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Antidumping Petition: To File or Not To File

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Abstract

Given the "normal value" of a product as common knowledge in an import-competing market, the profitability of a home firm in filing an antidumping (AD) petition against its foreign rival is shown to depend on the marginal cost differential between the home and foreign firms. When the marginal cost differential is "significantly large," the home firm's ability to put the foreign firm at the risk of an AD violation is limited. But when the marginal cost differential is "significantly small," the home firm is able to increase its output and lower the price of the product below its normal value, putting the foreign firm in the situation of an illegal dumping. One interesting implication is that, relative to the case without an AD law, the home firm has a stronger incentive to undertake cost-reducing activities (e.g., R&D investment or the adoption of a more efficient technology) under the law.

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1. Introduction

Dumping arises when a foreign firm sells product at a price below its "normal value" in the home market. Dumping as a strategy for exporting countries in international markets and antidumping (AD) policy as an instrument for restricting imports have been studied extensively in the trade literature.[1] The World Trade Organization (WTO) allows governments of member countries to take actions against dumped imports in order to protect their domestic industries.

In this paper, we present a simple duopolistic model to analyze the economic incentive of a home firm in filing petition for an AD investigation, taking into account output interactions between the firm and its foreign rival in the home country's market under an AD law.[2] Given the "normal value" of an imported product as common knowledge (Evenett, 2006), we show that whether the foreign firm is accused of violating an AD law depends on differences in marginal costs between the home and foreign firms. When the home firm is relatively inefficient in production, its ability to put a foreign firm at the risk of an AD charge by lowering the market price through an increase in output is rather limited. But this result changes when the marginal cost differential is "significantly small" and the home firm is capable of increasing its production. In this case, the increase in domestic production may cause the price of the product to fall below its normal value, with the result that the foreign firm violates an AD law.

The analysis with this paper may help identify the conditions under which a domestic firm finds it profitable to file an AD petition against its foreign rival or whether the foreign firm can successfully avoid an AD charge. In other words, the analysis shows possible types of domestic firms that tend to file petition against foreign firms of illegal dumping. Not surprisingly, these are domestic firms that are relatively efficient in production or those firms whose market shares are large relative to their foreign competitors.

Collie and Vandenbussche (2006) analyze the incentive for U.S. industries to file an AD petition under the Byrd Amendment when domestic industries alleging harm receive a share of the duty rent. The authors show that if the U.S. government puts a sufficiently large weight on domestic profits in social welfare, an industry has a strong incentive to file petition for an AD investigation when its market share exceeds 50%. In our paper, we show that Collie and Vandenbussche's (2006) finding carries over to the traditional case of an AD law without redistributing the duty revenue to domestic industries. In our simple model with the traditional AD law, we find condition under which adjustments in domestic production can put a foreign firm into an AD violation. This condition arises when the marginal cost differential between home and foreign firms is significantly low and the market share of the home firm exceeds 50%. Our finding is consistent with an interesting observation by Collie and Vandenbussche (2006) that, according to U.S. data on AD cases for 1980-1995, the average market share of U.S. firms that filed petitions was as high as 67%.[3]

One interesting implication of our analysis is that, compared to the case without an AD

[1] For studies on dumping and countervailing tariffs under the traditional antidumping law, see, e.g., Dixit (1988), Anderson (1992, 1993), Prusa (1992, 1994), Reitzes (1993), Marvel and Ray (1995), and Gao and Miyagiwa (2005). For issues related to administered protection and the political economy of antidumping, see, e.g., Finger, Hall, and Nelson (1982), Irwin (2004), and Nelson (2006). Stiglitz (1997) contains a review of the U.S. import laws including the AD and countervailing measures.

[2] We consider the traditional antidumping law under which AD duties are collected by the importing country's treasure as revenue. For other issues on AD such as the Continued Dumping and Subsidy Offset Act implemented by U.S. government under which the revenue from AD fines are redistributed to domestic firms alleging harm, see, for example, Chang and Gayle (2006), Collie and Vandenbussche (2006), Evenett (2006).

