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Research Department

**Why Do Firms Pay Antidumping Duty?<sup>1</sup>**

Prepared by Poonam Gupta

Authorized for distribution by Peter Wickham

December 1999

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**Abstract**

With the virtual elimination of tariffs and quotas under GATT, antidumping measures emerged as a key instrument of protection. Under antidumping actions exporters can either raise the price to eliminate the dumping margin or pay an antidumping duty. This paper analyzes the incentives to exporters to choose between duty or settlement outcomes and finds that due to the smaller loss in market share exporters may prefer an antidumping duty over voluntary settlement. The paper analyzes the welfare implications of these outcomes and finds that they are ambiguous.

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## I. INTRODUCTION

With the virtual elimination of the use of tariffs and quotas as tools of protection in the industrial sector in developed countries and their much reduced scope in developing countries, the GATT-sanctioned instrument of antidumping actions has emerged as the key instrument of protection. Aside from the developed countries, developing countries, such as India, Mexico and South Korea are becoming regular users of these actions.

Under antidumping laws in many countries, including Australia, Canada, European Community and United States, a foreign firm can avoid paying an antidumping duty if it voluntarily agrees to eliminate the dumping margin. Such settlements take place either between the foreign firm and the trade representative of the importing country, or between the governments of the two countries. If the settlement takes the form of a restriction on the price of exports it is referred to as a price negotiation and if it restricts the volume of exports it is referred to as a voluntary export restraint. Aside from these outcomes, the possibility, of course, also exists for domestic and foreign firms to reach an out of court settlement through negotiating a price increase, in which case the domestic firms withdraw the petition.

An important issue in the analysis of the practice of antidumping measures is to analyze the incentives to the exporters to pay the duty rather than undertake a settlement. Some work has been done in the literature on this issue, including important contributions by Rosendroff (1996) and Prusa (1992). These papers analyze private bargaining solutions between the domestic and foreign firms and show that it is always possible for firms to find a settlement that would dominate the antidumping duty outcome. The result is essentially based on the following two assumptions: first, that any level of price increase can be negotiated between the parties involved, since these papers refer to private bargaining rather than an official settlement to eliminate dumping; second, a price increase results in a collusive equilibrium where both parties earn higher profits.

More specifically, Rosendroff considers a model in which the choice between a price settlement or an antidumping duty depends on the political considerations of the government. The government, interested in maximizing its future election prospects, announces the level of antidumping duty such that the larger the weight assigned to industry profit in its objective function, the higher is the level of the antidumping duty. The foreign firm, faced with the alternative of paying high duty may choose to settle the case with the domestic firm. The settlement reduces the volume of trade by an amount greater than under the antidumping duty and generates a collusive equilibrium in which both firms earn a higher profit.

Prusa (1992) offers a Bertrand model in which a negotiated solution generates a collusive equilibrium as well and necessarily dominates the expected antidumping-duty outcome. A paper by Staiger and Wolak (1992) shows that domestic firms may use the threat of antidumping to facilitate collusion with foreign firms, thus necessitating fewer initiations of the antidumping cases.

However, the result whereby an antidumping duty is dominated by private settlement, therefore is ruled out in the literature as a possible outcome, is in sharp contrast to observed reality where an antidumping duty is the outcome in a large proportion of cases. Indeed, according to the evidence in DeVault (1993), in the United States less than 25 percent of the cases with

an affirmative preliminary determination during the 1980s resulted in settlement. Moreover, the majority of antidumping cases withdrawn were in the steel industry and the withdrawals took place under special circumstances that are not generally applicable. Collusive behavior, if any, occurred only in a handful of cases. Similar evidence for the European Community shows that in almost half the cases in the 1980s in which an action was taken, an antidumping duty was paid. Thus, exporters have generally forgone the voluntary settlement option and spent large sums of money to contest antidumping suits. Given this fact, a realistic model must allow for both outcomes.

Exporters will pay the duty in equilibrium only if the case can not be settled privately between the firms, and if the exporters do not prefer official settlement over an antidumping duty. Panagariya and Gupta (1998) provide an explanation whereby if there is asymmetric information between the domestic and foreign firms then private negotiations between them may break down, thus a price/quantity settlement may not result and the exporter in equilibrium will pay the duty.<sup>2</sup>

A complete explanation for the above stylized fact also needs to explain why the exporter may not prefer to keep the rent by agreeing to an official settlement rather than paying the duty. This paper analyzes the incentives to exporters to choose between an official price/quantity settlement or paying duty. Official settlement requires the exporter to eliminate exactly the dumping margin by increasing the price or restricting the quantity. Under the duty outcome, on the other hand, the exporter pays a duty equal to the margin, but retains the flexibility of choosing the price increase. We refer to the first outcome as a settlement outcome and the second outcome as the duty outcome.

Unlike the existing literature where collusive equilibrium under antidumping measures increases the profit of domestic firms as well as exporters, we use a framework in which the exporter initially maximizes its profit.<sup>3</sup> In the model presented in the paper, the exporter is a Stackleberg leader in the importing country and a monopolist in its own domestic market. Therefore, any policy interventions that force it to deviate from equilibrium, irrespective of whether by lowering or raising the price, reduce the firm's profits. Therefore both types of outcomes- settlement and antidumping duty reduce profits below what the firm earns under free trade.

The analysis is done from the perspective of the importing country, where a homogenous good is supplied by a domestic firm and a foreign firm (the analysis can easily be generalized to  $n$  domestic firms). The foreign firm also sells the good in its own domestic market. Dumping exists due to "*discriminating-monopoly*" behavior of the foreign firm. By assumption, the net demand

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<sup>2</sup>Panagariya and Gupta (1998) also shows that under complete information the exporters will reach a price agreement with domestic firms.

<sup>3</sup>The former would be difficult to justify in view of the fact that firms that are subjected to antidumping actions almost always resent the action and expend valuable resources to avoid prosecution. Moreover, in a large number of cases antidumping actions are met by retaliatory action by the foreign government.

faced by the foreign firm in the export market is more elastic than that in its own domestic market which results in dumping.<sup>4</sup>

The problem is analyzed in a two-period framework. There is free trade in period one, but the possibility exists that an antidumping action will be undertaken in period two. The probability for this to happen is constant and given to the firm. If antidumping efforts take place then the firm chooses between the settlement outcome or the duty outcome. The model is solved by backward induction. Solving for the second period first, it is found that the foreign firm would prefer settlement to antidumping duty only when the dumping margin is small, otherwise he would prefer to pay the duty. Moreover, under the duty outcome the foreign firm would pass on only some of the dumping margin, half in the case where the exporter is a Stackelberg leader, to the consumers through a price increase.

