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Anti-dumping duties and the Byrd amendment*

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Abstract

The Byrd amendment to US anti-dumping law distributes the revenue from anti-dumping duties imposed on foreign firms to the domestic firms that lodged the complaint of dumping. When the government sets its anti-dumping duty to maximise a welfare function that attaches greater weight to the profits of the domestic industry than to consumer surplus or tax revenue, it is shown that the Byrd amendment will lead to lower duties and higher welfare if the weight on the profits of the domestic industry is sufficiently large. Also, the Byrd amendment makes it less likely that the anti-dumping duty will be prohibitive.

Keywords: Tariffs, US trade policy, WTO, Cournot oligopoly.

JEL classification: F12, F13.

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1. Introduction

President Clinton signed into law the Byrd amendment, formally known as the Continued Dumping and Subsidy Offset Act (CDSOA), on 28th October 2000. It introduced a system where the liquidated anti-dumping and countervailing duty revenues are distributed to the ‘affected domestic producers’ who supported the petition for the investigation. An ‘affected domestic producer’ is defined in the CDSOA as any manufacturer, producer, farmer, rancher, or worker representative who was a petitioner or interested party in support of the anti-dumping or countervailing duty investigation. They may receive a portion of the anti-dumping or countervailing duty revenue to offset ‘qualifying expenditures’, which includes fixed cost and some variable costs (e.g. investment in manufacturing facilities and the acquisition of technology) incurred in the production of the good subject to duties. The major beneficiaries of the CDSOA have been the ball-bearing, steel and other metals, household items and food (in particular, pasta) sectors. In the financial year 2001, US\$230 million was distributed to 900 claimants; in the financial year 2002, US\$330 million was distributed to 1,200 claimants; and in the financial year 2003 it is estimated that US\$280million was distributed to 2,100 claimants. On the 1st October 2003, CDSOA deposits in the clearing account (i.e. duty revenue available to be distributed to affected domestic producers) were US\$2.6 billion of which US\$1.4 billion was from the anti-dumping and countervailing cases on softwood lumber from Canada.¹

The Byrd amendment was subject to criticism from its inception and when it passed into law President Clinton noted that it would ‘provide select US industries with a subsidy above and beyond the protection level needed to counteract foreign subsidies, while providing no

¹ Sources for this and the following paragraph are the World Trade Organisation, Trade Policy Review for the United States from 2001 and 2003, and various press releases from the European Commission from 2000 to 2004.

comparable subsidy to other US industries or to US consumers, who are forced to pay higher prices on industrial inputs or consumer goods as a result of the anti-dumping and countervailing duties'. The European Union together with Australia, Brazil, Chile, India, Japan, Korea and Thailand complained to the World Trade Organisation about the Byrd amendment on the grounds that the offsets under the CDSOA were an illegal response to dumping and subsidies. They also claimed that it would create a clear incentive to petition for anti-dumping or countervailing duties, and would make it more difficult for exporters subject to anti-dumping or countervailing investigations to secure an undertaking. A WTO Panel Report was issued in September 2002 and, following an appeal by the US, the Appellate Body confirmed in January 2003 that the Byrd amendment was inconsistent with the Anti-Dumping Agreement, the Subsidies and Countervailing Measures Agreement, the GATT 1994 and the WTO Agreement as the offsets under the CDSOA were a non-permissible action against dumping and subsidies. The US was given until 27th December 2003 to bring its legislation into conformity with its WTO obligations but, when it failed to repeal the CDSOA, the EU together with several other co-complainants applied in January 2004 for WTO authorisation to apply sanctions in the form of higher import tariffs on US products.

The criticisms of the Byrd amendment assume that the level of protection granted to the domestic industry would be unaffected by the Byrd amendment as the anti-dumping or countervailing duties would be defined by the regulations. However, economists would argue that the level of protection is likely to be endogenous, and determined by the maximisation of some government welfare function by the policy-makers. It will be shown in this paper that if the policy-makers maximise a government welfare function that attaches a greater weight to the interests of the domestic industry then the Byrd amendment may result in a lower anti-dumping duty and higher welfare for the home country. The reason is that as the Byrd amendment gives the anti-dumping duty revenue to the domestic industry, the interests of the

domestic industry will include the duty revenue as well as profits so if the government attaches a sufficiently large weight to the interests of the domestic industry then it may be optimal to lower the duty to increase the duty revenue. It is also shown that the anti-dumping duty is less likely to be prohibitive with the Byrd amendment.