[3] The data sets in Collie and Vandenbussche (2006) can be found at: http://darkwing.uoregon.edu/~bruce/adpage.

law, a domestic firm has a stronger incentive to undertake cost-reducing activities (e.g., R&D investment or the adoption of a more efficient technology) under the law. By reducing the marginal cost differential via such activities, the domestic firm is able to increase its output and lower the market price of the product below the normal value, putting its foreign competitor in the situation of a dumping violation. However, when the marginal cost differential is "significantly large" or when the domestic firm cannot afford cost-reducing investments, its foreign competitor is able to dominate the market without running the risk of being charged with an AD fine. In this case, filling an AD petition is ineffective.

The remaining of the paper is organized as follows. Section 2 presents a simple model of duopolistic competition to analyze strategic interactions between home and foreign firms under an AD law. We discuss possible equilibrium outcomes of the Nash equilibrium and examine the conditions under which AD policy increases domestic profits. In Section 3, we discuss implications of the model regarding the home firm's incentives in undertaking cost-reducing R&D under an AD law, relative to the case without the law. We also examine possible effects on domestic consumer surplus when the home firm may or may not invest in cost-reducing activities. Section 4 contains concluding remarks.

2. The Model

2.1 Basic Assumptions

We present a simple model of duopolistic competition in an import-competing market under an AD law. Our aim is to analyze how differences in production efficiency between home and foreign firms (in terms of marginal cost differential) affect the home firm's profitability in filing an AD petition. We assume that there is one firm located in each country, producing a homogeneous product. The home country's government implements an AD law and is committed to enforce the law. We use variable I to represent whether the foreign firm is accused and convicted of an AD violation. When $I = 1$, an AD order is placed on the good produced by the foreign firm and the firm is charged with an AD duty. Otherwise, $I = 0$.

If the foreign firm is convicted of an AD violation, the firm has to pay fines based on the dumping margin. Denote the margin of dumping as τ which is calculated according to the following formula:

$$\tau = \begin{cases} \phi - p & \text{if } \phi \geq p, \\ 0 & \text{if } \phi < p, \end{cases} \tag{1}$$

where ϕ is the "normal value" of the foreign import and p is market price of the product. As in Pauwels et. al. (2001) and Evenett (2006), we assume that ϕ is exogenously given and is common knowledge to both firms and the home country government.

Let q and q^* represent the quantities of the competing good produced by home and foreign firms, respectively. Market demand in the home country is taken to be linear: $P = a - Q$, where $Q(= q + q^*)$ is total consumption of the good and the positive parameter a (> 0) captures the good's market size. We assume that the home firm's marginal cost is constant at c and the foreign firm's marginal cost is constant at c^*, where $c > c^*$.[4] This assumption indicates that the

[4] Miyagiwa and Ohno (2007) present an interesting model to show that a foreign firm dumps because it possesses a new production technology. The authors argue that dumping may turn out to be a signal of innovation.

foreign firm is more efficient in production than the home firm.

The operating profits for the home and foreign firms are given, respectively, as

$$\pi = (a - Q - c)q \tag{2}$$

and

$$\pi^* = (a - Q - c^*)q^* - I(\phi, p)\tau q^*, \tag{3}$$

where τ is dumping margin (see eq. (1)) and $I(\phi, p)$ takes on the value of 1 or zero. That is,

$$I(\phi, p) = \begin{cases} 0 \text{ if } p > \phi; \\ 1 \text{ if } p \le \phi. \end{cases} \tag{4}$$

For the case in which $I = 0,$ there will be no AD charges against the foreign firm so that there is free trade. But for the case in which $I = 1,$ the foreign firm is convicted of an AD violation because the good's market price is below its normal value. Consequently, the foreign firm is charged with a fine equal to τq^*.

2.2 *Optimal Output Decisions of the Firms*

We assume that both the home and foreign firms employ a Cournot strategy in their production decisions. For analytical simplicity, we normalize c^* to zero and interpret $c(>0)$ as the marginal cost differential between the home and foreign firms.

