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***Antidumping Regulation and the Byrd Amendment: Does Revenue
Redistribution Reduce Dumping?***

by

Rod Falvey and Sarut Wittayarungruangsi

The Authors

Rod Falvey is a Professor of International Economics and an Internal Fellow of the Leverhulme Centre for Research on Globalisation and Economic Policy (GEP), University of Nottingham.

Sarut Wittayarungruang Sri is a Research Fellow in GEP.

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Abstract

While the brief experiment with redistributing antidumping duty revenue to import competing firms (via the Byrd Amendment) will soon be over, interest remains in how such a mechanism affects the strategic incentives of the firms involved. In this paper we use a simple two-period duopoly model where two countries differ only in market size to evaluate these incentives. An antidumping law provides an incentive for both firms to adjust sales so as to shift the dumping margin in their favor, and revenue redistribution strengthens this incentive for the filing firm. The outcome is that dumping is more prevalent and that the dumping margin is larger, except in some cases where the duty would otherwise be prohibitive. The profits of the filing firm are generally, but not always, higher, and the profits of the dumper are generally, but not always, lower. Consumers gain in one country and lose in the other, with the gainers and losers depending on the market size difference.

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Outline

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2. *Dumping in Free Trade*
3. *Antidumping*
4. *Welfare Effects*
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Non-Technical Summary

In 2000 the US Antidumping Law was amended so that the duty revenue was redistributed to those domestic producers who supported the antidumping petition. This legislation, commonly referred to as the Byrd Amendment (BA), gave domestic firms direct relief in addition to the benefits they indirectly received from the imposition of AD duties on their foreign competitors. A finding that such redistribution violated WTO Antidumping provisions in 2002 eventually led to its repeal. Despite this, the BA retains interest, particularly because of the incentives it provides to import-competing firms. Does transferring the duty revenue in this way increase or reduce the incidence of dumping and the extent of the dumping margin? Does a filing firm necessarily have higher profits? What happens to the profits of the dumper and to consumer welfare?

We investigate these issues in a simple model of duopolistic firms selling in each other's segmented markets. In free trade the firm from the larger market dumps in the smaller, providing incentives for both firms to manipulate their sales in both markets to influence any future antidumping duty. For small (large) differences in market size, the dumping (filing) firm's strategic actions dominate, and the dumping margin is reduced (increased) relative to free trade. We show that adding a redistributive mechanism strengthens the strategic incentives of the filing firm, particularly when the difference in market sizes is small. Now that firm always dominates the outcome; hence the dumping margin is widened compared to free trade, and the difference is greatest when the two markets are similar in size and becomes smaller as the market size difference grows. The filing firm has higher profits (including the revenue) under the BA, except when the markets are similar in size or when the duty exceeds the revenue maximum. The dumping firm generally has lower profits. Whether consumers gain or lose from the BA depends on what happens to prices in their respective markets. Generally consumers in the dumper's domestic market gain (lose) where market size differences are relatively large (small), and the opposite holds for consumers in the filing firm's domestic market. The effects on aggregate welfare tend to reflect the consumer surplus effects.

In summary, we examine the Byrd Amendment in a context that highlights the strong incentive effect that revenue redistribution implies for the filing firm, by reinforcing its interest that dumping be found and that the dumping margin is large, at least up to the revenue maximizing level. Does revenue redistribution reduce dumping? Clearly not.

1: Introduction

In 2000, Congress amended the US Antidumping Law so that the duty revenue was redistributed to those domestic producers who supported the petition that led to a finding of dumping, material injury to the domestic industry and imposition of an Antidumping (AD) duty. This legislation was formally known as the Continued Dumping and Subsidy Offset Act (CDSOA), but commonly referred to as the Byrd Amendment (BA). The main objective in modifying the Law in this way was to give domestic firms harmed by dumped imports direct relief¹ in addition to the benefits they indirectly received from the imposition of AD duties on their foreign competitors. Other countries objected, however, and in 2002 a WTO dispute panel found such redistribution in violation of the WTO Antidumping provisions². The Law has subsequently been repealed, although this does not take effect until October 2007.

Despite its seeming demise, the BA retains interest, particularly because of the incentives it provides to import-competing firms. Is transferring the duty revenue in this way likely to increase or reduce the incidence of dumping and the extent of the dumping margin? What are its welfare effects? Does a filing firm necessarily have higher profits (including the revenue) under the BA? What are the consequences for the profits of the dumper? How do consumers fare? We investigate these issues as a straightforward extension of a simple model that we have used elsewhere³ to investigate the links between dumping and market size. In that paper we considered 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. Firms had identical costs, but were located in countries with different market sizes (as a result of different maximum willingness to pay). In free trade the firm from the larger market dumped in the other market, providing incentives for both firms to manipulate their sales in the two markets to influence any future antidumping duty. It was shown that for small (large) differences in market size, the dumping (filing) firm's strategic actions dominate, and the dumping margin is reduced (increased) relative to free trade⁴.

¹The sums redistributed have been substantial - over US\$230 million in 2001; US\$330 million in 2002; US\$190 million in 2003; and US\$284 million in 2004. See Collie and Vandebussche (2006).

²Schmitz and Seale (2004) and Olson and Liebman (2004) provide details of the birth and death of the Byrd Amendment.

³In Falvey and Wittayarungruang (2006).

The incentives for strategic behavior that arise due to the presence of AD laws have received some attention in the literature. Typically this has involved consideration of two identical markets where dumping can be generated if say a monopolist in the home market competes with a foreign firm in the foreign market. The more competitive foreign market will then have the lower equilibrium price. If AD actions prevent price discrimination, the home firm exports less (Webb, 1992). In a two period version of the model, where dumping 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) shows that, even if it could export it may be in the interests of the foreign firm to commit not to export to the home market, when the home firm's ability to price discriminate is curtailed by the foreign country's AD Law.

The BA has been subject to limited academic analysis to date. The issue of whether it will lead to higher duties has received some attention, but there has been no analysis of the implications of revenue redistribution for the strategic incentives of the firms during the dumping phase⁵. Schmitz and Seale (2004) use a competitive partial equilibrium model to show that the “optimal anti-dumping tariff” (which maximizes the sum of producer surplus and revenue) exceeds the optimal tariff (which maximizes the sum of producer surplus, tariff revenue and consumer surplus), and the revenue maximizing tariff. Collie and Vandebussche (2006) are interested in the possibility that a transfer of revenue could result in lower duties and higher welfare in the dumped market. Their context is a duty-setting government with a political economy objective function that puts a higher weight on producer interests (profits) than on consumer interests or tax revenue. They remind us that the welfare maximising tariff can exceed the revenue maximizing tariff in a Cournot oligopoly, and then show that transferring the duty revenue from the government to firms may result in a lower tariff, if this generates more revenue and the weight on producer interests in the government objective function exceeds a critical value. These results suggest that the duty outcomes will depend on market structure. Evenett (2006) notes the

⁴ These results are briefly reviewed in Section 3.1 below.

⁵ Empirical analysis suggests that firms will respond to the change in incentives. Olson and Liebman (2004) find links among firms' campaign contributions, Congressional behaviour and firms' revenue receipts relating to the BA. Olson (2004), provides evidence of increases in AD filings, at least by firms familiar with AD

considerable bureaucratic discretion available in the calculation of the foreign market value (FMV) that import prices will be compared to in order to calculate duties owed after an AD order is put in place. He considers the extreme case where this value is determined independently of the dumping firm's pricing behaviour or cost levels, and then examines how the BA provisions and uncertainty over the FMV act independently and collectively to determine the equilibrium outcomes under an AD order. He finds that sometimes dumping is eliminated, sometimes the profits of importing firms increase and sometimes even the total value of imports increase.

