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Market Size and Antidumping in Duopolistic Competition

by

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Abstract

We consider the incentives that the existence of an Antidumping Law provides for strategic behaviour on the part of duopolistic firms selling in each other's segmented markets. Firms have identical costs, but are located in countries with different market sizes (maximum willingness to pay). In free trade the firm from the larger market dumps in the other market, providing incentives for both firms to manipulate their sales in the two markets to influence any future antidumping duty. We show that for small (large) differences in market size, the dumping (other) firm's strategic actions dominate, and the dumping margin is reduced (increased) relative to free trade. We also consider a price undertaking as an alternative to the duty, and show that the outcome depends on which firms have input into the policy choice.

Outline

Non Technical Summary

The decline in standard trade barriers has left antidumping (AD) actions as the major protective instrument available to governments, and they have become more popular as a consequence. One distinguishing feature of AD actions is that both their use and the level of protection provided can be influenced by the relevant exporting and import-competing firms. In this paper, we consider the incentives that the existence of an AD Law provides for strategic behaviour on the part of duopolistic firms selling in each other's segmented markets. We view dumping as a sign of price discrimination across national markets, and consider a world composed of two country markets, with one firm located in each. Firms are Cournot competitors, producing an homogeneous product which they sell in both markets, which differ in terms of size. In free trade the country with the larger market has the higher price and the firm located in that country "dumps" on the other market.

We then consider a two period version of the model, and suppose that the smaller country has in place an AD Law under which dumping in the present period results in an AD duty being imposed in the future, with the duty equal to the present period dumping margin. The existence of the AD law provides an incentive for both firms to act strategically in the present period. The dumping (home) firm reduces its exports and increases its domestic sales in an attempt to reduce the dumping margin. The firm based in the dumped market (the foreign firm) reduces its exports and increases its domestic sales so as to increase the dumping margin and hence the future costs of its rival. Trade falls, but the price outcomes depend on which firm's actions dominate. If the markets are similar in size, we show that the dumper's strategic actions dominate and this results in the equalisation of prices in the two markets in the present period. For slightly larger differences in market size, the dumping margin is reduced, but not eliminated. Once the market size difference is sufficiently large, however, it is the foreign firm's strategic actions that dominate, and we observe a larger dumping margin than would occur in free trade, bounded by the prohibitive duty. For even larger differences in market size, there is free trade in the present period, and the dumping firm is taxed out of the foreign market in the future.

We then consider a price undertaking by the dumping firm as an alternative outcome to the duty, where this undertaking requires that the dumping firm does not export at a price below that in its domestic market. If found dumping in the present period, the home firm is then committed to equalising prices in the two markets in the future period, and we show that there is a range of market size differences for which the dumping firm will be able to deliver on such an undertaking and a smaller range over which it will prefer this outcome to the corresponding equilibrium duty. But the foreign firm always has lower profits under a price undertaking than under free trade, and hence the overall outcome will depend on whether the foreign firm must agree for a price undertaking to be accepted. If so, then the foreign firm will never agree and we will observe the duty outcome. If not, then this firm will never petition for relief from dumping in circumstances where the dumper will choose the undertaking alternative.

1. **Introduction**

The decline in standard trade barriers as a result of both unilateral liberalisations and multilateral agreements within the GATT/WTO framework, has left antidumping (AD) actions as the major remaining available protective instrument. This explains their increasing popularity, both in terms of frequency of use and numbers of users (Zanardi, 2004). A product is considered as being dumped "...if the export price...is less than the comparable price...for consumption in the exporting country" (Article 2.1 WTO AntiDumping Agreement). Where dumping has occurred and caused "material" injury to the domestic industry, an AD duty can be imposed on the relevant imports. As Pauwels et al (2001) note, this means that AD protection is unlike other types of tariff protection in that the level of duty can be endogenously determined by the firms involved. The incentives that the existence of this statute provides for strategic behaviour on the part of oligopolistic firms selling in each others' segmented national markets is our main interest in this paper.

Most studies view dumping as a sign of price discrimination across national markets, and that is the approach we take here. We consider a world composed of two country markets, with one firm located in each. Both firms are Cournot competitors, producing an homogeneous product which they sell in both markets. The countries differ in terms of maximum willingness to pay (WTP), and markets are segmented. In the free trade equilibrium the country with the larger WTP has the higher price and the firm located in that country "dumps" on the other market. We then consider a two period version of the model, and suppose that the smaller country has in place an AD Law under which dumping in the first period would result in an AD duty being imposed in the second, with the duty equal to the dumping margin in the first period.

The existence of the AD law provides an incentive for both firms to act strategically in the first period. The dumping (home) firm reduces its exports and increases its sales in its domestic market so as to reduce the dumping margin. The firm based in the dumped market (the foreign firm) reduces its exports and increases its domestic sales in order to increase the dumping margin and hence the second period duty faced by its rival. Trade falls, but the price outcomes depend on which firm's actions dominate. If the difference in WTP is small, we show that the dumper's strategic actions dominate

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and this results in the equalisation of prices in the two markets in the first period. For slightly larger differences, the first period dumping margin is reduced, although not eliminated. But once the WTP difference is large enough it is the foreign firm's strategic actions that dominate, and we observe a larger dumping margin than would occur in free trade, bounded by the prohibitive duty. For even larger differences the first period equilibrium is as in free trade, and the dumping firm is taxed out of the foreign market in the second period.

We then consider a price undertaking on the part of the dumping firm as an alternative outcome to the AD duty. In many jurisdictions a dumping firm can avoid the duty if it agrees to eliminate the dumping margin. This has typically be investigated in the literature as a means of supporting more collusive behaviour between the firms. Here we have a different focus. We suppose that the price undertaking given by the dumping firm requires that it does not export at a price below that in its domestic market. In effect the dumping firm is then committed to equalising prices in the two markets (i.e. eliminating the dumping margin ex post). We show that there is a range of WTP differences for which the dumping firm will be able to deliver on such an undertaking and a smaller range over which it will prefer this outcome to the corresponding equilibrium duty. We also show that the foreign firm has lower profits under a price undertaking than under free trade. Hence the second period outcome will depend on whether the foreign firm must agree for a price undertaking to be accepted. If so, then the foreign firm will never agree and we will observe the duty outcome. If not, then this firm will never petition for relief from dumping in circumstances where the dumper will choose the undertaking alternative.

The remainder of this paper is structured as follows. Section 2 reviews the related literature. Section 3 sets up the model where AD policy is absent, solves for the equilibrium outcomes and identifies the conditions under which one firm dumps in the other country. Section 4 describes the AD outcome in the second period. In section 5, we incorporate the AD duty and show how this influences the strategic actions of the firms and equilibrium outcomes. The following section introduces the price undertaking option, and shows how this can reduce the likelihood of AD petitions. Section 7 provides a summary and conclusions.

2. Related literature

In principle at least, dumping can occur in any market structure under the appropriate circumstances. Some form of market segmentation, natural or policy generated, must exist for arbitrage to be unable to enforce the law of one price. In competitive markets dumping can occur in response to cyclical fluctuations in demand (Ethier, 1982) or in anticipation of voluntary export restraints proportional to current exports (Anderson, 1992, 1993). Monopolistically competitive markets can generate reciprocal dumping (Brander and Krugman, 1983) and dumping associated with the exit of unprofitable firms (Clarida, 1993). An aspiring monopolist might dump as part of a strategy of predatory pricing (Hartigan, 1994) or entry deterrence (Davis and McGuiness, 1982).