Maximizing the home firm's profit in equation (2) with respect to q, we derive the firm's output reaction function:

$$R(q^*; c) = \frac{a - c - q^*}{2}. \tag{5}$$

As for the foreign firm's reaction function, it depends crucially on the dumping margin as specified in equation (1) and whether the home government places any AD order on the foreign product as defines in equation (4). Maximizing the foreign firm's profit in equation (3) with respect to q^*, subject to these constrained conditions, we derive the following reaction function:

$$R^*(q;\phi) = \begin{cases} \dfrac{a - q}{2} & \text{if } q \le \overline{q}, \\ a - \phi - q & \text{if } \overline{q} \le q \le \tilde{q}, \\ \dfrac{2a - \phi - 2q}{4} & \text{if } q \ge \tilde{q}, \end{cases} \tag{6}$$

where $\overline{q} = a - 2\phi$ and $\tilde{q} = a - 3\phi/2$. We assume that $\phi < a/2$ which guarantees $\overline{q} > 0$ and $\tilde{q} > 0$. This assumption is plausible since it implies that the product's normal value (ϕ) is lower than its monopoly price $(a/2)$. Due to the dumping-margin constraint and the home government's AD actions, the foreign firm's reaction function has three components as shown in equation (6). It is instructive to use a graphical approach to explain the constrained conditions and the resulting reaction function.

First, we need to show the graphical interpretation of the dumping-margin constraint (see equation (1)). When the foreign firm produces at a level such that the equilibrium market price

of the good equals its normal value, i.e., $p = \phi$, no AD fines will be charged to the firm. It follows from equation (1) and the linear demand function that $\phi = a - q - q^*$. Under the assumption that the normal value is exogenously given, we have $d\phi = 0$ and $dq^* / dq = -1$. In Figure 1, line AA' with a slope of minus one illustrates this case. Line AA' can thus be referred to as the "zero-dumping-margin line." If the total output level of the home and foreign firms occurs at a point outside the AA' line, the foreign firm violates the law. In this case, the firm is charged with an amount of the AD fine equal to the dumping margin, $\tau (= \phi - p > 0)$, times the quantity of the foreign good dumped in the domestic market. If, instead, the total output level of the home and foreign firms occur at a point inside line the AA', there will be no antidumping charges.

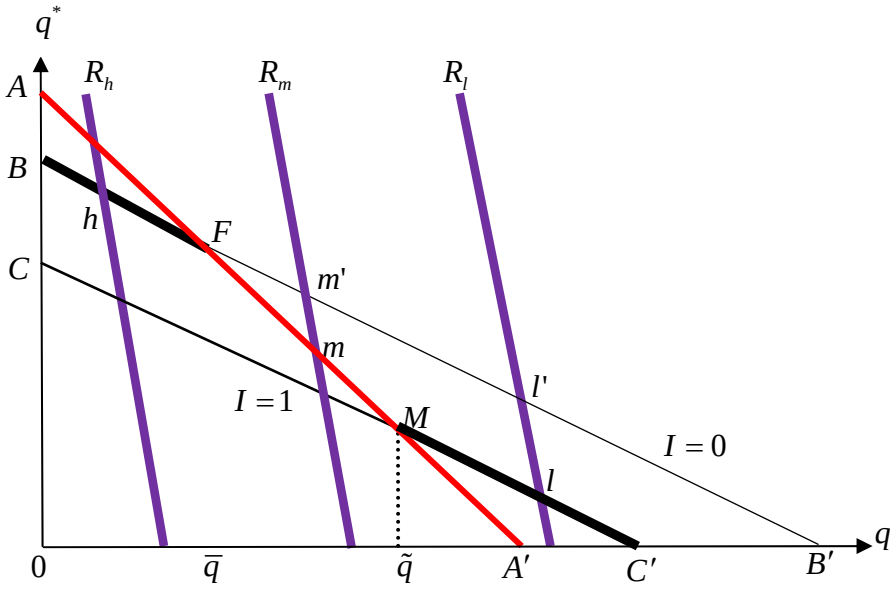

Figure 1. *The foreign firm's reaction function and Nash equilibrium when the marginal cost differential is high, moderate, or low*

