The simple analytics of U.S. antidumping orders: bureaucratic discretion, anti-importer bias, and the Byrd Amendment

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Abstract:

Using a standard linear version of the Bertrand duopoly model of competition, I analyse the effect on firm pricing behaviour of three prominent features of the U.S. antidumping system. I identify the circumstances under which these features eliminate dumping entirely as well as their effects on the profitability of the import-competing and foreign firms. The Byrd Amendment, which has been the subject of a dispute between WTO members, is found to create price floors for domestic firms and paradoxically to increase the volume and total value of imports.

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1. Introduction

As tariffs on manufactured products have fallen with successive rounds of multilateral trade negotiations and the signing of dozens of preferential trade agreements, economic analyses of remaining non-tariff barriers have grown in number (Baldwin, 1970; Laird and Yeats, 1990; Deardorff and Stern, 1998). Anti-dumping statutes and tariffs have featured prominently in this research programme, not least because of the spread of such laws since their introduction one hundred years ago, and over the past twenty years in particular (see, for example, the surveys of the relevant literature in Finger, 1993; Blonigen and Prusa, 2001.)¹ Moreover, legal practitioners and political scientists have begun to shed light on the non-market-related determinants of the design and operation of anti-dumping laws and on what might be termed the supply and demand for anti-dumping protection (Boltuck and Litan, 1991; Jackson and Vermulst, 1990; Nivola, 1993; Finger, Hall, and Nelson, 1982.) This relatively restrained scholarly literature has been augmented by blistering critiques and defences of anti-dumping in the print media, at international fora, and elsewhere (see, for example, Bovard, 1991; Mastel, 1998; Eckes, 1995, and just about any open editorial on anti-dumping on the pages of the *Wall Street Journal*.)

An important feature of the implementation of anti-dumping laws is that there is considerable room for discretion by administering officials (see, for example, Clarida, 1995; Blonigen, 2003; and the contributions to Boltuck and Litan, 1991). Sometimes this discretion can be exercised in a manner that results in the calculation of foreign market values, dumping margins, and the like that have little or no bearing to the underlying

¹ The global spread of anti-dumping laws and enforcement has been recently documented and discussed in Prusa (2005).

legal rationales for the anti-dumping statutes, namely deterring certain types of international price discrimination and foreign market sales below average total costs.² This is not to suggest that officials are breaking the law, rather that they may be using the discretion available to them to respond to incentives to supply protection to influential domestic interests and constituencies. Indeed, when the latter are especially aggressive in pressing their case, the weight given to any information supplied by a foreign firm or to the underlying legal concepts that motivate the anti-dumping law may come a poor second and third to the bureaucratic imperative to supply protection. Forward-looking foreign firms may thus want to anticipate the effects of such bureaucratic discretion and temper any expectations as to the likelihood that prices changes on their part may reduce, for example, the likelihood of anti-dumping order being imposed.

This paper focuses on one area where bureaucratic discretion can be very important, namely the calculation of the foreign market value that import prices will be subsequently be compared to after an anti-dumping order is put in place, and U.S. administrative practice is used to highlight this point. Although some nations' anti-dumping laws allow for the imposition of provisional ad-valorem duties to be levied once an order is imposed, the final amount of the duty typically depends on any (non-negative) difference between the implementing agency's estimate of the foreign market value and the prices charged on each import transaction.³ Using a standard linear Bertrand duopoly

² In this regard, the conclusion of one study is worth repeating in full: 'Here we offer a detailed, step-by-step guide to how dumping is defined and measured under current rules. In addition, we identify the many methodological quirks and biases that allow normal, healthy competition to be stigmatized as "unfair" and punished with often crippling high antidumping duties. The inescapable conclusion that follows from this analysis is that the antidumping law, as it currently stands, has nothing to do with maintaining a "level playing field." Instead, antidumping's primary function is to provide an elaborate excuse for old-fashioned protectionism' (Lindsey and Ikenson, 2002).

