Non-Duty Effects and a Strategic Use of Antidumping Petition

Honggue Lee

Konkuk University
1 Hwayang-dong, Gwangjin-gu
Seoul 143-701, Korea

January, 2004

Non-Duty Effects and a Strategic Use of Antidumping Petition

Honggue Lee

Abstract

This paper considers a signaling game in which the non-duty effects of antidumping petition influence filing motivations behind the domestic firm's filing strategies. In this game, "abusive" antidumping occurs when the domestic firm files petitions strategically so as to take advantage of private information regarding its filing motivations, which can be made possible when a pooling or a semi-separating equilibrium is obtained. A strategic use of antidumping takes place when the outcome filer happens to be a high-cost type instead of a low-cost type. In this case, no separating equilibrium exists, in which the outcome filer files and the process filer withdraws. The outcome filer may make so much efforts that its payoff net of petitioning expenses could be less than that it can obtain by withdrawing. Or the process filer may spend so little that its payoff for not filing could not be greater than that for filing. The possibility of abusive antidumping, a pooling or a semi-separating equilibrium, depends on the probability that the domestic firm is an outcome (or a process) filer, the expected loss that the foreign exporter might suffer due to antidumping, the initial profits that the foreign exporter earns in the home market, the cost competitiveness of the domestic firm, the initial sales to the home market, and the effects of a VER on the foreign exporter's reaction function. The existence of a pooling equilibrium shows why there are so many antidumping petitions, many of which come from outdated, less competitive industries.

Honggue Lee
Department of International Trade, Konkuk University,
Hwayang-dong 1, Gwangjin-gu, Seoul 143-701, Korea
Tel.: +82-02-450-3647; Fax: +82-02-3436-6610
honglee@konkuk.ac.kr

1. Introduction

Antidumping petition does more than merely responding to unfair trade and remedying consequential injury. When faced with increasing import penetration or decreasing profitability, domestic firms often resort to their antidumping law[1] not only to deter foreign exporters from dumping continuously and causing further damage, but also to circumvent foreign competition in the first place. Staiger and Wolak (1996) notice that *non-duty effects*[2] are instrumental in determining petitioners' filing strategies, which in turn are influenced by the corresponding filing motivations. They find that either one of the two distinct filing motivations is present behind every petition filing seeking the investigation effect: *outcome-oriented* petition with motivations for finding dumping and securing the accompanying relief, and *process-oriented* petition [3] with motivations for acquiring non-duty "protection" effects inherent in the investigation process itself.

Linking filing strategies with motivations helps understand petitioners' strategic behavior based on informational asymmetry concerning their filing motivations.[4] In the absence of informational asymmetry and strategic behavior on the part of the petitioners, foreign exporters can easily discern motivations behind filing strategies. They can make out whether they are facing "outcome filers" or "process filers." In the presence of informational asymmetry, however, the well-informed domestic petitioners whose filing motivations are not known to foreign exporters may want to take advantage of its private information provided that the uninformed foreign exporters can be misled. With the possible strategic behavior on petitioners' part based on asymmetric information, exporters might not able to tell outcome filers from process filers. Petitioners' filing strategies often match with their motivations, but not always. As filing motivations behind filing strategies are not revealed, foreign exporters, not able to see whether petitioners' behavior is strategic or not, have to conjecture first on petitioners' filing motivations before responding to petitioners' strategic moves.

It is this strategic behavior based on informational asymmetry that may result in "excessive" antidumping petitions. How is it possible that the presumption of distinct filing motivations and strategies against trading partners can explain the emergence of excessive antidumping actions that take advantage of private information? The existence of private information does not necessarily make a strategy-cum-motivation set for a certain type of informed petitioner represent the putative relationship existing between a particular motivation and a particular strategy. Each type of petitioners may not want to reveal its true intention in order to make the most of the filing procedure. In that case, since the observed strategy need not truthfully reveal petitioners' motivations, foreign exporters cannot tell whether an antidumping petition is filed solely to mislead them. If the foreign exporters are misled into believing untruthful revelation, then the antidumping petition filed out of strategic considerations will work. As domestic firms'

strategies succeed in changing foreign exporters' behavior, they will be able to accomplish the non-duty protection effects. On the other hand, if foreign firms do not believe that antidumping petition is filed to remedy what dumping has caused, domestic firms' strategic use of antidumping petition will be thwarted. Only a "justifiable" use of antidumping law to remedy the undesirable effects of dumping will be sustained.

Outcome filers are primarily concerned with the relief in the form of antidumping duties or suspension agreements. *Process filers* are less concerned with the remedying of injury than with securing the protection effects associated with the investigation process itself.[5] If foreign exporters believe that petitions are not frivolous (that is, outcome-oriented) ones, they expect that they have only a slim chance of winning. In that case, foreign exporters may promise an *undertaking* such as, for example, a VER (voluntary export restraint) that restrains the amount of exports, or they may carry out price adjustments by which they may increase import prices in exchange for the suspension of investigation or the withdrawal of petitions. On the other hand, if foreign exporters believe that petitions are not genuine (that is, process oriented) ones and hence that they have a good chance of winning, they may challenge the investigation. In this respect, linking filing motivations with filing strategies sheds new light on the understanding of antidumping practices. By relating distinct filing strategies to indirect non-duty effects, this effort will make it possible to identify conditions under which antidumping actions become excessive or unjustifiable.

This paper considers a signaling game in which a strategic use of antidumping petition emerges in a framework linking filing motivations with filing strategies. In this game, domestic firms take advantage of private information about their filing motivations, which in turn are conditioned on their *competitiveness* in the market, in filing antidumping petitions against foreign exporters. Then this paper will show how antidumping petitions filed out of strategic considerations may bring about non-duty effects, and it will indirectly answer why there exist so many antidumping petitions and why so many price undertakings and VERs are preceded by administrative actions. Foreign exporters may well acquiesce when they are sure that domestic firms are outcome filers. Otherwise, they may well challenge process filers. Yet incomplete information will make the foreign exporters unable to respond to the domestic firms' filing strategies in accordance with their knowledge on corresponding filing motivations. Then the domestic firms will be able to take advantage of private information they have on filing motivations. Moreover, the domestic firms may turn to antidumping petitions more actively when they expect to end up in a pooling or semi-separating equilibrium or they may file petitions contrary to their filing motivations.

The model developed in this paper differs from others such as Rosendorff's (1996)[6] in that it deals with a signaling game between two rival firms, foreign and domestic, in which their filing

and contesting motivations are taken into consideration. This research strategy is worth pursuing because it reveals how administered protection facilitates strategic behavior in the rivalry between firms.

The rest of the paper is organized as follows. In Section 2, a basic model is set up, composed of two segmented markets. In Section 3, preliminary discussion is offered on the peculiarities concerning payoffs and foreign responses. Section 4 states the conditions under which antidumping action occurs as equilibrium behavior, and Section 5 discusses the implications of the signaling game. In Section 6, a conclusion is provided.

2. The Model

Consider the segmented domestic and foreign markets: separate demand functions exist for these two markets. The domestic market is supplied both by a domestic firm (*Home*) and by a foreign firm (*Foreign*), and the foreign market is supplied entirely by a foreign firm. The domestic and foreign firms produce the same goods with constant marginal costs. The foreign firm's cost competitiveness is known *a priori*. Yet the domestic firm's cost competitiveness is known only as either one of the two types: relatively "strong" or relatively "weak."

2.1. The Segmented-Markets Model

The profits of the firms are given by
$$\pi_i = x\, p(x+y) - c_i\, x - f \quad (1),$$
$$\pi^* = y\, p(x+y) + y^*\, p^*(y^*) - c^*(y+y^*) - f^* \quad (2).$$

In equation (1), x and y denote the domestic and foreign firms' sales to the domestic market, p the price in the domestic market, c_i the domestic firm's marginal production cost, f the fixed cost, and the subscript i the domestic firm's *type*, such as H for a high cost firm, or L for a low cost firm. In terms of cost competitiveness, the domestic firm can be either one of the two *types*, a high cost ("weak") firm or a low cost ("strong") firm. For simplicity, a quasi-linear utility function is used to yield an inverse demand function $p = p(x+y) = A - x - y$.

In equation (2), the superscript, an asterisk *, indicates variables that belong to the foreign exporter, so that y^* denotes the foreign firm's sales to the foreign market, c^* the foreign firm's marginal production cost, and f^* the fixed cost. Unlike the duopolistic domestic market, the foreign market is monopolistic, so that the foreign inverse demand is a function of y^* only: that is, $p^* = p^*(y^*) = A^* - y^*$.

Now assume Cournot-Nash behavior on the part of the domestic and foreign firms. With the usual assumptions for the existence and uniqueness of the Cournot-Nash equilibrium, it is straightforward to derive the equilibrium profits and market shares of the domestic and foreign firms in both markets. In the domestic market, the equilibrium market share of the domestic

firm depends on its marginal production cost relative to that of the foreign firm. If the domestic firm's cost is higher than the foreign firm's, its market share will be smaller than that of the foreign firm. The equilibrium market share of the domestic firm would be larger for a low marginal production cost than for a high marginal production cost given the production cost of the foreign firm.

In the foreign market, however, the foreign firm is the sole supplier so that its market share is practically protected.[8] For simplicity, the foreign equilibrium price is assumed to be higher than the domestic price. This assumption is necessary for antidumping activities to start in the first place.