2. The Model

Consider a two-country model with the home country variables labelled with a subscript one and the foreign country variables labelled with subscript two. In the domestic market of the home country, there are n_1 domestic firms that compete with n_2 foreign firms in a Cournot oligopoly. Each home firm has constant marginal cost c_1 and its output for the domestic market is q_1 while each foreign firm has constant marginal cost c_2 and its exports to the home country are q_2 . Total domestic production for sale in the home country is $Q_1 = n_1 q_1$, and total imports of the home country (exports of the foreign country) are $Q_2 = n_2 q_2$; therefore, total sales in the home market are $Q = Q_1 + Q_2$. Consumer preferences in the home country are quasi-linear, and demand is given by the linear inverse demand function: $P = \alpha - \beta Q$, where the demand parameters are positive: $\alpha, \beta > 0$, $\alpha > c_1$ and $\alpha > c_2$. The anti-dumping duty (specific tariff) set by the government in the home country is t per unit imported. It is assumed that markets are segmented and that marginal costs are constant so the home market can be analysed independently of the foreign market.

The n_1 home and n_2 foreign firms compete as Cournot oligopolists in the domestic market of the home country taking the anti-dumping duty set by the government as given. With the Byrd amendment the anti-dumping duty revenue is given to the domestic industry so the profits of the i th domestic firm will include its share of the anti-dumping duty revenue,

which is tQ_2/n_1 if the duty is distributed equally between all domestic firms.² Thus, the profits of the i th domestic firm and the j th foreign firm are:

$$\pi_{1i} = \begin{cases} (P - c_1)q_{1i} & \text{without the Byrd amendment} \\ (P - c_1)q_{1i} + tQ_2/n_1 & \text{with the Byrd amendment} \end{cases} \quad (1)$$

$$\pi_{2j} = (P - c_2 - t)q_{2j}$$

In the Cournot equilibrium, each firm is setting its output to maximise its profits given the anti-dumping duty and the output of its competitors. Therefore, since $\partial Q_2/\partial q_1 = 0$ in a Cournot equilibrium, the presence of the anti-dumping duty revenue in the profits of the domestic firms will not have any effect on the Cournot equilibrium outputs. Assuming an interior solution where the home country is supplied by both domestic production and imports from the foreign industry, the first-order conditions for a Cournot equilibrium are:

$$\frac{\partial \pi_{1i}}{\partial q_{1i}} = P + q_{1i}P' - c_1 = \alpha - \beta Q - \beta q_{1i} - c_1 = 0 \quad i = 1, \dots, n_1$$

$$\frac{\partial \pi_{2j}}{\partial q_{2j}} = P + q_{2j}P' - c_2 = \alpha - \beta Q - \beta q_{2j} - c_2 - t = 0 \quad j = 1, \dots, n_2 \quad (2)$$

Since all home firms have the same marginal cost then they will all produce the same output in the Cournot equilibrium so $q_{1i} = q_1$, and since all foreign firms have the same marginal cost and face the same anti-dumping duty then they will all export the same output to the home market so $q_{2j} = q_2$. Thus, with this symmetry, the first-order conditions (2) can be solved for the outputs of the domestic industry and the imports from the foreign industry:

² This assumption about the distribution of the anti-dumping duty revenue is not important as the duty revenue turns out not to affect the Cournot equilibrium outputs.