The key explanation we identify for why the outcome may be either an antidumping duty or a settlement is based on the fact that under the duty outcome the foreign firm can control the share of the duty to be passed on to consumers and thus limit its loss in market share. It is possible that depending on the parameters this market saving effect would outweigh the burden of the duty. In fact, when the dumping margin is small (which implies that either the initial market conditions are such that the extent of price discrimination is small or the probability of an antidumping event is large) the loss in market share under duty may be sufficiently small compared to under settlement so that it outweighs the duty burden.

The paper analyzes the equilibrium in the first period and finds that in anticipation of an antidumping action the exporter will reduce the price in its home market and increase it in the exports market. Thus while consumers in the foreign market gain from the lower price, the country using antidumping measures manages to get protection for its industry in the first period at the cost of consumers.

The paper also compares the welfare implications of these actions and analyzes the effects of stricter enforcement of antidumping measures. The welfare effects of antidumping actions have been shown to be ambiguous in general. Comparative static results with respect to the enforcement of antidumping measures show that stricter enforcement may worsen the welfare of the importing country. Depending on the parameters, introduction of a small antidumping effort may improve or deteriorate welfare, but always improves the profit of the domestic industry. The welfare effects of imposing antidumping actions on the exporting country are ambiguous as well but by lowering the monopoly price it improves consumer welfare and can potentially be welfare-improving.

The paper is organized as follows. In Section II, the model is laid out. Section III, finds the subgame perfect equilibrium of the game where the exporter chooses between the settlement and duty outcomes in period two. Section IV compares the welfare implications of these outcomes and conducts some comparative static exercises. Section V concludes with suggestions for future work.

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<sup>4</sup>In practice, a large proportion of cases are prosecuted under the price discrimination definition of dumping. Another form of dumping is when sales are made below the average cost. Davies and McGuinness (1982), Ethier (1982), Gruenspecht (1988), Anderson (1993), Clarida (1993) and Hartigan (1994) offer alternative explanations of such dumping.

## II. THE MODEL

Let there be two countries: Home and Foreign (HC and FC). Each country has one firm. The Foreign firm also sells the product in its own market, i.e., the Foreign market. The Foreign firm is a monopolist in the Foreign market and a Stackleberg leader in the Home market. A dumping charge originates in the firm selling the product in a relatively less competitive environment in the Foreign market than in the Home market.<sup>5</sup>

To keep the analysis simple, we assume linear demand and constant marginal and average costs of production for the two firms (none of the key results will change if these assumptions are relaxed as long as they do not affect the general shapes of the associated reaction curves); and do not allow for entry and exit in the industry. We assume market segmentation in order to rule out the possibility of a resale of the good across countries and assume that there are no transport costs or tariffs. Variables relating to the Foreign firm and Foreign market are distinguished by an asterisk. The inverse demand functions in Home country and Foreign country are given by equations (1) and (2), where  $P$  is the price,  $Q$  is the total quantity purchased in Home country, and  $q$  and  $q^*$  denote quantities sold by Home and Foreign firms, respectively, in Home Country;  $P^*$  is the price and  $Q^*$  the quantity purchased in Foreign country:

$$P = a - Q = a - (q + q^*) \quad (1)$$

$$P^* = a^* - Q^* \quad (2)$$

Letting  $c$  and  $c^*$  be the constant average and marginal costs, profits of the two firms can be written as:

$$\Pi(q, q^*) = [a - (q + q^*)]q - cq \quad (3)$$

$$\Pi^*(q, q^*, Q^*) = [a - (q + q^*)]q^* + (a^* - Q^*)Q^* - c^*(q^* + Q^*) \quad (4)$$

The reaction function of the Home firm is:

$$a - c - (q^* + 2q) = 0 \quad (5)$$

Under Stackleberg the Foreign firm internalizes the reaction function of the Home firm and its first-order conditions with respect to  $q^*$  and  $Q^*$  are:

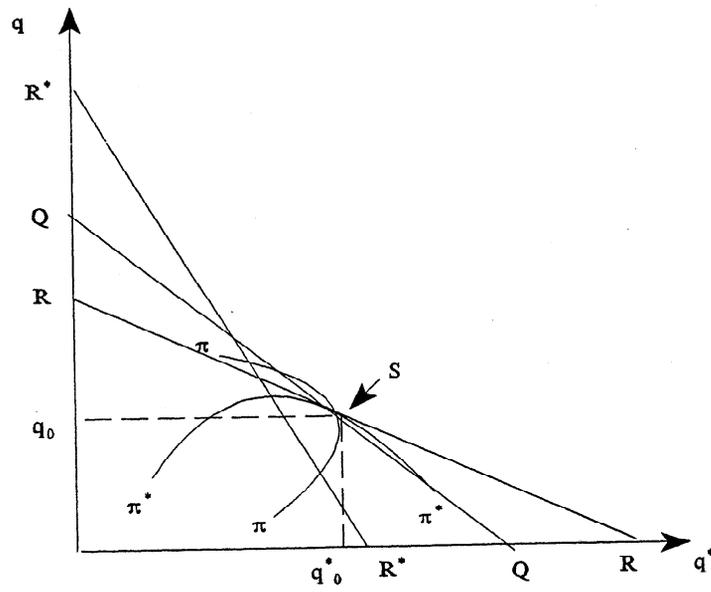
$$\frac{a}{2} - c^* + \frac{c}{2} - q^* = 0; \quad a^* - c^* - 2Q^* = 0 \quad (6)$$

Solving these equations, we obtain the usual Stackleberg equilibrium in the Home country. This solution is shown in Figure 1 where the Stackleberg equilibrium is depicted in  $(q, q^*)$  space

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<sup>5</sup>Note that we need a market structure different from perfect competition for price discrimination to exist.

