lim_{Z^* \to \infty} p^*(Z^*) = 0.$$ 

\textsuperscript{2}FOB price stands for 'free on board' price and is the price not including transportation costs at which the good is made available for export.

\textsuperscript{3}Although the 'lay' definition of dumping tends to involve a comparison of foreign prices with landed prices, this is not how dumping margins are calculated for the purposes of U.S. or international law. For example, under the GATT a product is considered dumped 'if the export price of the product exported from one country to another is less than the comparable price ... for the like product when destined for consumption in the exporting country'. The United States has used both this price discrimination definition as well as comparisons with a 'fair value' standard in making dumping determinations.

\textsuperscript{4}Wherever possible, the original Brander–Krugman notation has been used.
Let $n$ represent the number of firms in the home country and $n^*$ the number of firms in the foreign country. The home firm, $i$, produces $x_i$ units of the good for the home market and $x_i^*$ units of the good for the foreign market, while the foreign firm, $j$, produces $y_j$ units of the good for export and $y_j^*$ units for its domestic market. For simplicity, assume all of the firms have identical cost functions with constant marginal cost:

- for home firms: $C(x_i, x_i^*) = c[x_i + x_i^*]$, for all $i = 1, \ldots, n$,
- for foreign firms: $C(y_j, y_j^*) = c[y_j + y_j^*]$, for all $j = 1, \ldots, n^*$.

Transportation costs are assumed to be of the Samuelson 'iceberg' form, i.e. the marginal cost of producing and exporting a good is assumed to be $c/g$, where $g$ is a number on the interval $(0, 1]$. Therefore, the cost of transporting a good is

$$t = \frac{c(1-g)}{g} \text{ (note: } c + t = c/g).$$

Firms export by selling goods to perfectly competitive exporters who sell the goods in turn to the overseas market. Thus, if the price in the foreign market is $p^*$, then a domestic firm selling abroad must sell at an FOB price of $p^* - t$. Each firm is assumed to play a Cournot quantity game by trying to select an output that maximizes the firm's profits, subject to the production decisions of the other firms. Thus, home and foreign firm profits can be written as follows:

- for home firms: $\pi_i = x_i p(Z) + x_i^* p^*(Z^*) - c[x_i + x_i^*/g]$, for all $i = 1, \ldots, n$, \hspace{1cm} (1)
- for foreign firms: $\pi_j^* = y_j p(Z) + y_j^* p^*(Z^*) - c[y_j/g + y_j^*]$, for all $j = 1, \ldots, n^*$, \hspace{1cm} (2)

Assume further that the Novshek (1985) condition is valid in each market, i.e.

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5While Brander and Krugman do mention that it would be possible to perform a similar analysis with a multifirm model, they do not discuss any of the asymmetrical results that will occur with different numbers of firms in each country.

6$t$ could also be thought of as including tariffs. However, since the point of this paper is to demonstrate how unilateral dumping can arise without government intervention, $t$ has been assumed to be equal for both domestic and foreign firms.
\[
\frac{d[Zp'(Z)]}{dZ} = p'(Z) + Zp''(Z) \leq 0.
\]

Now, consider a situation in which all firms sell positive quantities in both markets. Differentiating (1) and (2) with respect to production sold in the home country \((x_i \text{ and } y_j)\) and setting these derivatives equal to zero yields:

\[
\pi_{x_i} = x_i p'(Z) + p(Z) - c = 0, \quad \text{for all } i = 1, \ldots, n, \tag{3}
\]

\[
\pi_{y_j} = y_j p'(Z) + p(Z) - c/g = 0, \quad \text{for all } j = 1, \ldots, n^*, \tag{4}
\]

\[
Z = \sum_{i=1}^{n} x_i + \sum_{j=1}^{n^*} y_j, \tag{5}
\]

and

\[
\pi_{x_i}^* = x_i^* p^*(Z^*) + p^*(Z^*) - c/g = 0, \quad \text{for all } i = 1, \ldots, n, \tag{3'}
\]

\[
\pi_{y_j}^* = y_j^* p^*(Z^*) + p^*(Z^*) - c = 0, \quad \text{for all } j = 1, \ldots, n^*, \tag{4'}
\]

\[
Z^* = \sum_{i=1}^{n} x_i^* + \sum_{j=1}^{n^*} y_j^*. \tag{5'}
\]

Given the above assumptions it is possible to show that eqs. (3), (4), and (5) generate a unique equilibrium in the home market, and eqs. (3'), (4'), and (5') are sufficient for uniqueness in the foreign market. Furthermore, the symmetry of the equations guarantees that all firms from a given country will produce the same amount of output in equilibrium, and therefore the notation can be simplified by letting \(x_i = x, \ x_i^* = x^*, \ y_j = y, \) and \(y_j^* = y^*\).