$$Q_1 = \frac{n_1}{(N+1)\beta} [\alpha - (n_2 + 1)c_1 + n_2c_2 + n_2t] \quad (3)$$

$$Q_2 = \frac{n_2}{(N+1)\beta} [\alpha + n_1c_1 - (n_1 + 1)c_2 - (n_1 + 1)t]$$

where $N \equiv n_1 + n_2$ is the total number of firms in the domestic market. Note that to sign some of the later results it will be assumed that the quantity of imports is positive under free trade, $Q_2 > 0$ when $t=0$, which implies that $\alpha + n_1c_1 - (n_1 + 1)c_2 > 0$. Substituting the Cournot equilibrium outputs (3) into the demand function gives the Cournot equilibrium price:

$$P = \frac{1}{N+1} [\alpha + n_1c_1 + n_2c_2 + n_2t] \quad (4)$$

Although trade-lawyers may argue that the anti-dumping duties imposed on foreign firms are simply calculated, in line with the regulations, as being equal to the dumping or injury margin, trade-economists would argue that anti-dumping duties are endogenous and that policy-makers set anti-dumping duties to maximise some government welfare function. It seems plausible to suggest that the policy-makers are maximising a government welfare function that attaches more weight to the interests of the domestic industry than to the general interests of the consumers and the taxpayers. Such a government welfare function arises in the Grossman and Helpman (1994) model where special-interest groups lobby for protection by making political contributions to the government politicians who have a payoff function that depends upon the political contributions received and the welfare of the country. Grossman and Helpman (1994) analyse this problem as a menu-auction as in Bernheim and Whinston (1986). They show that the outcome of this problem is equivalent to the outcome if the government was maximising a welfare function that attached greater weight to the special-interest groups than to the general consumer and taxpayer interests. Hence, it will be assumed that the government attaches more weight to the profits of the domestic industry, the

special-interest group in this case, than to consumer surplus or tax revenue. Thus, the government in the home country chooses its anti-dumping duty to maximise its welfare, which is given by the weighted sum of consumer surplus, profits of domestic firms (producer surplus) and tariff revenue:

$$G = V(P) + \lambda(P - c_1)Q_1 + \mu t Q_2 \quad (5)$$

The government attaches a weight of one to consumer surplus, given by the indirect utility function: $V(P)$, a weight $\lambda > 1$ on the profits of the domestic industry, and a weight μ on duty revenue. Without the Byrd amendment, the duty revenue goes to the general taxpayers and has a weight of one ($\mu = 1$), whereas with the Byrd amendment the duty revenue goes to the domestic industry so it has the same weight as the profits of the domestic industry in the welfare of the government ($\mu = \lambda$). Therefore, the Byrd amendment can be modelled as an increase from $\mu = 1$ to $\mu = \lambda$, and by treating it as a continuous variable it is possible to analyse the problem using calculus.

Assuming an interior solution where the domestic market is supplied by both domestic production and imports from the foreign industry, the first-order condition for the maximisation of government welfare is:

$$\frac{\partial G}{\partial t} = -Q \frac{\partial P}{\partial t} + \lambda(P - c_1) \frac{\partial Q_1}{\partial t} + \lambda Q_1 \frac{\partial P}{\partial t} + \mu Q_2 + \mu t \frac{\partial Q_2}{\partial t} = 0 \quad (6)$$

The first term is the effect of the tariff on consumer surplus, the second and third effects are the effect on the profits of the domestic firms, and the fourth and fifth terms are the effect on tariff revenue. Using the Cournot equilibrium outputs (3) and price (4), and noting that the price-cost margin of the home firms is: $P - c_1 = \beta q_1 = \beta Q_1 / n_1$, the first-order condition can be re-written as:

$$\frac{\partial G}{\partial t} = \frac{1}{(N+1)\beta} \left[(2\lambda - 1)n_2\beta Q_1 + \{(N+1)\mu - n_2\}\beta Q_2 - n_2(n_1+1)\mu t \right] = 0 \quad (7)$$

Further differentiation yields the second-order condition for the maximisation of government welfare:

$$\frac{\partial^2 G}{\partial t^2} = \frac{-n_2}{(N+1)^2 \beta} \left[2(n_1+1)(N+1)\mu - 2n_1n_2\lambda - n_2 \right] < 0 \quad (8)$$

The second-order condition will be satisfied provided the term in square brackets is positive, and this will be the case if the weight on the profits of the domestic industry is not too large: $\lambda < \lambda^S \equiv \left[2(n_1+1)(N+1)\mu - n_2 \right] / 2n_1n_2$, which implies that $\lambda < 11/2$ in the case of a duopoly ($n_1 = n_2 = 1$) without the Byrd amendment, $\mu = 1$.³ The second-order condition will always be satisfied with the Byrd amendment when the weight on tariff revenue is the same as the weight on the profits of the domestic industry ($\mu = \lambda$) as the term in square brackets will be positive: $2\lambda(n_1+1)^2 + (2\lambda - 1)n_2 > 0$.