Figure 1. Equilibrium in Home Country under Free Trade



In the figure,  $RR$  and  $R^*R^*$  are the reaction functions of the Home and Foreign firms respectively and  $\pi\pi$  and  $\pi^*\pi^*$  are their iso-profit curves. The Stackleberg equilibrium is shown by point S. Draw the  $45^\circ$  line  $QQ$  through point S. The sum of the quantities along this line is  $q + q^*$  everywhere. Therefore, point  $Q$  on the vertical axis also gives the total quantity supplied by Home and Foreign firms. The equilibrium prices and quantities under free trade are denoted by a subscript 0 and are given by:

$$q_0^* = \frac{a + c - 2c^*}{2}; \quad q_0 = \frac{a - 3c + 2c^*}{4} \quad (7)$$

$$Q_0^* = \frac{a^* - c^*}{2}; \quad P_0^* = \frac{a^* + c^*}{2} \quad (8)$$

$$Q_0 = \frac{3a - c - 2c^*}{4}; \quad P_0 = \frac{a + c + 2c^*}{4} \quad (9)$$

The dumping margin, defined as  $P_0^* - P_0$ , equals:

$$DM_0 = \frac{2a^* - a - c}{4} \quad (10)$$

The dumping margin is, thus, affected by the factors that affect the relative elasticities of demand in the Home and Foreign countries, such as relative size of the markets, number of Home firms and their cost parameter. More specifically, the dumping margin is higher, the larger the number of domestic firms, the lower their relative costs and the smaller the relative size of the market in the Home country.

Now consider the following two-period scenario: the Foreign firm exports freely in period one, but the possibility of an antidumping action exists in period two with probability  $\rho$ . This probability is given exogenously and is known to the firm in period one.<sup>6</sup> If antidumping actions occur then the Foreign firm chooses between eliminating the dumping by increasing the price and paying a duty equal to the dumping margin. The two-period objective function of the Foreign firm is now given by:

$$E\Pi = \Pi_1^* + \pi_1^* + \rho[\pi_2^* + \Pi_2^*] + (1 - \rho)[\pi_0^* + \Pi_0^*] \quad (11)$$

Profits in the first year are denoted with a subscript 1. If antidumping occurs in period two then the profit is denoted by subscript 2, otherwise free trade profit is realized, hence the subscript 0. In fact since the game ends after two years the firm, irrespective of whether antidumping actions occur or not, can choose the free trade quantity in the foreign market in period two, thus  $\Pi_2^* = \Pi_0^*$ . Incorporating this information, the objective function can be rewritten as:

$$E\Pi = \Pi_1^* + \pi_1^* + \rho\pi_2^* + (1 - \rho)\pi_0^* + \Pi_0^* \quad (12)$$

<sup>6</sup>We could have endogenized the probability by assuming, e.g., that it depends positively on the dumping margin.

The terms  $\Pi_1^*$ ,  $\pi_1^*$  and  $\pi_2^*$  depend on what antidumping outcome the Foreign firm prefers in equilibrium. If the firm chooses to increase the price under the settlement outcome then price in the HC in period two equals:  $P_2 = P_1 + DM_1 = P_1^*$ , and  $\pi_2^*$  is given by:

$$\pi_2^* = [a - c^* - (q_2 + q_2^*)]q_2^* \quad s.t. \quad a - (q_2 + q_2^*) = P_1^* = (a^* - Q_1^*) \quad (13)$$

If the firm selects the duty outcome then it pays a per unit duty =  $DM_1$ , but can choose the price increase to be passed on to the consumers. The profit of the Foreign firm under the duty outcome is given by:

$$\begin{aligned} \pi_2^* &= [a - c^* - (q_2 + q_2^*)]q_2^* - DM_1q_2^* & (14) \\ \text{where } DM_1 &= P_1^* - P_1 = (a^* - Q_1^*) - a - (q_1 + q_1^*) \end{aligned}$$

Notice that in both outcomes the profit is affected by the dumping margin in the first period. Hence, when the first-period quantities are chosen under the antidumping duty they will differ from the free trade level and the profit earned by the exporter in period one will be smaller than under free trade.

#### A. The Settlement Outcome

Equilibrium under settlement is illustrated in Figure 2. The constraint on quantity put under this outcome is depicted by the 45° line  $Q_2Q_2^*$ , because this line contains all the combinations of  $q$  and  $q^*$ , which sum to the quantity consistent with the settlement outcome. Thus the equilibrium under the settlement necessarily lies on this line. Moreover, since the Home firm continues to choose its profit maximizing  $q$  for each  $q^*$  the equilibrium also lies on  $RR$ . Thus the equilibrium is given by the point VER, where the 45° line intersects  $RR$ . At this point the Home firm sells  $q_2$  and the Foreign firm sells  $q_2^*$ .

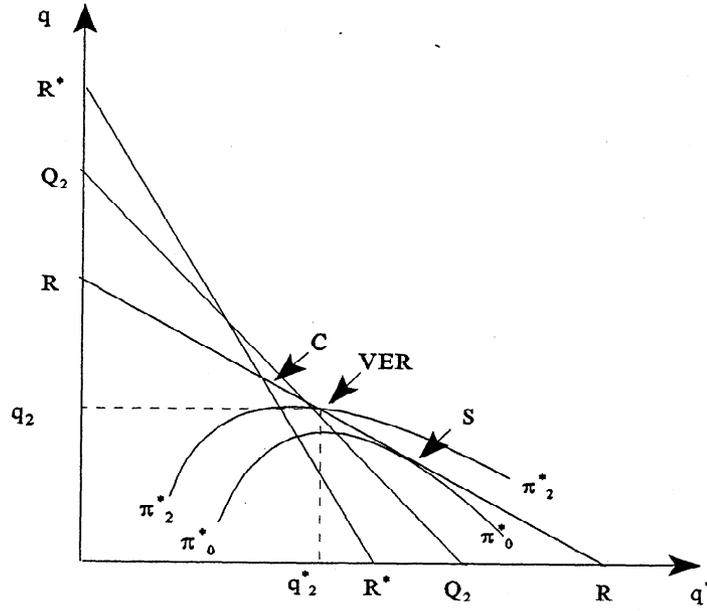
Note that the profit of the foreign firm increases as it moves down along the segment on  $RR$  between the points VER and S. The equilibrium on this segment can be attained through an increase in  $Q_1^*$ , therefore  $\frac{d\pi_2^*}{dQ_1^*} > 0$ . Thus when the Foreign firm takes into account the possibility of the settlement outcome in period two, its first period sales in FC are larger relative to the free trade level. The volume of exports in period one remains at the free trade level though.<sup>7</sup> By substituting for  $\pi_2^*(Q_1^*)$  in equation (12) and maximizing with respect to  $Q_1^*$  and  $q_1^*$ , the following first-order conditions are obtained:

$$a^* - 2Q_1^* - c^* + \rho \frac{d\pi_2^*}{dQ_1^*} = 0 \quad (15)$$

$$\frac{\alpha - 2q_1^* + nc}{2} - c^* = 0 \quad (16)$$

<sup>7</sup>If, however,  $\rho$  is assumed to be endogenous, such that it is a function of the dumping margin, then the Foreign firm would reduce its exports to HC in period one also.