In outline the remainder of this paper is as follows. In section 2, we set up a model without AD legislation, solve for the equilibrium outcome, and identify the conditions under which one firm dumps in the other country. Section 3 analyses the incentives AD policy with and without the BA provides for competing firms. We show that adding a redistributive mechanism strengthens the strategic incentives of the filing firm, particularly when the difference in market sizes is small. Now that firm always dominates the outcome; hence the dumping margin is widened compared to free trade. The difference between the free trade dumping margin and that with AD and the revenue redistribution is greatest when the two markets are similar in size and becomes smaller as the market size difference grows. Section 4 considers the welfare effects, where we find that the filing firm has higher profits (including the revenue) under the BA, except when the markets are similar in size or when the duty exceeds the revenue maximum. The dumping firm generally has lower profits. Whether consumers gain or lose from the BA depends on what happens to prices in their respective markets. Generally consumers in the dumper's domestic market gain (lose) where market size differences are relatively large (small), and the opposite holds for consumers in the filing firm's domestic market. The effects on aggregate welfare tend to reflect the consumer surplus effects. Section 5 concludes.

2: Dumping in Free Trade

In this section, we set up a simple model and show the conditions under which one firm dumps onto the other country. We will then identify the effects of firm strategic actions on equilibrium outcomes in the next section. Let there be two countries, home and foreign.

procedures, and increases in the proportion of firms participating in AD actions after the BA. The latter she attributes to a reduction in the free rider problem.

Each has one firm. Both firms produce a homogeneous product and supply both markets. The markets are segmented so that there is no possibility of arbitraging by other economic agents. The firms are involved in a Cournot competition. For simplicity, both firms incur zero cost of production and there are no transport costs.

We assume linear demand in both countries. The demand functions for the home and foreign country are, respectively

$$D = A - p \quad \text{and} \quad D^* = A^* - p^* \quad (1)$$

where D denotes home demand, A denotes maximum willingness to pay and p denotes the home price. The corresponding variables for the foreign country are indicated by an asterisk. Considering a representative period, the profits function for two firms can be written as

$$\pi = px + p^*x^* \quad (2)$$

$$\pi^* = py + p^*y^* \quad (3)$$

where x (y) denotes home (foreign) firm output sold in the home market, and x^* (y^*) denote home (foreign) firm output sold in the foreign market. Differentiating (2) and (3) with respect to output quantities yields the following first order conditions

$$\frac{\partial \pi}{\partial x} = p - x = 0; \frac{\partial \pi}{\partial x^*} = p^* - x^* = 0; \frac{\partial \pi^*}{\partial y} = p - y = 0; \frac{\partial \pi^*}{\partial y^*} = p^* - y^* = 0$$

These can in turn be solved for equilibrium outputs and prices

$$x = y = \frac{A}{3} = p; \quad x^* = y^* = \frac{A^*}{3} = p^* \quad (4)$$

The profits for the home and foreign firm are then

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

In free trade, both firms sell the same amount in each market (but more in the larger market) and earn the same total profits. As 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 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). Since the price is higher in this market, this 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 (DM), in this case the price difference, will depend on the difference in market size between the two markets (e.g. in free trade $DM = p - p^* = (A - A^*)/3$). Note that the two firms only differ in terms of their locations. The 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.

[Figure 1 here]

In Figure 1, we plot the first period price outcomes against the relative market size, with p^F and p^{*F} denoting home and foreign free trade prices respectively. Without loss of generality, we assume that the home market is larger (i.e. $A > A^*$) and fix A^* but consider different values of A ($A \geq A^*$). Then p^* does not change as A increases (a horizontal line), while p increases in the same proportion as A . The vertical distance between the two lines is the (free trade) dumping margin. The larger the difference in market size, the larger the dumping margin.

3: Antidumping

Now consider a dynamic version of our model. We assume two periods, and for simplicity, that the demand functions are as above in both periods and agents do not discount the future. 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 (period 1) it will be subject to a tax on its future (period 2) sales in the foreign market equal to the dumping margin (price difference) in the present. In addition, the foreign AD legislation may provide that the filing firm also receives any revenue collected from the AD duty (the Byrd Amendment)⁶. Our specific interest is in how this revenue redistribution affects the equilibrium outcomes.

We begin by determining the second period equilibrium when there is an AD duty of t in place. The second period profit-maximising problems of the two firms become, respectively

⁶ In practice, the government transfers all revenue to the qualifying producers in proportion to their qualifying expenditures. These are quite broad, including manufacturing facilities, equipment, R&D, health care benefits, pension benefits and working capital.

$$\max_{x_2, x_2^*} \pi_2 = p_2 x_2 + [p_2^* - t] x_2^* \quad (5)$$

$$\max_{y_2, y_2^*} \pi_2^* = p_2 y_2 + p_2^* y_2^* + x_2^* t \quad (6)$$

We can be solved for the second-period outputs and prices as

$$x_2 = y_2 = \frac{A}{3} = p_2; \quad x_2^* = \frac{[A^* - 2t]}{3}; \quad y_2^* = \frac{[A^* + t]}{3} = p_2^* \quad (7)$$

While profits are

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

In the first period, both firms maximise their lifetime profits, taking into account the future duty and any redistribution of duty revenue. The firms understand that their sales in the current period can affect the future duty and therefore their profits in both. Since our primary objective is to illustrate, as simply as possible, the role of the BA in determining the equilibrium outcomes when both firms behave strategically, we restrict attention to pure strategy equilibria. This simplifies the analysis considerably, but still leaves us with some constraints to be dealt with. 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 (i.e. a subsidy) nor act effectively above the prohibitive level. 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 market size. To encompass this feature we therefore constrain

$x_1^* \geq \varepsilon$ where ε is some arbitrarily small positive amount⁷. 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' firm (since the filing firm has no incentive to take actions that reduce the duty).

The second period equilibrium outcomes are as in (7) 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 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 $A > 5A^*/2$.

The respective profit maximisation problems for the home and foreign firm are then

$$\max_{x_1, x_1^*} \pi = p_1 x_1 + p_1^* x_1^* + \pi_2 \quad \text{s.t. } x_1^* \geq \varepsilon \quad \text{and} \quad p_1 - p_1^* \geq 0$$

$$\max_{y_1, y_1^*} \pi^* = p_1 y_1 + p_1^* y_1^* + \pi_2^* \quad \text{s.t. } p_1 - p_1^* \leq \frac{A^*}{2}$$

We write the Lagrangean functions for the home and foreign firm as

$$\max_{x_1, x_1^*} \Pi = p_1 x_1 + p_1^* x_1^* + \left[\frac{A}{3} \right]^2 + \left[\frac{A^* - 2(p_1 - p_1^*)}{3} \right]^2 + \lambda [p_1 - p_1^*] + \eta [x_1^* - \varepsilon] \quad (8)$$

$$\begin{aligned} \max_{y_1, y_1^*} \Pi^* = p_1 y_1 + p_1^* y_1^* + \left[\frac{A}{3} \right]^2 + \left[\frac{A + (p_1 - p_1^*)}{3} \right]^2 \\ + \left[\frac{(p_1 - p_1^*) \{A^* - 2(p_1 - p_1^*)\}}{3} \right] + \gamma \left[\frac{A^*}{2} - (p_1 - p_1^*) \right] \end{aligned} \quad (9)$$