The optimum anti-dumping duty (specific tariff) for the government is obtained by setting the expression in square brackets in (7) equal to zero and rearranging:

$$t^* = \frac{\beta}{n_2(n_1+1)\mu} \left[(2\lambda - 1)n_2Q_1 + \{(N+1)\mu - n_2\}Q_2 \right] > 0 \quad (9)$$

Since the outputs of the domestic and foreign industry are assumed to be positive quantities, the optimum anti-dumping duty for the government is unambiguously positive, but it is interesting to consider how it depends upon the weight that the government puts on the profits of the domestic industry. The effect of the weight attached to the profits of the

³ The profits of the domestic industry are increasing and convex in the anti-dumping duty so if the government puts a large weight on the profits of the domestic industry then the welfare of the government will

domestic industry on the optimum anti-dumping duty can be assessed by totally differentiating the first-order condition for welfare maximisation (7), which yields:

$$\frac{dt^*}{d\lambda} = -\frac{\partial^2 G}{\partial \lambda \partial t} / \frac{\partial^2 G}{\partial t^2} \quad \text{where} \quad \frac{\partial^2 G}{\partial \lambda \partial t} = \frac{2n_2 Q_1}{N+1} > 0 \quad (10)$$

The denominator is the second-order condition for welfare maximisation (8), which is negative. Thus, the effect of an increase in the weight that the government attaches to the profits of the domestic industry in its welfare function is:

$$\frac{dt^*}{d\lambda} = \frac{2(N+1)\beta Q_1}{2(n_1+1)(N+1)\mu - 2n_1 n_2 \lambda - n_2} > 0 \quad (11)$$

As one would expect, the greater the weight that the government attaches to the profits of the domestic industry then the larger will be the optimum anti-dumping duty. This leads to the following proposition:

Proposition 1: *The optimum anti-dumping duty (specific tariff) is positive, and increasing in the weight on the profits of the domestic industry in the welfare function of the government.*

If $\mu = \lambda = 1$ then optimum anti-dumping duty formula would be the same as the optimum tariff in Brander and Spencer (1984a and b), where the tariff improves welfare by shifting profits from foreign firms to domestic firms and by extracting rent from the foreign firms. When the government puts a weight greater than one on the profits of the domestic industry then the anti-dumping duty will be larger than the optimum tariff in Brander and Spencer (1984a and b). Using a general demand function, Brander and Spencer (1984a and b) show that the optimum tariff is positive unless demand is extremely convex. However, when the

be convex in the anti-dumping duty. Then, the optimum anti-dumping duty will be prohibitive so imports will be equal to zero. The case of prohibitive duties will be analysed explicitly in section five.

government attaches a weight greater than one to the profits of the domestic industry then the anti-dumping duty is more likely to be positive.

3. Anti-dumping Duties and the Byrd Amendment

Having derived the optimum anti-dumping duty of the government, one can now consider how the Byrd amendment affects the optimum anti-dumping duty. With the Byrd amendment, the duty revenue is distributed to the domestic industry so the firms are now concerned about duty revenue as well as their profits and therefore the government will attach the same weight to duty revenue as to the profits of the domestic industry. Thus, the Byrd amendment can be represented by an increase in the weight on duty revenue from $\mu = 1$ to $\mu = \lambda$ in the welfare function of the government. The effect of the Byrd amendment can be derived by looking at the comparative static results for how the optimum anti-dumping duty is affected by an increase in the weight on duty revenue. Totally differentiating the first-order condition for the maximisation of government welfare (7) and solving yields:

$$\frac{dt^*}{d\mu} = - \frac{\partial^2 G}{\partial \mu \partial t} / \frac{\partial^2 G}{\partial t^2} \quad (12)$$

The denominator is the second-order condition for the maximisation of government welfare (8) and hence is negative. Evaluating the second-order derivative in the numerator yields:

$$\begin{aligned} \frac{\partial^2 G}{\partial \mu \partial t} &= \frac{1}{(N+1)\beta} [(N+1)\beta Q_2 - n_2(n_1+1)t] \\ &= \frac{n_2}{(N+1)\mu} (Q - 2\lambda Q_1) \end{aligned} \quad (13)$$