Figure 2. Equilibrium in Home Country under Settlement



From equation (15)  $Q_1^* > Q_0^*$ . Thus the profit of the Foreign firm is smaller under settlement as compared to free trade. Notice that  $q_2^*$  is smaller and  $q_1$  is larger than their respective levels under free trade. By solving for  $Q_1^*$  and substituting in the demand function,  $P_1^*$  is found to be equal to:

$$P_1^* = \frac{P_0^* + 2\rho P_0}{1 + 2\rho} \quad (17)$$

$P_1^*$  is a weighted average of free trade price levels in HC and FC. The weight assigned to the HC price is an increasing function of  $\rho$  (and  $n$  in the more general case with  $n$  number of domestic firms).

### B. Antidumping Duty

Figure 3 depicts the equilibrium under the duty outcome. The duty alters the iso-profit functions and the reaction function of the Foreign firm. The new reaction function,  $R^*R^*$  is given such that the new iso-profit curves are horizontal at the point where they intersect it. The equilibrium under the duty outcome is determined at the point where  $RR$  is tangent with the new iso-profit curve. The quantities supplied by the Foreign and Home firms under the duty outcome are  $q_1^*$  and  $q_2$ . By comparing the  $45^\circ$  lines drawn from the points  $ADD$  and  $S$  it can be noticed that the total market supply is less than the free trade level.

By substituting equation (14) in (12), the first-order conditions with respect to  $Q_1^*$ ,  $q_1^*$  and  $q_2^*$  are:

$$Q_1^* = Q_0^* + \frac{\rho}{2}q_2^* \quad (18)$$

$$q_1^* = q_0^* - \frac{\rho}{4}q_2^* \quad (19)$$

$$q_2^* = \frac{a + c - 2c^*}{2} - DM_1 \quad (20)$$

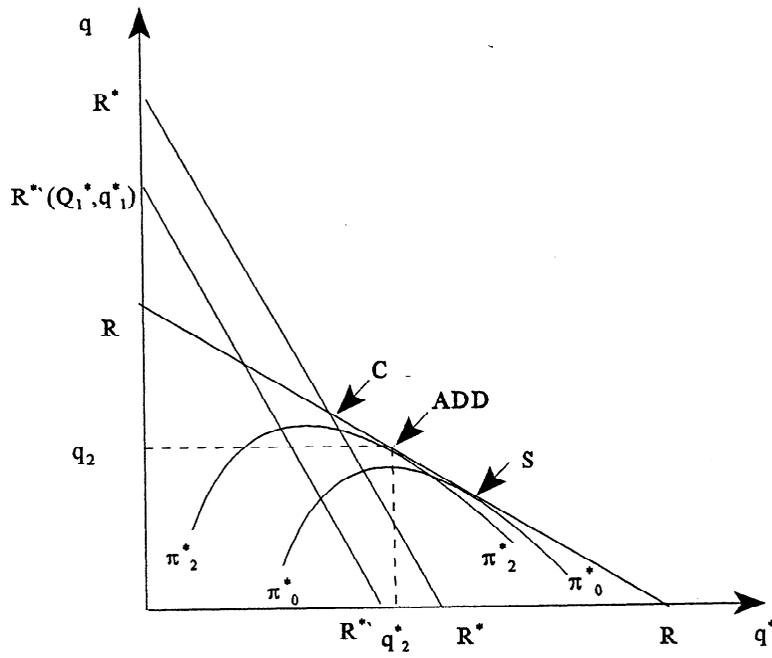
Solving for the first period, since a higher  $Q_1^*$  and a lower  $q_1^*$  result in a smaller dumping margin, the Foreign firm sells more in  $FC$  and less in  $HC$  in period one in order to lower the dumping margin. The terms of trade deteriorate for HC in period one and consumer surplus becomes smaller, but the share of domestic industry in total market supply and its profit is higher.

Solving for the second period equilibrium, it can be shown that the firm chooses quantity under duty outcome such that half the duty is passed on to consumers, thus:

$$P_2 = P_0 + \frac{P_1^* - P_1}{2} \quad (21)$$

From equation(20) it can also be seen that  $q_2^*$  decreases in the dumping margin and that the volume of exports under duty would be smaller than under free trade so long as the dumping margin is positive. Thus the duty outcome improves the terms of trade for the HC in period two.

Figure 3. Equilibrium in Home Country under Anti-dumping Duty



The Foreign firm earns a smaller profit not only in HC but also in the FC. Since antidumping duty manages to lower the firm's monopoly power it has the same effect as anti-trust in FC.<sup>8</sup>

### III. CHOOSING BETWEEN THE SETTLEMENT AND DUTY OUTCOMES

In this section we solve the complete game in which the Foreign firm chooses between a settlement or a duty outcome in period two. The moves of the game are illustrated in Figure 4. Solving recursively, if the outcome of trade policy is antidumping measures in period two, then the Foreign firm chooses between settlement or duty outcomes by comparing profits under these two outcomes for a given set of quantities or prices,  $(P_1^*, P_1)$ . Thus the firm compares  $\pi_{2,ver}^*(P_1^*, P_1)$  and  $\pi_{2,add}^*(P_1^*, P_1)$  and chooses the antidumping action that yields higher profits.<sup>9</sup> Profit under settlement, obtained by substituting for the demand functions from equations (1) and (2), can be written as:

$$\pi_{2,ver}^* = (P_1^* - c^*) q^*(P_1^*) = (P_1^* - c^*) (a + c - P_1^*) \quad (22)$$

and profit under the duty outcome, can be written as:

$$\begin{aligned} \pi_{2,add}^* &= (P_2 - c^*) q^*(P_2) - (P_1^* - P_1) q^*(P_2) \\ &= (P_2 - c^*) (a + c - P_2) - (P_1^* - P_1) (a + c - P_2) \end{aligned} \quad (23)$$

The first term on the right hand side of equation (23) is gross profit under the duty option and the second term is the amount of duty collected by the HC government. To compare the profit of the Foreign firm under settlement or duty, notice that if  $P_2 > P_1^*$  then the settlement unambiguously yields greater profit to the Foreign firm in period two. However it can be shown that in equilibrium  $P_2$  never exceeds  $P_1^*$ . Substituting for  $P_2$  from equation (21),  $P_2 > P_1^*$  implies that  $P_0 > \frac{P_1^* + P_1}{2}$ . From the first-order conditions established in the previous section we know that  $P_0^* \geq P_1^* \geq P_1 \geq P_0$ , therefore  $P_0 \leq \frac{P_1^* + P_1}{2}$ .