Incidentally, the role of government in the administration of antidumping is assumed to be *passive*. Political influence plays a less important role in the antidumping investigation procedures, in which non-political, legal considerations prevail.[9] Government agencies in charge of antidumping are supposed to apply mechanically to the investigation process the criteria predetermined by the WTO or the local legislature.[10] This assumption of "passive antidumping administration" is not in conflict with the practices of governments in general and those of the U.S. government in particular.[11]

2.2. Antidumping: Process Filing versus Outcome Filing

Dumping in the segmented markets model is represented by price discrimination, in which the foreign exporter charges different prices across domestic and foreign customers. The *dumping margin* is proportional to the difference between the domestic and foreign prices, which in turn depends on the difference in the marginal production costs between the domestic and foreign firms. Other things being equal, the larger the difference in the marginal production costs between the domestic and foreign firms is, the larger the difference between the foreign and domestic equilibrium prices will be. For example, for a low marginal production cost of the domestic firm, the difference between the home and foreign prices will be large. Since it is proportional to the price difference, the expected dumping margin will be greater when the low-cost domestic firm files than when the high-cost domestic firm files.[12]

Showing the occurrence of dumping, however, is not enough to bring about the remedial actions taken by the antidumping authorities. It is required to show that "material injury" has been caused by dumping. In standard practice, *injury* is determined when the condition that the domestic firm's relative market share would have increased "but for" the foreign firm's unfair dumping is satisfied.[13] Dumping would be deemed to have caused injury if the market share increased with the imposition of antidumping duties. The counterfactual change in the market share reflects that the domestic firm is severely "injured" by dumping.

Within the set up of the model, it is obvious that material injury is caused by dumping.[14]

What is notable, however, is that the magnitude of changes in the market share depends on the domestic firm's cost competitiveness and the tariff rates. Let dS_H be the change in the market share when the domestic firm has high marginal production cost, and dS_L be the change in the market share when it has low marginal production cost. Then the putative material injury to the domestic firm can be represented by dS_H or dS_L as follows, both of which are positive.

$$dS_H = \frac{3\tau_M^H(A-c_H)}{(2A-c_H-c^*)(2A-c_H-c^*-\tau_M^H)} \qquad (3)$$

$$dS_L = \frac{3\tau_M^L(A-c_L)}{(2A-c_L-c^*)(2A-c_L-c^*-\tau_M^L)} \qquad (4)$$

where $dS_H = S_H^\tau - S_H$, $dS_L = S_L^\tau - S_L$, $S_H = \frac{x_H}{x_H+y_H}$, $S_L = \frac{x_L}{x_L+y_L}$, $S_H^\tau = \frac{x_H^\tau}{x_H^\tau+y_H^\tau}$,

$S_L^\tau = \frac{x_L^\tau}{x_L^\tau+y_L^\tau}$, $\tau_M^H = \frac{3A^*-2A-2c_H+c^*}{6}$, and $\tau_M^L = \frac{3A^*-2A-2c_L+c^*}{6}$.

Besides marginal costs, filing motivations also characterize the domestic firm's types. Each type of the domestic firm has a distinct filing motive, which the foreign exporter does not know *a priori*. Filing an antidumping petition does not necessarily reveal the domestic firm's filing motivations to the foreign firm. Yet the foreign firm can figure out the probability that the domestic firm has a particular filing motive. The foreign firm guesses that the domestic firm is either an outcome oriented filer with the probability $\mu \in (0,1)$ or a process oriented filer with the probability $(1-\mu)$. This probability distribution[15] is predetermined and commonly known.

Since there is no predetermined one-to-one correspondence between cost types and filing motivations, each cost type may behave as either an outcome filer or a process filer. With the types of the domestic firm differentiated by both cost competitiveness and filing motivations, four possible type combinations can be considered in the discussion of the strategic use of private information by the domestic firm against the foreign firm.[16] Yet only two of them are worth considering.[17] The first possibility is concerned with the case in which the foreign firm meets an outcome filer that is the low cost firm or a process filer that is the high cost firm. The second possibility is the case in which the foreign firm meets an outcome filer that is the high cost firm or a process filer that is the low cost firm.[18]

Confronted with foreign competition in its own market, the domestic firm may consider filing a petition for the purpose of undoing the effects of dumping. Such an outcome filer files an antidumping petition to secure antidumping duties, provided that it is able to meet the necessary requirements for dumping determination. Yet it is also possible that the domestic firm may want to file a petition with a view to circumventing import competition in the first place by taking advantage of private information regarding its competitiveness and filing motivations.

For example, a process filer may mimic the behavior of an outcome filer, so that the foreign firm may be misled into believing that it is an outcome filer. Then, uncertain about the resulting dumping margin and antidumping duties, the foreign firm may want to avoid the antidumping investigation. However, knowing that it is in the domestic firm's interest to keep the foreign firm out of the domestic market whatever the domestic firm's types are, the foreign firm cannot rule out the possibility that the domestic firm is pretending to be an outcome-oriented filer. Once the investigation process starts, the foreign firm may give up dumping or challenge the antidumping investigation. Whether the foreign firm gives in or not depends on the expected profits associated with its respective responses.

2.3. Payoffs under Antidumping

Antidumping petition will change the profits of the domestic firm and the foreign firm by influencing the underlying variables such as market shares, strategies, responses, and beliefs. In particular, the finding of dumping and the determination of injury will affect the payoffs of both firms, as they lead to the imposition of antidumping duties. It will simplify the analysis to assume that the antidumping process continues over two stages, and that both the preliminary determination and the final outcome are identical.[19] In the presence of private information, the domestic firm may want to act strategically in the first stage in order to influence the beliefs and the subsequent choice of response by the foreign firm in the second stage. It can do so by filing an antidumping petition. Thus, in the first stage the domestic firm will decide whether to file a petition or not. At the end of the first stage, the foreign firm forms beliefs about the types of the domestic firm. Then the foreign firm may decide to challenge the investigation in the second stage. Or it may decide to acquiesce by seeking a suspension agreement in the form of a VER or a price undertaking. The imposition of antidumping duties is expected to reduce the amount of imports and hence to increase the amount of the domestic firm's supply. It is assumed that the reduction in imports is exactly replaced by an increase in the local supply when the final determination is made.[20]

For dumping regarded as price discrimination, establishing the act of dumping by the administrators of antidumping law is nothing but a technical exercise.[21] The determination of dumping and injury would be guaranteed once the relevant information about the "model" is revealed to the administrators of antidumping petition.[22] However, information is not always perfectly available. Unless the home government initiates petitioning, it does not necessarily have all the relevant information. The administrators of antidumping law do not know all the parameters of the underlying model. As a result, the finding of dumping and the imposition of antidumping duties are not guaranteed every time antidumping petitions are filed. For this reason, it will be assumed in the following that the finding of dumping depends entirely on

how well the domestic firm makes preparations for antidumping petition, given the "countervailing" efforts made by the foreign firm. Let v_i be the probability of dumping and injury determination when the cost type i domestic firm files, and assume that this probability increases with the level of the domestic firm's antidumping efforts. In particular, suppose that the probability distribution function $v_i = v(e_i)$ is a monotonously increasing, concave function in e_i given the level of foreign firm's counteracting efforts. In this distribution, a marginal increase in petitioning expenses at the lower level of petition-related efforts increases the probability of dumping and injury determination much larger than it does at the higher level of petition-related efforts.

Petition filing is costly for both cost types of the domestic firm, but petition-related costs are differently perceived by them. The *nominal* cost denotes the cost of providing necessary information to prove the existence of dumping. The *perceived* petitioning cost can be interpreted as *disutility* (the opportunity cost) associated with petition filing. Let the high cost and low cost firms' petitioning costs be expressed as e_H and e_L respectively. Even when the nominal cost of petition filing is the same for both types of the domestic firm, the perceived cost cannot be equal because the opportunity cost of *not-filing* antidumping petition is different.[23] Petitioning is perceived to be more costly by the process-oriented firm than by the outcome-oriented firm,[24] so that petitioning can serve as a signal to transmit the domestic firm's type.[25] If the purpose of antidumping is to prove the act of dumping and seek a remedy for the injury due to dumping, the maximum amount of resources that the domestic firm would pour into such efforts (for example, preparing for petition filing, influence peddling, lobbying, and so forth) will be equal to the expected increase in benefits, the difference between the counterfactual dumping-free profits and the current duopoly profits. On the other hand, when the foreign firm challenges the antidumping investigation, it will be burdened with going through the arduous investigation procedure. Suppose that the foreign firm spends the amount of e^* to challenge the investigation.[26]

Now consider how an antidumping petition filed by the domestic firm changes the profit functions. First, consider how the finding of dumping and the imposition of antidumping duties change the profits of the domestic and foreign firms. The imposition of antidumping duties will shift the foreign reaction curve down from y(x) to y^T(x) in Fig.1. The domestic firm now earns higher profits as indicated by the downward movement of its iso-profit curve. Note that the rate of change in the domestic firm's profits depends on where its reaction function is located initially, which is determined by its cost competitiveness. Since the low-cost firm's reaction curve x^L(y) is on the right side of the high-cost firm's x^H(y), it is easy to see that the benefits of antidumping duties are greater for the low-cost domestic firm than for the high-cost domestic firm:[27] for example, the change in profits when the equilibrium points move from 2 to

4 in Figure 1 is greater than when they move from 1 to 3.

<p align="center">***Figure 1***</p>

Second, consider how the suspension agreement affects the payoffs. The domestic firm may agree to a suspension agreement when it can secure an out-of-court settlement with its foreign rival in the form of price or quantity restriction. Whatever its types are, however, the domestic firm will not agree to a suspension agreement unless what it expects to gain by doing so is at least as large as what it can get without antidumping petition. Suppose that the foreign exporter promises to increase the sales price by reducing the amount of exports. A suspension agreement is usually made in the form of fixing the amount of exports in proportion to the free-trade demand or maintaining the sales price above the free-trade level.[28] This will change both the foreign firm's reaction curve and the strategic relationship between the home and foreign firms. The home firm can now assume a quantity leadership role, since a VER gives clear information to the domestic firm about the foreign exporter's reaction curve. At the same time, the foreign exporter's reaction curve will be distorted by a VER. The locus $y(x)EGy^{VER}(x)$ in Figure 2 represents a combination of values satisfying a VER. It is downward sloping because higher x should be matched by lower y to hold the supply at the level prescribed by the VER. This locus passes through E, the free-trade point. Yet on the right hand side of E, y^{VER} positions itself between $y(x)$ and $x(y)$ with its slope larger than one in absolute value. Otherwise, it is not possible to maintain the price level above the present one.[29] Then the home firm can maximize its profits by setting its output where its iso-proift curve is tangent to the locus $y(x)EGy^{VER}(x)$ at G. At the same time, it is possible (but not necessary) that the foreign firm can secure profits at G not less than those it can get at F where the foreign exporter ends up when antidumping duties are imposed.[30] The rise in the profits of the foreign exporter is possible because, if the reduction in exports to the home market is not too much below the free-trade level, the foreign exporter will be able to earn much the same profits as before at a high price. Mutual gains of this kind can be made obtainable through a VER, since 'tacit' collusion between them is possible.[31] Since both home and foreign firms *can* earn higher profits through a VER, a suspension agreement may become an attractive option for both home and foreign firms. In general, however, the gains from a suspension agreement are not guaranteed, but the foreign firm may consent to a suspension agreement in order to avoid facing potential antidumping duties.