The second expression is obtained by substituting the optimum anti-dumping duty into the first expression. Thus, the effect of the Byrd amendment on the optimum anti-dumping duty is:

$$\frac{dt^*}{d\mu} = \frac{\beta(N+1)[Q - 2\lambda Q_1]}{\mu[2(n_1+1)(N+1)\mu - 2n_1n_2\lambda - n_2]} \quad (14)$$

The sign of the expression in square brackets in the denominator is positive if the second-order conditions are satisfied while the term in square brackets in the numerator is negative if the weight on the profits of the domestic industry exceeds a critical value: $\lambda^* \equiv Q/2Q_1 = 1/2d$, where $d \equiv Q_1/Q$ is the market share of the domestic industry. Note that if the market share of the domestic industry is greater than one-half then the critical weight is less than one so $dt^*/d\mu$ is negative for any $\lambda \geq 1$. If $\lambda > \lambda^*$ the optimum anti-dumping duty will decrease as a result of the Byrd amendment (an increase in μ), and this leads to the following proposition:

Proposition 2: *The Byrd amendment (an increase in μ) will result in a lower anti-dumping duty if the weight on the profits of the domestic industry in the government welfare function exceeds the critical value $\lambda^* \equiv 1/2d$.*

To understand this result one has to appreciate that in a Cournot oligopoly model, in contrast to a model with perfect-competition, optimum-welfare tariff may exceed the maximum-revenue tariff. In a Cournot duopoly model, Collie (1991) showed that the optimum welfare tariff would exceed the maximum revenue tariff if both firms had the same marginal costs and, generally, this would be the case unless the foreign firm had a sufficiently large cost advantage. When the government attaches a weight greater than one on the profits of the domestic industry then it is even more likely that the optimum anti-dumping duty exceeds the duty that maximises duty revenue. Then, if there is an increase in the weight that

the government attaches to duty revenue then this will lead the government to reduce its optimum anti-dumping duty as this will increase duty revenue. Proposition two shows that if the weight that the government attaches to the profits of the domestic industry is sufficiently large, $\lambda > \lambda^*$, then the optimum anti-dumping duty will exceed the duty that maximises duty revenue and the Byrd amendment will lead to a reduction in the anti-dumping duty. Since the critical value of the weight is less than one if the market share of the domestic industry is larger than one-half, this would seem to be more than a remote theoretical possibility.

The critical value of the weight on the profits of the domestic industry is obviously an important factor in this analysis, and therefore the critical value will be investigated in some detail. The critical value is inversely related to the market share of the domestic industry, which is an endogenous variable depending upon the number of domestic and foreign firms and their costs. It is possible to solve the model explicitly and to obtain an explicit solution for the critical weight:

$$\lambda^* = \frac{1}{2n_1} \cdot \frac{\{2n_1(N+1) + n_2\} \alpha - n_1(2n_1 + n_2 + 2)c_1 - n_2(n_1 + 1)c_2}{(2n_1 + n_2 + 2)\alpha - \{n_1(n_2 + 2) + 2(n_2 + 1)\}c_1 + n_2(n_1 + 1)c_2} \quad (15)$$

This expression is rather complicated, but when there is a duopoly and the firms have the same marginal cost the critical value of the weight is less than one, $\lambda^* = 7/10$. The comparative static results for the critical value of the weight on the profits of the domestic industry can be obtained by differentiating (15) with respect to the costs and the number of firms:

$$\begin{aligned}
\frac{\partial \lambda^*}{\partial c_1} &= \frac{(n_1 + 1)^2 n_2 (N + 1)(\alpha - c_2)}{\Delta} > 0 \\
\frac{\partial \lambda^*}{\partial c_2} &= \frac{-(n_1 + 1)^2 n_2 (N + 1)(\alpha - c_1)}{\Delta} < 0 \\
\frac{\partial \lambda^*}{\partial n_2} &= \frac{(n_1 + 1)^2 (\alpha - c_1)}{\Delta} \{ \alpha + n_1 c_1 - (n_1 + 1) c_2 \} > 0 \\
\frac{\partial \lambda^*}{\partial n_1} \Big|_{c_1=c_2} &= \frac{-n_2}{2n_1^2 (2n_1 + n_2 + 2)^2} \{ 2(n_1 + 1)^2 + n_2 \} < 0
\end{aligned} \tag{16}$$