Next we show the graphical interpretations of AD actions by the home government and the resulting output decisions by the foreign firm. When there are no dumping charges so that $I = 0$, the foreign firm's reaction function is given by line BB'. This is exactly the case under free trade. Line BB' and the zero-dumping-margin line AA' determine a critical point F such that the foreign firm does not violate an AD law when producing at any point over the segment BF. The critical level of the domestic output at point F is $\bar{q}$. When there is an AD charge against the foreign firm (i.e., $I = 1$), the foreign firm's reaction function shifts leftward to the one as shown by line CC'. Line CC' and the zero-dumping-margin line AA' determine another critical point M such that the foreign firm violates the AD law when producing at a point on MC'. The critical level of the domestic output at point M is $\tilde{q}$. Thus, if the home firm's output is "low" ($q < \bar{q}$) or "moderate" ($\bar{q} < q < \tilde{q}$), the foreign firm responds by producing at a point over BF or FM without being charged with an AD fine. But if the home firm's output is "high" ($q > \tilde{q}$), the foreign firm responds by producing at a point over MC'. The foreign firm

sells its product at a price below the normal value and is subject to an AD fine. Thus, the foreign firm's reaction curve has three components as shown by $BFMC'$.

We are now in a position to characterize the Nash equilibrium of the import-competing market. To do so, we use the reaction functions in (5) and (6) to solve for the equilibrium outputs of the home and foreign firms as follows:

$$q = \begin{cases} \dfrac{a-2c}{3} & \text{if } c \geq 3\phi - a, \\ (\phi - c) & \text{if } \dfrac{5\phi}{2} - a \leq c \leq 3\phi - a, \\ \dfrac{2a-4c+\phi}{6} & \text{if } c \leq \dfrac{5\phi}{2} - a, \end{cases} \tag{7}$$

$$q^* = \begin{cases} \dfrac{a+c}{3} & \text{if } c \geq 3\phi - a, \\ (a+c-2\phi) & \text{if } \dfrac{5\phi}{2} - a \leq c \leq 3\phi - a, \\ \dfrac{a+c-\phi}{3} & \text{if } c \leq \dfrac{5\phi}{2} - a. \end{cases} \tag{8}$$

We then calculate the product's market equilibrium price:

$$p = \begin{cases} \dfrac{a+c}{3} & \text{if } c \geq 3\phi - a, \\ \phi & \text{if } \dfrac{5\phi}{2} - a \leq c \leq 3\phi - a, \\ \dfrac{2a+2c+\phi}{6} & \text{if } c \leq \dfrac{5\phi}{2} - a. \end{cases} \tag{9}$$

It follows from equations (7)-(9) that the equilibrium outcomes differ in terms of differences in production efficiency between the two firms as reflected by their marginal cost differential. For the purpose of our analysis, we show three possible scenarios in Figure 1. When the marginal cost differential is "high," "moderate," or "low," the home firm's reaction curve is given by R_h, R_m, or R_l, respectively. Nash equilibrium outputs of the firms then occur at h, m, or l, respectively. It comes as no surprise that under Cournot competition the optimal outputs of the two competing firms are strategic substitutes. The equilibrium points h and m indicate that the foreign firm does not violate an AD law since they are lying either inside or on the zero-dumping-margin line AA'. An equilibrium point like l is where the foreign firm sells the product at a price below its normal value and hence is subject to an AD duty.