Therefore we focus on the case when  $P_2 < P_1^*$ . Now the gross profit of the Foreign firm is larger under antidumping duty but profit net of antidumping duty may be larger or smaller than the profit under settlement, as illustrated in Figure 5. Whether the net profit is higher under the duty outcome or under the settlement outcome depends on the following three factors:

(i) The extent of the difference between  $P_2$  and  $P_1^*$ : if the difference between  $P_2$  and  $P_1^*$  is small then the firm is likely to choose the settlement outcome, because the gross profits under duty would exceed profits under settlement and is likely to be outweighed by the duty burden; otherwise the firm will choose the duty outcome. Writing  $P_1^* - P_2$  as:  $2(P_1 - P_0) - (P_1^* - P_1)$ ,

<sup>8</sup>If  $DM_1$  is very large, so as to make it unviable for the Foreign firm to remain in the market in period two, the firm would choose the free trade level of exports in the first period and exit the export market in period two if anti-dumping duty occurs.

<sup>9</sup>We find it analytically easier to compute the equilibrium in terms of prices, therefore profit has been defined as a function of prices in the remaining section.

Figure 4. The Complete Game

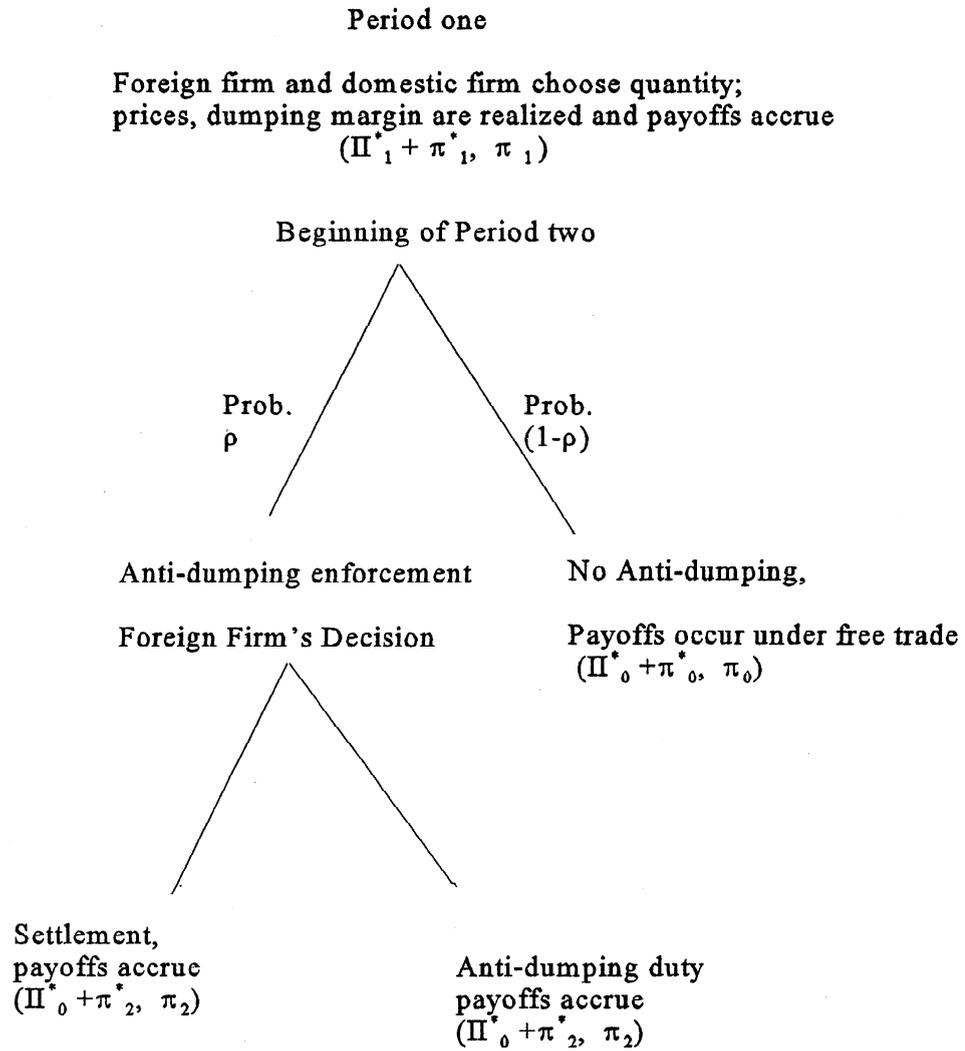
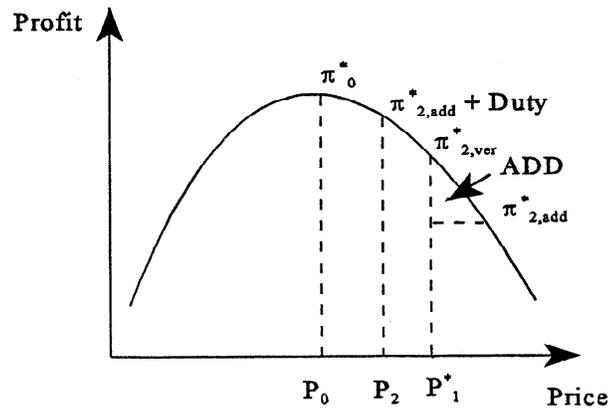
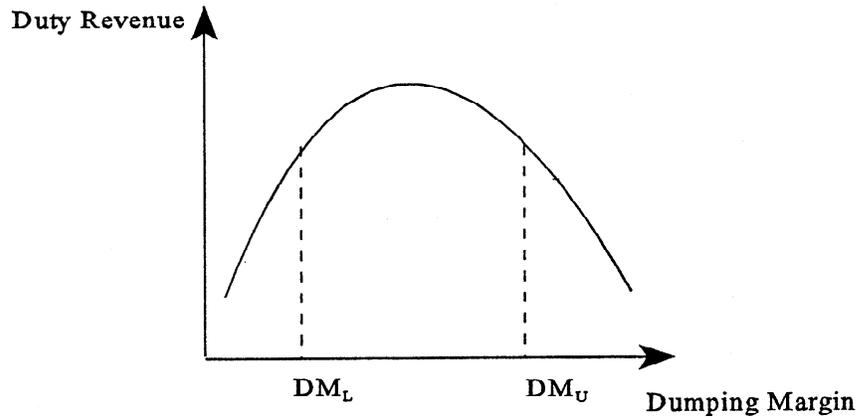