⁷ Details are available in an Appendix from the authors. Note 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

Differentiating (8) and (9) with respect to first-period outputs yield the following

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

$$\frac{\partial \Pi}{\partial x_1^*} = \{p_1^* - x_1^*\} - \left\{\frac{4}{9}[A^* - 2(p_1 - p_1^*)]\right\} + \lambda + \eta \quad (11)$$

$$\frac{\partial \Pi^*}{\partial y_1} = \{p_1 - y_1\} - \left\{\frac{2}{9}[A^* + (p_1 - p_1^*)]\right\} - \left\{\frac{1}{3}[A^* - 4(p_1 - p_1^*)]\right\} + \gamma \quad (12)$$

$$\frac{\partial \Pi^*}{\partial y_1^*} = p_1^* - y_1^* + \left\{\frac{2}{9}[A^* + (p_1 - p_1^*)]\right\} + \left\{\frac{1}{3}[A^* - 4(p_1 - p_1^*)]\right\} - \gamma \quad (13)$$

In the dumping firm's derivatives ((10) and (11)), we decompose the expressions on the right hand side into two terms. The first is the corresponding expression in free trade. The second shows the incentive for strategic behaviour produced by the existence of the foreign AD regulation. In the derivatives for the filing firm ((12) and (13)), we have divided the strategic incentives into two parts, the second of which only appears if the BA applies. The presence of the BA has no direct impact on the dumping firm's incentive to behave strategically.

Before obtaining the explicit solutions, it is informative to consider what these derivatives reveal about the firms' incentives and the strengths of those incentives when the threat of AD action exists. As long as the dumping margin is below the prohibitive level (i.e. $p_1 - p_1^* < A^*/2$) the home firm has an incentive to sell more in its domestic market and to export less. This incentive is stronger, the larger the second period sales (i.e. the smaller the AD duty). The strategic effects in (10) and (11) are of equal magnitude but opposite sign, indicating that rather than changing total output, the firm would adjust its sales between markets⁸.

For the foreign firm, the AD incentives can have two components. In the absence of the BA, the foreign firm also has an incentive to sell more in its domestic market and to export less. This incentive becomes larger as the duty increases and its second period profits increase. Adding the BA reinforces this incentive, up to the point where the implied duty reaches the revenue maximum (i.e. $p_1 - p_1^* = A^*/4$). From that point on the presence of the

that involves this firm abandoning the foreign market.

BA reduces the strategic incentive of the foreign firm. Again note that, as for the home firm, the strategic effects in (12) and (13) are of equal magnitude but opposite sign, indicating a tendency to switch sales rather than changing total output.

Each firm's strategic action counters the other's. Which firm's behaviour dominates depends on the relative market size. If we suppose that the BA does not apply and substitute the free-trade dumping margin ($p_1 - p_1^* = (A - A^*)/3$), into the strategic incentives for sales in the home market we find that, for the home firm

$$\frac{4}{9}[A^* - 2(p_1 - p_1^*)] = \frac{4}{27}[5A^* - 2A]$$

while for the foreign firm

$$\frac{2}{9}[A^* + (p_1 - p_1^*)] = \frac{2}{27}[2A^* + A]$$

As noted above, given the size of the foreign market, increases in the size of the home market increase the free trade dumping margin, which reduces the strategic incentive of the home firm, but strengthens that of the foreign firm. When $A = 8A^*/5$, the firm's strategic incentives are offsetting. This suggests that, for small differences in market sizes, we should expect to see the home firm's strategic actions dominate the equilibrium outcome, and observe a smaller dumping margin than in free trade. For larger market size differences, it is likely that the foreign firm's actions that dominate, leading to a larger dumping margin than in free trade.

When the BA applies, the two parts of the strategic incentive of the foreign firm are combined, and we have

$$\frac{\partial \Pi^*}{\partial y_1} = \{p_1 - y_1\} - \left\{ \frac{5}{9}[A^* - 2(p_1 - p_1^*)] \right\} + \gamma \quad (14)$$

$$\frac{\partial \Pi^*}{\partial y_1^*} = \{p_1^* - y_1^*\} + \left\{ \frac{5}{9}[A^* - 2(p_1 - p_1^*)] \right\} - \gamma \quad (15)$$

A comparison of (14) and (15) with (10) and (11) is particularly revealing of the strategic incentives facing the two firm. They are opposite in sign and that of the foreign firm is stronger over the entire range of non-prohibitive dumping margins. It is expected that this dominance of the foreign firm's strategic actions will be reflected in a higher dumping

⁸ This is true as long as exports are not at their minimum level (i.e. as long as $x_1^* > \varepsilon$ and $\eta = 0$).

margin in the first period equilibrium. But note that both firms' strategic incentives fall as the difference in market sizes becomes larger.

The following subsections, present explicit solutions for these two cases. We begin by considering the AD Law without the BA.

3.1: Antidumping without the Byrd Amendment

As discussed above, compared with free trade, the dumping firm has an incentive towards higher domestic sales and smaller exports, in the first period, and the filing firm's incentives are to do the opposite. Before discussing the outcomes when both firms behave strategically to influence the duty size, we first look at what the outcomes would be if only one of the firms behaved strategically⁹. Figure 1 also illustrates the first period price outcomes (p_h^A, p_h^{*A}) when only the home (dumping) firm behaves strategically as compared to free trade. It is seen that the dumping margin is always lower than in free trade up to the point where the duty becomes prohibitive $A = 5A^*/2$. At larger market size differences, the dumping firm sells as in free trade in the first period and is taxed out of the foreign market in the second. For small differences in market size ($A \leq 17A^*/9$), the outcome is *temporary market integration*, where the dumping margin is eliminated ($p_1 = p_1^*$). When the difference in market sizes gets larger, we have *moderated dumping*, where there is a positive dumping margin, but it is smaller than in free trade. Where this is the case, the dumping firm is subject to an AD duty in the second period.

If only the foreign firm acts strategically, the dumping margin is always larger than in free trade. Again the price outcomes (p_f^A, p_f^{*A}) are shown in Figure 1. When $A < 11A^*/6$ we have *aggravated dumping*, where the dumping margin has increased but the implied duty is not prohibitive. For larger market size differences, the implied duty is prohibitive¹⁰.

⁹ The other firm continues to act as a Cournot competitor in each period, ignoring the links between periods.

¹⁰ The constraint that $p_1 - p_1^* \leq A^*/2$ is binding on the foreign firm over the range $11A^*/6 \leq A \leq 5A^*/2$.

In Figure 2, we plot the first period price outcomes (p^A, p^{*A}) derived from the case where both firms behave strategically¹¹. The full solutions are shown in Appendix Table 1. As expected, for small differences in market size, the dumping firm's actions dominate the outcomes. If $A < 25A^*/18$ we have temporary market integration and a zero dumping margin. Moderated dumping is observed when $25A^*/18 < A < 8A^*/5$. But after this point the filing firm's strategic actions begin to dominate and the dumping margin is higher than in free trade. The duty becomes prohibitive at $A = 11A^*/6$ which is the same point as when only the foreign firm behaves strategically.

[Figure 2 here]

3.2: Antidumping with the Byrd Amendment

As seen above, the addition of the BA has no effect on the strategic incentives faced by the home firm. But the behavior of the foreign firm will be affected by having any duty revenue redistributed in its favor¹². The likely influences are shown by comparing the cases where only the foreign firm behaves strategically, with and without the BA. In Figure 3, p_f^A, p_f^{*A} are the price outcomes without the BA (as in Figure 1) and p_f^B, p_f^{*B} are the price outcomes with the BA. As one would expect the dumping margin is larger than in free trade in both cases.