Brander and Krugman demonstrated that for the case in which countries have identical demand functions and \(n = n^* = 1\), each country's firm will dump into the other country's market. Proposition 1 demonstrates that this result continues to be valid for all values of \(n\) and \(n^*\) that are compatible with an interior solution. In other words, provided that prices in each market are higher than the production and shipping costs to that market, bilateral intra-industry trade will occur and firms in each country will dump into the other's market.

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1This condition guarantees that the best response curves are downward sloping in each firm's output, and thus if any one firm increases output, the marginal revenue of the other firms will decrease.

2The proof of existence and uniqueness is essentially the same as that laid out in Gaudet and Salant (1990).
Proposition 1 (Reciprocal dumping). If the inverse demand functions are equal in the two markets \( p(u) = p^*(u) \) for all \( u \geq 0 \) and all firms sell in both markets, then firms will carry out 'reciprocal dumping'.

**Proof.** Dumping by home country firms occurs if \( p > p^*-t \) and by the foreign firms if \( p^* > p-t \). Now, summing up eqs. (3) and (4) over all firms and setting them equal to the sum of eqs. (3') and (4') yields

\[
(n+n^*)p(Z) + [nx+n^*y]p'(Z) - nc - n^*c/g = (n+n^*)p(Z^*) + [nx^*+n^*y^*]p'(Z^*) - nc - n^*c. \tag{6}
\]

If we let \( N = n + n^* \), we can rewrite eq. (6) as

\[
Np(Z) + Zp'(Z) = Np(Z^*) + Z^*p'(Z^*) - nt + n^*t.
\]

Without any loss of generality we can assume that \( n \geq n^* \). This implies that

\[
Np(Z) + Zp'(Z) \leq Np(Z^*) + Z^*p'(Z^*),
\]

and since

\[
\frac{d}{dZ}[Np(Z) + Zp'(Z)] = [N + 1]p(Z) + Zp'(Z) < 0,
\]

we know that \( Z \geq Z^* \). But this means that \( p(Z) \leq p(Z^*) \) and \( p-t < p^* \). Thus, it is clear that if \( n \geq n^* \) and foreign firms sell into the domestic market, then they will dump into it.\(^9\)

Now, to prove that firms in the more competitive market will also dump, we first note that profit maximization in both the foreign and domestic market implies that

\[
p(Z) + xp'(Z) - c = p(Z^*) + x^*p'(Z^*) - c/g
\]

or

\[
p(Z) + xp'(Z) = p(Z^*) + x^*p'(Z^*) - t.
\]

\(^9\)For the sake of clarity, I have included the arguments of \( p \) and \( p^* \) in certain stages of this proof. However, throughout the proof \( p = p(Z) \) and \( p^* = p(Z^*) \).

\(^10\)It is important to note here that the ability of firms in the less competitive foreign market to dump into the more competitive domestic market is contingent on the condition that \( p > c/g \). The price level in the domestic market is crucially dependent on the number of domestic firms, and therefore if \( n \) is large enough there will be no foreign penetration of the domestic market, but, as Proposition 2 will demonstrate, domestic firms will nonetheless continue to dump into the foreign market.
Dumping will occur if
\[ xp'(Z) < x^*p'(Z^*). \]
Suppose that this condition does not hold, then
\[ xp'(Z) \geq x^*p'(Z^*). \]
Recalling the Novshek condition and the fact that \( Z \geq Z^* \), it is clear that \( Z^*p'(Z^*) \geq Zp(Z) \), or
\[ nx^*p'(Z^*) + n^*y^*p'(Z^*) \geq nxp'(Z) + n^*yp'(Z). \] (7)
But by the counter assumption, this equation means that
\[ n^*y^*p'(Z^*) \geq n^*yp'(Z) \text{ or } y^*p'(Z^*) \geq yp'(Z). \]
The first-order conditions for profit maximization then imply that
\[ p + yp' - c/g = p^* + y^*p^* - c \]
or
\[ p - c/g \geq p^* - c, \]
which can be rewritten as
\[ p - t \geq p^*. \] (8)
But this cannot be possible since we know from above that \( p - t < p^* \). Therefore, \( xp'(Z) < x^*p'(Z^*) \) and \( p > p^* - t \).11