Figure 5. Profit on the Foreign Firm under Settlement and Duty



B. Laffer Curve for the Duty Revenue



it can be seen that it depends on how much the HC price in period one has been adjusted compared to the price under free trade and the initial dumping margin. The difference between  $P_1^* - P_2$  will be large if the probability of an antidumping duty is large or the initial dumping margin is small. Thus if the latter condition(s) is true then the Foreign firm is likely to choose the duty outcome in equilibrium.

(ii) The curvature of the profit function: the relative profit under the two outcomes also depends on how elastic the demand is, specially the residual demand curve that the Foreign firm faces in HC. If the demand is relatively elastic then the higher market price under the settlement outcome will imply a bigger loss in the market and would imply a smaller profit. Therefore when the demand is more elastic the firm would likely choose the duty outcome. The factors such as the number of home firms, the size of the market, and the cost parameter of the Home firms will determine how elastic demand is and therefore what outcome will be chosen in equilibrium. The outcome is likely to be antidumping duty when the number of Home firms ( $n$ ) is large, the Home firm's cost parameter ( $c$ ) is small or the size of the Home market ( $a$ ) is small.

(iii) The amount of duty revenue: the smaller is the duty revenue paid the more likely it is that the duty outcome will be chosen in equilibrium. Given the concave Laffer curve for duty revenue (see Figure 5), the duty revenue will be small either at low or high levels of the dumping margin. If the HC is operating at the upward rising part of the Laffer curve then the Foreign firm is likely to choose duty when either  $\rho$  is large or the initial dumping margin is small. Both of these conditions would imply a small dumping margin in period one and may make the duty outcome the preferred choice.

Combining the results of this analysis, the duty outcome is likely to be chosen in equilibrium when the dumping margin is small (either because of strict enforcement or because the initial conditions yield a small dumping margin) or the demand in HC is not too elastic.

The complete equilibrium strategy of the Foreign firm can be written as: The Foreign firm compares  $\pi_{2,ver}^*(P_1^*, P_1)$  and  $\pi_{2,add}^*(P_1^*, P_1)$ . If  $\pi_{2,ver}^*(P_1^*, P_1) > \pi_{2,add}^*(P_1^*, P_1)$  then maximizes the following objective function in period one

$$\text{Foreign firm: } \max \Pi_1^* + \pi_1^* + [\pi_0^* + \Pi_0^* - \rho (\pi_0^* - \pi_{2,ver}^*)] \quad (24)$$

Domestic firms also maximize their respective profit functions, and profits,  $\{(\Pi_1^* + \pi_0^*), \pi_0\}$ , are realized. The dumping margin in equilibrium equals:

$$DM_1 = DM_{1,ver} = \frac{P_0^* - P_0}{1 + 2\rho}$$

In period two, if the outcome of trade policy is antidumping actions, then the Foreign firm chooses the settlement outcome and payoffs,  $\{(\Pi_0^* + \pi_{2,ver}^*), \pi_{2,ver}\}$  occur. If the outcome of trade policy is free trade then payoffs  $\{(\Pi_0^* + \pi_0^*), \pi_0\}$  occur.

If the parameters are such that  $\pi_{2,ver}^*(P_1^*, P_1) < \pi_{2,add}^*(P_1^*, P_1)$  then the Foreign firm prefers paying the duty to settling the case. The Foreign firm maximizes the following objective function in period one:

$$\text{Foreign firm :max } \Pi_1^* + \pi_1^* + [\pi_0^* + \Pi_0^* - \rho (\pi_0^* - \pi_{2,add}^*)] \quad (25)$$

Domestic firms also maximize their respective profit functions, profits,  $\{(\Pi_1^* + \pi_1^*), \pi_1\}$ , are realized and the dumping margin is given by:

$$DM_1 = DM_{1,add} = \frac{1}{1 - \frac{3\rho}{4}} \left[ DM_0 - \frac{3\rho}{4} q_0^* \right]$$

If the outcome of trade policy is antidumping measures in period two, then the Foreign firm chooses to pay the duty, and payoffs,  $\{(\Pi_0^* + \pi_{2,add}^*), \pi_{2,add}\}$  occur. If the outcome of trade policy is free trade then payoffs  $\{(\Pi_0^* + \pi_0^*), \pi_0\}$ , occur.

#### IV. WELFARE IMPLICATIONS OF ANTIDUMPING OUTCOMES

In this section we analyze the welfare implications of an increased enforcement effort. Welfare in any country at time  $t$ , denoted by  $W_t$ , is defined as the sum of consumer surplus, profit of the domestic industry and the amount of duty collected by the government, if any. The consumer surplus in HC in period  $t$ ,  $CS_t$ , equals:

$$CS_t = \frac{1}{2} (a - P_t) Q_t \quad (26)$$

which by substituting for the demand function can be rewritten as:

$$CS_t = \frac{1}{2} (a - P_t)^2$$

Profit of the Home Firm,  $\pi_t$ , can be shown to be equal to,<sup>10</sup>

$$\pi_t = (P_t - c)^2 \quad (27)$$

and the duty revenue equals:

$$\text{Duty Revenue} = DM_1 q_2^* \quad (28)$$

Total expected welfare in HC equals the sum of welfare in the first period and expected welfare in the second period,

$$\sum_{t=1,2} EW_t = W_1 + [\rho W_2 + (1 - \rho)W_0] \quad (29)$$

<sup>10</sup>For simplification we assume that the cost of seeking protection through antidumping measures is zero for the domestic industry. The profit of a representative Home firm in each period is given by  $\pi_t = (P_t - c) q_t$ , where  $P_t = a - q_t^* - (Q_t - q_t^*)$ . From the reaction function of the Home firm  $q_t = \frac{(a - q_t^* - c)}{2}$ . Substituting for  $q_t^*$  in the inverse demand function we get  $q_t = (P_t - c)$  and  $\pi_t = (P_t - c)^2$ .