All have the expected sign: an increase in the costs of the home firms, a decrease in the costs of the foreign firms, and an increase in the number of foreign firms will all reduce the market share of the domestic industry and result in a consequent increase in the critical value of the weight. In general, the effect of an increase in the number of home firms is ambiguous but will increase the critical value of the weight if home and foreign firms have the same costs. The ambiguity is due to the fact that the direct effect of the increase in the number of home firms is to increase the market share of the domestic industry, but the indirect effect is to reduce the price-cost margin of the home firms and thereby to reduce the optimum anti-dumping duty, which will decrease the market share of the domestic industry. The critical value of the weight will be relatively large if there are many foreign firms with low costs and a few home firms with high costs, and it may be that this case is the most relevant for anti-dumping cases. However, it should be pointed out that there are only a few anti-dumping cases where the market-share of the domestic industry is less than one-half and in these cases the critical value of the weight will be less than one so proposition two will hold.⁴

⁴ It should be stressed that the relevant market-share of the domestic industry is the market-share with the anti-dumping duty and not the market-share under free trade as the results were evaluated with the optimum anti-dumping duty.

4. Welfare and the Byrd Amendment

As the optimum anti-dumping duty is larger than the optimum-welfare tariff, it may be conjectured that if the Byrd amendment results in a lower anti-dumping dumping duty then it will increase the welfare of the home country. To ascertain whether this conjecture is correct, one has to analyse how the welfare of the home country is affected by changes in the optimum anti-dumping duty as a result of the Byrd amendment. The welfare of the home country (as opposed to the welfare of the government) is defined as the unweighted sum of consumer surplus, producer surplus and government revenue.

$$W = V(P) + (P - c_1)Q_1 + tQ_2 \quad (17)$$

As the government is setting the anti-dumping duty to maximise its welfare, G , it is advantageous to re-write the welfare of the country in terms of government welfare. By comparing (5) and (17) it can be seen that the welfare of the country can be written as:

$$W = G - (\lambda - 1)(P - c_1)Q_1 + (\mu - 1)tQ_2 \quad (18)$$

To evaluate the effect of the Byrd amendment on the welfare of the home country differentiate (18) with respect to μ , while noting that $\partial G/\partial t = 0$ since the optimum anti-dumping duty maximises government welfare (5) and also that $\partial G/\partial \mu = tQ_2$. This yields the following:

$$\frac{dW}{d\mu} = - \left[(\lambda - 1) \left\{ (P - c_1) \frac{\partial Q_1}{\partial t} + Q_1 \frac{\partial P}{\partial t} \right\} + (\mu - 1) \left\{ Q_2 + t \frac{\partial Q_2}{\partial t} \right\} \right] \frac{dt^*}{d\mu} \quad (19)$$

Using the comparative static results from (3) and (4) this can be simplified to:

$$\frac{dW}{d\mu} = \frac{-1}{(N+1)\beta} \left[2(\lambda - 1)n_2\beta Q_1 + (\mu - 1)\{(N+1)\beta Q_2 - n_2(n_1+1)t\} \right] \frac{dt^*}{d\mu} \quad (20)$$

Then, substituting the optimal anti-dumping duty (9) into (20) yields:

$$\frac{dW}{d\mu} = \frac{-n_2}{(N+1)\mu} [(2\lambda - \mu - 1)Q_1 + (\mu - 1)Q_2] \frac{dt^*}{d\mu} \quad (21)$$

Since $1 \leq \mu \leq \lambda$ and the outputs of the domestic and foreign industries are positive, the term in square brackets is positive so the overall sign is the opposite to the effect on the tariff of an increase in the weight on the profits of the domestic industry, $dt^*/d\mu$. Therefore, if the Byrd amendment results in a lower anti-dumping duty then the welfare of the home country will increase as a result. This leads to the following proposition:

Proposition 3: *If $\lambda > \lambda^* \equiv 1/2d$ then the Byrd amendment (an increase in μ) will result in a lower anti-dumping duty and higher welfare for the home country.*

The explanation is that when the government puts a weight greater than one on the profits of the domestic industry then the optimum anti-dumping duty is larger than the optimum-welfare tariff for the home country so if the Byrd amendment leads to a lower anti-dumping duty then it will increase the welfare of the home country. Conversely, if the Byrd amendment leads to a higher anti-dumping duty then it will decrease the welfare of the home country.