³ This is the case in the United States when one affected party asks for an ex-post review of the provisional duties that were originally imposed.

model with differentiated products, I show how a foreign firm and its domestic rival might respond to the incentives created by various types of what I term *pure bureaucratic discretion*. By the latter, I mean that the agency sets the foreign market value used for computing the amount of duties owed in a way that is completely independent of (or unrelated to) the foreign firm's pricing behaviour or cost levels.⁴ Furthermore, rather than specify the process by which the enforcement agency chooses the foreign market value I show, for every foreign market value that exceeds the foreign firm's free trade equilibrium price, how such discretion alters that firm's reaction function. Pure bureaucratic discretion is shown to have a non-negative effect on the prices charged by foreign firm (compared to the respective best response function under free trade⁵) and that, over a finite range of the domestic firm's prices, the best response of the foreign firm is to set a price equal to the foreign market value; that is, the foreign firm raises its prices above its (free trade) best response just enough to eliminate the dumping margin. The resulting kinked best response function creates two types of equilibrium market outcome under the antidumping order.

The next step in my analysis is to introduce a Byrd Amendment-like provision, whereby the domestic firm is given all of the dumping duties that are paid by the foreign firm.⁶ This provision has the effect⁷ of creating an additional incentive for the domestic

⁴ Rather than thinking of the enforcement agency as completely ignoring the either "home market" price of the foreign firm or the latter's average costs, one might consider that the enforcement agency uses whatever legal provisions that it has at its disposal to evaluate data provided by the foreign firm in such a way that validates a pre-conceived foreign market value. Therefore, pure bureaucratic discretion can be associated with the appearance of foreign-supplied information being taken into account.

⁵ Throughout this paper the market outcomes under an anti-dumping order are compared to those where no such order prevails. The latter are referred to as the market equilibrium outcomes under free trade.

⁶ The so-called Byrd Amendment became U.S. law on 28 October 2000. Formally, this amendment is known as the Continued Dumping and Subsidy Offset Act. One of the goals of this Act was to give U.S. import-competing firms harmed by dumped or subsidised imports further relief, in addition to whatever benefits flowed to such firms from the imposition of anti-dumping or counter-vailing duty orders. Since its

firm to its raise price as doing so increases the sales of foreign firm, thereby increasing the total value of the dumping duties paid. I show that the Byrd Amendment provision effectively introduces a price floor into the domestic firm's best response function, although this finding is due to the symmetric nature of the own price-responsiveness of the linear demand functions assumed for the domestic and foreign firms.⁸ I also show that where the Byrd Amendment raises prices in equilibrium (compared to the case where there is no Byrd Amendment provision), a seemingly paradoxical result arises; namely, that the foreign firm is better off. This latter finding occurs in part because the foreign firm's profit margin rises for two reasons: the excess of price over marginal costs increases and the amount of dumping duties paid per unit falls as the foreign firm's price increases.

In the third model that I solve I return to the case where there is no Byrd Amendment. However, I introduce uncertainty over the level of the foreign market value that the enforcement agency uses to calculate the actual or final level of dumping duties. I consider the case where the agency sets the foreign market value after the firms have chosen their prices. (As noted earlier, an agency conducts an *ex-post* review of the foreign firm's pricing decisions to establish the amount of duties, if any, to be collected.) Specifically, I assume that the agency sets one of two possible levels of the foreign

enactment, this law has seen US\$231m, US\$330m, and US\$293m disbursed to U.S. firms in 2001, 2002, and 2003, respectively.

⁷ Note here that I am considering the effect of the Byrd Amendment after an anti-dumping order is put in place. The effect of this Amendment on the credibility and potency of the threat to file an anti-dumping petition, which some have alleged is important, is beyond the scope of this paper.

⁸ This finding highlights a dilemma faced when modeling the effects of the Byrd Amendment in a Bertrand duopoly with differentiated products and linear demand curves. Under this symmetric assumption some rather stark results emerge. But what asymmetric assumption (on the own-price responsiveness of demand) is reasonable or, at least, defensible? For example, what confidence do we have that the price responsiveness of import demand is greater (say) than in the comparable demand function for domestically-produced good? In the section on this particular model it is also suggested that the price-floor results from what can be thought of as a limiting case when the proportion of the collected dumping duties paid to the domestic firm equals one.

market value and that the duopolists do not know which level will prevail at the time they make their pricing decisions. Two parameters are introduced with this uncertainty: the probability that the high level of the foreign market value is used to compute any dumping duties and the ratio of the higher to the lower level of the foreign market value. Higher levels of either parameter can be interpreted as greater bias against the importing firm.⁹ In such a model I show that a further kink is introduced into the foreign firm's reaction function and that, perhaps as expected, greater anti-importer bias results in the foreign firm setting a higher price in equilibrium.