As can be seen from Figure 1, when the home firm's output is equal to or lower than $\bar{q}$, the foreign firm is capable of selling its product with a relatively high market share along line BF. In this case, the foreign firm is not vulnerable to any AD charge. The reason is that the home firm is a high-cost firm and its ability to put the foreign rival in the situation of an illegal dumping is limited. When the home firm's output is greater than $\bar{q}$ but is less than $\tilde{q}$, foreign output along line FB' will result in an AD charge. The question of interest is: what would be the foreign firm's strategy in exports? To answer this question, we find that there are two

possibilities depending on the level of output produced by the home firm. The first possibility is when the home firm's output is at a level over the range of $\bar{q} \le q \le \tilde{q}$. The foreign firm chooses to produce at a point along the line segment of FM. Since FM is part of line AA', there involves no AD violations. The second possibility is when the home firm's output is relatively large so that $q > \tilde{q}$. Interestingly, the foreign firm may simply pay fines by selling its product along the MC' segment. This situation arises when the market share of the home firm is large relative to that of the foreign firm's.

The graphical analysis indicates that, given a product's normal value, whether a foreign firm will be convicted of an AD violation depends crucially on the marginal cost differential. We show in Proposition 1 that there is a critical level of marginal cost differential below which the foreign firm is convicted of illegal dumping.

PROPOSITION 1. *Whether a foreign firm will be charged with a dumping violation depends on the marginal cost differential (or the relative efficiency in production) between home and foreign firms. If the marginal cost differential is "significantly small," the home firm is able to increase its output and lower the product price, causing the foreign firm at the situation of violating an AD law. In this case, the home firm has an economic incentive to file an AD petition against its foreign competitor. Moreover, the market share of the home firm is greater than 50%.*

Proof: See A-1 in the Appendix. ■

This proposition indicates that the more efficient the home firm is in production, the greater its incentive to file an AD petition, and the higher the likelihood that its foreign competitor will be selling a product at a price below its normal value.

Based on the above analytical framework, we find that marginal cost differential between home and foreign firms plays a key factor in determining (i) a domestic industry's market share in the face of foreign competition and (ii) whether the foreign firm sells its product at a price below the product's normal value. Proposition 1 implies that, given the normal value of an imported good, a domestic firm whose market share is significantly large tends to file petition for an AD investigation against its foreign rival. This finding is consistent with the analysis of Collie and Vandenbussche (2006). The authors examine the incentive for U.S. industries to file an AD petition under the Byrd Amendment and find that an industry has a strong incentive to file an AD petition when its market share exceeds 50%.

With respect to the effect on domestic profits, we have

PROPOSITION 2. *When the marginal cost differential between home and foreign firms is moderate or small, domestic profits are higher under the AD law than under free trade, regardless of whether or not the foreign firm is convicted of an illegal dumping.*

Proof: See A-2 in the Appendix. ■

Reitzes (1993) presents a two-period model of duopoly and finds that adjustment in domestic production in period one can strategically put a foreign firm at the risk of an AD violation. In our one-period analysis, we pay particular attention to the aspect of marginal cost differential in affecting whether an imported product is dumped at a price below its normal value. In other words, production technology is an important factor in determining the profitability of a home firm in filing a successful AD charge against its foreign competitor.

3. Cost-Reducing Activities and an AD Law

In this section, we discuss implications of the model regarding the home firm's incentive to invest in cost-reducing activities that lower its marginal cost under an AD law. We will show that, relative to the case without an AD law, it is more profitable for the home firm to lower the marginal cost differential by undertaking cost-reducing activities.