Dumping is most commonly viewed as the outcome of price discrimination between national markets (Viner, 1923), and here we deal with price discrimination due to differences in WTP. This is similar to reciprocal dumping, except that dumping is a result of asymmetrical markets rather than transport costs. Where this happens, a firm in the country where the price is lower, i.e. where dumping takes place, could initiate an AD case by filing an AD petition against the dumping firm. The procedure for investigating the case is divided into two parts. Firstly, the dumping margin (in our case the price difference between two countries) is calculated. Secondly, where the dumping margin is sufficiently high, evidence that dumping causes material injury to the domestic industry is sought. Both dumping and material injury must be found before an AD action can be taken. Since our interest is in the incentives for strategic actions by the firms involved, we minimise the administrative aspects by assuming that if there is a difference in the prices at which a product is sold in the two markets, and if the firm in the lower priced market chooses to file an AD petition, both dumping and material injury will be found.

The incentives for strategic behaviour that arise due to the presence of AD laws have received some attention. Dumping between two identical markets can be generated if one assumes that one firm is a monopolist in, say, the home market but competes with a foreign firm in the foreign market. The more competitive foreign market will have the lower equilibrium price. If AD actions prevent price discrimination, then the home firm exports less (Webb, 1992). In a two period version of the model, where dumping

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in the first period generates duties in the second, the home firm's first period exports fall to reduce the second period duty (Reitzes, 1993). The foreign firm will also expand its sales in order to increase the dumping margin, and the net effect could be an increase in the quantity sold in the foreign market in the first period (Fischer, 1992). Collie (2004) observes that, even if the foreign firm could export to the dumper's home market, by committing not to do so it grants the home firm monopoly power in the home market, which induces it to raise its price there and also its export price so as not to fall foul of the foreign country's AD Law. If the firms' products are sufficiently close substitutes, the increased profits of the foreign firm in the foreign market, as a result of this price increase, may more than compensate for the loss of export profits, and both firms gain.

Sometimes the extent of injury can be important for the success of the petition, either by increasing the probability of a duty being imposed (Prusa, 1994), or because the duty itself may be set at the level of the injury margin (the difference between the exporter's price and that of its domestic competitor), as under the EU Legislation (Pauwels et al, 2001)[1]. In these cases, the domestic firm has an incentive to reduce its sales to 'exaggerate' the injury.

A duty is not the only possible outcome from an AD case, however. In some jurisdictions the dumping firm may agree a price undertaking with the AD Authority. Indeed the firms themselves may reach an agreement that sees the AD petition withdrawn. Absent antitrust constraints, it is usually possible for the firms to find a private settlement that dominates the AD duty outcome (Prusa, 1992; Panagariya and Gupta, 1998), and the threat of AD action can be used to facilitate collusion between the firms (Staiger and Wolak, 1992; Veugelers and Vandenbussche, 1998). Given that this is the case, the issue then arises of why firms pay duty rather than accept some price settlement. Panagariya and Gupta (1998) illustrate circumstances under which asymetric information between firms may prevent a bargaining equilibrium, and Gupta (1999) shows that the dumping firm may prefer the duty outcome, which leaves

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[1] Note that Pauwels et. al. assume that a fixed reference price is applied with respect to the dumper's home market by the foreign AD Authorities. This means that neither firm has an incentive to undertake strategic action in the home market.

it free to set the price in the foreign market, to the negotiated outcome which fixes this price. This is most likely to be the case when the dumping margin is small[2] .

Our work extends this literature in two main directions. First, by considering the implications of differences in market size (generated by differences in WTP) for the outcomes of the strategic behaviour by the firms. We show that when the markets are similar in size, as has typically been assumed in the literature, it is the strategic behaviour of the dumping firm that dominates the outcomes. Neglecting the strategic behaviour of the other firm may not be serious in such circumstances. But if the markets differ significantly in size, it is the behaviour of this other firm that dominates, and should be taken into account. Second, we consider the choice between an AD duty and a price undertaking when the firms continue to act non-cooperatively. We show that a price undertaking by the dumping firm will be feasible if the markets are not too different in size, and will generally be preferred to the duty by that firm. The best result for the other firm is the duty outcome, and it even prefers free trade to the price undertaking. Where both the duty and undertaking options are available, the outcome depends on which firms have input into the choice.

3. Free Trade

In this section we set up a very simple model, that will allow us to identify the effects of firm strategic actions on equilibrium outcomes in later sections. Let there be two countries, home and foreign. Each country has one firm, both firms produce a homogeneous product at zero production costs and supply both markets. The two markets are segmented and there are no transport costs. The firms engage in Cournot competition. Assume the demand functions for the home and foreign country are

$$D = A - p; \quad \text{and} \quad D^* = A^* - p^* \tag{1}$$

where D, p and A denote home demand, price and maximum willingness to pay respectively, and * indicates the corresponding variables for the foreign country. These demand curves are both linear, with the same slopes (normalised to unity) but different intercepts. Consumers in the country with the larger intercept are willing to

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[2] AD laws may also provide an incentive for foreign direct investment as analysed by Haaland and Wooton (1998), Blonigen and Ohno (1998) and Vandenbussche et al. (1999). Vandenbussche and Wauthy (2001) consider their effects on the product quality choices of firms.

pay a higher price for any given quantity and will purchase more at any given price. Given that markets are segmented, this market will have the higher price and larger total sales in the free trade equilibrium. It can therefore be referred to as the larger market (Gupta, 1999), and we will follow this usage, although we note that this is not the only way to represent differences in market size, and other representations do not necessarily have higher prices in the larger market. If we let x, x^* denote the home firm's sales in the home and foreign markets, and y, y^* the corresponding sales of the foreign firm, their respective profits are

$$\pi = px + p^* x^* \qquad \text{and} \qquad \pi^* = py + p^* y^*$$

Maximising profits under the Cournot assumptions yields equilibrium sales, prices, and profits as shown in (3) and (4)

$$\frac{\partial \pi}{\partial x} = p - x; \frac{\partial \pi}{\partial x^*} = p^* - x^*; \frac{\partial \pi^*}{\partial y} = p - y; \frac{\partial \pi^*}{\partial y^*} = p^* - y^* \tag{2}$$

$$x = y = \frac{A}{3}; x^* = y^* = \frac{A^*}{3}; p = \frac{A}{3}; p^* = \frac{A^*}{3} \tag{3}$$

$$\pi = \pi^* = \left[\frac{A}{3}\right]^2 + \left[\frac{A^*}{3}\right]^2 \tag{4}$$

Both firms sell the same amount in each market (but more in the larger market) and earn the same total profits. The price is higher in the larger market, which generates the possibility that the firm from the larger market could be subject to a claim of dumping in the smaller market. The dumping margin (in this case the price difference) will depend on the difference in WTP between the two markets (e.g. in free trade $p - p^* = [A - A^*]/3$). Note that the two firms have identical (zero) costs and only differ in terms of their locations. The only reason that dumping occurs is that national markets are segmented and it is profit maximising for both firms to sell quantities that yield a higher price in the larger market. The dumping firm does not benefit from a "sanctuary" home market (Lindsey and Ikenson, 2003) and free trade provides a "level playing field".