[Figure 3 here]

The influence of the revenue redistribution on the foreign firm's behaviour is clear from Figure 3. When markets are similar in size, the revenue provides an incentive for greater strategic action by the foreign firm and the equilibrium dumping margin (DM_1^B) is larger than it would be without the BA (DM_1^A) and always larger than in free trade (DM_1^F). Since

$$DM_1^B - DM_1^F = \frac{10[5A^* - 2A]}{141}; \quad DM_1^B - DM_1^A = \frac{43A^* - 36A}{1081}$$

¹¹ Note that the constraints discussed earlier are binding over some ranges of market size differences as indicated by the equilibria shown in Table 1.

¹² Revenue is increasing in the duty until $t = A^*/4$, while second period profits are always increasing until the duty becomes prohibitive. The total benefits to the foreign firm are increasing in the duty all the way to the prohibitive level.

we see that the difference between DM_1^B and DM_1^F declines as the difference in market sizes becomes larger (i.e. as A becomes larger). The dumping margin eventually falls below what it would be without the BA once the revenue starts to decline with increases in market size (the equilibrium dumping margins are equal with and without the BA when $A = 43A^*/36$). Further, one can show that

$$DM_1^A - DM_1^F = \frac{4[A + 2A^*]}{69}$$

Thus strategic action by the foreign firm only, in the absence of the BA, results in ever larger dumping margins relative to free trade as the difference in market size increases. Note further, that in the absence of the BA the dumping margin reaches the prohibitive level at a smaller market size difference ($A = 11A^*/6$) than it does with the BA ($A = 5A^*/2$, which is the same as in free trade).

Finally we are in a position to consider and interpret the case where both firms behave strategically. Figure 4 plots the first period prices and compares them with the case when the BA is absent. The full solutions are provided in Appendix Table 2.

[Figure 4 here]

The broad pattern of outcomes is as predicted by the earlier results¹³. If the Byrd Amendment applies, then the foreign firm's strategic incentives dominate for all market size differences. The result is an increased dumping margin, relative to free trade, though the difference declines as the market size difference becomes larger. The comparison with and without the BA is also revealing. If revenue is not redistributed, then the AD Law actually eliminates dumping for small market size differences and moderates it over an additional range. It is only when the market size difference becomes so large that the foreign firm's strategic incentives dominate that the AD Law leads to an increased dumping margin. Interestingly this pattern is reversed once the BA is added. Then there is no range of temporary market integration or moderated dumping. But once the difference in market sizes is large enough, so that we are in the range where the foreign firm's strategic actions dominate even without the BA, then the revenue redistribution will result in a reduced

¹³ Again there are ranges of market size differences where the constraints specified in (8) and (9) apply to the relevant firms. These are indicated in Appendix Table 2. The most striking outcome is that when market sizes are very similar and the equilibrium under the Byrd Amendment results in prices in *both* markets being lower than in free trade. This is a heavily constrained equilibrium, however, with almost no trade (i.e.

$x_1^* = \varepsilon$ and $y_1 = 0$).

dumping margin as the decline in revenue as the duty increases tempers the foreign firm's strategic actions. Only over this range can the BA be said to "discourage" dumping, even then only relative to the outcome without revenue redistribution and because of the incentive it provides to the foreign firm – not the dumper. The dumping margin is always higher than in free trade.

4: Welfare effects

It seems that revenue redistribution is unlikely to reduce instances of dumping, and indeed may increase or reduce the dumping margin, depending on relative market sizes. The more similar the markets are in size, the more likely the BA is to lead to an outcome of aggravated dumping, because of the strategic behavior it induces. Now we compare how the firms have fared under the two scenarios. Does the BA "punish" the dumping firm, in the sense that its profits are lower than they otherwise would be? Does it "support" the filing firm through the same channel? Since the strategic behavior induced by the AD legislation in either form has quite dramatic effects on equilibrium prices in the two markets in the first period, the implications for consumer surplus and aggregate welfare are also likely to be significant. In the interests of brevity, we restrict attention to the broad welfare outcomes rather than attempting a comprehensive discussion of each of the regimes identified in Tables 1 and 2. Profits, consumer surplus and welfare are continuous, though nonlinear, functions of market size differences, where the exact functional relationship depends on the regime in operation.

4.1. Profits

We begin by considering the foreign firm's profits, since political economy considerations suggest that supporting these profits is likely to be an important objective of the AD Law and any amendments to it. Since the BA gives the foreign firm the duty revenue in the second period, one might expect that its profits in that period at least are higher with the BA than without. While this is true for small differences in market size, recall that these same revenue considerations induce the foreign firm to be less aggressive in the first period for market size differences where the duty would already be significant, implying a lower equilibrium duty and in fact lower foreign firm profits in the second period once the market difference becomes large enough. In the first period the foreign firm is induced to switch sales to the foreign market. For small market size differences the BA induces the foreign

firm to act so aggressively as to drive up an otherwise small (or indeed nonexistent) dumping margin, reducing the foreign market price and its first period profits in the process. But when market size differences become sufficiently large its aggression is tempered. The net results for the foreign firm's profits are shown in Figure 5. Its profits are higher under the BA, except where markets are very similar in size (and we have the outcome where prices in both markets are lower in the first period) and where market size differences are large.

The difference in outcomes for the home firm's profits is also shown in Figure 5. Again this reflects the combination of outcomes from the two periods. Recall that the home firm has been induced to switch sales to its domestic market. The home firm's profits are lower in the first period under the BA for small market size differences and for large market size differences, because in each case the price in the home market is lower under the BA. Its second period profits are lower under the BA, except for large market size differences, where duty revenue considerations induce the foreign firm to act less aggressively, so that the duty is lower under the BA and the home firm profits in the foreign market are higher. Combining these we get the outcomes shown in Figure 5. The home firm is worse off under the BA for small and large market size differences (in the latter case the loss of first period profits outweighs the gain in the second period). But there is an interrupted intermediate range where the home firm has slightly higher profits under the BA. These correspond to regimes where the gain in the first period outweighs the loss in the second¹⁴.

Overall, both firms lose under the BA for small and large market size differences. The foreign firm gains in the intermediate range, where the home firm has ranges of (small) gains and losses. There are market size differences for which both firms gain, but in general the foreign firm is more likely to gain and has the larger gains.

4.2. Consumer Surplus

The general pattern of differences in consumer surplus in the first period can be inferred from the price schedules in Figure 4. Foreign consumers face lower prices under the BA as long as market size differences are relatively small, and higher prices if market size

¹⁴ The difference in the home firm's profits in each of the periods are plotted in Appendix Figure A1. There we see clear losses in both periods for small market size differences, and for larger differences gains in one period and losses in the other.

differences are larger. Conversely in the second period, foreign consumers face higher prices when market sizes are relatively small, and lower prices when they are large under the BA. The net result, shown in Figure 6 shows foreign consumer surplus is higher under the BA as long as markets are similar in size and is lower otherwise. The differences in the first period dominate.

Home consumers are unaffected in the second period. From the price differences in Figure 7 we see that home consumers face lower prices under the BA when market sizes are very similar and when they are very different. In the intermediate range they face higher prices. The difference in consumer surplus reflects this. Overall both groups of consumers gain if market size differences are small and one group gains and the other loses when market size differences are larger.