5. Prohibitive Anti-Dumping Duties and the Byrd amendment

The analysis in sections three and four assumed an interior solution where the domestic market in the home country was supplied by both domestic production and imports from the foreign industry. However, it is possible that the optimum anti-dumping duty will be prohibitive and result in zero imports from the foreign industry especially if the weight that the government attaches to the profits of the domestic industry is large. Therefore, the possibility of a boundary solution where the anti-dumping duty is prohibitive and there are no

imports will be considered in this section. From (3), the exports of the foreign industry to the home country will be equal to zero, $Q_2 = 0$, if the anti-dumping duty set by the government is larger than the prohibitive duty:

$$t \geq t^P \equiv \frac{\alpha + n_1 c_1 - (n_1 + 1)c_2}{n_1 + 1} > 0 \quad (22)$$

There will be a boundary solution where the optimum anti-dumping duty is prohibitive if government welfare is increasing when evaluated at the prohibitive duty, $t = t^P$, which implies that imports are equal to zero, $Q_2 = 0$. This will be the case if the welfare of the government is convex so that the second-order conditions are not satisfied, $\lambda > \lambda^S$, or it may happen if the welfare of the government is concave. Using (7), the derivative of government welfare evaluated at the prohibitive anti-dumping duty is:

$$\frac{\partial G}{\partial t} = \frac{n_2}{(N+1)\beta} \left[(2\lambda - 1)\beta Q_1 - (n_1 + 1)\mu t^P \right] \quad (23)$$

Using (3) and (22), it can be shown that this will be positive if the weight on the profits of the domestic industry is larger than the prohibitive weight λ^P , which is defined as:

$$\lambda^P \equiv \frac{1}{2} \left[1 + \frac{(n_1 + 1)\mu}{n_1(\alpha - c_1)} \{ \alpha + n_1 c_1 - (n_1 + 1)c_2 \} \right] \quad (24)$$

Without the Byrd amendment, $\mu = 1$, when firms have the same marginal costs the prohibitive weight is: $\lambda_N^P = (2n_1 + 1)/2n_1$, whereas with the Byrd amendment, $\mu = \lambda$, it is: $\lambda_B^P = n_1/(n_1 - 1)$, which is higher than without the Byrd amendment, $\lambda_B^P > \lambda_N^P$. In general, it can be seen that the critical value is increasing in the weight on duty revenue, $d\lambda^P/d\mu > 0$, so the critical value will be higher with the Byrd amendment than without the Byrd amendment. This leads to the following proposition:

Proposition 4: *The Byrd amendment (an increase in μ) reduces the prohibitive weight λ^p and makes it less likely that the optimum anti-dumping duty will be prohibitive.*

Thus, the optimum anti-dumping duty is more likely to be prohibitive without the Byrd amendment than with the Byrd amendment. Also, since the market-share of the domestic industry is 100% with a prohibitive anti-dumping duty, the critical value of the weight on the profits of the domestic industry is one-half, $\lambda^* = \frac{1}{2}$, so proposition three implies that if the Byrd amendment leads to the anti-duty being reduced to below the prohibitive rate then it will lead to higher welfare.

6. Conclusions

It has been shown that the Byrd amendment can result in a lower anti-dumping duty and higher welfare for the home country if the weight that the government attaches to the interests of the domestic industry is sufficiently large. The reason is that when the government attaches a sufficiently large weight to the interests of the domestic industry then the optimum anti-dumping duty will exceed the maximum revenue tariff so the government can increase duty revenue, which goes to the domestic industry, by reducing the optimum anti-dumping duty. This increases welfare of the home country by shifting the optimum anti-dumping duty closer to the optimum-welfare tariff. Note that if the Byrd amendment results in a lower anti-dumping duty, it will also result in higher welfare for the foreign country.

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