4. Dumping

Now consider a two period, present (period 1) and future (period 2), version of this model. Both periods are of equal length. For simplicity we assume that the demand

functions are as above in both periods, and that agents do not discount the future. Without loss of generality we assume that the home market is larger (i.e. $A > A^*$) and that the foreign country has in place AD Legislation which provides that if the foreign firm files an AD petition and the home firm is found to have dumped in the present it will be subject to a tax on its future sales in the foreign market equal to the dumping margin (price difference) in the present. It will always be in the interests of the foreign firm to file such a petition if dumping has occurred in the first period.

In the second period, firms maximise their profits, with the home firm subject to antidumping duty t. Hence

Home firm
$$\max_{x_2, x_2^*} \pi_2 = p_2 x_2 + [p_2^* - t] x_2^*$$

Foreign firm
$$\max_{y_2, y_2^*} \pi_2^* = p_2 y_2 + p_2^* y_2^*$$

Where $t = \max\{0, p_1 - p_1^*\}$. The equilibrium outcomes are

$$x_2 = y_2 = \frac{A}{3}; x_2^* = \frac{A^* - 2t}{3}; y_2^* = \frac{A^* + t}{3}; p_2 = \frac{A}{3}; p_2^* = \frac{A^* + t}{3} \tag{5}$$

$$\pi_2 = \left[\frac{A}{3}\right]^2 + \left[\frac{A^* - 2t}{3}\right]^2; \pi_2^* = \left[\frac{A}{3}\right]^2 + \left[\frac{A^* + t}{3}\right]^2 \tag{6}$$

Home firm exports are reduced (but are positive as long as $t < A^*/2$) and the foreign price is increased by the antidumping action. Home firm profits fall, foreign firm profits increase. In this case the outcomes in the two periods are linked by the antidumping duty, and we must explicitly consider this link in analysing firm strategies in the first period. If the home firm were to ignore this threat and to continue to act as in free trade it would be subject to an antidumping duty of $t = [A - A^*]/3$ in the future.

Both firms understand these second period consequences at the time that they determine their first period sales. The home firm recognises that it can adjust its sales in *both* markets in the first period in order to reduce or remove the dumping margin. Of course the foreign firm can also influence the dumping margin through its present period sales in both markets and can be expected to strategically modify its behaviour

accordingly. The strategic actions of both firms are important in determining the range of possible outcomes.

5. Firms Behave Strategically

Our primary objective in this section is to illustrate, as simply as possible, the role of differences in market size in determining the equilibrium outcomes when both firms behave strategically. We therefore only consider pure strategy equilibria. This simplifies the analysis considerably, but still leaves us with some constraints to be dealt with expeditiously since they are peripheral to our main interests. These relate to the minimum level of sales of the dumping firm in the first period, and the fact that the AD duty cannot be negative. As noted above, the AD duty imposed on the home (dumping) firm's sales in the foreign market in the period 2 is equal to any dumping margin (price differential) found in period 1. However, regardless of this price differential, no duty will be imposed if the home firm makes no sales in the foreign country in the first period. Thus there are two circumstances under which no duty will be levied in the second period: (i) the home firm exports in the first period but the dumping margin is zero; and (ii) there is a positive dumping margin in the first period but there are no home firm exports. This second circumstance has the complication of generating a discontinuity in our functions at $x_1^* = 0$. As x_1^* approaches zero from above a finite dumping margin applies, but this drops to zero when first period exports cease. We can show that abandoning the foreign market in the first period is not a pure-strategy equilibrium outcome for the home firm. But reducing "dumped" foreign sales to a minimal level in the first period will be an equilibrium outcome for some differences in WTP. To encompass this feature we therefore constrain $x_1^* \geq \varepsilon$ where ε is some arbitrarily small positive amount, which can be thought of as the minimum detectable level of dumping[3].

We can capture the requirement that the antidumping duty cannot be negative (i.e. cannot be a subsidy) by imposing the constraint that $p_1 - p_1^* \geq 0$ on the "dumping"

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[3] Details are available in an Appendix from the authors. A referee has noted that setting exports to zero may be a best reply for the home firm to some strategies of the foreign firm, and there may be a mixed strategy Nash equilibrium that involves this firm abandoning the foreign market.

firm (since the other firm has no incentive to take actions that reduce the duty). The second period equilibrium outcomes are as in (5) and (6) above, and these solutions indicate a further constraint that must be imposed on the antidumping duty. These expressions for second period profits only apply if the antidumping duty is no greater than the prohibitive duty. From that point the home firm ceases to export in the second period, leaving the foreign firm to act as a monopolist in the foreign market. We can capture this requirement by imposing the constraint that $p_1 - p_1^* \leq A^*/2$ on the foreign firm (since the dumping firm has no incentive to take actions that raise the duty), and by restricting attention to the range of market sizes for which the free trade dumping margin would be less than the prohibitive duty (i.e. $A \leq 5A^*/2$) in the first instance. Since we show that the combined strategic actions of the firms lead to the prohibitive duty before we get to this upper bound, it is clear that the equilibrium will involve free trade in the first period generating a prohibitive duty in the second when $A > 5A^*/2$.

Both firms understand these second period consequences at the time that they determine their first period sales. The profit maximisation problems facing the two firms at the beginning of the first period are now

Home firm
$$\max_{x_1, x_1^*} \pi = p_1 x_1 + p_1^* x_1^* + \pi_2$$

$$s.t. \ x_1^* \geq \varepsilon \quad \text{and} \quad p_1 - p_1^* \geq 0$$

Foreign firm
$$\max_{y_1, y_1^*} \pi^* = p_1 y_1 + p_1^* y_1^* + \pi_2^*$$

$$s.t. \ p_1 - p_1^* \leq \frac{A^*}{2}$$

Where π_2 and π_2^* are as given in (6). Including these constraints, the respective objective functions for the home and foreign firm can be written as

$$\max_{x_1, x_1^*} \Pi = p_1 x_1 + p_1^* x_1^* + \left[\frac{A}{3}\right]^2 + \left[\frac{A - 2(p_1 - p_1^*)}{3}\right]^2 + \lambda[p_1 - p_1^*] + \eta[x_1^* - \varepsilon] \quad (7)$$

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$$\max_{y_1, y_1^*} \Pi^* = p_1 y_1 + p_1^* y_1^* + \left[\frac{A}{3}\right]^2 + \left[\frac{A + (p_1 - p_1^*)}{3}\right]^2 + \gamma\left[\frac{A^*}{2} - (p_1 - p_1^*)\right] \tag{8}$$

where λ, η and γ are lagrange multipliers for the inequality constraints, $p_1 - p_1^* \geq 0$, $x_1^* \geq \varepsilon$ and $p_1 - p_1^* \leq A^*/2$ respectively.