Analogously, total expected welfare in FC equals the sum of welfare in period one and the sum of expected welfare in period two. We can see from the analysis in the previous section that antidumping outcomes affect welfare not only in the HC but also in FC during the period when it is exercised as well as in the period prior to it. The welfare implications of antidumping actions in both countries in general are ambiguous as antidumping measures affect the consumer surplus and the profit of the firm differently.

Looking at the HC and the second period first, the welfare implications of a settlement outcome in period two are depicted in Figure 6. The price increases to  $P_2$  under settlement. The Home firm sells a larger market share with quantity  $q_2$ , leaving a smaller market for the Foreign firm, which sells a quantity equal to  $Q_2 - q_2$ . The consumer's surplus is smaller by the area 1+2+3 and Home firm's profit is increased by the area 1+4. The net effect on welfare therefore is 4-2-3. This net effect can be positive or negative depending on the parameters. The settlement option does not affect welfare in HC in period one.

The welfare implications of the duty outcome are depicted in Figure 7. Besides affecting the consumer surplus and profit of the Home firm it also affects welfare due to the revenue collected by the government, which equals the areas 2+5. The net effect on welfare is 4+5-3. Notice that this outcome involves a terms of trade improvement for the country, the net welfare gain due to which is equal to the area 5 in the figure. In our example the condition that would ensure the net effect to be positive is that  $3P_0 - 2c - a > 0$ , which is likely to be true when the size of the Home market is not very large (implies that the demand is sufficiently elastic), or the cost parameter of the Home firm is small. The net welfare effect of duty in period 1 depends on the relative magnitudes of the loss in the consumer surplus and the gain in the Home firm's profit.

Both outcomes of antidumping measures improve consumer surplus in the FC in the first period and reduce firm's profit in both the periods, therefore the net welfare effects are ambiguous as in HC.

#### A. Increase in the Probability of Settlement

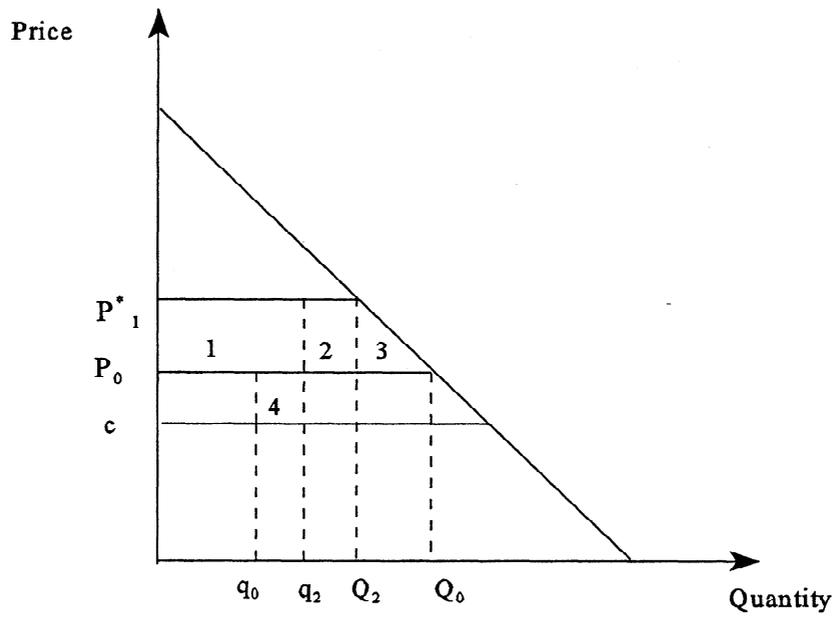
When settlement is the dominant outcome, an increase in the probability of an antidumping action implies that  $P_1$  and  $DM_1$  decrease at a decreasing rate with an increase in  $\rho$ . Since a change in  $\rho$  affects consumer and producer surpluses in opposite ways, its effect on welfare is in general ambiguous. In our example a small enforcement may improve the total expected welfare if the

following condition, is satisfied, i.e.,  $\left. \frac{d \sum_t EW_t}{d\rho} \right|_{\rho=0} \begin{matrix} \geq \\ \leq \end{matrix} 0$ , if

$$P_0 + P_0^* - \frac{2}{3}a - \frac{4}{3}c \begin{matrix} \geq \\ \leq \end{matrix} 0 \text{ which translates to: } a^* + 2a^* - \frac{5}{6}a - \frac{13}{6}c \begin{matrix} \geq \\ \leq \end{matrix} 0 \quad (30)$$

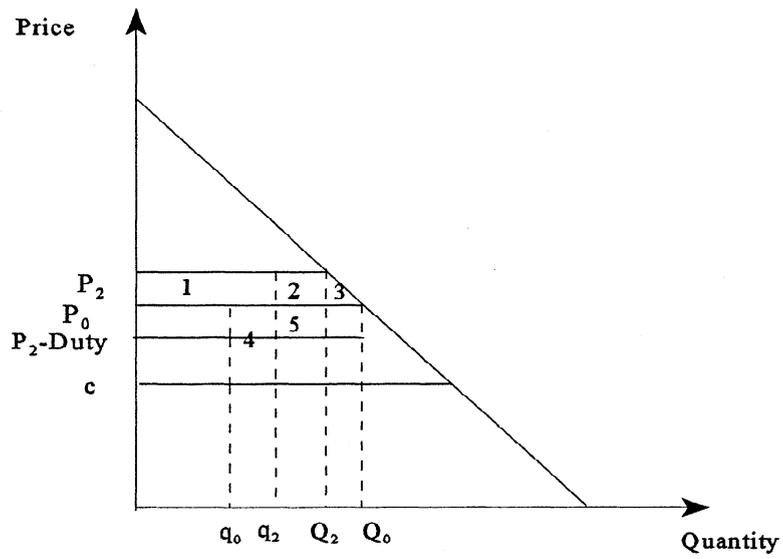
The welfare is likely to improve when the size of the Home market is small relative to that of Foreign country (implying that demand is relatively elastic in HC) and the Home firm is efficient, i.e., its cost parameter is small. The former condition implies that the loss in consumer surplus will be small when price increases, and the latter implies that when the Home firm's market share increases it continues to be supplied by an efficient firm, thus a smaller loss in efficiency. There are two effects of an increase in  $\rho$  on Home firm's profit. First, an increase in  $\rho$  increases the expected profit of the domestic industry, second it implies a smaller profit under