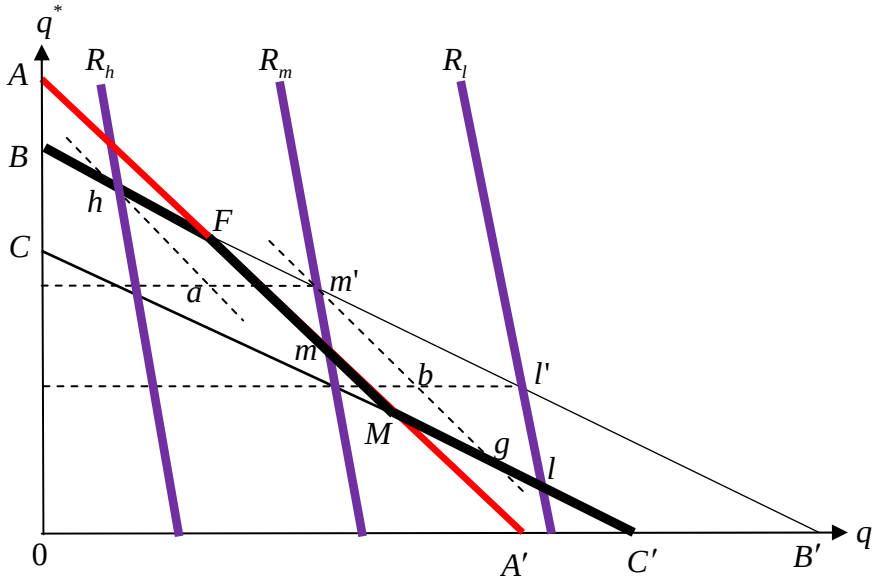

Figure 2. *Incentives of the home firm in undertaking cost-reducing R&D*

Recall that we examine three possible scenarios for the home firm's reaction function when its marginal cost is high (c_h), moderate (c_m), or low (c_l). Consider the case where the home producer is initially a high-cost firm (c_h) such that its reaction curve is R_h. In the absence of an AD law, the foreign firm's reaction curve is BB' and the free trade equilibrium occurs at h. Suppose that by undertaking a certain level of cost-reducing activities, the home firm is able to lower the marginal cost differential from c_h to c_m. This generates a rightward shift in the home firm's reaction curve from R_h to R_m. Consequently, the free trade equilibrium changes from point h to point m'. For evaluating the profitability of the cost-reducing activities for the home firm, we compare domestic profits between m' and h. We first draw a hypothetical line passing through point h which is parallel to line AA' of the 45-degree right triangle, $0AA'$. We then draw a horizontal line passing through m'. The hypothetical line and the horizontal line intercept at point a. Since h and a are on the same line parallel to segment AA' of the right triangle, the aggregate output levels at h and a are exactly identical, that is, $q_h + q_h^* = q_a + q_a^*$. So will the product's market price at these two points, i.e., $p^h = p^a$. It follows that when the marginal cost differential is as high as c_h, the home firm's profit is lower at h than at a. That is, $\pi^h(c_h) < \pi^a(c_h)$. At point a, domestic profit is higher when the marginal cost differential is lower, other things being equal. That is, $\pi^a(c_h) < \pi^a(c_m)$. When the marginal cost differential is

reduced from c_h to c_m because of investment in cost-reducing activities, the home firm's profit is higher at m' than at a. That is, $\pi^a(c_m) < \pi^{m'}(c_m)$. Taking together all these results, we have

$$\pi^h(c_h) < \pi^a(c_h) < \pi^a(c_m) < \pi^{m'}(c_m). \quad (10)$$

In the presence of the AD law, the foreign firm's reaction curve is $BFMC'$ as shown in the previous section. Nash equilibrium can occur at a point like m for a high-cost domestic firm if cost-reducing investment allows the firm to shift its reaction curve rightward from R_h to R_m. In this case, we have

$$\pi^{m'}(c_m) < \pi^m(c_m). \quad (11)$$

From equations (10) and (11), it follows that

$$\pi^h(c_h) < \pi^{m'}(c_m) < \pi^m(c_m). \quad (12)$$

Apparently, the home firm has an economic incentive to invest in cost-reducing activities, regardless of where or not there is an AD law. But for a given level of cost-reducing investment, the increase in domestic profit turns out to be relatively higher in the presence of an AD law.