<p align="center">***Figure 2***</p>

The payoffs under antidumping can be considered in terms of six possible combinations. First, the process filer may opt to file an antidumping petition and the foreign exporter may challenge the investigation. Second, the process filer may file an antidumping petition and the foreign exporter may acquiesce by adopting a VER. Third, the outcome filer may choose to file an

antidumping petition and the foreign firm may challenge the investigation. Fourth, the outcome filer may file an antidumping petition and the alleged dumper may acquiesce with a VER. Fifth, the process filer may choose to withdraw. Sixth, the outcome filer may choose to withdraw. Since there are two possible cost types for each filer, a pair of six payoff functions can be constructed. The payoff functions when the outcome filer is a low cost type and the process filer is a high cost type are summarized in Table 1.[32] Those functions when the outcome filer is a high cost type and the process filer is a low cost type are expressed in Table 2.

Table 1

Table 2

The model has been set up as an incomplete information model, yet it can be transformed into one with complete but imperfect information. With Harsanyi transformation, the new game can be interpreted as an *extensive form* game in Figure 3, in which Nature moves first and chooses the domestic firm's filing motivations – an outcome filer with the probability μ and a process filer with the probability $1-\mu$. Since there is no *predetermined* one-to-one correspondence between cost types and filing motivations, each type of the domestic firm can become an outcome filer or a process filer. The foreign firm decides whether to challenge, without knowing the actual type of the domestic firm. The domestic firm in turn decides whether to file a petition, knowing that the foreign firm responds as such.

Figure 3

3. Antidumping as a Signaling Game

In the presence of private information concerning the domestic firm's filing motivations, antidumping activities can be modeled as a signaling game. In this game, the "sender" (the domestic firm) who has two possible "types" sends "signals" to the "receiver" (the foreign firm) who responds by choosing actions.

Information about filing motivations of the domestic firm is "asymmetric" in the sense that the foreign exporter and the administrators of antidumping law do not have it *a priori.* The foreign exporter can observe whether the domestic firm files a petition, but not filing motivations. Yet the fact that each filer files a petition with a different intensity of "petition-related efforts" signals to the foreign exporter. Since the antidumping petition and the foreign exporter's reaction affect its profits, the home firm may want to limit or distort the information its signal conveys. In response to this act, the foreign firm may opt to challenge or acquiesce in accordance with its expectations on the domestic firm's filing motivations.

3.1. Antidumping Petition

The level of petition-related efforts made by the domestic firm will be determined by the

expected change in the benefits the antidumping petition brings about, the difference between the counterfactual dumping-free profits and the current duopoly profits, which in turn depends on the probability that the government finds dumping and imposes remedial actions. Yet this probability is determined by the antidumping efforts made by the domestic firm in anticipation of the gains from antidumping activities.[33] This circular causality can be formalized as follows.

Lemma 1. *Let v_L and v_H be the probabilities of dumping determination and subsequent remedial action for the low-cost and high-cost domestic firms respectively with $0 \leq v_L \leq 1$ and $0 \leq v_H \leq 1$. Suppose that these probabilities are increasing in the domestic firm's antidumping efforts, given the foreign firm's "counteracting" efforts. Let e_L and e_H be the respective "petition-related expenses (costs)" these firms willing to bear.[34] Then it can be shown*

i) that the relevant probability space is confined by the intervals

$$\frac{e_L}{\Delta_L} \leq v_L \leq 1 \quad and \quad \frac{e_H}{\Delta_H} \leq v_H \leq 1, \text{ where } \Delta_L = \frac{2}{3} x_L \tau_M^L + \frac{1}{9} \tau_M^{L\,2}, \Delta_H = \frac{2}{3} x_H \tau_M^H + \frac{1}{9} \tau_M^{H\,2}, \text{ and}$$

ii) that the magnitude of "petition-related efforts" made by each type of the domestic firm depends on whether it is an outcome filer or a process filer.

(1) If the low cost firm is an outcome filer and the high cost firm a process filer, petition-related efforts made by the low cost firm e_L would be greater than those made by the high cost firm e_H : that is, $e_L > e_H$, and the probability of dumping determination for the outcome-oriented firm v_L would be greater than that for the process-oriented firm v_H : that is, $v_L > v_H$.

(2) On the other hand, if the high cost is an outcome filer and the low cost firm a process filer, it can be shown that $e_L < e_H$ and $v_L < v_H$.

According to Lemma 1, the probability space, in which an antidumping petition results in the domestic firm's favor, is partitioned into two right triangles and closed by the intervals of the petition-related efforts relative to the potential gains from the positive dumping finding. The larger the potential benefits given the necessary costs or the smaller the relative expenses of petitioning are, the more aggressive the petitioning efforts will be and the larger the area of the relevant probability space will be. The implications of Lemma 1 can be illustrated as in Figure 4.

Figure 4

3.2. Foreign Responses

An antidumping petition signals information about the domestic firm's filing motivations. The foreign firm will respond to the domestic firm's move in accordance with its perception on the domestic firm's type. In fact, the domestic firm decides to file a petition, knowing that the foreign firm has to decide whether to challenge or to acquiesce without knowing the actual type

of the domestic firm. The foreign firm observes signals only: whether the domestic firm filed a petition or not. Since it has no other information, it will calculate the expected payoff from challenging and compare it with that from acquiescing. If the payoff from challenging is greater than that from acquiescing, the foreign firm will challenge the petition. Otherwise, it will acquiesce. The foreign responses can be formalized as follows.

Lemma 2. *Let* e^* *denote the expenses that the foreign firm is willing to bear in order to meet the investigation requirements. Let* μ *,* v_L *,* τ_M^L *, and* y_L *each represent the probability of being an outcome filer, the probability of dumping determination for the low-cost type, the dumping margin for the low-cost type, and the sales of the foreign exporter competing with the low-cost domestic firm respectively. Analogously, let* $(1-\mu)$ *,* v_H *,* τ_M^H *, and* y_H *each represent the corresponding variables for a process filer or the high-cost firm.*

i) When the outcome filer is a low-cost type and the process filer is a high-cost type, the foreign firm will challenge if

$$v_H < -\frac{\mu\Delta_L^*}{(1-\mu)\Delta_H^*}v_L + \frac{(1-\mu)(1-\alpha_H)y_H^2 + \mu(1-\alpha_L)y_L^2 - e^*}{(1-\mu)\Delta_H^*} ,$$

where $\alpha_i = \left\{\frac{m(m-2)}{m-1} + \frac{y_i}{x_i}\right\}\left\{(3-m) + \frac{c_i - c^*}{x_i}\right\}$ *,* $\Delta_i^* = \left(\frac{4}{3}y_i\tau_M^i - \frac{4}{9}\tau_M^{i\,2}\right) > 0$ *for* $i = H, L$ *.*

Otherwise, it will acquiesce.

ii) When the outcome filer is a high-cost type and the process filer is a low-cost type, the foreign firm will challenge if

$$v_H < -\frac{(1-\mu)\Delta_L^*}{\mu\Delta_H^*}v_L + \frac{\mu(1-\alpha_H)y_H^2 + (1-\mu)(1-\alpha_L)y_L^2 - e^*}{\mu\Delta_H^*} .$$ *Otherwise, it will acquiesce.*

The foreign firm exporter's action depends on both filing-motive probabilities and changes in the payoffs. The foreign firm's decision whether to fight or to give in to a petition filer also depends on how it assesses the expenses. So it is important to distinguish the process filer from the outcome filer. If the foreign firm believes that the domestic firm is an outcome filer, it may as well acquiesce. Otherwise, it makes sense to fight against a process-oriented filer. The implications of Lemma 2 can be drawn as in Figure 5.

Figure 5

4. Equilibria

Strategies for Perfect Bayesian Equilibrium are considered: a separating equilibrium in which the domestic firm behaves differently depending on its type, a pooling equilibrium in which the domestic firm behaves the same regardless of its type, or a combination of the two. In the following, what matters in determining equilibrium strategies is shown to be the relationship between cost types and filing motivations. If the outcome filer happens to be a low-cost type and the process filer a high-cost type, a separating equilibrium is the unique one. If the outcome filer happens to be a high-cost type while the process filer is a low-cost type, no separating equilibrium exists, but a pooling equilibrium or a semi-separating equilibrium exists.

4.1. Pure Strategies

4.1.1. Separating Equilibrium

In a *separating equilibrium*, when the domestic firm files a petition, it must convince the foreign firm that it is an outcome filer. In order to be credible, the domestic firm must also be truthful when it is a process. So the domestic firm will behave differently in the first stage depending on its type: if it is an outcome filer, it files; and if it is a process filer, it withdraws. In its turn, the foreign firm will seek a suspension agreement if it faces an outcome filer and challenge if it faces a process filer.[35]

In a separating equilibrium, the process filer does not file even when the foreign firm infers that the domestic firm is an outcome filer. In other words, the payoff the process filer can obtain when it does not file a petition must be greater than the payoff it can obtain by filing a petition when the foreign firm "mistakes" the process filer for the outcome filer and acquiesces to give up continuing "price discrimination." Analogously, the outcome filer does not withdraw as the payoff it can obtain when it files a petition must be greater than the payoff it can obtain by withdrawing.