The last model presented in this paper combines the uncertainty over the level of the foreign market value (created by bureaucratic discretion) and the implementation of the Byrd Amendment. The latter continues to provide a price floor for the domestic firm, but is now equal to the domestic firm's best response to the expected value of the foreign market value. The impact of the Byrd Amendment cannot, therefore, be properly analysed independently of the other features of the U.S. antidumping system. Indeed, the greater the anti-importer bias in the calculation of the foreign market value, the greater the incentive to U.S. import-competing firms to raise their prices once an anti-dumping order is put in place. Paradoxically, this further increases the positive impact of the Byrd Amendment on the total value of U.S. imports.

In summary, the goal of this paper has been to examine the effects on price setting and market outcomes of certain features of the U.S. anti-dumping laws and their implementation, that latter of which create the scope for bureaucratic discretion. I have

⁹ J. Michael Finger, among others, have referred to the U.S. Department of Commerce as a "hanging jury" in respect to their conduct of less-than-fair-value determinations and the calculation of dumping margins. Consistent with this claim Blonigen (2003) has shown that the estimated dumping margins have grown over time. Higher values of the parameters of the stochastic process determining the foreign market value in this model can be thought of stacking the jury further against a foreign firm.

sought to show how these features interact in interesting ways. I do not claim that every relevant aspect of such discretion has been modelled, nor have I characterised the decision-making process by which such discretion is exercised. This is because focus is inevitable in modelling strategy and, with respect to the latter caveat, I do not want to be tied to any particular political economy model of how bureaucratic discretion is exercised. Instead, I draw out the implications for price setting by forward-looking firms of a wide range of bureaucratic outcomes, uncertainty over those outcomes, and the Byrd Amendment. Such models of pure bureaucratic discretion may provide a useful benchmark against which to compare the findings of theoretical approaches that assume the implementation of anti-dumping orders faithfully takes into account the prices set by foreign firms at home and abroad and those firms' average cost levels. Indeed, it would be useful to compare the theoretical predictions of both types of model to see if empirical tests could be devised for samples of observed pricing behaviour under anti-dumping orders.

The rest of this paper is organised as follows. The next section of this paper introduces some basic notation and the recounts the structure of the Bertrand duopoly with differentiated products. The third through sixth sections presents the four models described in this introduction. Concluding remarks follow in section seven.

2. Benchmark case: Bertrand duopoly with differentiated products.

Throughout this paper the following assumptions about the market structure and nature of inter-firm rivalry will apply.

A1. There are two firms supplying a given nation's market.

- A2. The two firms do not compete with one another in any other market.
- A3. Each firm supplies a differentiated product.
- A4. The firms are assumed to compete once on prices in a Bertrand manner.
- A5. One firm is located in the same jurisdiction as the purchasers (the consumers) of the good and that firm is called the "home" or "domestic" firm. All variables relating to this firm are denoted by the subscript h.
- A6. The other firm is located outside of the jurisdiction where the purchasers reside. This firm is known as the "foreign" firm. All variables relating to this firm are denoted by the subscript f.
- A7. Each firm has constant marginal costs of production, denoted by c_f and c_h . These two costs need not be equal.
- A8. The firms' demand functions are linear and take the following linear form:

$$\begin{aligned} q_f &= q_0 - b(\mu P_f - P_h) \\ q_h &= q_0 - b(\mu P_h - P_f) \end{aligned}$$

where $q_0 > 0$, $b > 0$, $\mu > 1$, P_x is the price set by firm x, and q_x equals the quantity demanded of the good produced by firm x (where x equals f or h).

With these assumptions, and denoting the profits of the foreign and domestic firms by π_f and π_h respectively, the reaction functions of both firms can be derived in the traditional manner. The foreign firm's reaction function is given by:

$$\begin{aligned} P_f = \rho_f(P_h) &= \left(\frac{q_0}{2b\mu} + \frac{c_f}{2} \right) + \frac{P_h}{2\mu} \quad [1] \\ \frac{\partial P_f}{\partial P_h} &= \frac{1}{2\mu} < \frac{1}{2} \end{aligned}$$

Likewise the home firm's reaction function is given by

$$P_h = \rho_h(P_f) = \left(\frac{q_0}{2b\mu} + \frac{c_h}{2} \right) + \frac{P_f}{2\mu} \quad [2]$$

Solving [1] and [2] simultaneously yields the equilibrium prices, denoted P_f^B and P_h^B (where the superscript B refers to the "benchmark" or free trade case.) Here:

$$P_f^B = \left(\frac{\frac{q_0}{2b\mu} \left(1 + \frac{1}{2\mu} \right) + \frac{c_f}{2} + \frac{c_h}{4\mu}}{1 - \frac{1}{4\mu^2}} \right)$$

Figure 1 portrays the equilibrium market outcome in the benchmark case.