The same line of reasoning can be used to analyze the case where the home firm is initially a medium-cost firm (c_m) with the reaction curve R_m. As shown in Figure 2, the firm may want to lower the marginal cost differential and shift its reaction curve from R_m to R_l through cost-reducing R&D. To see this, we draw two hypothetical lines: (i) $m'b$, which is parallel to line ha, and (ii) $l'b$, which is parallel to line $m'a$. It is easy to verify that

$$\pi^{m'}(c_m) < \pi^b(c_m) < \pi^b(c_l) < \pi^{l'}(c_l) < \pi^l(c_l).$$

This indicates that, irrespective of whether or not there is an AD law, the medium-cost home firm has a strong incentive to undertake cost-reducing investment. Nevertheless, such cost-reducing investment generates a relatively higher profit for the home firm under the protection of an AD law. Interestingly, the foreign firm is in the situation of a dumping violation because the product's equilibrium market price is lower than its normal value.

It should be noted that if cost-reducing activities' start-up costs (denoted as F) are "large," we cannot rule out the following possibilities:

$$\pi^{m'}(c_m) - \pi^h(c_h) < F < \pi^m(c_m) - \pi^h(c_h) \text{ or } \pi^{l'}(c_l) - \pi^{m'}(c_m) < F < \pi^l(c_l) - \pi^{m'}(c_m).$$

These inequalities imply that investment in cost-reducing activities can be unprofitable to the home firm under free trade, but is profitable in the case with an AD law.

The findings of the analyses are summarized in the following proposition:

PROPOSITION 3. *Compared to the case without an AD law, the home firm has a stronger incentive to undertake cost-reducing activities under the law and may put its foreign rival in the risk of a dumping violation.*

Finally, it is instructive to see how the home firm's cost-reducing investment affects domestic consumers under an AD law. We have

PROPOSITION 4.. *Domestic consumers may be better off under an AD law when the home firm further undertakes cost-reducing activities sufficiently enough to lower its marginal cost of production, other things being equal.*

Proof: See A-3 in the Appendix. ■

It is generally held that the imposition of an AD law benefits domestic firms at the expense of domestic consumers since the product's market price will go up. In the absence of an AD law, domestic consumers are unambiguously better off when a foreign import is dumped at a price below its normal value. Our analysis shows that if the home firm is able to significantly lower its production cost through investment in cost-reducing activities, consumer surplus may increase despite the presence of an AD law.

4. Concluding Remarks

In this paper, we present a simple model of duopolistic competition between domestic and foreign firms in the home market under AD policy. We show conditions under which the domestic firm is able to strategically adjust its production in order to put its foreign rival in the risk of an AD violation. These situations arise when AD enforcement is effective and the marginal cost differential between the two firms is significantly small. The increase in domestic production lowers the price of the import below its normal value, causing the foreign firm to violate an AD law.

Given the normal value of a product as common knowledge, a domestic producer's technology plays a role in affecting whether its foreign rival will be convicted of illegal dumping. We find that a home firm has a stronger incentive to undertake cost-reducing activities under an AD law.[5] Interestingly, domestic consumers can be better off when the home firm further invest in cost-reducing activities. But for the case in which the marginal cost differential is "significantly large," the foreign firm is able to dominate the market without violating an AD law. Filling an AD petition is ineffective. Our analysis helps identify the types of domestic firms that tend to file petition or the likelihood that the petition is successful or not.[6]

[5] Because we focus on the home firm's incentives to file an AD petition and the profitability of investment in cost-reducing activities resulting from an AD law, we do not examine R&D game between the home and foreign firms. For issues on how R&D activities are affected by the imposition of an AD law by a single country or by two trading nations, see the interesting study by Gao and Miyagiwa (2005).