Whether a separating equilibrium that meets these requirements exists depends on the relationship between cost types and filing motivations. In the present model, as Lemma 1-ii) indicates, the petition-related efforts of the outcome filer is always greater than those of the process filer. Yet the outcome filer (or the process filer) can be either cost type. Thus, when the low-cost type is an outcome filer, its petition-related efforts e_L will be greater than the high-cost type's (a process filer's) petition-related efforts e_H. Otherwise, the high-cost type's (an outcome filer's) petition-related efforts e_H will be greater than the low-cost type's (a process filer's) petition-related efforts e_L. When the low-cost type is an outcome filer and the high-cost type is a process filer, the requirements for a separating equilibrium condition are satisfied. Thus, a separating equilibrium can be shown to exist for this cost-type and filing-motive relationship, as summarized in the following proposition.

Proposition 1-A. (Separating) *When the outcome filer is a low-cost type and the process filer is a high-cost type, a separating equilibrium exists in which the process filer chooses withdrawal and the outcome filer chooses petitioning.*

On the other hand, when the high-cost type is an outcome filer and the low-cost type is a process filer, the requirements for a separating equilibrium are not satisfied. The process filer may possibly spend so little that the payoff for not filing could not be greater than the payoff for filing even when the foreign firm behaves as if the domestic firm were the outcome filer. At the same time, the outcome filer may invest so much that the payoff it can obtain by filing could be less than that it can obtain by withdrawing. In this case, no separating equilibrium exists, as formalized in the following proposition.

Proposition 1-B. (Non-separating) *When the outcome filer is a high-cost type and the process filer is a low-cost type, no separating equilibrium exists in which the process filer chooses withdrawal and the outcome filer chooses petitioning.*

Implications of Proposition 1-A and Proposition 1-B are drawn in Figure 6.

4.1.2. Pooling Equilibrium

Now consider another form of pure strategy equilibrium. Both types of the domestic firm choose the same strategy in a *pooling equilibrium*. Two strategies are available: withdrawal and petition filing. Choosing withdrawal does not constitute a pooling equilibrium, but choosing petition filing does. When the cost of filing an antidumping petition is not substantial, a process filer may well want to take advantage of the antidumping procedure and pretend to be an outcome filer. The domestic firm is likely to file a petition regardless of its types. Yet this strategy makes a pooling equilibrium emerge only if it induces the foreign firm to acquiesce. The foreign firm will try to fight unless the probability of meeting the outcome filer is very high. Thus a necessary condition for a pooling equilibrium is that the foreign firm's expected profit from challenging the investigation is less than that from acquiescing, which in turn can be expressed in terms of the probability of facing the outcome filer.

For the foreign firm's beliefs about the domestic firm's type to be consistent with a pooling equilibrium, the foreign firm should have the same posterior beliefs as its priors even when it observes the filing of a petition. In a pooling equilibrium the foreign firm cannot update its beliefs when observing the equilibrium action, since both types of the domestic firm file a petition.[36] The foreign firm will have posterior beliefs that $P(process \,/\, file) = 1 - \mu$. Thus, if the condition for a separating equilibrium is violated, these strategies and beliefs should

constitute a pooling equilibrium.

Proposition 2. *Suppose that the condition for a separating equilibrium is not satisfied:* $v_H > v_L$. *That is, the outcome filer is a high-cost type and the process filer is a low-cost type. Suppose also that*

$$v_H > -\frac{(1-\mu)\Delta_L^*}{\mu\Delta_H^*}v_L + \frac{\mu(1-\alpha_H)y_H^2 + (1-\mu)(1-\alpha_L)y_L^2 - e^*}{\mu\Delta_H^*}. \text{ Then a pooling equilibrium exists,}$$

consisting of a strategy profile in which both types of the domestic firm file a petition, and the foreign exporter acquiesces and a belief profile in which the foreign firm has posterior beliefs that $P(type = c_H | file) = 1 - \mu$ *and* $P(type = c_I | file) = \mu$.

A pooling equilibrium exists because, for the foreign firm, the expected payoff for acquiescing is greater than the payoff for challenging, and, for the domestic firm, the payoff for a 'file-acquiesce' strategy profile is greater than the payoff for withdrawal. The foreign firm can be made better off if it acquiesces as shown in Lemma 2. Moreover, since $e_H \leq \Delta_H$ and $e_L \leq \Delta_L$ according to Lemma 1-i), and $\frac{3-m}{m-1} > 1$, the domestic firm will gain if it files.

Incidentally, a strategy profile in which both types of the domestic firm withdraw, and the foreign firm challenges does not constitute another pooling equilibrium. Should this strategy profile make a pooling equilibrium, then the payoff associated with a 'withdraw-challenge' strategy profile is greater than the payoff associated with a 'file-challenge' strategy profile. Yet this is not the case either for the process filer or for the outcome filer, as long as the petition-related efforts fall short of the expected gains from petition filing.[37] On the other hand, when both types of the domestic firm choose withdrawal, the expected payoff of the foreign firm does not depend on the domestic firm types. Thus, the 'withdrawal-challenge' strategy pair does not constitute another pooling equilibrium.

Figure 6

Proposition 2 is graphically represented in Figure 6, from which it can be inferred that a pooling equilibrium is more likely when the petition-related expenses the foreign firm has to bear become larger, reducing the value of the vertical intercept of the 'challenge-acquiesce' line. When the probability that the domestic firm is a process filer gets lower, both the slope and the vertical intercept of the 'dividing' line will decrease. The reduction of the slope for a given vertical intercept causes a pooling equilibrium to be less likely, while the moving-down of the intercept for a given slope increases that possibility. As a result, the net effect of the slope change on the likelihood of a pooling equilibrium is indeterminate. If the foreign firm's profit-loss ascribable to outcome-oriented filing gets larger, it will decrease the steepness of the 'challenge-acquiesce' line and reduce the possibility of a pooling equilibrium given the value of

the vertical intercept. Yet, at the same time, it will also reduce the vertical intercept, increasing the possibility of a pooling equilibrium given the slope of the line. Thus, the net effect on the possibility of a pooling equilibrium is again uncertain. On the other hand, if the profit-loss ascribable to a process-oriented filing increases, then the slope will become steeper and increase the possibility of a pooling equilibrium. The foreign exporter's initial sales to the home market and the value of α_i also have influence on the likelihood of a pooling equilibrium. The larger the initial sales to the domestic market are, the smaller the chance of a pooling equilibrium is. On the contrary, the larger the value of α_i is, the larger the chance of a pooling equilibrium.

4.2. Mixed Strategies

A *semi-separating equilibrium* exists when both separating and pooling equilibrium conditions are violated. In a semi-separating equilibrium, two types of the domestic firm randomize between petition filing and withdrawal, and so does the foreign exporter between challenging and acquiescing. The foreign firm forms the beliefs as given by $P(process|file) \in (0, 1-\mu)$. The foreign firm updates its beliefs using Bayes' Rule when it observes the domestic firm's action. A semi-separating equilibrium is the equilibrium with mixed strategies, in which a process filer files with the probability of γ^P, an outcome filer files with the probability of γ^O, and the foreign firm challenges with the probability of γ^F. For Bayesian updating, the total probability of filing is calculated as a sum of the probabilities that different types of the domestic firm file. Suppose that a process filer files with uncertainty so that $0 \leq \gamma^P \leq 1$, but an outcome filer files with certainty so that $\gamma^O = 1$. Then the total probability of filing is expressed as $\mu\gamma^O + (1-\mu)\gamma^P = \mu + (1-\mu)\gamma^P$, in which $\mu\gamma^O = \mu$ is the product of the foreign firm's prior belief that the domestic firm is an outcome filer by the probability that it files, and $(1-\mu)\gamma^P$ is the product of the foreign firm's prior belief that the domestic firm is a process filer by its mixed strategy probability. The foreign firm updates the probability that the domestic firm is an outcome filer into $\dfrac{\mu\gamma^O}{\mu\gamma^O + (1-\mu)\gamma^P} = \dfrac{\mu}{\mu + (1-\mu)\gamma^P}$, and that the domestic firm is a process filer into $\dfrac{(1-\mu)\gamma^P}{\mu\gamma^O + (1-\mu)\gamma^P} = \dfrac{(1-\mu)\gamma^P}{\mu + (1-\mu)\gamma^P}$ after observing an antidumping petition.

With its updated probability of meeting with a process filer versus that with an outcome filer, the foreign firm will recalculate and compare the expected payoffs from challenging and acquiescing respectively. The foreign firm will also mix its strategy so that the expected payoff from challenging must equal that from acquiescing.

Proposition 3. *Suppose that neither a separating nor a pooling equilibrium condition is satisfied, so*

that $v_H > v_L$ *and* $v_H < -\dfrac{(1-\mu)\Delta_L^*}{\mu\Delta_H^*}v_L + \dfrac{\mu(1-\alpha_H)y_H^2 + (1-\mu)(1-\alpha_L)y_L^2 - e^*}{\mu\Delta_H^*}$. *Then a semi-*

separating equilibrium consists of a belief profile in which the foreign firm forms the posterior beliefs

given by $P(process|file) \in (0, 1-\mu)$ *and a strategy profile in which the foreign firm randomizes its*

strategies of selecting "challenge" with the probability $\gamma^F = \dfrac{2(m-2)\pi_L + (m-1)e_L}{2(m-2)\pi_L + (m-1)v_L\Delta_L}$ *when*

observing the domestic firm to file, and the process filer (a low-cost type) randomizes between "file" and

"withdraw" by selecting "file" with the probability, $\gamma^P = \dfrac{e^* - \mu\left\{(1-\alpha_H)y_H^2 - v_H\Delta_H^*\right\}}{(1-\mu)\left\{(1-\alpha_L)y_L^2 - v_L\Delta_L^*\right\}}$, *where*

$\gamma^F \le 1$, $\gamma^P < 1$, *and the probability of the outcome filer (a high-cost type) filing* $\gamma^O = 1$.

The factors that work in the direction of enhancing the possibility of a pooling equilibrium will produce the opposite effects on a semi-pooling equilibrium. Other things being equal, a semi-separating equilibrium emerges if the cost of filing is sufficiently low. In this equilibrium, both firms randomize their strategies so that their expected payoffs may be maximized. The process filer has a good chance to complicate the foreign firm's process of drawing inferences about its type. Implications of Proposition 3 are drawn in Figure 6.