4.2. Aggregate Welfare

Aggregate welfare in the foreign country is the sum of foreign consumer surplus, foreign firm profits and duty revenue (where the latter two are combined when the BA is in effect). The difference in foreign welfare is shown in Figure 7, and is higher under the BA as long as the markets are not too different in size, when both foreign firm profits and consumer surplus are lower. The opposite holds for aggregate home welfare, which is higher (lower) under the BA when the foreign welfare is lower (higher). From an aggregate welfare perspective the trading partners clearly have opposing interests in whether revenue should be redistributed.

5: Summary and Conclusions

This paper has examined the effects of revenue redistribution on the behavior of firms engaged in an AD case, and the consequences for the market outcomes. To do this, we set up a simple model of two segmented national markets, differing only in terms of market size. There were two firms, one located in each country, producing identical goods and selling in both markets. The free trade equilibrium then has the firm located in the country with a larger market dumping onto the other. When the AD policy was implemented, the equilibrium outcome depended on the difference in market sizes. We considered first the case without the BA. The two firms had different incentives. The dumping firm attempted

to reduce the dumping margin by switching sales between national markets while the other firm performed the opposite action. The outcome was dominated by the dumping firm when the market size difference was small, and we saw a reduced dumping margin relative to free trade. But when the market sizes differed more, it was the other firm that dominated the outcome and then the dumping margin was increased.

The addition of revenue redistribution (via the Byrd Amendment) in the second period influenced the incentives facing the filing firm in the first period, but those of the dumping firm were unchanged. Now the strategic behavior of the filing firm always dominated the outcome. This resulted in a higher dumping margin relative to free trade, and relative to AD without the BA, except for large differences in market size where revenue considerations lead to a smaller dumping margin (but still greater than in free trade). Taking into account the strategic incentives that the BA provides, we conclude that it is likely to increase the incidence of dumping and the extent of the dumping margin. The best one can claim is that, compared to the situation in which the duty revenue is not redistributed, the duty is less likely to be prohibitive.

The welfare effects of revenue redistribution in this model are an aggregate of changes in the two periods. In broad terms, the foreign firm sacrifices first period profits to increase the dumping margin, and then benefits from higher profits and the revenue in the second period. The BA gives higher profits for the foreign firm, except where market size differences are small (and its quest for a higher dumping margin results in lower prices in both markets in the first period), and where market size differences are relatively large (and it becomes more interested in maintaining its duty revenue income). The dumping firm has lower profits under the BA, except for an intermediate range of market size differences where it can have small gains. We would generally expect exporting firms to oppose revenue redistribution of this form.

Consumers in the two countries have generally opposing interests, except where the market size difference is small and consumers in both countries gain from lower prices. Otherwise home consumers prefer the BA when market size differences are larger and their first period prices are lower, and foreign consumers prefer the BA when market size differences are smaller and their first period prices are lower. When these profit and consumer surplus effects are combined, the effects of the BA on aggregate welfare are clear cut. The foreign

country gains if market size differences are small and the home country gains if market size differences are large.

Clearly we have examined the BA in a very specific context. This context has highlighted the strong incentive effect that revenue redistribution implies for the filing firm and that this can have a significant impact on the equilibrium outcomes. Redistributing the AD duty revenue to the import-competing firms reinforces its interest that dumping be found and that the dumping margin is large, at least up to the revenue maximizing level. It acts more aggressively as a consequence leading to a larger dumping margin in the first period, through lower foreign prices and higher home prices (except where market size differences are small and both prices fall). The foreign country gains and the home country loses. Once the duty becomes larger, however, revenue redistribution leads the import-competing firm to act less aggressively than otherwise, leading to a smaller dumping margin and higher prices in the foreign country and lower prices at home than otherwise. The home country gains and the foreign country loses. But dumping continues. Does revenue redistribution reduce dumping? Clearly not.

References

- Collie, D., 2004. Anti-dumping regulations: anti-competitive and anti-export, mimeo, Cardiff Business School.
- Collie, D. and H. Vandenbussche, 2005, "Tariffs and the Byrd Amendment" *European Journal of Political Economy*, 22(3), 750-758.
- Evenett, S., 2005, "The Simple Analytics of US Antidumping Orders: Bureaucratic Discretion, Anti-importer Bias, and the Byrd Amendment" *European Journal of Political Economy*, 22(3), 732-749.
- Falvey, R. and S. Wittayarungruangsi, 2006, "Market Size and Antidumping in Duopolistic Competition" *European Journal of Political Economy*, 22(3), 771-786.
- Fischer, R., 1992. Endogenous probability of protection and firm behaviour, *Journal of International Economics* 32, 149-63.
- Gupta, P., 1999, Why do firms pay antidumping duty? International Monetary Fund Working Paper WP/99/166, Washington DC.
- Olson, K., 2004, "Subsidizing Rent-Seeking: Antidumping Protection and the Byrd Amendment", *American University Working Paper* 2004-05.
- Olson, K. and B. Liebman (2004) "The Returns to rent-Seeking: Campaign Contributions, Firm Subsidies and the Byrd Amendment" *American University Working Paper* 2004-09.
- Reitzes, J., 1993. Antidumping policy, *International Economic Review* 34, 745-63.
- Schmitz, T. G. and J. L. Seale, Jr. (2004) "Countervailing Duties, Antidumping Tariffs and the Byrd Amendment: A Welfare Analysis", *International Journal of Applied Economics* 1(1), 65-80.

Webb, M., 1992. The ambiguous consequences of anti-dumping laws, *Economic Inquiry* 30, 437-48.

Appendix Table 1. Both Firms Behave Strategically (No Byrd Amendment)

	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	$\frac{A + A^*}{6}$	$\frac{7A^*}{18}$	$\frac{24A - 17A^*}{42}$	$\frac{17A - 16A^*}{21}$	$\frac{2A + 5A^*}{12}$	$\frac{A}{3}$
p_1^*	$\frac{A + A^*}{6}$	$\frac{7A^*}{18}$	$\frac{41A^* - 6A}{84}$	$\frac{23A^* - 10A}{21}$	$\frac{2A - A^*}{12}$	$\frac{A^*}{3}$
$p_1 - p_1^*$	0	0	$\frac{18A - 25A^*}{28}$	$\frac{9A - 13A^*}{7}$	$\frac{A^*}{2}$	$\frac{A - A^*}{3}$
x_1	$\frac{6A - A^*}{9}$	$\frac{9A - 5A^*}{9}$	$\frac{5A^*}{6}$	$\frac{4A^* - A}{3}$	$\frac{2A + 5A^*}{12}$	$\frac{A}{3}$
x_1^*	$\frac{4A^* - 3A}{9}$	ε	ε	$\frac{2A - 3A^*}{3}$	$\frac{2A - A^*}{12}$	$\frac{A^*}{3}$
y_1	$\frac{3A - A^*}{18}$	$\frac{A^*}{6}$	$\frac{3A - 3A^*}{7}$	$\frac{11A - 12A^*}{21}$	$\frac{4A - 5A^*}{6}$	$\frac{A}{3}$
y_1^*	$\frac{3A + 7A^*}{18}$	$\frac{11A^*}{18}$	$\frac{6A + 43A^*}{84}$	$\frac{19A^* - 4A}{21}$	$\frac{7A^* - 2A}{6}$	$\frac{A^*}{3}$
p_2^*	$\frac{A^*}{3}$	$\frac{A^*}{3}$	$\frac{6A + A^*}{28}$	$\frac{3A - 2A^*}{7}$	$\frac{A^*}{2}$	$\frac{A^*}{2}$
x_2^*	$\frac{A^*}{3}$	$\frac{A^*}{3}$	$\frac{13A^* - 6A}{14}$	$\frac{11A^* - 6A}{7}$	0	0
y_2^*	$\frac{A^*}{3}$	$\frac{A^*}{3}$	$\frac{6A + A^*}{28}$	$\frac{3A - 2A^*}{7}$	$\frac{A^*}{2}$	$\frac{A^*}{2}$
λ	$\frac{13A^* - 9A}{18}$	$\frac{25A^* - 18A}{18}$	0	0	0	0
η	0	$\frac{3A - 4A^*}{3}$	$\frac{3A^* - 2A}{4}$	0	0	0
γ	0	0	0	0	$\frac{6A - 11A^*}{12}$	NA