3. A model of pricing behaviour with pure bureaucratic discretion over the implementation of anti-dumping orders.

In this section I consider the incentives created by the imposition of an antidumping order. An anti-dumping order is a sliding scale of tariffs and, as such, differs from either an ad-valorem tariff or a specific tariff (which are often used to model the effects of anti-dumping measures see, for example, Pauwels, Vandenbussche, and Weverbergh, 2001.) In this model the following four assumptions are added.

A9. The "home" government imposes an antidumping order on the foreign firm. The government commits in advance to collect a per unit tariff, t_f , on the foreign firm's sales after the firms have played their Bertrand game. The tariff is set according to the following schedule:

$$t_f = \begin{cases} FMV - P_f & \text{where } FMV \geq P_f \\ 0 & \text{otherwise} \end{cases}$$

A10. FMV is a constant, is set *ex ante* by the home government, and is common knowledge.

A11. Any tariffs paid by the foreign firm are kept by the home government and are not redistributed.

A12. FMV is set such that it exceeds P_f^B (that is, the tariff schedule is set so that it potentially has a restrictive effect on the foreign firm.)

Here the imposing government sets the foreign (fair) market value of the imported good at whatever level it likes. The associated model is therefore called the pure discretion model. I deliberately did not make any additional assumptions about how the government chooses the parameter FMV, so ensuring that the findings of this paper are not dependent on any additional political-economy assumptions as to how the parameter FMV is determined.

I now consider the effect of the commitment to this tariff schedule (the antidumping order) on the pricing behaviour of both firms.¹⁰ The reaction function of the home firm is unchanged as it does not pay any tariffs nor does it receive any resulting tariff revenue from the government. Knowing that certain choices of P_f will result in tariff payments to the home government, the foreign firm's optimisation problem (for a given P_h) is:

$$\begin{aligned} \max_{P_f} \quad & \pi_f - t_f q_f I(P_f) \\ \text{where} \quad & I(P_f) = \begin{cases} 1 & \text{if } P_f \leq FMV \\ 0 & \text{otherwise} \end{cases} \end{aligned}$$

Denote:

$$\pi'_f \equiv \pi_f - t_f q_f = (P_f - c_f - t_f) q_f$$

Two remarks follow. The first is that, for a given P_h ,

$$\frac{\partial \pi'_f}{\partial P_f} = 0 \Rightarrow P_f = \frac{q_0}{2b\mu} + \left(\frac{c_f + FMV}{4} \right) + \frac{P_h}{2\mu} \quad [3]$$

The second remark is that, when $\rho_f(P_h) \geq FMV$, the foreign firm has no incentive to raise prices above the free trade best response $\rho_f(P_h)$ as no duties are payable at those values of P_f . It can, therefore, be shown that under an antidumping order the reaction function of the foreign firm is given by:

¹⁰ For the sake of clarity let me restate the so-called “order of moves.” First the government sets a level of FMV. Second, the firms compete in a Bertrand manner. Third, the government collects any tariffs that are due from the foreign firm.

$$\rho_f^3(P_h) = \begin{cases} \rho_f(P_h) & \text{when } P_h \geq \mu(2FMV - c_f) - \frac{q_0}{b} \\ FMV & \text{when } \frac{\mu}{2}(3FMV - c_f) - \frac{q_0}{b} \leq P_h \leq \mu(2FMV - c_f) - \frac{q_0}{b} \\ \rho_f(P_h) + \frac{1}{4}(FMV - c_f) & \text{when } P_h < \frac{\mu}{2}(3FMV - c_f) - \frac{q_0}{b} \end{cases}$$

This reaction function is portrayed in figure 2.¹¹ The explanation for this reaction function is as follows. From [3] above the foreign firm is willing to raise its price P_f by up to $\frac{1}{4}(FMV - c_f)$ so as to reduce the total value of duties paid. When the prospect of doing so results in a price P_f that is greater than FMV , the foreign firm actually raises its price by just enough to eliminate the dumping margin (that is, by setting $P_f = FMV$). For a range of P_h the antidumping order, therefore, creates a kink in the foreign firm's reaction function.