Figure 6

5. Discussion

The magnitude of petition-related efforts made by the outcome filer is always greater than that made by the process filer. Yet the outcome filer can be of any cost type, so that which of the low-cost type's efforts e_L and the high-cost type's efforts e_H is greater depends on the cost-type and filing-motive relationship. The domestic firm's decision space consisting of the nonnegative probability pairs of v_L and v_H is partitioned into the areas lying below and above the 45 degree line, $v_L = v_H$, and confined by a vertical line, the ratio of the petition-related expenses to the expected gain of a low-cost type, $v_L = \dfrac{e_L}{\Delta_L}$, and a horizontal line, the ratio of the petition-

related expenses to the expected gain of a high-cost type, $v_H = \dfrac{e_H}{\Delta_H}$.

Given the expected profits, the location of the vertical v_L line and the horizontal v_H line is determined by the extent of the low-cost and high-cost types' petition-related efforts. The domestic firm is willing to put into petition-related efforts less than or equal to the gains from antidumping actions. The 45 degree $v_H = v_L$ line divides the relevant probability region into the area of pooling or separating equilibrium and the area of separating equilibrium. The foreign firm will challenge when it expects to face a process filer and will give in when expects

to face an outcome filer. The foreign firm's decision depends on the amount of expenses that it has to bear when it faces different types of petitioners. The foreign firm's decision also partitions the relevant probability space. The probability region is also divided by the foreign firm's 'challenge-acquiesce' decision line, a function of expected gains, the amount of sales, filing-motive probabilities, and counteracting expenses, into a pooling or a semi-separating equilibrium region.

Three types of equilibrium have been considered. When the outcome filer is a low-cost type and the process filer is a high-cost type, $e_H < e_L$ and the unique separating equilibrium exists. Yet when the outcome filer is a high-cost type and the process filer is a low-cost type, a separating equilibrium is ruled out. The probability of a successful petition by an outcome filer is always greater than that by a process filer so that $e_H > e_L$. This implies that an outcome filer may spend too much and a process filer too little, which in turn may cause the separating equilibrium conditions not to be satisfied. In order to increase the likelihood of success, an outcome filer may want to increase petition-related efforts to such an extent that the net gain from filing may actually become negative.[38] Similarly, a process filer may make so little efforts that the net gain from filing may actually become positive. As a result, the probability combination of a high probability for a high-cost type's success and a low probability for a low-cost type's success does not constitute a separating equilibrium in which an outcome filer (a high-cost type) files and a process filer (a low-cost type) withdraws.

That a separating equilibrium does not exist implies that the cost of petition filing is relatively small for a process filer. The process filer may well pretend to be an outcome filer to take advantage of the antidumping procedure. The pooling strategy works only if it induces the foreign firm to acquiesce. The foreign firm acquiesces in case that its expected profit from challenging is less than that from acquiescing, which is a function of the probability of facing the outcome filer. Therefore, the likelihood of a pooling equilibrium depends on the possibility of the domestic firm's being an outcome filer. The higher the chance of the domestic firm's being an outcome filer is, the lower is the possibility of winning the antidumping case and hence the less will the foreign firm be inclined to challenge.

The likelihood of a pooling equilibrium will increase, if the ratio of the potential loss to the foreign exporter with a low-cost type's petitioning to that with a high-cost type's petitioning[39] becomes larger. That is, the loss to the foreign exporter (the gain to the domestic firm) due to a process-oriented filing is relatively larger, the possibility of a pooling equilibrium increases. The amount of the initial profits of the foreign exporter in the home market (y_H^2 or y_L^2) also plays a role in effecting a pooling equilibrium. If the initial profits are substantially large, it does not pay for the foreign exporter to acquiesce readily to the possibly "strategic" petitioning of the domestic firm and to give up the "vested" interests.

In addition, the possibility of a pooling depends on the value of α_i, which depends on the steepness of a VER reaction curve, the magnitude of initial sales to the home market, and the relative cost competitiveness.[40] The influence of the slope of a VER reaction curve is ambiguous. On the other hand, the magnitude of the domestic firm's initial sales is inversely related to the value of α_i. The larger it is, the smaller the value of α_i and the pooling possibility will be.

Finally, what brings about a semi-separating equilibrium works in the opposite direction of what works for a pooling equilibrium. Moreover, a semi-separating equilibrium is encountered if the petitioning cost and/or if the counteracting cost is low. Since the outcome filer is assumed to file a petition when it faces dumping from abroad, the domestic firm will be identified as a process filer if it does not file a petition. Even if the domestic firm files a petition, it still leaves some ambiguity about its type. While the probability of being an outcome filer (or a process filer) affects the likelihood of a semi-separating equilibrium, its net effect is undetermined as it has impacts on both the slope and the intercept of the 'challenge-acquiesce' dividing line, which work in opposite directions.

The possibility of a pooling or a semi-separating equilibrium has implications for the potentially abusive nature of antidumping activities. The non-existence of a separating equilibrium implies that a "normal" petition filing is ruled out, in which only the genuine "victim" of dumping with a greater opportunity cost (or larger gains at stake) files a petition, and the "frivolous" filer with a smaller opportunity cost (or smaller gains at stake) does not file. The likelihood of abusive antidumping depends on the relative size of the area of the *probability region* in which a pooling or a semi-separating equilibrium emerges.

When the potential gain from antidumping petition for a low-cost type becomes larger, the horizontal intercept will get smaller for a given amount of petition-related efforts. When the potential gain from antidumping for a high-cost type becomes smaller, the vertical intercept will get larger. With a smaller horizontal intercept and a larger vertical intercept, the area of a pooling or a semi-pooling equilibrium is elongated toward the vertical axis. As the gain from antidumping petition becomes relatively larger, the incentive for the process filer to mimic the outcome filer increases the possibility of a pooling or a semi-separating equilibrium in comparison with the possibility of a separating equilibrium.

Given the size of the relevant probability area, the likelihood of a pooling equilibrium decreases with the costs of petition-related efforts by the domestic firm and with the counteracting efforts by the foreign exporter. The greater the foreign firm's efforts to thwart the domestic firm's petitioning actions[41] are, the less successful the domestic firm's strategy will be. Similarly, the greater the domestic firm's costs of petition-related activities are, the less aggressive the domestic firm will be. In both cases, it is less likely that a pooling strategy work or, equivalently, a strategic use of antidumping petition succeeds.

In addition, the less competitive the domestic firm is, the more likely the pooling strategy will emerge. So will the abusive antidumping actions. With the gap between the domestic and foreign firms' competitiveness getting larger, the likelihood of abusive antidumping increases as the difference in the marginal production costs between the foreign exporter and the both cost types of the domestic firm.[42]

6. Conclusion

Given the assumption that import competing domestic firms maintain distinct antidumping motivations and strategies against their trading partners, the use or abuse of antidumping law occurs as an equilibrium outcome of a signaling game. In the presence of private information, linking antidumping motivations with antidumping strategies makes it possible to distinguish cases in which antidumping actions can be made abusive from those in which antidumping can be justified. Antidumping petitions filed out of strategic consideration would result in the abuse of antidumping law, and antidumping petitions filed out of preventing genuine dumping would not.

Abusive antidumping is expected to occur, when the domestic firm is able to file petitions taking advantage of its filing motivations which is private information, so that the equilibrium involves a pooling or a semi-separating equilibrium. In particular, how likely abusive antidumping is to occur can be assessed from the size of a pooling or a semi-separating equilibrium region in the probability space. For a given size of the domestic market, the possibility of abusive antidumping increases with the domestic firm's potential gain from antidumping petitioning given the petition-related expenses. In particular, this possibility increases with the probability that the petition filer seeking remedial actions (the outcome filer) happens to be a high-cost type, the probability that the domestic firm is an outcome (a process) filer, the expected loss that the foreign exporter might suffer due to antidumping, the initial profits that the foreign exporter earns in the home market, the cost competitiveness of the domestic firm, the initial sales to the home market, and the effects of a VER on the foreign exporter's reaction.

The existence of a pooling equilibrium shows why there are so many antidumping petitions, many of which come from outdated, less competitive industries. In the signaling game considered in this paper, the domestic firm has been able to take advantage of antidumping petition against the foreign exporter, because the antidumping rules are set in favor of the domestic firm in comparison with what would have been the case if the objective of antidumping actions were to avoid economically defined predation not price discrimination. Moreover, according to the findings of this paper, these rules need no "partiality" in securing the results favorable to the petitioners. Only a few simplifying conditions are needed to

establish that effect. Indeed, establishing the act of dumping in the administration of U.S. antidumping law is merely a technical exercise that cannot prove anything unfair about dumping.[43] At the same time, unconditional reliance on those formulas that compare export price and *normal* value is likely to help apply antidumping measures even to *incidental* dumping[44] that competition law would not find objectionable.[45]

Appendix A

A.1. Proof of Lemma 1

i) Start from equations (1) and (2). For the segmented domestic and foreign markets, the domestic equilibrium price can be expressed as $p_i = A - x_i - y_i = \frac{1}{3}\left(A + c_i + c^*\right)$ for $i = H, L$.

These prices depend on the types of the domestic firm competing with the foreign exporter in the home market. Since $c_H > c_L$, it can be shown that $p_H > p_L$. Given the assumption that the foreign equilibrium price, $p^* = A^* - y^* = \frac{1}{2}\left(A^* + c^*\right)$, is greater than the domestic equilibrium price, it can also be shown that $p^* - p_L > p^* - p_H > 0$. Since the dumping margin is identical to the difference between the foreign and domestic prices, remedial antidumping duties will be larger when the low-cost type files a petition and succeeds in finding dumping than otherwise.

That is, $\tau_M^H < \tau_M^L$, where $\tau_M^H = \dfrac{3A^* - 2A - 2c_H + c^*}{6}$ and $\tau_M^L = \dfrac{3A^* - 2A - 2c_L + c^*}{6}$ are antidumping duties to be imposed when the high-cost and low-cost types win the antidumping case respectively. By assumption, the probability of success v_i in the antidumping investigation is an increasing function of "petition-related efforts" (costs or expenses), which in turn depends on the expected change in the benefits (profits) due to those efforts.