In this case the derivatives of the optimisation functions[4] with respect to each of the sales are:

$$\frac{\partial \Pi}{\partial x_1} = p_1 - x_1 + \frac{4}{9}[A^* - 2(p_1 - p_1^*)] - \lambda \tag{9}$$

$$\frac{\partial \Pi}{\partial x_1^*} = p_1^* - x_1^* - \frac{4}{9}[A^* - 2(p_1 - p_1^*)] + \lambda + \eta \tag{10}$$

$$\frac{\partial \Pi^*}{\partial y_1} = p_1 - y_1 - \frac{2}{9}[A^* + (p_1 - p_1^*)] + \gamma \tag{11}$$

$$\frac{\partial \Pi^*}{\partial y_1^*} = p_1^* - y_1^* + \frac{2}{9}[A^* + (p_1 - p_1^*)] - \gamma \tag{12}$$

These derivatives are quite informative about the properties of the equilibrium outcomes. Compared with the corresponding derivatives in free trade (shown in (2)), the dumping firm has an incentive towards higher domestic sales and smaller exports, thereby moderating the price difference. The foreign firm's incentives are to do the opposite. For each firm the incentives to adjust domestic sales and exports are equal in magnitude and opposite in sign, except for the home firm when it is bound by the minimum export constraint (where $x_1^* = \varepsilon$ and $\eta > 0$). This implies equilibrium outcomes where sales are switched between markets, but each firm's total output is unchanged from free trade. The strengths of these incentives to reallocate sales between markets depend on the size of second period sales in the foreign market

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[4] For (7) and (8) the Kuhn-Tucker conditions are: $\frac{\partial \Pi}{\partial x_1} \leq 0; x_1 \geq 0; x_1 \frac{\partial \Pi}{\partial x_1} = 0$; and $\frac{\partial \Pi}{\partial x_1^*} \leq 0; x_1^* \geq \varepsilon$.

for the home firm's outputs ; $\frac{\partial \Pi^*}{\partial y_1} \leq 0; y_1 \geq 0; y_1 \frac{\partial \Pi^*}{\partial y_1} = 0$ and $\frac{\partial \Pi^*}{\partial y_1^*} \leq 0; y_1^* \geq 0; y_1^* \frac{\partial \Pi^*}{\partial y_1^*} = 0$ for the

foreign firm's outputs. For the inequality constraints they are: $\frac{\partial \Pi}{\partial \lambda} = p_1 - p_1^* \geq 0; \lambda \geq 0; \lambda \frac{\partial \Pi}{\partial \lambda} = 0$;

$\frac{\partial \Pi}{\partial \eta} = x_1^* - \varepsilon \geq 0; \eta \geq 0; \eta \frac{\partial \Pi}{\partial \eta} = 0$; and $\frac{\partial \Pi^*}{\partial \gamma} = \frac{A^*}{2} - (p_1 - p_1^*) \geq 0; \gamma \geq 0; \gamma \frac{\partial \Pi^*}{\partial \gamma} = 0$.

(which determines second period profits in that market). Thus the incentive for the home firm to reallocate sales so as to reduce the price differential is larger the smaller the dumping margin (price differential), while the incentive for the foreign firm to reallocate sales is larger the larger the dumping margin. These considerations are reflected in the solutions discussed below and presented in Table 1. For small differences in willingness to pay, when the underlying free trade price differential is also small, the strategic behaviour of the home firm dominates the equilibrium and the dumping margin is reduced. But for larger differences in willingness to pay it is the strategic behaviour of the foreign firm that dominates, and the dumping margin increases relative to free trade. The cross over point is where the two firms face equal incentives (i.e. $2[A^* + (p_1 - p_1^*)]/9 = 4[A^* - 2(p_1 - p_1^*)]/9$) and occurs when $A = 8A^*/5$. Three types of equilibrium outcomes arise depending on relative market sizes.

[Table 1 about here]

5.1. Temporary market integration

Where the markets are very similar in size, the equilibrium solution has the two prices equalised in the first period (i.e. $p_1 - p_1^* = 0$ implying $\lambda \geq 0$). In the second period, the solutions are the same as in free trade since no duty is levied. There are two subcases of market integration.

    (a) If $x_1^* > \varepsilon$ ($\eta = 0$) then the equilibrium prices are $p_1 = p_1^* = [A + A^*]/6$. Compared with free trade, the total sales of each firm are unchanged, but each has switched sales towards its domestic market, thereby reducing trade.

$$\Delta[x_1 + x_1^*] = \Delta[y_1 + y_1^*] = 0; \Delta x_1 = -\Delta x_1^* = 3[A - A^*]/9$$

$$\Delta y_1 = -\Delta y_1^* = -3[A + A^*]/18; \quad \Delta[x_1^* + y_1] = -[9A - A^*]/18 < 0.$$

The net result is that the total sales rise in the home market and fall in the foreign, thereby equalising prices.

$$\Delta[x_1 + y_1] = -\Delta[x_1^* + y_1^*] = [A - A^*]/6$$

The profits of both firms fall ($\Delta\pi = \Delta\pi^* = -[A - A^*]^2/18$). All outputs and prices are positive as long as $A^* < A < 4\{A^*/3\} - 3\varepsilon$. At the upper bound we switch to the second subcase.

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(b) If $x_1^* = \varepsilon \ (\eta \geq 0)$ equilibrium prices are $p_1 = p_1^* = [7A^* - 9\varepsilon]/18$. In this range the home firm's ability to switch sales from exports to its domestic market is constrained because exports are at the minimal level. Compared with free trade, total home firm output rises, since domestic sales increase over the range. Total foreign firm sales are constant over this range, but are less than in free trade (reflecting that outputs are strategic substitutes). This firm exports less and sells more in its domestic market.

$$\Delta[x_1 + y_1] = [6A - 7A^* + 9\varepsilon]/18 > 0; \ \Delta[x_1^* + y_1^*] = -[A^* - 9\varepsilon]/18 < 0;$$

$$\Delta x_1 = [6A - 5A^* + 9\varepsilon]/9 > 0; \ \Delta x_1^* = -[A^* - 3\varepsilon]/3 < 0;$$

$$\Delta y_1 = [A^* - 2A - 2\varepsilon]/6 < 0; \ \Delta y_1^* = [5A^* - 9\varepsilon]/18 > 0$$

Total sales in the home market increase, total sales in the foreign market fall, and trade is reduced.

$$\Delta[x_1 + x_1^*] = -2\Delta[y_1 + y_1^*] = [6A - 8A^* + 18\varepsilon]/9 > 0;$$

$$\Delta[x_1^* + y_1] = -[2A + A^* - 3\varepsilon]/6 < 0$$

Both firms' profits are lower than in free trade over the range of this equilibrium. This yields a feasible equilibrium as long as $4\{A^*/3\} - \varepsilon < A < 25\{A^*/18\} - 3\{\varepsilon/2\}$. The lower bound to this range coincides with the upper bound of the previous case, and it is the point at which the constraint $x_1^* \geq \varepsilon$ starts to bind $(\eta = 0)$. At the upper bound we have $\lambda = 0$, indicating that this is the maximum WTP difference for which $p_1 - p_1^* = 0$ is an equilibrium outcome. For larger WTP differences we switch from temporary market integration to moderated dumping.