Figure 6. Welfare Effects of Settlement in HC in Period Two



Loss in Consumer Surplus =  $1+2+3$   
Increase in Home Firm's Profit =  $1+4$   
Gain/loss in Welfare =  $4-2-3$

Figure 7. Welfare Effects of Duty in HC in Period Two



Loss in Consumer Surplus =  $1+2+3$   
Increase in Home Firm's Profit =  $1+4$   
duty revenue =  $2+5$   
Gain/loss in Welfare =  $5+4-3$

settlement in period two, because of a smaller dumping margin. The net effect of an increase in  $\rho$  is therefore indeterminate. It can however be shown that moving from no enforcement to a small enforcement effort, at the margin, increases the expected profits of the domestic industry, i.e.,  $\left. \frac{d \sum_t E\pi_t}{d\rho} \right|_{\rho=0} > 0$ .

Welfare implications of an increase in the probability of a settlement for FC are ambiguous. Consumer surplus is higher and the Foreign firm's profit is higher in FC. The profit of the Foreign firm in HC does not change in period one. The effect on the expected profit in period two is ambiguous.

### B. Increase in the Probability of Duty

It can be shown that when paying the duty is the dominant strategy, then an increase in  $\rho$  results in a smaller dumping margin in period one, because the Foreign firm sells more in FC and less in HC in period one.  $P_1^*$  decreases at an increasing rate and  $P_1$  increases at an increasing rate with an increase in  $\rho$ , hence the dumping margin decreases at an increasing rate, and for a sufficiently high  $\rho$ , the dumping margin in period one may be driven down to zero.

Since a change in  $\rho$  affects consumer and producer surpluses differently, its effect on welfare is not clear. An increase in the enforcement of antidumping duty increases the market share and profit of the domestic industry and reduces consumer surplus in the first period, and has the opposite effects on the consumer and producer surpluses in the second period. Moreover it may increase or decrease the duty revenue depending on which side of the Laffer curve the economy is operating. A small enforcement may improve the total expected welfare if the following condition, is satisfied, i.e.,  $\left. \frac{d \sum_t EW_t}{d\rho} \right|_{\rho=0} > 0$ , if:

$$3P_0 - 2c - a > 0 \text{ which translates to: } 6c^* - 5c - a > 0 \quad (31)$$

The above condition is a sufficient condition for welfare to improve. Thus, while it is more difficult to say whether stricter enforcement would be welfare-improving or not, we can say a bit more clearly whether introduction of antidumping actions which would result in a duty outcome will improve welfare. The answer depends on the efficiency of the Home firm relative to the Foreign firm. If the Home firm is relatively efficient then the gain in market share under antidumping actions would more than offset the negative effect on the consumer surplus for a small enforcement level.

As far as the effects on total expected profit of the industry are concerned, the effect of an increase in  $\rho$  on the first-period profit is positive because it results both in a higher price and a larger market share of the domestic industry. In the second period there are two kinds of effects. First, an increase in  $\rho$  increases the expected profit, and second it results in a smaller dumping margin in period one, which reduces the profit of domestic industry under the duty outcome in period two. The net effects are ambiguous. It can however be shown that moving from no enforcement to a small enforcement effort, at the margin, increases the expected profits of the domestic industry, i.e.,  $\left. \frac{d \sum_t E\pi_t}{d\rho} \right|_{\rho=0} > 0$ . The effects of an increase in  $\rho$  on the expected profit of the Foreign firm and expected welfare of the FC are ambiguous. An increase in  $\rho$  unambiguously

improves the consumer surplus and reduces the firm's profit in FC, but the effect on the expected profit in period two is ambiguous.

## V. CONCLUSION

Possible outcomes of antidumping actions, if the case is not settled privately between the domestic and foreign firms, include eliminating the dumping margin and paying an antidumping duty. Evidence shows that the exporters pay duties in a significant proportion of cases, even when they have the option of keeping the rent by increasing the price. This paper analyzes the incentives of the exporter to choose between these outcomes.

The issue is analyzed in a two-period framework and the exporter's market is analyzed explicitly. The problem is solved backwards and the subgame perfect equilibrium is derived. The paper finds that due to the smaller loss in market share exporters may prefer an antidumping duty to voluntary settlement. Therefore depending on the parameters, the outcome may be either settlement or duty. The welfare implications of these outcomes are analyzed and compared, and it is found that the welfare implications are ambiguous in general. Stricter enforcement of antidumping measures may improve or deteriorate welfare. A small enforcement of antidumping actions, starting from no antidumping actions, however, is found to increase the profit of the domestic industry.

For future research, several avenues are worth pursuing. First, we find that antidumping duty and settlement may have, potentially, very different welfare implications. To enhance our understanding of the economic implications of antidumping measures, the effects of voluntary settlements and antidumping duty need to be compared empirically. The findings of this exercise would also be useful in the design of antidumping policies.

Second, in response to antidumping actions on their exports several countries in recent years have retaliated by initiating antidumping actions on their imports. It has been shown in the paper that the antidumping actions may reduce the welfare of the importing country, and by reducing the market power of the exporter, they may indeed improve the welfare of the exporting country. Therefore it seems to be worth examining whether the exporting country can do better by using some alternative fiscal or trade policy to maximize its social surplus, than by initiating retaliatory antidumping actions. The role of the foreign country's government also becomes important because of the externality that current antidumping practices give rise to in many countries, including Unites States: under current practice, if an exporter from a particular country is found to be dumping, then all other exporters from that country become liable to antidumping actions. In the circumstances it may be optimal for the exporting country's government to impose an export tax.

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