[6] As we focus on incentive to file an AD petition, we follow Reitzes (1993), Anderson, Schmitt, and Thisse (1995), and Collie and Le (2008) in modeling AD issues without considering injury margin. Another reason that we only consider the dumping margin is because of the assumption of homogenous products. A more complete analysis should consider both dumping margin and injury margin. According to AD regulation set by GATT/WTO, a successful AD case against a foreign firm requires both foreign dumping and material injuries to be well documented. An import is being dumped or sold at "less fair value" when a foreign firm charges a higher price in its own market than in its export market, or when the firm sells its product at a price below production cost. A determination of injury shall be made only if the dumped import is causing material injury to an established domestic industry. A number of injury indicators are checked which include import volume, capacity utilization, profits, employment, market share, and the evolution of domestic prices. Vermulst and Waer (1991) provide a detailed measurement in calculating injury margin, which is often modeled as the difference between foreign product price in the domestic market and the price of a similar product also in the domestic market (see, e.g., Pauwels, Vandenbussche, and Weverbergh (2001)). For an interesting empirical study on injury margins, see Tharakan, Greenaway, and Kerstens. (2006).

Appendix

This appendix contains proofs of some propositions discussed in the main body of the paper.

A-1. ***Proof of Proposition 1***

To prove the first part of Proposition 1, we define the critical level of the marginal cost differential as $c^A = (5\phi - 2a)/2$. It follows directly from the price equation in (9) that if $c < c^A$ the market equilibrium price is below its normal value, causing the foreign firm to be violating an AD law. To prove the second part of Proposition 1, we use output equations in (7) and (8) to calculate for the case of a significantly low marginal cost differential (i.e., $c \le (5\phi/2) - a$) the home firm's market share: $s = \dfrac{q}{q+q^*} = \dfrac{2a - 4c + \phi}{4a - 2c - \phi}$. It follows that $s - 50\% = \dfrac{3(\phi - 2c)}{2(4a - 2c - \phi)}$. The denominator of the fraction on the right hand side of the above equation is strictly positive since $(q + q^*) = (4a - 2c - \phi)/6 > 0$. To prove that the market share is greater than 50%, it suffices to show that $\phi > 2c$. Given the marginal cost differential condition that $c \le (5\phi/2) - a$, we have $5\phi \ge 2a + 2c$. Since the product's normal value (ϕ) is lower than the monopoly price $(a/2)$ such that $a > 2\phi$, we have $2a + 2c > 2\phi + 2c$. It follows from the above two inequalities that $5\phi \ge 2a + 2c > 4\phi + 2c$, which further implies that $\phi > 2c$. We thus have $s > 50\%$. ■

A-2. ***Proof of Proposition 2***

We use Figure 1 to prove this proposition. In the absence of an AD law, free trade equilibrium occurs at *h*, *m*, and *l* when the marginal cost differential is high, moderate, or low, respectively. For the three possibilities of marginal cost differential, the equilibrium occurs at *h*, *m*', and *l*', respectively, in the presence of an AD law. Given that m' lies to the southeast of m on the same reaction curve R_m and that l' lies to the southeast of l on the same reaction curve R_l, it follows immediately that $\pi^m > \pi^{m'}$ and $\pi^l > \pi^{l'}$. ■

A-3. ***Proof of Proposition 4***

We use Figure 2 to prove this proposition. Assume that the initial equilibrium occurs at point h in the absence of an AD law (that is, there is free trade). After an AD law has been implemented, other things being equal, the equilibrium remains unchanged at point h and there is no change in consumer surplus. If the home firm further invests in cost-reducing activities such that its reaction curve shifts from R_h to R_m, the equilibrium changes from *h* to *m*. Investigation of Figure 3 reveals that the aggregate output level is greater at m than at h, i.e., $Q^m > Q^h$. Since $p^m < p^h$, consumer surplus is relatively higher at *m*. Next, assume that the initial equilibrium occurs at m' under free trade. If the home firm does not invest in cost-reducing activities, the imposition of an AD law shifts the equilibrium from m' to m. But if the home firm further undertakes cost-reducing investment, the equilibrium may change from m' to a point like *l*. As illustrated in Figure 2, an extension of line $m'b$ intersects the MC' segment of the foreign firm's reaction function at point *g*. If *l* is lying to the southeast of *g*, the aggregate output level is greater at *l* than at m'. That is, $Q^l > Q^{m'}$. Since $p^l < p^{m'}$, consumer surplus is relatively higher at a point like *l*. ■

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