5.2. Moderated Dumping

For this range of market size differences the dumping firm moderates its behaviour but not to the point of full price equalisation, and a less than prohibitive duty is actually imposed in period 2. Again there are two subcases.

(a) For small differences in WTP in this range we have $x_1^* = \varepsilon \ (\eta \geq 0)$ and the home firm's ability to switch sales from exports to its domestic market is constrained by the lower bound on exports. Compared with free trade, the home firm exports less,

sells more domestically and produces more overall. The foreign firm also exports less and sells more domestically, but produces less overall.

$$\Delta[x_1 + x_1^*] = -2\Delta[y_1 + y_1^*] = [3A^* - 2A + 3\varepsilon]/6 \geq 0;$$

$$\Delta x_1 = [5A^* - 2A - 3\varepsilon]/6 > 0; \ \Delta x_1^* = -[A^* - 3\varepsilon]/3 < 0;$$

$$\Delta y_1 = [2A - 9A^* + 3\varepsilon]/21 < 0; \ \Delta y_1^* = [2A + 5A^* - 11\varepsilon]/28 > 0$$

Total sales in the home market rise and in the foreign market fall, but not enough to equalise prices. Trade falls.

$$\Delta[x_1 + y_1] = [17A^* - 10A - 15\varepsilon]/42 > 0;$$

$$\Delta[x_1^* + y_1^*] = [6A - 13A^* + 51\varepsilon]/84 < 0;$$

$$\Delta[x_1^* + y_1] = [2A - 16A^* + 24\varepsilon]/21 < 0$$

The home firm's profits are less than in free trade over this range (i.e. $\Delta\pi < 0$). At the lower bound, where the dumping margin is zero, first period profits are less than in free trade. As we move towards the upper bound, the dumping margin increases, and second period profits fall, but first period profits are rising, and even exceed those in free trade once $A = 1.4A^*$. The gain in first period profits is never sufficient to compensate for the second period loss, however. The foreign firm has lower profits in the first period and higher profits in the second, relative to free trade. But the second period gain is insufficient to compensate for the first period loss, and its total profits are also less than in free trade over this range (i.e. $\Delta\pi^* < 0$). This solution is feasible over the range $25\{A^*/18\} - 3\{\varepsilon/2\} < A < 3\{A^*/2\} + 3\{\varepsilon/2\}$, with $p_1 = p_1^*$ at the lower bound and $\eta = 0$ at the upper bound (where $x_1^* = \varepsilon$ ceases to be binding).

(b) For larger differences in willingness to pay we move to the second subcase where no constraints are binding. For this range of relative market sizes, neither firm is "constrained" and each produces the same total output as in free trade, but sells more in its domestic market and consequently exports less. Trade falls.

$$\Delta[x_1 + x_1^*] = \Delta[y_1 + y_1^*] = 0; \ \Delta[x_1^* + y_1] < 0;$$

$$\Delta x_1 = -\Delta x_1^* > 0; \ \Delta y_1 = -\Delta y_1^* < 0$$

The most striking feature of these outcomes is that the dumping margin actually increases, relative to free trade, in the latter part of the range (i.e. once $A \geq 8A^*/5$), where, as noted above, the strategic incentive for the foreign firm becomes dominant. Prior to this point, sales in the home market are higher, and the price is lower than in

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free trade, while after this point the reverse is true. The opposite holds for the foreign market.

$$\Delta[x_1 + y_1] = -\Delta[x_1^* + y_1^*] \geq (\leq) \, 0 \text{ and } \Delta DM \leq (\geq) \, 0 \text{ as } A \leq (\geq) 8A^*/5$$

The home firm's profits are less than in free trade (i.e. $\Delta\pi < 0$), with higher profits in the first period more than offset by lower profits in the second. The foreign firm's profits are lower than in free trade at the lower bound of the range and higher than in free trade at the upper bound (i.e. $\Delta\pi^* \leq (\geq) \, 0$ as $A \leq (\geq) 1.63A^*$). Again this is made up of a reduction in the first period and a gain in the second. For these equilibrium prices and outputs to be positive, we require that $3\{A^*/2\} + 3\{\varepsilon/2\} < A < 11\{A^*/6\}$. At the lower bound $x_1^* = \varepsilon$. At the upper bound, $x_2^* = 0$, because once $A = 11A^*/6$ the duty reaches the prohibitive level $A^*/2$.

5.3. Prohibitive Dumping

In this range the first period price differential implies an antidumping duty at the prohibitive level (i.e. $p_1 - p_1^* = A^*/2$). The foreign firm then becomes a monopolist in its local market in the final period. The strategic actions of the firms, particularly the foreign firm, result in a higher dumping margin than in free trade in the first period. Firms' total sales are unchanged from free trade, with more sold domestically and less exported. Total sales fall in the home market and rise in the foreign, which generates the higher dumping margin. Total trade falls.

$$\Delta[x_1 + x_1^*] = \Delta[y_1 + y_1^*] = 0;$$

$$\Delta[x_1^* + y_1^*] = -\Delta[x_1 + y_1] = [5A^* - 2A]/12 = \Delta DM/2 \geq 0;$$

$$\Delta x_1 = -\Delta x_1^* = -\Delta y_1/2 = \Delta y_1^*/2 \geq 0$$

$$\Delta[x_1^* + y_1] = [2A - 5A^*]/4 \leq 0$$

The relevant range of relative WTP in this case is $11\{A^*/6\} < A < 5\{A^*/2\}$ where $\gamma = 0$ at the lower bound and we remain with the free trade equilibrium in the first period at the upper bound. Home firm profits are lower than in free trade over the whole range (i.e. $\Delta\pi < 0$) but first period profits are higher than in free trade (higher in the home market and lower in the foreign market). Foreign firm profits are the opposite, higher overall (i.e. $\Delta\pi^* > 0$), but lower than free trade in the first period.

5.4. Unconstrained Dumping

At the lower bound of this range, the first period equilibrium is unchanged from free trade, and free trade is the outcome that prevails when $5\{A^*/2\} \le A$. The home firm is then taxed out of the foreign market in the second period. The changes in profits are

$$\Delta\pi = -[A^*/3]^2 < 0; \Delta\pi^* = 5[A^*/6]^2 > 0$$

We now illustrate these first period price outcomes diagrammatically. We begin by considering the case where only the dumping firm behaves strategically[5], and the foreign firm remains a (passive) Cournot competitor ignoring the links between periods. By comparing this solution with that discussed above, we can isolate the effects of each firm's strategic actions. Figure 1 illustrates the case where only the dumping firm behaves strategically. The same range of outcomes is observed as above. If the difference in WTP is sufficiently small ($A^* < A < 17A^*/9$), then the home firm adjusts its sales in the two markets so as to equalise product prices, thereby avoiding the antidumping duty in the second period. Where the WTP difference is slightly larger ($17A^*/9 < A < 5A^*/2$), the home firm adjusts its sales so as to moderate the duty it faces in the second period. For larger differences, the home firm finds it optimal to abandon the foreign market in the second period as the antidumping duty is prohibitive. The threat of the antidumping duty will remove or moderate dumping, except where the difference in WTP is large. The dumping firm is worse off than in free trade and so is the foreign firm unless the difference in WTP is large enough that moderation of the price difference is slight.