Let $\Delta_H = \pi_H^\tau - \pi_H$ and $\Delta_L = \pi_L^\tau - \pi_L$, with the profit functions of the different cost types expressed as

$$\pi_H^\tau = v_H\left(x_H + \frac{\tau_M^H}{3}\right)^2 + (1 - v_H)x_H^2, \quad \pi_H = x_H^2, \quad \pi_L^\tau = v_L\left(x_L + \frac{\tau_M^L}{3}\right)^2 + (1 - v_L)x_L^2, \quad \pi_L = x_L^2.$$

The superscript τ denotes a profit function with antidumping duties (equal to the dumping margin) and the subscripts H, L indicate the high-cost type and the low-cost type respectively. The home firm's sales to the home market depends on its cost type as shown in $x_H = \dfrac{A - 2c_H + c^*}{3}$ and $x_L = \dfrac{A - 2c_L + c^*}{3}$, and it also depends on the dumping margins or antidumping duties τ_M^H and τ_M^L. Given the standard assumption that the domestic firm will put

22

into the petition-related efforts less than or equal to the total value of the expected gains from the antidumping activities, these efforts can be approximated by $v_H \Delta_H$ or $v_L \Delta_L$ depending on its cost type. Thus the amount of petition-related efforts can be expressed as $e_H \le v_H \Delta_H \le \Delta_H$ and $e_L \le v_L \Delta_L \le \Delta_L$ for the high cost firm and the low cost firm respectively, which can be rewritten as

$$\left(\frac{9e_H}{6x_H \tau_M^H + \tau_M^{H\,2}} \right) \le v_H \le 1 \ \text{ and } \ \left(\frac{9e_L}{6x_L \tau_M^L + \tau_M^{L\,2}} \right) \le v_L \le 1 , \text{ so that the relevant probability}$$

space is partitioned by the closed intervals. The area of the probability space depends on the size of petition-related efforts e_H and e_L relative to the potential gains from antidumping petition

$$\Delta_H = \frac{2}{3} x_H \tau_M^H + \frac{1}{9} \tau_M^{H\,2} \ \text{ and } \ \Delta_L = \frac{2}{3} x_L \tau_M^L + \frac{1}{9} \tau_M^{L\,2} .$$

ii) The optimal level of e_i maximizes the expected "remedial gain," so that

$$e_i(dS_i) = \arg \max_{e_i \in \{0, e^{\max}\}} \left\{ v(e_i) S_i^\tau + (1 - v(e_i)) S_i - e_i \right\} \qquad i = H, L \quad (A.1).$$

The necessary condition for the expected gain from petition-related efforts to be maximized is that e_i should satisfy

$$v'(e_i) S_i^\tau - v'(e_i) S_i - 1 = 0 \qquad i = H, L \quad (A.2).$$

Consequently, $v'(e_H) = (dS_H)^{-1}$ and $v'(e_L) = (dS_L)^{-1}$ where $dS_H = S_H^\tau - S_H$, $dS_L = S_L^\tau - S_L$,

$$S_H = \frac{x_H}{x_H + y_H}, \ S_L = \frac{x_L}{x_L + y_L}, \ S_H^\tau = \frac{x_H^\tau}{x_H^\tau + y_H^\tau}, \text{ and } S_L^\tau = \frac{x_L^\tau}{x_L^\tau + y_L^\tau} .$$

The second-order condition is satisfied, since $v(e_i)$ is a monotonously increasing, concave function in e_i for a given level of foreign firm's counteracting efforts.

(1) If the low cost type is an outcome filer and the high cost type is a process filer, it is necessary

that $dS_H = \dfrac{3\tau_M^H (A - c_H)}{(2A - c_H - c^*)(2A - c_H - c^* - \tau_M^H)} < \dfrac{3\tau_M^L (A - c_L)}{(2A - c_L - c^*)(2A - c_L - c^* - \tau_M^L)} = dS_L$. On

the other hand, if the high cost type is an outcome filer and the low cost type is a process filer, the direction of the inequality is reversed.

Thus, in case the low cost type is an outcome filer and the high cost type a process filer, $v'(e_H) > v'(e_L)$ for $dS_H < dS_L$. Since $v(e_i)$ is a concave function, $e_H < e_L$. Moreover, as v_i is monotonously increasing, $e_H < e_L$ implies that $v_H = v(e_H) < v(e_L) = v_L$.

(2) On the other hand, if the high cost type is an outcome filer and the low cost type a process

filer, $v'(e_H) < v'(e_L)$ for $dS_H > dS_L$. Again, since $v(e_i)$ is a concave function, $e_H > e_L$. Moreover, v_i is monotonously increasing, so that $e_H > e_L$ implies $v_H = v(e_H) > v(e_L) = v_L$.

□

A.2. Proof of Lemma 2

i) Suppose that the outcome filer is a low-cost type and the process filer a high-cost type. Then the expected payoff from challenging for the foreign exporter is expressed as:

$$(1-\mu)\left(y_H^2 - \frac{4}{3} v_H y_H \tau_M^H + \frac{4}{9} v_H \tau_M^{H\,2} \right) + \mu\left(y_L^2 - \frac{4}{3} v_L y_L \tau_M^L + \frac{4}{9} v_L \tau_M^{L\,2} \right)$$

$$+ \left(\frac{A^* - c^*}{2} \right)^2 - f^* - e^* \quad (A.3)$$

where $y_H = \left(\dfrac{A - 2c^* + c_H}{3} \right)$, $y_L = \left(\dfrac{A - 2c^* + c_L}{3} \right)$.

The expected payoff from acquiescing is expressed as:

$$(1-\mu)\alpha_H y_H^2 + \mu \alpha_L y_L^2 + \left(\frac{A^* - c^*}{2} \right)^2 - f^* \quad (A.4)$$

where $\alpha_i = \left\{ \dfrac{m(m-2)}{m-1} + \dfrac{A - 2c^* + c_i}{A - 2c_i + c^*} \right\} \left\{ 3 - m + \dfrac{3(c_i - c^*)}{A - 2c_i + c^*} \right\}$ for $i = H, L$.

The foreign exporter will challenge, if the expected payoff from challenging, $(A.3)$, is greater than that from acquiescing, $(A.4)$. In other words, the foreign exporter will challenge if

$$e^* < (1-\mu)(1-\alpha_H)y_H^2 + \mu(1-\alpha_L)y_L^2 - (1-\mu)v_H\left(\frac{4}{3} \tau_M^H y_H - \frac{4}{9} \tau_M^{H\,2} \right)$$

$$- \mu v_L\left(\frac{4}{3} \tau_M^L y_L - \frac{4}{9} \tau_M^{L\,2} \right) \quad (A.5)$$

Otherwise, the foreign exporter will acquiesce. Collecting the terms in $(A.5)$ will yield the condition for the foreign firm to challenge as follows:

$$v_H < -\frac{\mu \Delta_L^*}{(1-\mu)\Delta_H^*} v_L + \frac{(1-\mu)(1-\alpha_H)y_H^2 + \mu(1-\alpha_L)y_L^2 - e^*}{(1-\mu)\Delta_H^*} \quad (A.6)$$

where $\Delta_i^* = \left(\dfrac{4}{3} y_i \tau_M^i - \dfrac{4}{9} \tau_M^{i\,2} \right) > 0$ for $i = H, L$. Analogously, the condition for the foreign

firm to acquiesce can be derived as follows:

$$v_H > -\frac{\mu \Delta_L^*}{(1-\mu)\Delta_H^*}v_L + \frac{(1-\mu)(1-\alpha_H)y_H^2 + \mu(1-\alpha_L)y_L^2 - e^*}{(1-\mu)\Delta_H^*} \quad (A.7).$$

ii) Suppose the outcome filer is a high-cost type and the process filer a low-cost type. The expected payoff from challenging is identical to $(A.3)$ except that $(1-\mu)$ in front of the first bracket of $(A.3)$ is replaced by μ and μ in front of the second bracket of $(A.3)$ by $(1-\mu)$. Similarly, the expected payoff from acquiescing is identical to $(A.4)$ with $(1-\mu)$ in the first term of $(A.4)$ replaced by μ and μ in the second term of $(A.4)$ by $(1-\mu)$. Then, with some manipulation, the condition for the foreign firm to challenge can be given as follows:

$$v_H < -\frac{(1-\mu)\Delta_L^*}{\mu\Delta_H^*}v_L + \frac{\mu(1-\alpha_H)y_H^2 + (1-\mu)(1-\alpha_L)y_L^2 - e^*}{\mu\Delta_H^*} \quad (A.6')$$

And the condition for the foreign firm to acquiesce can be expressed as

$$v_H > -\frac{(1-\mu)\Delta_L^*}{\mu\Delta_H^*}v_L + \frac{\mu(1-\alpha_H)y_H^2 + (1-\mu)(1-\alpha_L)y_L^2 - e^*}{\mu\Delta_H^*} \quad (A.7'). \; \square$$

A.3.1. Proof of Proposition 1-A

Suppose that the outcome filer is a low-cost type and the process filer a high-cost type. The separating equilibrium must satisfy the standard constraints. The *participation* constraint is satisfied by the assumption that the foreign exporter's profits are not negative. The *self-selection* or *incentive compatibility constraints* are satisfied when a process filer does not file a petition and an outcome filer files it without deviation. For a process filer not to file, it is necessary that the following *incentive compatibility constraint* is satisfied.

$$\left(\frac{3-m}{m-1}\right)\left(\frac{A-2c_H+c^*}{3}\right)^2 - f - e_H < \left(\frac{A-2c_H+c^*}{3}\right)^2 - f \quad (A.8)$$

For an outcome filer to file, it is necessary that the following *incentive compatibility constraint* is satisfied when an outcome filer files a petition with the foreign firm giving up fighting.

$$\left(\frac{3-m}{m-1}\right)\left(\frac{A-2c_L+c^*}{3}\right)^2 - f - e_L > \left(\frac{A-2c_L+c^*}{3}\right)^2 - f \quad (A.9).$$

Collecting terms for e_H and e_L yields the necessary conditions for a separating equilibrium.

$$\frac{2(2-m)}{m-1}\left(\frac{A-2c_H+c^*}{3}\right)^2 < e_H \quad (A.10),$$

$$e_L < \frac{2(2-m)}{m-1}\left(\frac{A-2c_L+c^*}{3}\right)^2 \qquad (A.11),$$

By Lemma 1-ii), $e_H < e_L$. Thus the incentive compatibility constraint should satisfy that

$$\frac{2(2-m)}{m-1}\left(\frac{A-2c_H+c^*}{3}\right)^2 < e_H < e_L < \frac{2(2-m)}{m-1}\left(\frac{A-2c_L+c^*}{3}\right)^2 \qquad (A.12).$$

Compare $\dfrac{2(2-m)}{m-1}\left(\dfrac{A-2c_H+c^*}{3}\right)^2$ and $\dfrac{2(2-m)}{m-1}\left(\dfrac{A-2c_L+c^*}{3}\right)^2$ to see if $(A.12)$ holds. By

assumption, $\dfrac{1}{2} < m < 2$. Yet, given $p = A - x - y$, the price undertaking is sustained

$(\Delta p = -\Delta x - \Delta y > 0)$, only if the slope of the VER-reaction curve satisfies $-m = \Delta y/\Delta x < -1$.