3. Unilateral dumping

The analysis in the previous section was based on the assumption of an arbitrager. Suppose an arbitrager moves simultaneously with the producers and picks a quantity \( \Delta \) to ship from the domestic market to the foreign market. Thus, \( \Delta \in [0, Z] \). In this case, the arbitrager's profits will be
\[ \pi^t = [p(Z^* + \Delta) - p(Z - \Delta) - t] \Delta. \]
Suppose that the firms do not change their production decisions in the presence of the arbitrager. Since the domestic firms are dumping we know that
\[ p(Z^*) - p(Z) - t < 0. \]
But this means that the bracketed term in the profit equation is negative for all possible values of \( \Delta \) and that the arbitrager’s optimal strategy is not to sell any output at all.

11 It is interesting to note that this equilibrium will be unaffected by the presence of an arbitrager. Suppose an arbitrager moves simultaneously with the producers and picks a quantity \( \Delta \) to ship from the domestic market to the foreign market. Thus, \( \Delta \in [0, Z] \). In this case, the arbitrager’s profits will be
\[ \pi^t = [p(Z^* + \Delta) - p(Z - \Delta) - t] \Delta. \]
interior solution, i.e. that firms sell in both markets. This assumption was needed in the original Brander and Krugman paper because, with the symmetry of only one firm in each country, the only corner solution possible was one in which transportation costs were so high that no trade took place. In the multi-firm case, however, while that trivial corner solution is still possible, there is also a more interesting corner solution in which the firms in one country are not able to export, but the firms in the other country can and do export. In any home market, foreign firms act like high-cost firms while domestic firms act like low-cost firms. Hence, if there are a sufficient number of low-cost home firms, they can drive the home market price down to a level that is above their marginal cost but below the cost of production plus transportation. This means that foreign firms cannot export to the home market but home firms can still export abroad. As Proposition 2 demonstrates, this will result in unilateral dumping.

**Proposition 2 (Unilateral dumping).** There exists an $n^e$ such that if there are at least $n^e$ firms in the home market and less than $n^e$ in the foreign market and $p(u) = p^*(u)$ for $u \geq 0$, no firms operating out of the foreign market will sell in the home market, but firms in the home market will dump into the foreign market.

**Proof.** Because $p$ monotonically declines in output and $\lim_{Z \to \infty} p(Z) = 0$, there exists a unique $Z^e$ such that

$$p(Z^e) = c/g.$$  \hfill (9)

If $p$ is equal to $c/g$, however, then eq. (4) indicates that the foreign firms will not sell anything in the domestic market. We now want to find an $n^e$ such that a Cournot equilibrium with this number of firms will result in the aggregate output of domestic firms equalling $Z^e$. Ignoring the integer problem, eqs. (3), (5), and (9) can be written as three equations in $n$, $x$, and $Z$ that uniquely determine $n^e$ as shown below:

$$n^e = \frac{Z^e}{x^e}, \quad \text{where} \quad x^e = -\frac{t}{p'(Z^e)}.$$  \hfill (10)

It is important to remember, however, that provided that there are fewer than $n^e$ firms in the foreign market, the aggregate output in the foreign market will be less than $Z^e$ and the home market firms will continue to
export into the foreign market. The proof that the home firms will dump abroad is essentially the same as the proof of the second half of Proposition 1 with \( y = 0 \). Thus, unilateral dumping arises because the foreign price is high enough to allow the home market firms to continue to export and dump but the home price is too low to allow foreign firms to penetrate the more competitive home market.