The outcomes where both firms behave strategically are shown in Figure 2[6]. A comparison of Figures 1 and 2, shows that the outcomes that could be observed when only the dumping firm behaved strategically, can still be observed when both behave strategically, but are now compressed into the range of market size differences where the dumping firm has the stronger incentives for strategic behaviour (i.e. $A < 8A^*/5$). Beyond this range, the other firm has the stronger incentives, and the dumping margin

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[5] Details of the equilibrium outcomes are available from the authors on request.
[6] Note that ε is taken to be negligible in Figure 2, to avoid cluttering the diagram.

exceeds that in free trade, though it is capped by the prohibitive duty (until $A = 5A^*/2$). Interestingly, when $A = 8A^*/5$ the two firm's strategic actions offset each other, and the dumping margin remains as in free trade, though trade has been reduced.

6. Price undertakings

In this section we introduce the alternative outcome to the AD petition, namely that a firm found to have dumped in the first period may undertake to equalise prices across markets in the second period (i.e. stop dumping) in preference to paying an AD duty. To begin with we assume that the choice between such an undertaking or an AD duty is made by the dumper alone, and that the foreign firm continues to act as a Cournot competitor in the second period. In this way we rule out the use of AD to foster collusion between the firms or that the foreign firm will change its behaviour to take advantage of the constraint assumed by the dumper. Clearly the presence of this option will affect the equilibrium outcomes in both periods.

Our first step is to determine the range of market size differences over which the price undertaking option is feasible. The equilibrium outputs correspond to those under temporary market integration when only the home firm behaves strategically. One can show that this requires $A \leq 2A^*$. When the market size difference exceeds this, then a price undertaking is not feasible. From the results above, we know that the price undertaking involves lower profits for the dumping firm, relative to free trade, as does an AD duty. We can solve for the *equivalent duty* (τ) - i.e. the duty that leaves the dumping firm with the same second period profits as under the price undertaking, from

$$\left[\frac{A}{3}\right]^2 + \left[\frac{A^* - 2\tau}{3}\right]^2 = \frac{1}{2}\left[\frac{A + A^*}{3}\right]^2$$

which yields solution

$$\tau = \frac{A^*}{2} - \left[\frac{A^{*2} + 2AA^* - A^2}{8}\right]^{\frac{1}{2}}$$

Thus the dumping firm chooses the price undertaking if the first period dumping margin $DM_1 = p_1 - p_1^* \geq \tau$ and pays the duty otherwise.

An interesting aspect of the comparison between the AD duty and the price undertaking, is the contrast in their effects on the profits of the foreign firm. While that firm will always file a dumping claim if this leads to the home firm being subject to a duty, the foreign firm prefers free trade in the second period to a home firm price undertaking, since

$$\left[\frac{A}{3}\right]^2 + \left[\frac{A^* + \tau}{3}\right]^2 > \left[\frac{A}{3}\right]^2 + \left[\frac{A^*}{3}\right]^2 = \frac{1}{2}\left[\frac{A + A^*}{3}\right]^2$$

This implies that the foreign firm will never file a dumping claim if it knows that the home firm will choose the price undertaking option. Taking this into account, the second period profits when the price undertaking option is included are then, for the home firm

$$\pi_2 = \left[\frac{A}{3}\right]^2 + \left[\frac{A^* - 2DM_1}{3}\right]^2 \qquad \text{if } DM_1 < \tau$$

$$\text{and} \qquad \pi_2 = \left[\frac{A}{3}\right]^2 + \left[\frac{A^*}{3}\right]^2 \qquad \text{if } DM_1 \geq \tau$$

and for the foreign firm

$$\pi_2^* = \left[\frac{A}{3}\right]^2 + \left[\frac{A^* + DM_1}{3}\right]^2 \qquad \text{if } DM_1 < \tau$$

$$\text{and} \qquad \pi_2^* = \left[\frac{A}{3}\right]^2 + \left[\frac{A^*}{3}\right]^2 \qquad \text{if } DM_1 \geq \tau$$

There is a sense in which the first period objectives of the two firms are reversed by the price negotiation alternative. Now the home firm would prefer a first period dumping margin above the equivalent duty, as then the foreign firm will not file, while the foreign firm will prefer a dumping margin below the equivalent duty as then it can file knowing that the home firm will opt for the duty.

One can also show that the free trade dumping margin (DM_1^f) is larger than the equivalent duty over the range of market size differences for which the price undertaking is feasible. This involves solving for A when the two are equal from

$$DM_1^f = \frac{A - A^*}{3} = \frac{A^*}{2} - \left[\frac{A^{*2} + 2AA^* - A^2}{8}\right]^2 = \tau$$

and finding two solutions, $A = A^*$ and $A = 41A^*/17$. So we have $DM_1^f > \tau$ over the relevant range. If only the dumping firm behaves strategically, then it will note that the profit maximising free trade output in the first period will lead to a dumping margin that exceeds the equivalent duty and hence would lead the firm to choose the price undertaking in the second period if an AD petition were successful. The foreign firm will not petition in such circumstances, leading to the free trade output in the second period also. Hence the home firm has no incentive to vary its behaviour and free trade will continue in both periods.

When both firms behave strategically, we now have the potential for two equilibria. If $DM_1^f \geq \tau$, then the first order conditions are as for free trade, and the free trade outcome is therefore a potential first period solution over the relevant range. If $DM_1^f < \tau$, then the first order conditions are as derived in the duty only case above, and hence that equilibrium is also possible here, *as long as* the implied dumping margin (DM_1^t) is less than the equivalent duty. This is clearly true over the full range of temporary market integration. It is also true for part of the range of moderated dumping where the constraint applies to dumped sales (i.e. $x_1^* = \varepsilon$) as found by solving for A from

$$DM_1^t = \frac{18A - 25A^*}{28} = \frac{A^*}{2} - \left[\frac{A^{*2} + 2AA^* - A^2}{8}\right]^2 = \tau$$

So when $A \leq 1.42A^*$, the first period outcome under the duty only option is still an equilibrium solution. When $A > 1.42A^*$ we have $DM_1^t > \tau$, so that the price undertaking will be preferred by the dumper and no petition will be filed.

In summary, if both firms act strategically, there are two possible equilibria when market sizes are not too different (i.e. $A \leq 1.42A^*$). These are free trade in both periods and the solutions derived for the duty only case in the previous section. Over this range one can show that both firms prefer the free trade outcome, so one expects they would have no difficulty coordinating on that equilibrium. When market sizes are

less similar, free trade is the only equilibrium, despite the existence of the AD Law and the presence of dumping in the first period.

So even where the firms continue to act non-cooperatively, the addition of a price undertaking as an option, if the dumping firm prefers it, has significant implications for the equilibrium outcomes. The price undertaking and duty outcomes have profoundly different consequences for the foreign firm. While the foreign firm will always petition if a duty will be the outcome, it will never petition if this means that the home firm will negotiate to equate the prices in the second period. Anticipating this the firms are likely to coordinate on the free trade equilibrium, and hence on free trade in both periods, as the outcome they both prefer. Of course this changes if the price negotiated outcome requires the assent of the foreign firm. The foreign firm will never agree if the alternative would be the imposition of a duty, and knowing this, both firms will behave strategically as in section 5.