Since the intersection of $\dfrac{1}{2} < m < 2$ and $m > 1$ is $1 < m < 2$, $\dfrac{2(2-m)}{m-1} > 0$. Then it can be shown

that $\dfrac{2(2-m)}{m-1}\left(\dfrac{A-2c_H+c^*}{3}\right)^2 < \dfrac{2(2-m)}{m-1}\left(\dfrac{A-2c_L+c^*}{3}\right)^2$, so that $(A.12)$ always holds. In

case that $e_H < e_L$ and $v_H < v_L$, the inequality $(A.12)$, the separating equilibrium condition,
is satisfied. □

A.3.2. Proof of Proposition 1-B

Suppose that a separating equilibrium exists in which the outcome filer is a high-cost type
and the process filer a low-cost type. Then, from the incentive compatibility constraint that the

process filer should not file, $\dfrac{2(2-m)}{m-1}\left(\dfrac{A-2c_L+c^*}{3}\right)^2 < e_L$. From the incentive constraint that

the outcome filer should file, $e_H < \dfrac{2(2-m)}{m-1}\left(\dfrac{A-2c_H+c^*}{3}\right)^2$. By Lemma 1-ii), if the outcome

filer is a high-cost type and the process filer is a low-cost type, then $e_L < e_H$. Thus the
incentive compatibility constraint should satisfy that

$$\frac{2(2-m)}{m-1}\left(\frac{A-2c_L+c^*}{3}\right)^2 < e_L < e_H < \frac{2(2-m)}{m-1}\left(\frac{A-2c_H+c^*}{3}\right)^2 \qquad (A.12').$$

Yet, since $\dfrac{2(2-m)}{m-1}\left(\dfrac{A-2c_H+c^*}{3}\right)^2 < \dfrac{2(2-m)}{m-1}\left(\dfrac{A-2c_L+c^*}{3}\right)^2$, contradiction arises. The

incentive constraint for a separating equilibrium is not satisfied. □

A.4. Proof of Proposition 2

When the outcome filer is a high-cost type and the process filer is a low-cost type, no separating equilibrium exists as shown in Proposition 1-B. In this case, for a 'file-acquiesce' strategy profile to constitute a pooling equilibrium, the difference in the expected payoff between challenging and acquiescing should be less than zero. The foreign firm will not want to challenge the domestic firm if the expected gain from challenging is less than that from acquiescing.

The expected payoff of the foreign firm when it challenges can be expressed as

$$\mu\left(y_H^2 - v_H\Delta_H^*\right) + (1-\mu)\left(y_L^2 - v_L\Delta_L^*\right) + \left(\dfrac{A^*-c^*}{2}\right)^2 - f^* - e^* \quad (A.3').$$

The expected payoff the foreign firm when it acquiesces to seek suspension (or a VER) can be expressed as

$$\mu\alpha_H y_H^2 + (1-\mu)\alpha_L y_L^2 + \left(\dfrac{A^*-c^*}{2}\right)^2 - f^* \quad (A.4').$$

With some manipulation, that the difference between challenging and acquiescing is less than zero can be expressed as

$$e^* > \mu(1-\alpha_H)y_H^2 + (1-\mu)(1-\alpha_L)y_L^2 - \mu v_H\Delta_H^* - (1-\mu)v_L\Delta_L^* \quad (A.13'),$$

which is equivalent to

$$v_H > -\dfrac{(1-\mu)\Delta_L^*}{\mu\Delta_H^*}v_L + \dfrac{\mu(1-\alpha_H)y_H^2 + (1-\mu)(1-\alpha_L)y_L^2 - e^*}{\mu\Delta_H^*} \quad (A.14').$$

When $(A.14')$ is satisfied, the 'file-acquiesce' strategy combination will constitute a Nash equilibrium given the beliefs and the strategies of the foreign firm. So $(A.14')$ is a necessary condition for a pooling equilibrium.

Now consider the foreign firm's beliefs. On the equilibrium path, the foreign firm updates its posterior beliefs by Bayes' Rule given the observed actions of the domestic firm. The foreign firm's posterior beliefs, $P(process|file) = 1-\mu$ and $P(outcome|file) = \mu$, are rational in the senses that they conform with the Bayes' Rule, given the observed actions of the domestic firm. These posterior beliefs are *consistent*.

Thus, given that the separating equilibrium condition is not satisfied, if the necessary

27

condition $(A.14')$ is satisfied and the strategy and belief profiles are specified as above, a pooling equilibrium exists. □

A.5. Proof of Proposition 3

If neither of the separating and pooling equilibrium conditions is satisfied, then the equilibrium should involve mixed strategies. If the foreign firm is to mix its strategy, it will want to make the expected payoff from challenging equal to that from acquiescing. That is,

$$\frac{(1-\mu)\gamma^P}{\mu+(1-\mu)\gamma^P}\pi_A^* + \frac{\mu}{\mu+(1-\mu)\gamma^P}\pi_B^* = \frac{(1-\mu)\gamma^P}{\mu+(1-\mu)\gamma^P}\pi_C^* + \frac{\mu}{\mu+(1-\mu)\gamma^P}\pi_D^* \quad (A.15),$$

where

$$\pi_A^* = v_L\left(y_L - \frac{2\tau_M^L}{3}\right)^2 + (1-v_L)y_L^2 + \left(\frac{A^*-c^*}{2}\right)^2 - f^* - e^* \ ;$$

$$\pi_B^* = v_H\left(y_H - \frac{2\tau_M^H}{3}\right)^2 + (1-v_H)y_H^2 + \left(\frac{A^*-c^*}{2}\right)^2 - f^* - e^* \ ;$$

$$\pi_C^* = \alpha_L y_L^2 + \left(\frac{A^*-c^*}{2}\right)^2 - f^* \ ; \text{ and } \ \pi_D^* = \alpha_H y_H^2 + \left(\frac{A^*-c^*}{2}\right)^2 - f^* .$$

Substituting these variables into $(A.15)$ and collecting the terms will yield

$$(1-\mu)\gamma^P\left[(1-\alpha_L)y_L^2 - v_L\Delta_L^*\right] + \mu\left[(1-\alpha_H)y_H^2 - v_H\Delta_H^*\right] = e^* \quad (A.16)$$

where $\Delta_H^* = \left(\frac{4}{3}\tau_M^H y_H - \frac{4}{9}\tau_M^{H2}\right) \ \Delta_L^* = \left(\frac{4}{3}\tau_M^L y_L - \frac{4}{9}\tau_M^{L2}\right)$.

Then the equilibrium mixed strategy of the domestic firm can be derived as

$$\gamma^P = \frac{e^* - \mu\{(1-\alpha_H)y_H^2 - v_H\Delta_H^*\}}{(1-\mu)\{(1-\alpha_L)y_L^2 - v_L\Delta_L^*\}} \quad (A.17).$$

Proposition 2 implies that $e^* < \mu(1-\alpha_H)y_H^2 + (1-\mu)(1-\alpha_L)y_L^2 - \mu v_H\Delta_H^* - (1-\mu)v_L\Delta_L^*$ for a semi-separating equilibrium. The numerator is less than the denominator. So $\gamma^P < 1$.

Given the foreign firm's strategies and inferences, the process filer (a low-cost type) expects its payoff from filing to be equal to that from withdrawing. That is,

$$\gamma^F\pi_L^A + (1-\gamma^F)\pi_L^B = \pi_L^C \quad (A.18),$$

where

$$\pi_L^A = v_L\left(x_L + \frac{\tau_M^L}{3}\right)^2 + (1-v_L)x_L^2 - f - e_L \ ; \pi_L^B = \left(\frac{3-m}{m-1}\right)x_L^2 - f - e_L \ ; \text{ and } \ \pi_L^C = x_L^2 - f .$$

Solving equation $(A.18)$ for γ^F yields $\gamma^F = \dfrac{2(m-2)\pi_L + (m-1)e_L}{2(m-2)\pi_L + (m-1)v_L\Delta_L}$ where $\pi_L = x_L^2$.

Since $e_L \leq v_L\Delta_L$ by Lemma 1-i), $\gamma^F \leq 1$. $\square$

References

Anderson, J. E., 1992. Domino dumping I; competitive exporters. American Economic Review 82, 65-83

Baldwin, R. E., Moore, M. E., 1991. Political aspects of the administration of the trade remedy laws. In: Boltuck, R. D., Litan, R. E. (Eds.), Down in the Dumps: Administration of the Unfair Trade Laws. Brookings Institution, Washington, D.C.

Boltuck, R. D., Litan, R. E., 1991. America's "unfair" trade laws. In: Boltuck, R. D., Litan, R. E. (Eds.), Down in the Dumps: Administration of the Unfair Trade Laws. Brookings Institution, Washington, D.C.