We now consider the effect of the antidumping order on equilibrium prices. Recall from assumption A12 that $FMV > P_f^B$. With this assumption, two logical possibilities emerge—one equilibrium in which duties are paid and one where they are not. Figure 3 portrays the two equilibria. Which equilibrium prevails depends on whether the parameters of the home firm's reaction function are such that it lies to the left or to the right of the first kink in the foreign firm's reaction function. It can be shown that dumping duties are paid in equilibrium if the following condition is satisfied:

$$\frac{1}{\left(3\mu - \frac{1}{\mu}\right)} \left(\frac{q_0}{b} \left(2 + \frac{1}{\mu} \right) + c_h + \mu c_f \right) \leq FMV.$$

Moreover, when duties are paid in equilibrium, the relationship between the free trade price and the tariff-ridden price is given by:

¹¹ The numerical superscripts on the reaction functions and the equilibrium prices in this paper refer to the model considered in the respective section of this paper. This will facilitate comparisons across models of equilibrium prices etc.

$$P_f^3 - P_f^B = \left(\frac{4\mu^2 - 1}{4\mu^2} \right) \left(\frac{FMV - c_f}{4} \right)$$

Given μ exceeds one and is finite, then the effect on the foreign firm's price of imposing an anti-dumping order that does not eliminate dumping is bounded by:

$$\frac{3}{4} \left(\frac{FMV - c_f}{4} \right) < P_f^3 - P_f^B < \left(\frac{FMV - c_f}{4} \right).$$

Turning to the effect of imposing the anti-dumping order on equilibrium profit levels, it is trivial to show that the home firm's profits have risen (after all it has moved "up" or along its free trade best response function.) Matters are a little more complex for the foreign firm. When dumping is eliminated in equilibrium, there are circumstances under which the foreign firm's profits can be higher than under free trade. It can be shown that the anti-dumping order "facilitates practices" when:

$$\left(\frac{FMV - P_f^B}{P_f^B} \right) < \left(\frac{-\frac{1}{2\mu}}{\frac{1}{2\mu} - \mu} \right) \left(\frac{P_f^B - c_f}{P_f^B} \right).$$

That is, when the dumping margin (evaluated at free trade prices) is not too large compared to the free-trade price-cost mark-up, then imposing an anti-dumping order will raise the profits of the importing as well as domestic firm. Moreover, as the own price sensitivity of demand increases (μ increases), the range of FMV that "facilitates practices" shrinks.

4. A model of pricing behaviour with anti-dumping orders, pure bureaucratic discretion, and the Byrd Amendment.

In this model I combine the bureaucratic discretion of the last section with the right of the domestic firm to receive any duties that the foreign firm pays to the home government. This amounts to replacing assumption A11 with the following assumption:

A11'. The total value of any tariff payments made by the foreign firm to the

government are passed in their entirety to the home firm.

Given the home firm can anticipate the receipt of such tariff revenues, how does assumption A11' affect its reaction function? It should be clear that for $\forall P_f \geq FMV$ no tariffs are collected, a fact that is not altered whatever price the home firm sets. Formally, the home firm's maximisation problem can be stated as, given P_f :

$$\begin{aligned} \max_{P_h} \quad & (P_h - c_h)q_h + I(P_f)(FMV - P_f)q_f \\ \text{where } I(P_f) = & \begin{cases} 1 & \text{if } FMV > P_f \\ 0 & \text{otherwise} \end{cases} \end{aligned}$$

Let $L = \pi_h + (FMV - P_f)q_f$.