While this sort of unilateral dumping will not cause landed prices in the country receiving the dumped goods to fall below the domestic price in the other country, the relation between competition and dumping can mean that 'less than fair value' tests of dumping may not be economically justifiable. These tests, such as the one used by the U.S. Department of Commerce, determine dumping margins by considering whether export prices are below 'fair value'. 'Fair value', in turn, is calculated by estimating average cost and then adding on a mark-up for profits and administrative costs [Jackson (1989, p. 235)]. Leaving aside the issue of whether the investigating authority uses appropriate mark-ups, in light of the above discussion it is possible to argue that dumping findings based on an average cost standard may serve more to punish relatively competitive foreign firms than as evidence of a concerted effort to dominate the U.S. market.

To see this reasoning a bit more clearly, suppose that firms have to pay some fixed costs and that there is sufficient competition in the more competitive market so that firms are dumping and just breaking even. Consider, now, a dumping test that uses average cost as a measure of 'fair value' and finds firms guilty of dumping if they export at prices below average cost. If firms are absorbing some of their transportation costs on their exported units, then clearly the firms in the more competitive country will be charging a lower price for exported units than for domestic units. Since average cost must equal average revenue when firms break even and average revenue must lie between the domestic price and the export price, average cost must also lie between these two prices. However, this means that the export price must be lower than average cost and the firms in the more competitive market will be engaging in dumping by exporting at 'less than fair value'.

Exporting at prices below average cost, then, may not be evidence of predatory dumping. Rather, since relatively competitive firms are more likely to be closer to the break-even point, regulations that target firms that export at prices below average cost may punish relatively competitive firms more than less competitive firms. This analysis, therefore, suggests that the conventional justification for antidumping regulation may be completely backwards. Not only can the flow of dumped goods be from the more competitive market to the less competitive one, but the cases in which the laws and tariffs are applied with the most vigor – cases in which the FOB
price is below cost – may be precisely the cases in which the foreign sector is likely to be the most competitive.

4. Conclusion

Although dumping has traditionally been seen as a phenomenon that is similar to predatory pricing, in reality the practice may simply be a reflection of the tendency of competitive rent-seeking firms to expand into less competitive markets that have high rents. Since selling abroad does not lower prices in the domestic market, firms are willing to export at prices that provide them with lower profit margins on their foreign sales (i.e. dump) whenever prices in a foreign market are sufficiently high to cover production and transportation costs. This incentive to dump products from more competitive markets into less competitive markets implies that even if production technologies and demand conditions are identical, trade will arise as a means of equalizing rents in various national markets.

If it is true that countries with competitive market structures may have relatively little foreign penetration of their markets, then this provides additional support for arguments in favor of developing infant industries and competitive industrial bases. The existence of large domestic oligopolistic firms will generate significant rents in the domestic market that will tend to encourage foreign firms to dump products into the home market and reduce the ability of that sector to be a major source of exports. Although careful empirical testing of this effect is difficult, there is some circumstantial evidence to support the claim. Firms in Asian Pacific Rim economies such as Hong Kong often have been the targets of antidumping actions in spite of the absence of clear trade barriers or a large market that could be used to generate 'deep pockets'. Since transportation costs to and from these countries are, on average, two to three times higher than the transportation costs that other industrialized nations face with their trading partners, it may be possible that some of the dumping has arisen out of the absorption of these costs or other trade barriers.

Similar conclusions are possible in the case of Japan, where international industry concentration statistics indicate that Japanese firms tend to be smaller and more numerous than U.S. firms. According to this model, both the alleged higher mark-ups by U.S. firms that many observers see as being the cause of the U.S. 'loss of competitiveness' as well as the relatively low level of foreign penetration in Japan's export industries may be linked closely to the relative levels of competitiveness in the two markets. Japanese producers have long held that the factor that prevents U.S. entry into their markets is not tariff or non-tariff barriers against U.S. products but rather highly competitive domestic industries. If many key Japanese markets are indeed relatively less concentrated than their U.S. counterparts, then the
model presented in this paper predicts that Japan will tend to import less than the United States in these sectors but will have a higher propensity to engage in unilateral dumping. When seen in this light, it seems reasonable to conclude that many antidumping actions on the part of the United States and other industrialized nations may serve more as a means of protecting domestic industry rents than as a means of promoting competitive domestic markets.

Bibliography