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

Appendix Table 2. Both Firms Behave Strategically (With Byrd Amendment)

	Aggravated Dumping [$x_1^* = \varepsilon; y_1 = 0$]	Aggravated Dumping [$x_1^* = \varepsilon$]	Aggravated Dumping [$\frac{17}{13}, \frac{5}{2}$]	Unconstrained Dumping [$\frac{5}{2}, \infty$]
	$[1, \frac{7}{6}]$	$[\frac{7}{6}, \frac{17}{13}]$	$[\frac{17}{13}, \frac{5}{2}]$	$[\frac{5}{2}, \infty]$
p_1	$\frac{7A-4A^*}{10}$	$\frac{7A+A^*}{22}$	$\frac{29A+5A^*}{93}$	$\frac{A}{3}$
p_1^*	$\frac{A}{4}$	$\frac{5A+7A^*}{44}$	$\frac{2A+26A^*}{93}$	$\frac{A^*}{3}$
$p_1 - p_1^*$	$\frac{9A-8A^*}{20}$	$\frac{9A-5A^*}{44}$	$\frac{9A-7A^*}{31}$	$\frac{A-A^*}{3}$
x_1	$\frac{3A+4A^*}{10}$	$\frac{3A+13A^*}{22}$	$\frac{65A^*+5A}{93}$	$\frac{A}{3}$
x_1^*	ε	ε	$\frac{26A-34A^*}{93}$	$\frac{A^*}{3}$
y_1	0	$\frac{6A-7A^*}{11}$	$\frac{59A-70A^*}{93}$	$\frac{A}{3}$
y_1^*	$\frac{4A^*-A}{4}$	$\frac{37A^*-5A}{44}$	$\frac{101A^*-28A}{93}$	$\frac{A^*}{3}$
p_2^*	$\frac{3A+4A^*}{20}$	$\frac{13A^*+3A}{44}$	$\frac{3A+8A^*}{31}$	$\frac{A^*}{2}$
x_2^*	$\frac{6A^*-3A}{10}$	$\frac{9A^*-3A}{22}$	$\frac{15A^*-6A}{31}$	0
y_2^*	$\frac{3A+4A^*}{20}$	$\frac{3A+13A^*}{44}$	$\frac{3A+8A^*}{31}$	$\frac{A^*}{2}$
η	$\frac{16A^*-13A}{20}$	$\frac{17A^*-13A}{44}$	0	0

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

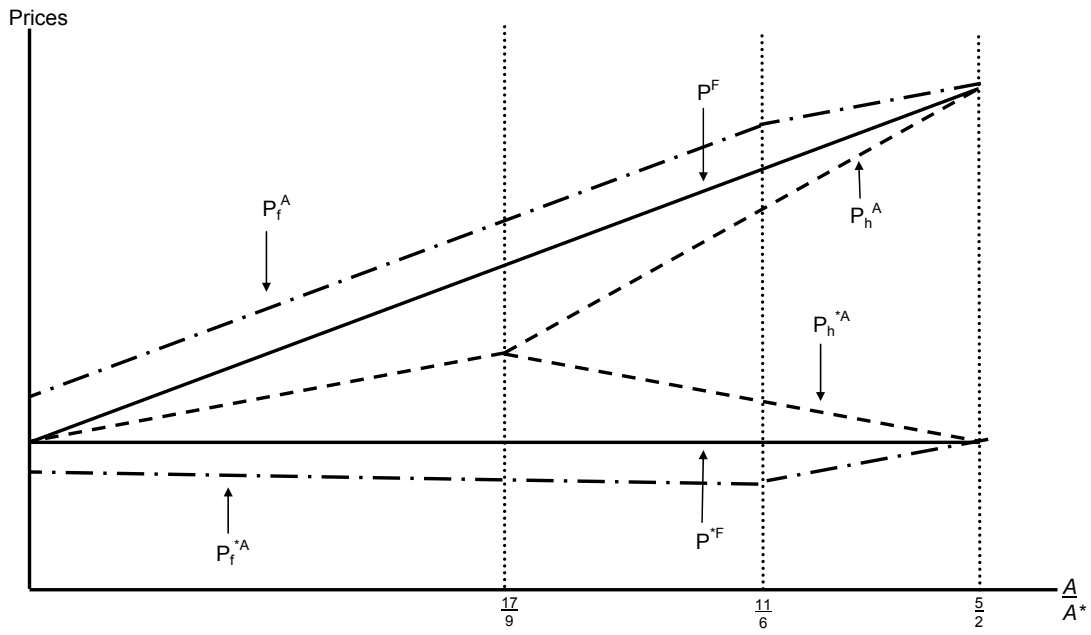


Figure 1: Only one firm behaving strategically (without the Byrd Amendment)

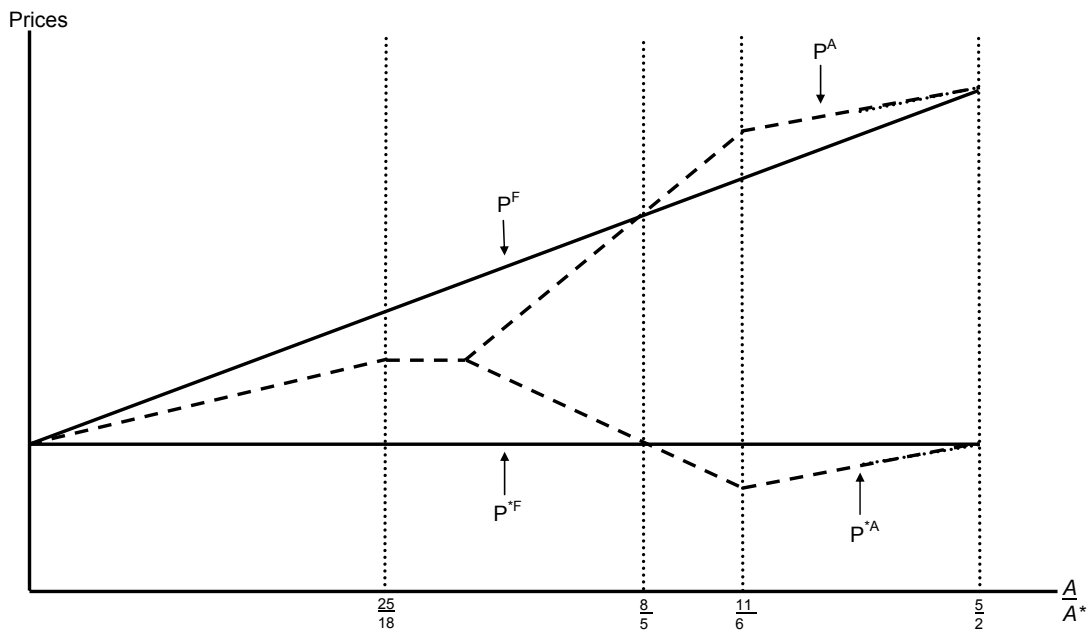


Figure 2: Both firms behaving strategically (without the Byrd Amendment)