When $P_f < FMV$,

$$\frac{\partial L}{\partial P_h} = \left\{ (q_o - b(\mu P_h - P_f)) - b\mu(P_h - c_h) \right\} + b(FMV - P_f) = \frac{\partial \pi_h}{\partial P_h} + b(FMV - P_f)$$

And,

$$\frac{\partial L}{\partial P_h} = 0 \Rightarrow P_h = \frac{q_o}{2b\mu} + \frac{c_h}{2} + \frac{FMV}{2\mu}.$$

A remark is in order. When $P_f < FMV$ the reaction function for the home firm is such that its best responses are independent of the foreign firm's price. That is, the imposition of the Byrd Amendment creates a price floor (see figure 4). How robust is this finding of a minimum price? It can be shown that, if the home firm received only a proportion $0 < s < 1$ of the total tariff revenues, then the home firm's reaction function would retain an upward slope. Moreover, the price floor described above is associated with the limiting case as proportion s tends to one.

Turning now to the market equilibria, two again are possible (see figures 5 and 6). It can be shown that dumping will be eliminated in equilibrium if the dumping margin (evaluated at free trade prices) is not too large; specifically, when:

$$\left(\frac{FMV - c_f}{FMV} \right) > \left(1 - \frac{1}{\mu^2} \right) \left(\frac{FMV - P_f^B}{FMV} \right)$$

In both market equilibria the home firm's price equals the price floor, $\frac{q_0}{2b\mu} + \frac{c_h}{2} + \frac{FMV}{2\mu}$.

Moreover, compared to the free trade equilibria (P_f^B, P_h^B) both firms' prices have risen.

Compared to the equilibria identified in section 3 (where there was bureaucratic discretion but no Byrd Amendment), here prices only differ in the equilibrium when dumping persists. In the latter equilibrium, as well as both firms' prices rising, the sales (imports) of foreign firm are higher than in the absence of the Byrd Amendment! All of these factors ensure that the total profits of the foreign firm (net of tariff payments) increase when the Byrd Amendment is imposed and dumping is not eliminated.

5. A model of pricing behaviour with uncertainty over the exercise of bureaucratic discretion.

In this section I extend the model of pure bureaucratic discretion (developed in section 3) to allow for ex-ante uncertainty over the level of the foreign market value (FMV) that the home government uses to calculate any dumping duties. In this model, both firms face this uncertainty before they set their prices. So as to focus on the effects of introducing uncertainty alone, I retain assumption A11. (That is, the effects of the Byrd Amendment are not considered in this section.)

The following assumption about the level of the foreign market value used by the home government is made. This value, denoted FMV^* , takes one of two possible values:

$$A13. \quad FMV^* = \begin{cases} \lambda FMV & \text{with probability } a \\ FMV & \text{with probability } 1-a \end{cases}$$

where $\lambda > 1$, $1 > a > 0$.

This formulation of the uncertainty allows for a specific characterisation of the degree of “anti-import” bias. Higher levels of λ and higher values of probability a are associated with more stringent views as to what minimum price imports can enter domestic commerce without being deemed as “dumped.” An important question will be the manner in which the foreign firm responds to greater anti-import bias, if it responds at all. Higher

values of λ and probability a may well be generating the higher dumping margins found over time by the International Trade Administration, the agency in the U.S. Department of Commerce charged with investigating and calculating dumping margins (see Blonigen, 2003.)

What is the effect of this uncertainty on the foreign firm's reaction function? A forward looking foreign firm will take into account the uncertainty concerning the level of FMV^* used in the ex-post review of its pricing decisions. Specifically, assuming the foreign firm is risk neutral, for a given P_h , its optimisation problem is:

$$\begin{aligned} \max_{P_f} \quad & \pi_f - I_1(P_f)(1-a)(FMV - P_f)q_f - I_2(P_f)a(\lambda FMV - P_f)q_f \\ \text{where} \quad & I_1(P_f) = \begin{cases} 1 & \text{if } FMV > P_f \\ 0 & \text{otherwise} \end{cases} \\ \text{and} \quad & I_2(P_f) = \begin{cases} 1 & \text{if } \lambda FMV > P_f \\ 0 & \text{otherwise} \end{cases} \end{aligned}$$