7. Conclusions

This paper has examined the incentives for strategic action by duopolistic competitors generated by the existence of an AD Law in the smaller market. To do this we set up a simple model of two segmented (country) markets, with linear demands differering only in their intercepts, reflecting differences in willingness to pay and acting as an indicator of country size. There were two firms, identical except for their locations (one in each market). The equilibrium generated by these actions depended on the policy regime adopted by the smaller country and the difference in market sizes.

Where the AD duty was the sole possible outcome of a successful AD petition, the incentives for strategic action by the two firms were seen to depend on the size of their second period profits, and hence on their sales in the foreign market. Starting from the free trade equilibrium, the sales for the home (dumping) firm are larger the smaller the difference in first period prices and hence the more similar the markets in size. For the foreign firm the opposite is true. Its second period profits in its domestic market were increasing in the first period price differential and thus the difference in market size. Hence our outcomes. For small differences in market size, the strategic behaviour of the dumping firm dominated and first period prices were equalised. For

large differences in market size, the strategic behaviour of the other firm dominated and the first period price difference was widened to generate the prohibitive duty in the second period. In between, the free trade dumping margin was moderated (up or down) between zero and the prohibitive value. The smaller the relative size of the market in which the dumping tales place, the greater the protection the AD law extends to the foreign firm. Indeed, for small differences in market size this firm is made worse off by the strategic behaviour induced by the law.

We then showed that all of this can change quite significantly when a price undertaking is offered as an alternative outcome to the duty. While the literature has tended to focus on the possibility that a collusive price agreement between firms can be passed off as a price undertaking by the dumping firm, here we supposed that the firms maintained their non-cooperative behaviour and asked what could be the outcomes if the choice could be made by the dumper alone, or if it required the assent of its rival. In the context of homogeneous goods, removing the dumping margin required equalising prices. This was only a feasible outcome over a range of market size differences. Within this range, both firms preferred free trade to market integration. This implied that the foreign firm would not file an AD petition where a price undertaking of this type was the likely outcome. If the consent of the foreign firm was not required for a negotiated price, free trade was shown to be the likely result. But if its consent was required, then it would never be given.

Table 1. Solutions When Both Firms Behave Strategically

	Temporary Market Integration	Temporary Market Integration $[x_1^* = \varepsilon]$	Moderated Dumping $[x_1^* = \varepsilon]$	Moderated Dumping	Prohibitive Dumping	Unconstrained Dumping
	$[1, \frac{4}{3}]$	$[\frac{4}{3}, \frac{25}{18}]$	$[\frac{25}{18}, \frac{3}{2}]$	$[\frac{3}{2}, \frac{11}{6}]$	$[\frac{11}{6}, \frac{5}{2}]$	$[\frac{5}{2}, \infty]$
p_1	$\dfrac{A+A^*}{6}$	$\dfrac{7A^*}{18}$	$\dfrac{24A-17A^*}{42}$	$\dfrac{17A-16A^*}{21}$	$\dfrac{2A+5A^*}{12}$	$\dfrac{A}{3}$
p_1^*	$\dfrac{A+A^*}{6}$	$\dfrac{7A^*}{18}$	$\dfrac{41A^*-6A}{84}$	$\dfrac{23A^*-10A}{21}$	$\dfrac{2A-A^*}{12}$	$\dfrac{A^*}{3}$
$p_1 - p_1^*$	0	0	$\dfrac{18A-25A^*}{28}$	$\dfrac{9A-13A^*}{7}$	$\dfrac{A^*}{2}$	0
x_1	$\dfrac{6A-A^*}{9}$	$\dfrac{9A-5A^*}{9}$	$\dfrac{5A^*}{6}$	$\dfrac{4A^*-A}{3}$	$\dfrac{2A+5A^*}{12}$	$\dfrac{A}{3}$
x_1^*	$\dfrac{4A^*-3A}{9}$	ε	ε	$\dfrac{2A-3A^*}{3}$	$\dfrac{2A-A^*}{12}$	$\dfrac{A^*}{3}$
y_1	$\dfrac{3A-A^*}{18}$	$\dfrac{A^*}{6}$	$\dfrac{3A-3A^*}{7}$	$\dfrac{11A-12A^*}{21}$	$\dfrac{4A-5A^*}{6}$	$\dfrac{A}{3}$
y_1^*	$\dfrac{3A+7A^*}{18}$	$\dfrac{11A^*}{18}$	$\dfrac{6A-43A^*}{84}$	$\dfrac{19A^*-4A}{21}$	$\dfrac{7A^*-2A}{6}$	$\dfrac{A^*}{3}$
p_2^*	$\dfrac{A^*}{3}$	$\dfrac{A^*}{3}$	$\dfrac{6A+A^*}{28}$	$\dfrac{3A-2A^*}{7}$	$\dfrac{A^*}{2}$	$\dfrac{A^*}{2}$
x_2^*	$\dfrac{A^*}{3}$	$\dfrac{A^*}{3}$	$\dfrac{13A^*-6A}{14}$	$\dfrac{11A^*-6A}{7}$	0	0
y_2^*	$\dfrac{A^*}{3}$	$\dfrac{A^*}{3}$	$\dfrac{6A+A^*}{28}$	$\dfrac{3A-2A^*}{7}$	$\dfrac{A^*}{2}$	$\dfrac{A^*}{2}$
λ	$\dfrac{13A^*-9A}{18}$	$\dfrac{25A^*-18A}{18}$	0	0	0	0
η	0	$\dfrac{3A-4A^*}{3}$	$\dfrac{3A^*-2A}{4}$	0	0	0
γ	0	0	0	0	$\dfrac{6A-11A^*}{12}$	NA