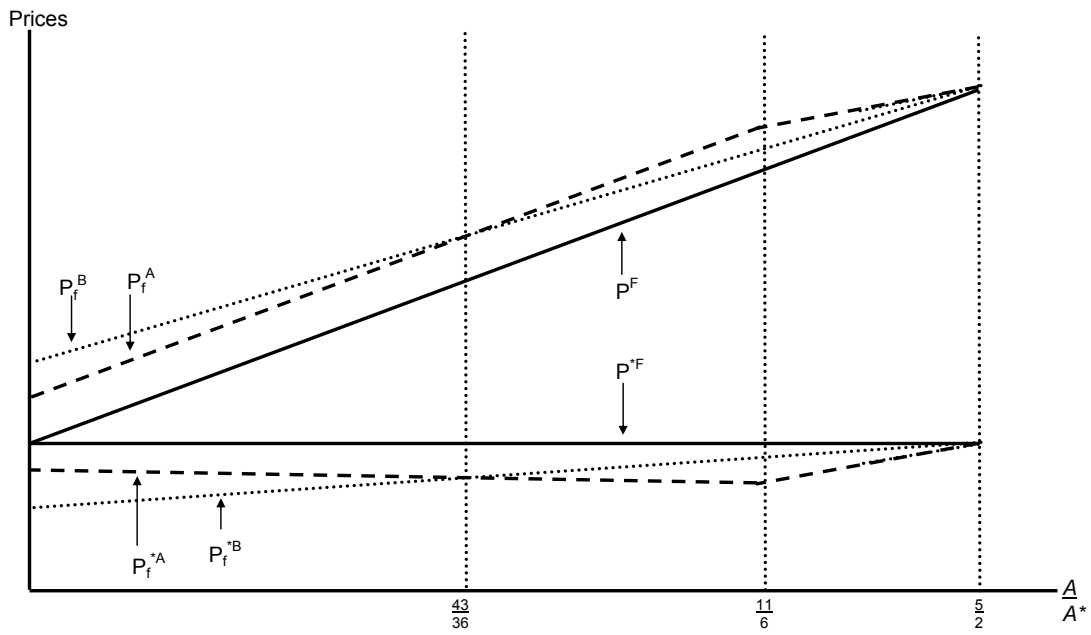


Figure 3: Only the foreign firm behaving strategically (with and without the Byrd Amendment)

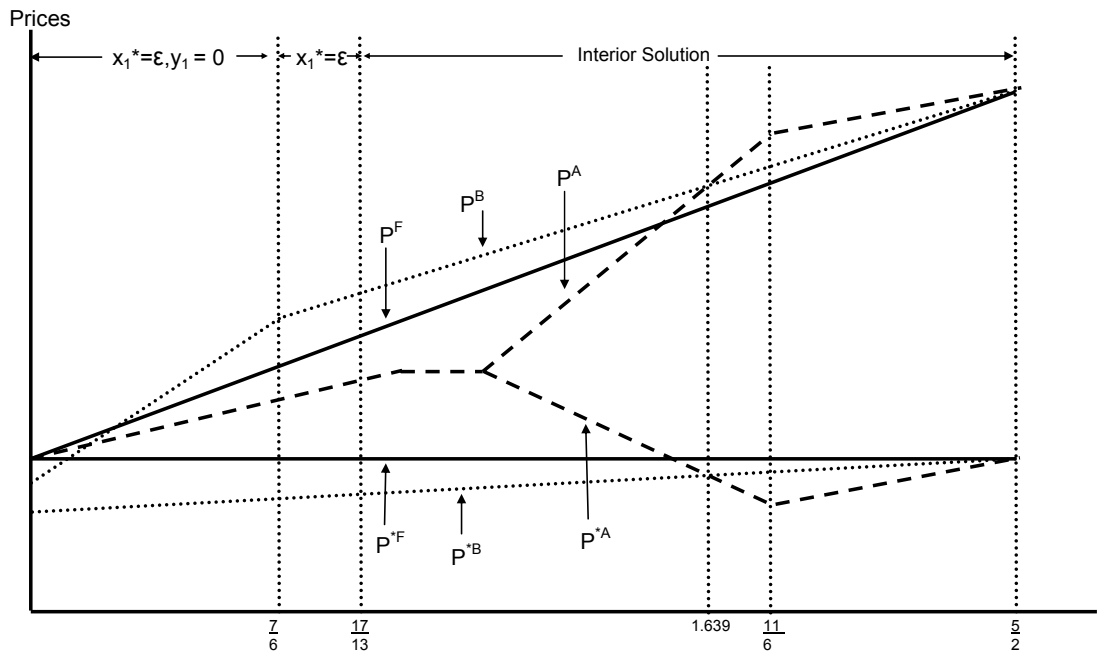


Figure 4: Both firms behaving strategically (with the Byrd Amendment)