The solution to this optimisation problem yields the following reaction function for the foreign firm:

$$P_f = \begin{cases} \rho_f(P_h) + \frac{1}{4}(FMV(a\lambda + (1-a)) - c_f) & \forall P_h \leq P_\alpha \\ FMV & \forall P_h \in [P_\alpha, P_\beta] \\ \rho_f(P_h) + \frac{c_f}{2} \left(\frac{a}{1+a} \right) \left(\frac{\lambda FMV}{c_f} - 1 \right) & \forall P_h \in [P_\beta, P_\gamma] \\ \lambda FMV & \forall P_h \in [P_\gamma, P_\delta] \\ \rho(P_h) & \forall P_h \geq P_\delta \end{cases}$$

where $P_\alpha, P_\beta, P_\gamma, P_\delta$ are defined implicitly as follows:

$$\begin{aligned}
(i) \quad FMV &= \frac{q_0}{2b\mu} + \frac{c_f}{4} + \frac{FMV(a\lambda + (1-a))}{4} + \frac{P_\alpha}{2\mu} \\
(ii) \quad FMV &= \frac{q_0}{2b\mu} + \frac{c_f}{4} + \frac{FMV(a\lambda)}{4} + \frac{P_\beta}{2\mu} \\
(iii) \quad \lambda FMV &= \frac{q_0}{2b\mu} + \frac{c_f}{4} + \frac{FMV(a\lambda)}{4} + \frac{P_\gamma}{2\mu} \\
(iv) \quad \lambda FMV &= \frac{q_0}{2b\mu} + \frac{c_f}{2} + \frac{P_\delta}{2\mu}
\end{aligned}$$

Given the linear nature of equations (i)-(iv) above, there are straightforward arithmetic relationships between P_α and P_β , between P_β and P_γ , and between P_γ and P_δ .

The foreign firm's reaction function can be represented graphically (see figures 7 and 8 for the two possible cases.) This reaction function has a price floor at $P_f = FMV$ when

$$\frac{q_0}{2b\mu} + \frac{c_f}{4} + \frac{FMV(a\lambda + (1-a))}{4} \geq FMV \quad (4).$$

It is worth noting that for any particular values of FMV and probability a , there exists a scalar λ which ensures that condition (4) is met. Moreover, whenever $(a\lambda + (1-a)) > 1$, then there exists an FMV such that condition (4) is met. When condition (4) does not hold, then the foreign firm's reaction function will have two kinks in it (see figure 8). The principal finding here is that in both cases the introduction of the anti-importer bias ensures that the best response of the foreign firm to any given home firm's price is greater than under the certain case (the model in section 3.) Given the home firm's reaction function is unaffected by the presence of this bias, the latter finding ensures that anti-importer bias has a non-decreasing impact on the prices charged by both the home firm and the foreign firm. The home firm, therefore, is better off with such bias.¹²

6. A model of pricing behaviour with uncertainty over bureaucratic discretion and the Byrd Amendment.

¹² It can also be shown that increases in parameters a and λ have a non-decreasing effect on the foreign firm's best responses to any given domestic firm's price.

In this section I add the Byrd Amendment into the model described in the last section. The goal here is to examine in what ways, if at all, the anti-import bias of the last section interacts with the payment of dumping duties to the home firm. As far as the foreign firm is concerned, its optimisation problem is unaffected by the transfer of any tariffs collected by the government to the home firm. The home firm, however, must anticipate the likely effect of its pricing decisions on the expected amount of duties paid by the foreign firm (which, in turn, it receives from the home government.) Of course, one important parameter determining the actual amount of duties paid is whether FMV^* equals FMV or λFMV . The home firm's optimisation problem is, for any given P_f ,

$$\max_{P_h} \quad \pi_h + I_1(P_f)(1-a)(FMV - P_f)q_f + I_2(P_f)a(\lambda FMV - P_f)q_f$$

It can be shown that the home firm's reaction function is given by:

$$P_h = \begin{cases} \frac{q_0}{2b\mu} + \frac{c_h}{2} + \frac{((1-a)FMV + a\lambda FMV)}{2\mu}, & P_f \in [0, FMV] \\ \frac{q_0}{2b\mu} + \frac{c_h}{2} + \frac{a\lambda FMV}{2\mu} + \frac{P_f(1-a)}{2\mu}, & P_f \in [FMV, \lambda FMV] \\ \rho(P_f), & P_f \geq \lambda FMV \end{cases}$$

This reaction function is drawn in figure 9 and compared to the free trade case. The combination of the Byrd Amendment and the anti-importer related uncertainty creates a higher price floor for the home firm (than in the certainty case). The price floor here is equal to the home firm's best response to the expected value of FMV^* . Therefore, any change in the parameters λ , a , and FMV will alter the minimum price that the home firm is prepared to charge. One consequence of any tendency for the anti-importer bias in the implementation of U.S. anti-dumping law to grow over time (which can be modelled as increases in parameters λ and a) is to raise the minimum prices that U.S. firms will charge as a result of the Byrd Amendment. This finding highlights the interaction between key institutional features of the U.S. anti-dumping system.