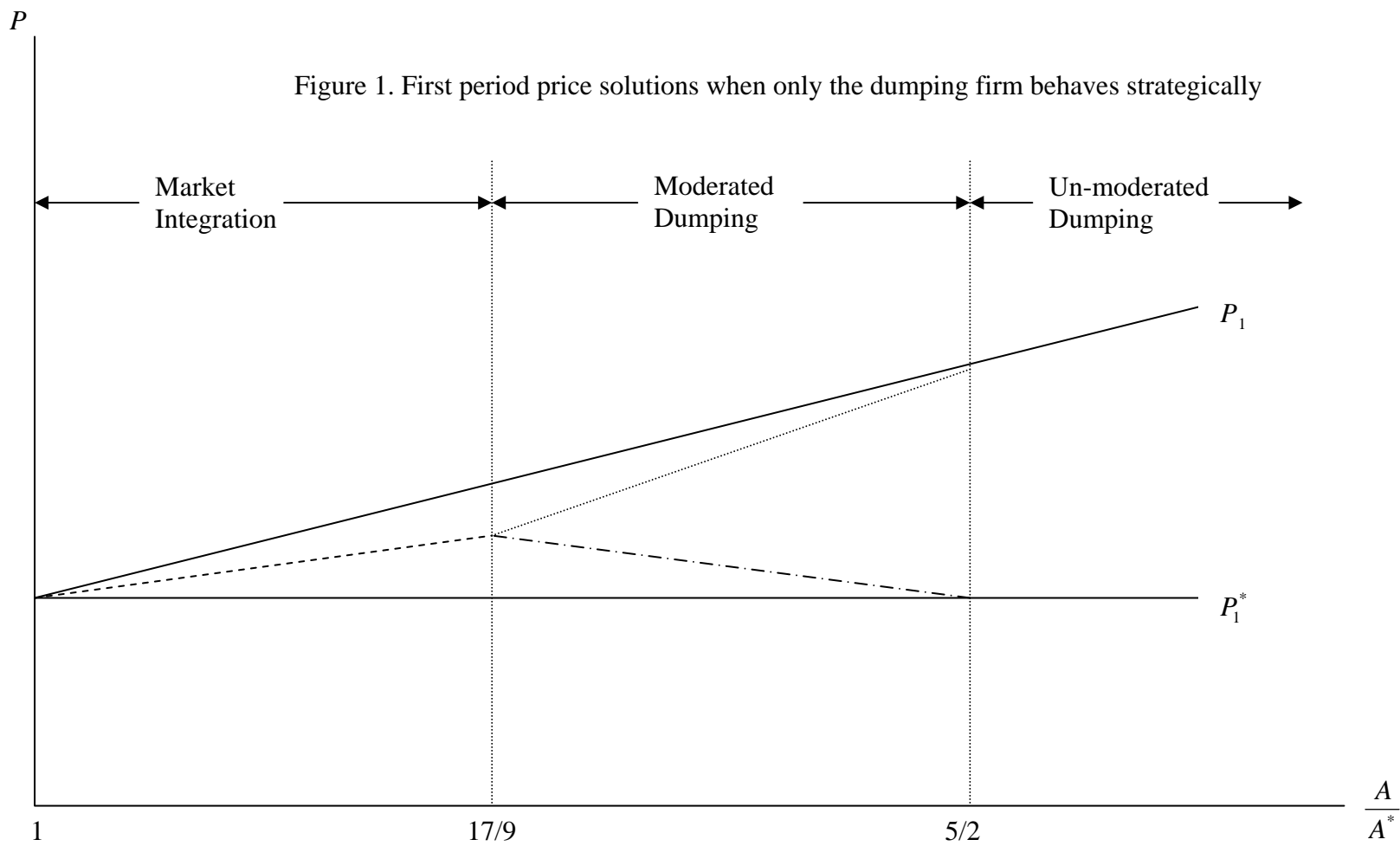Note. For convenience $\varepsilon \approx 0$ is used in this Table, except for where $x_1^* = \varepsilon$
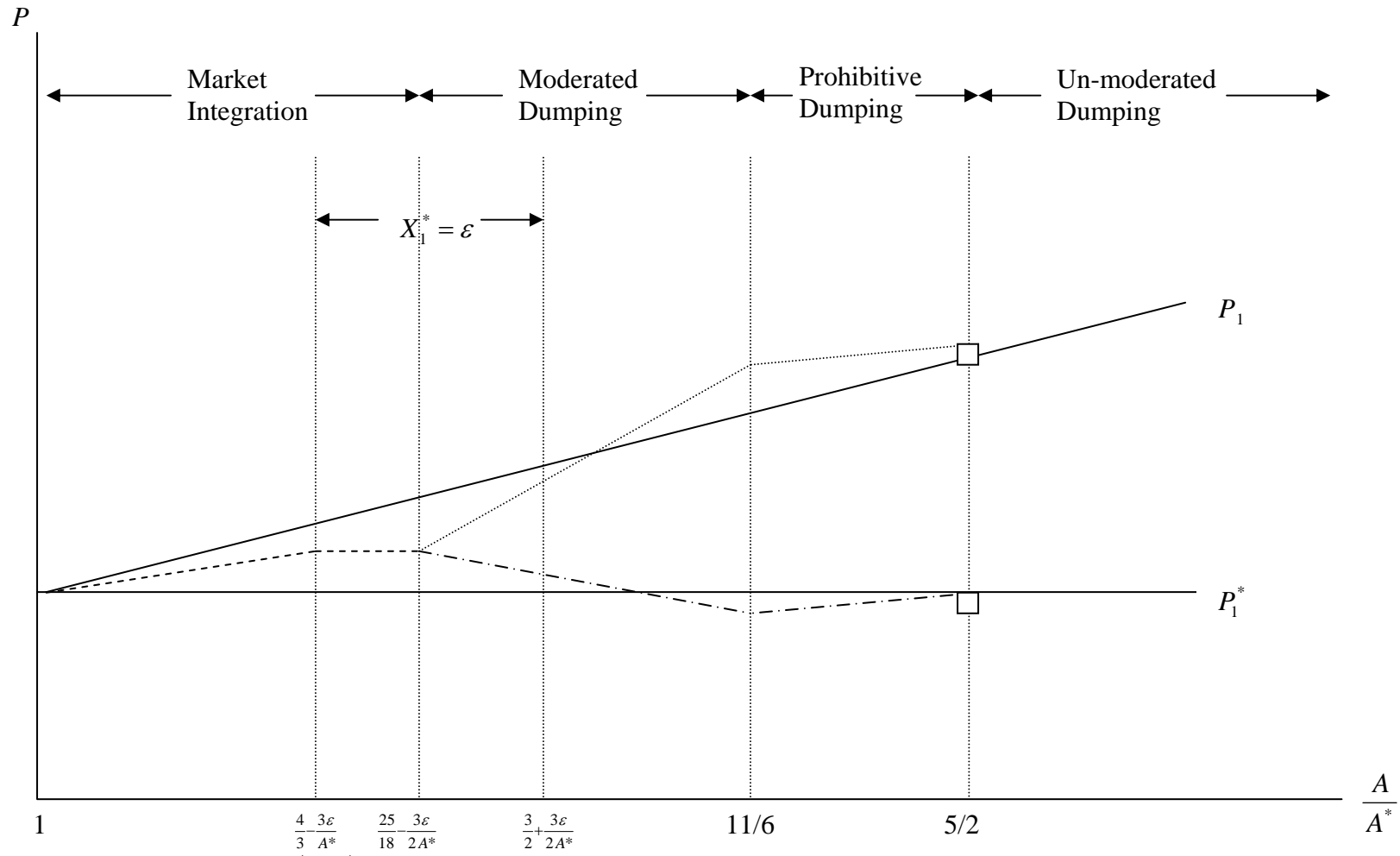
P

Figure 1. First period price solutions when only the dumping firm behaves strategically

Market
Integration

Moderated
Dumping

Un-moderated
Dumping

P_1

P_1^*

1

17/9

5/2

$\dfrac{A}{A^*}$

Figure 2. First period price solutions when both firms behave strategically

P

Market
Integration

Moderated
Dumping

Prohibitive
Dumping

Un-moderated
Dumping

$X_1^* = \varepsilon$

P_1

P_1^*

$\dfrac{A}{A^*}$

1

$\dfrac{4}{3} - \dfrac{3\varepsilon}{A^*}$

$\dfrac{25}{18} - \dfrac{3\varepsilon}{2A^*}$

$\dfrac{3}{2} + \dfrac{3\varepsilon}{2A^*}$

11/6

5/2

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