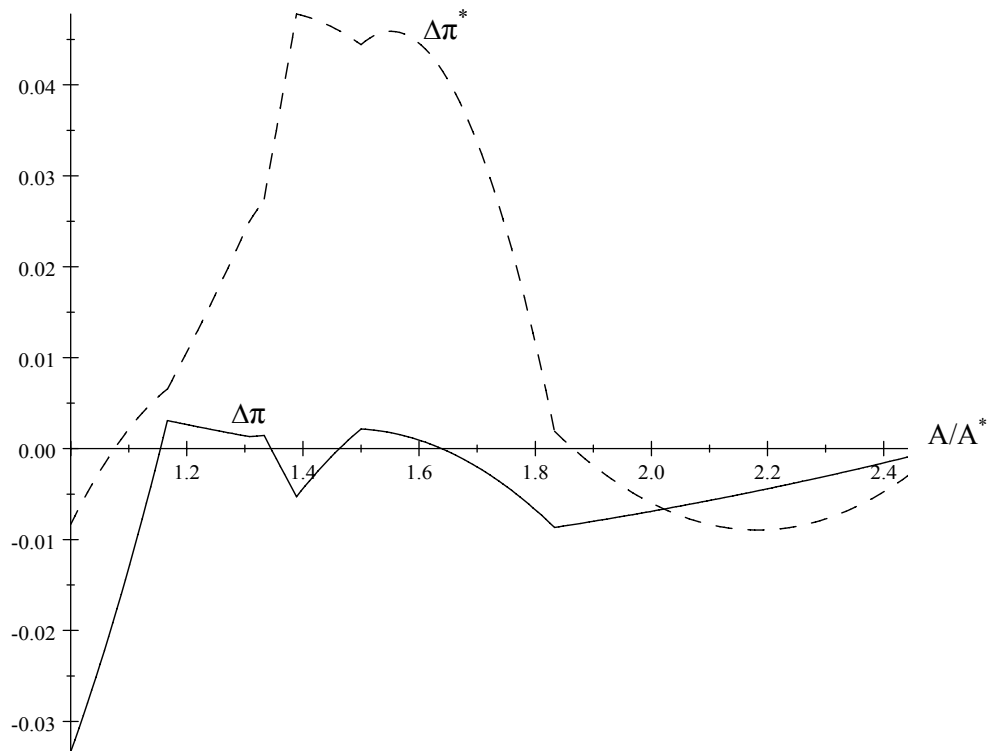


Figure 5: Differences in home firm's and foreign firm's profits

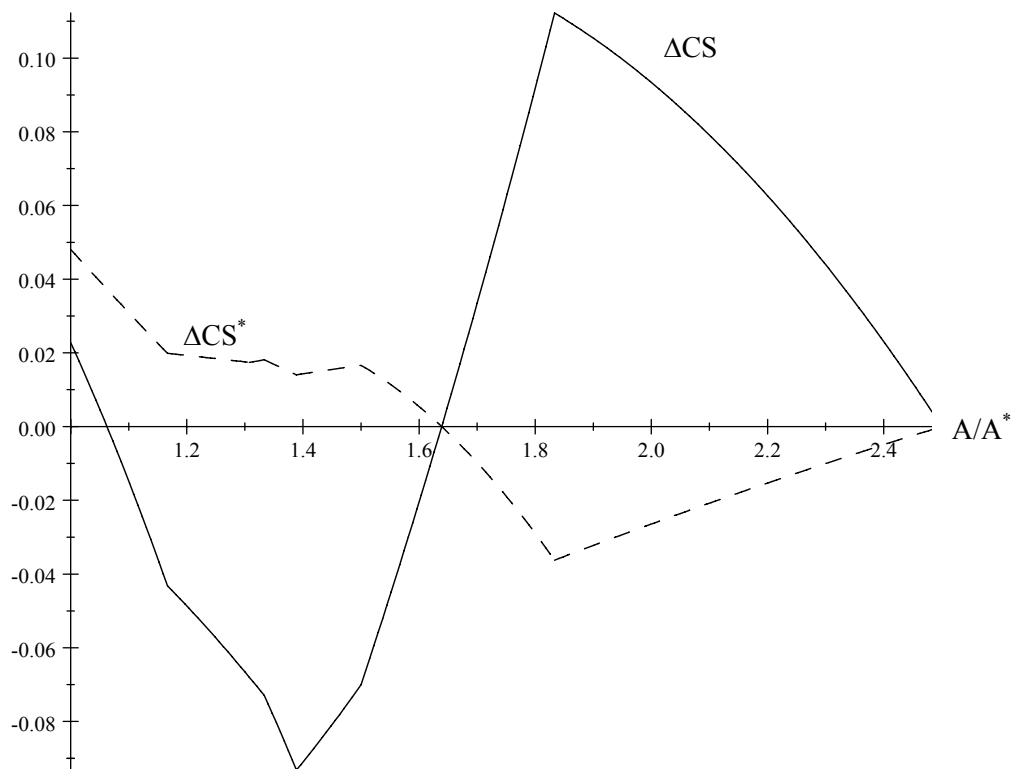


Figure 6: Differences in home and foreign consumer surplus

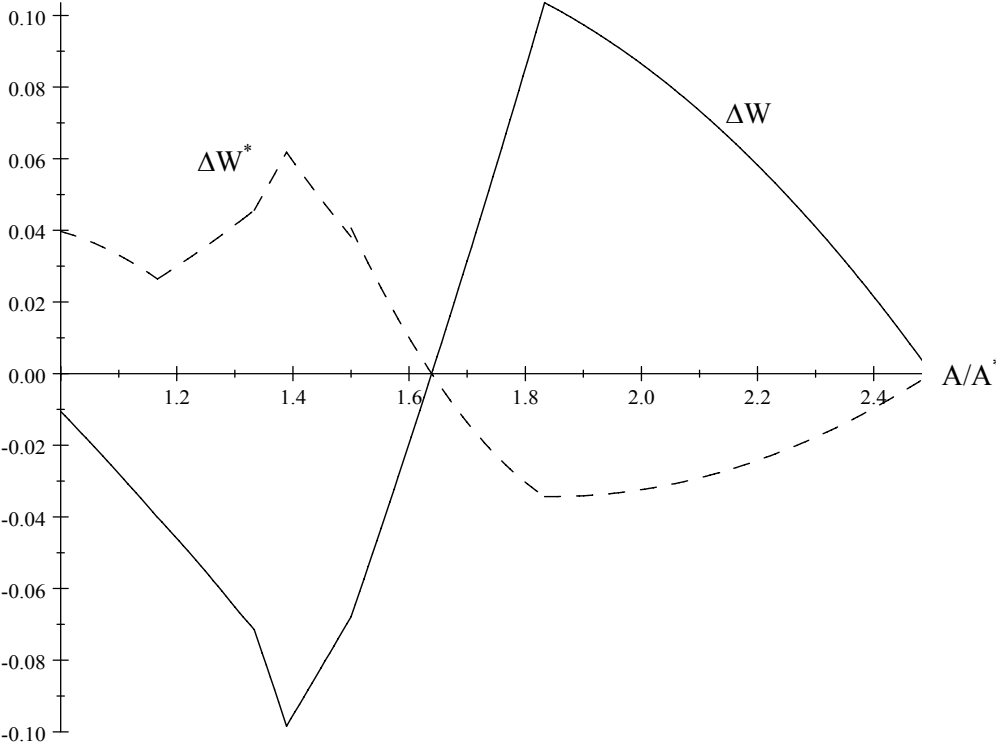


Figure 7: Differences in home and foreign aggregate welfare

$\Delta\pi_1$

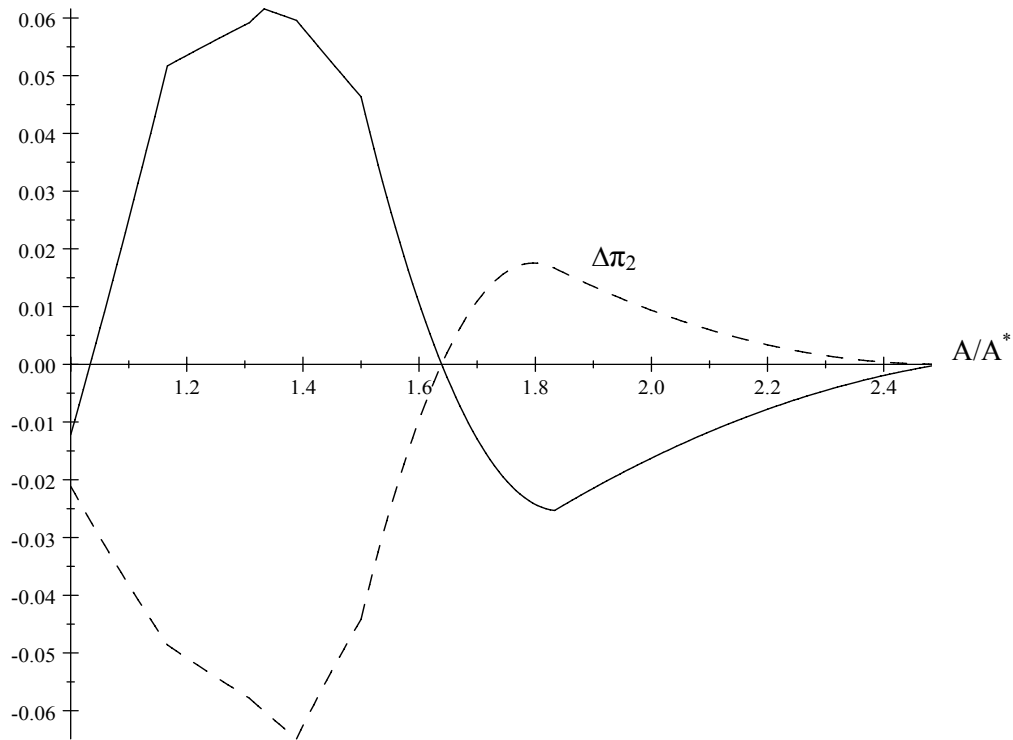


Figure A1: Differences in home firm's profits in periods 1 and 2.