The “upward shift” in the home firm's best response function ensures that the introduction of the Byrd Amendment has a non-decreasing effect on the equilibrium

prices of the foreign firm and an increasing effect on the home firm's price. Moreover, it can be shown that imports are higher in equilibrium in this model, compared to the model with uncertainty and no Byrd Amendment (the model in section 6). Like Collie and Vandebussche (2004), whose theoretical model differs markedly from mine, I find that the Byrd Amendment increases international trade and not reduces it as some legal experts have contended.¹³

7. Concluding remarks

It is common to model anti-dumping orders as equivalent to the imposition of a fixed ad-valorem or specific tariff. Some jurisdictions anti-dumping regimes are such that this is an accurate assumption. However in the case of the United States, a major user of anti-dumping legislation to regulate the price of imports, this is not the case. This paper attempts to model the sliding-scale nature of tariffs charged under U.S. anti-dumping orders as well as two other important features of the U.S. antidumping system; namely, the potential for anti-importer bias in the calculation of foreign market value (fair market value) and the Byrd Amendment. The latter is particularly contentious and was recently the subject of a dispute settlement case at the World Trade Organization. No claims are made for the sophistication of the market structure modelled here or for the assumptions made on the calculation of foreign market values. Instead, the goal was to understand the effects on pricing behaviour—individually and collectively—of three important features of the U.S. anti-dumping system. These features combine in interesting ways, sometimes to eliminate dumping, sometimes to raise the profits of importing firms, and in some cases even to raise the total value of imports. This analysis suggests that it is unwise to examine the impact of any given component of U.S. anti-dumping system without reference to the other practices employed.

Analyses of the type presented here could have important implications for the manner in which certain disputes between members of the World Trade Organization are

¹³ This is not to say that other consequences of the Byrd Amendment are trade expanding. For instance, to the extent that the incentive to file for anti-dumping protection is increased by the possibility of receiving tariff duties as well as protection, then the threat of filing an anti-dumping measure may become more potent. Foreign firms may well contract their exports as a result. I should stress that the latter matter has not been examined in this paper and therefore the above argument is entirely conjectural.

resolved. A large number of those disputes concern the provisions of national anti-dumping laws and their implementation, and often much turns on the effects of such provisions on the total value of imports of specific goods and commodities. Moreover, determination of the harm done by one nation's anti-dumping laws on another's commercial interests tends to focus on the effects on total trade, rather than on prices, profits, or producer surplus. It is hoped that this paper stimulates others to analyse the economic impact of important features of national anti-dumping practice.¹⁴

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¹⁴ Rather amusingly, in a recent dispute Chile argued modeling features of the Byrd Amendment would be "tedious." Others argued that a modeling exercise would be "complex and burdensome." Interestingly, a representative for the United States argued "[T]he fact that an exercise is complex, tedious, or even burdensome does not mean it can be dispensed with." See footnote 78, page 34 of WTO (2004).

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Figure 1: The benchmark case.

Figure 2: Foreign firm's reaction function under pure bureaucratic discretion.

Figure 3: In only one of the two possible equilibria are dumping duties actually paid.

Figure 4: The Byrd Amendment creates a floor in the home firm's best responses.

Figure 5: Dumping is eliminated in equilibrium.

Figure 6: Dumping persists in equilibrium.

Figure 7: A price floor is created in the foreign firm's reaction function (marked in bold) when anti-import bias exceeds a given threshold.

Condition for price floor:

$$\frac{q_o}{2b\mu} + \frac{c_f}{4} + \frac{FMV(a\lambda + (1-a))}{4} > FMV \quad \text{condition} \quad (4)$$

Figure 8: Without the price floor, the foreign firm's reaction function (marked in bold) has two kinks in it.

Figure 9: The combination of the Byrd Amendment and uncertainty creates a price floor for the home firm. The home firm's reaction function is marked in bold.

Note:

$EFMV^* = (1 - a)FMV + a\lambda FMV$, the expected value of FMV .