Clarida, R. H., 1996. Dumping: in theory, in policy, and in practice. In: Bhagwati, J. N., Hudec, R. E. (Eds.), Fair Trade and Harmonization: Prerequisite for Free Trade? vol. 1. MIT Press: Cambridge

Fudenberg, D., Tirole, J., 1991. Game Theory. MIT Press, Cambridge

Harris, R. D., 1985. Why voluntary restraints are 'voluntary'? Canadian Journal of Economics 18, 799-809

Krishna, K., 1989. Trade restrictions as facilitating practices. Journal of International Economics 26, 251-70

Krueger, A., 1996. Introduction. In: Krueger, A.O. (Ed.), The Political Economy of American Trade Policy. University of Chicago Press, Chicago

Murray, T., 1991. The administration of the antidumping duty law by the Department of Commerce. In: Boltuck, R. D., Litan, R. E. (Eds.), Down in the Dumps: Administration of the Unfair Trade Laws. Brookings Institution, Washington, D.C.

Palmeter, N. D., 1991. The antidumping law: a legal and administrative nontariff barrier. In: Boltuck, R. D., Litan, R. E. (Eds.), Down in the Dumps: Administration of the Unfair Trade Laws. Brookings Institution, Washington, D.C.

Prusa, T. J., Skeath, S., 2001. The economic and strategic motives for antidumping filings, National Bureau of Economic Research, Working paper 8424

Rosendorff, B. P., 1996. Voluntary export restraint, antidumping procedure, and domestic politics. American Economic Review 86, 544-61

Staiger, R. W., Wolak, F. A., 1996. Differences in the uses and effects of antidumping law across import sources. In: Krueger, A.O. (Ed.), The Political Economy of American Trade Policy. University of Chicago Press, Chicago

Vermulst, E., 2000. Anti-dumping and countervailing duties. In: United Nations Conference on Trade and Development, Positive Agenda and Future Trade Negotiations. United Nations, New York

Wong, K.R., 1995. International Trade in Goods and Factor Mobility. MIT Press, Cambridge

Table 1-A: High cost firm as a process filer - $(1-\mu)$ (Chance selects the process filer.)

		Foreign firm	
		Challenges $E(\pi^*)$	Acquiesces $E(\pi^*)$
Home firm	Files $E(\pi^H)$	$v_H\left(\dfrac{A-2c_H+c^*}{3}+\dfrac{\tau_M^H}{3}\right)^2+(1-v_H)\left(\dfrac{A-2c_H+c^*}{3}\right)^2$ $-f-e_H$ $v_H\left(\dfrac{A-2c^*+c_H}{3}-\dfrac{2\tau_M^H}{3}\right)^2+(1-v_H)\left(\dfrac{A-2c^*+c_H}{3}\right)^2$ $+\left(\dfrac{A^*-c^*}{2}\right)^2-f^*-e^*$	$\left(\dfrac{3-m}{m-1}\right)\left(\dfrac{A-2c_H+c^*}{3}\right)^2-f-e_H$ $\left\{\dfrac{m(m-2)}{m-1}+\dfrac{A-2c^*+c_H}{A-2c_H+c^*}\right\}\left\{(3-m)+\dfrac{3(c_H-c^*)}{(A-2c_H+c^*)}\right\}\times$ $\left(\dfrac{A-2c^*+c_H}{3}\right)^2+\dfrac{(A^*-c^*)^2}{4}-f^*$
	Withdraws $E(\pi^H)$		$\left(\dfrac{A-2c_H+c^*}{3}\right)^2-f$ $\left(\dfrac{A-2c^*+c_H}{3}\right)^2+\left(\dfrac{A^*-c^*}{2}\right)^2-f^*$

With a VER, the foreign firm's reaction curve becomes $y^{VER}=\dfrac{(A-2c^*+c_i)}{3}+\dfrac{(A-2c_i+c^*)m}{3}-mx$ where m_i denotes the slope of the locus satisfying the quantitative restriction or the price increase the foreign exporter promises when it faces the type i domestic firm. The home firm can maximize its profits by setting its quantity at $x^{VER}=\dfrac{(A-2c_i+c^*)}{3(m-1)}$ where its iso-porift curve is tangent to y^{VER}. The slopes of y^{VER} are bounded

31

Table 1-B: Low cost firm as an outcome filer - μ (Chance selects the outcome filer.)

		Foreign firm	
		Challenges $E(\pi^*)$	Acquiesces $E(\pi^*)$
Home firm	Files $E(\pi^L)$	$v_L\left(\dfrac{A-2c_L+c^*}{3}+\dfrac{\tau_M^L}{3}\right)^2+(1-v_L)\left(\dfrac{A-2c_L+c^*}{3}\right)^2$ $-f-e_L$ $v_L\left(\dfrac{A-2c^*+c_L}{3}-\dfrac{2\tau_M^L}{3}\right)^2+(1-v_L)\left(\dfrac{A-2c^*+c_L}{3}\right)^2$ $+\left(\dfrac{A^*-c^*}{2}\right)^2-f^*-e^*$	$\left(\dfrac{3-m}{m-1}\right)\left(\dfrac{A-2c_L+c^*}{3}\right)^2-f-e_L$ $\left\{\dfrac{m(m-2)}{m-1}+\dfrac{A-2c^*+c_L}{A-2c_L+c^*}\right\}\left\{(3-m)+\dfrac{3(c_L-c^*)}{(A-2c_L+c^*)}\right\}\times$ $\left(\dfrac{A-2c^*+c_L}{3}\right)^2+\dfrac{(A^*-c^*)^2}{4}-f^*$
	Withdraws $E(\pi^L)$	$\left(\dfrac{A-2c_L+c^*}{3}\right)^2-f$ $\left(\dfrac{A-2c^*+c_L}{3}\right)^2+\left(\dfrac{A^*-c^*}{2}\right)^2-f^*$	

by those of home and foreign firms' reaction curves. $(1<m\le 2)$.

Table 2-A: Low cost firm as a process filer - $(1-\mu)$ (Chance selects the process filer.)

		Foreign firm	
		Challenges $E(\pi^*)$	Acquiesces $E(\pi^*)$
Home firm	Files $E(\pi^L)$	$v_L\left(\dfrac{A-2c_L+c^*}{3}+\dfrac{\tau_M^L}{3}\right)^2+(1-v_L)\left(\dfrac{A-2c_L+c^*}{3}\right)^2$ $-f-e_L$ $v_L\left(\dfrac{A-2c^*+c_L}{3}-\dfrac{2\tau_M^L}{3}\right)^2+(1-v_L)\left(\dfrac{A-2c^*+c_L}{3}\right)^2$ $+\left(\dfrac{A^*-c^*}{2}\right)^2-f^*-e^*$	$\left(\dfrac{3-m}{m-1}\right)\left(\dfrac{A-2c_L+c^*}{3}\right)^2-f-e_L$ $\left\{\dfrac{m(m-2)}{m-1}+\dfrac{A-2c^*+c_L}{A-2c_L+c^*}\right\}\left\{(3-m)+\dfrac{3(c_L-c^*)}{(A-2c_L+c^*)}\right\}\times$ $\left(\dfrac{A-2c^*+c_L}{3}\right)^2+\dfrac{(A^*-c^*)^2}{4}-f^*$
	Withdraws $E(\pi^L)$	$\left(\dfrac{A-2c_L+c^*}{3}\right)^2-f$ $\left(\dfrac{A-2c^*+c_L}{3}\right)^2+\left(\dfrac{A^*-c^*}{2}\right)^2-f^*$	

Table 2-B: High cost firm as an outcome filer - μ (Chance selects the outcome filer.)

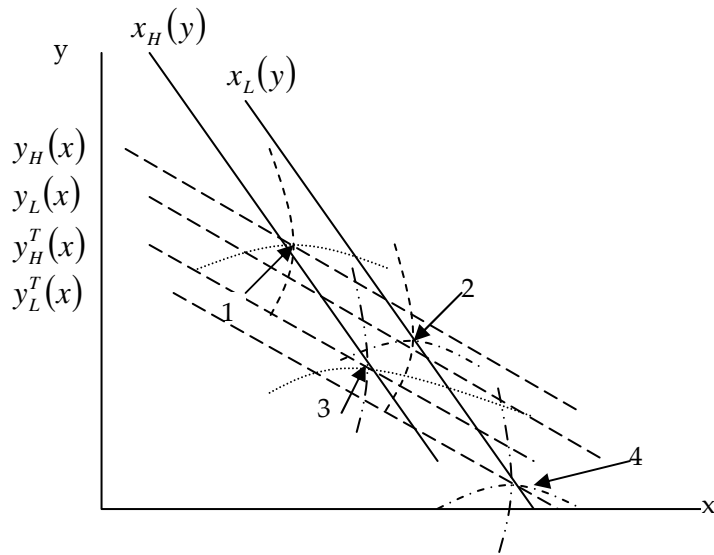|		Foreign firm	
		Challenges $E(\pi^*)$	Acquiesces $E(\pi^*)$
Home firm	Files $E(\pi^H)$	$v_H\left(\dfrac{A-2c_H+c^*}{3}+\dfrac{\tau_M^H}{3}\right)^2+(1-v_H)\left(\dfrac{A-2c_H+c^*}{3}\right)^2$ $-f-e_H$ $v_H\left(\dfrac{A-2c^*+c_H}{3}-\dfrac{2\tau_M^H}{3}\right)^2+(1-v_H)\left(\dfrac{A-2c^*+c_H}{3}\right)^2$ $+\left(\dfrac{A^*-c^*}{2}\right)^2-f^*-e^*$	$\left(\dfrac{3-m}{m-1}\right)\left(\dfrac{A-2c_H+c^*}{3}\right)^2-f-e_H$ $\left\{\dfrac{m(m-2)}{m-1}+\dfrac{A-2c^*+c_H}{A-2c_H+c^*}\right\}\left\{(3-m)+\dfrac{3(c_H-c^*)}{(A-2c_H+c^*)}\right\}\times$ $\left(\dfrac{A-2c^*+c_H}{3}\right)^2+\dfrac{(A^*-c^*)^2}{4}-f^*$
	Withdraws $E(\pi^H)$	$\left(\dfrac{A-2c_H+c^*}{3}\right)^2-f$ $\left(\dfrac{A-2c^*+c_H}{3}\right)^2+\left(\dfrac{A^*-c^*}{2}\right)^2-f^*$	

Fig.1. Reaction curves and iso-profit curves
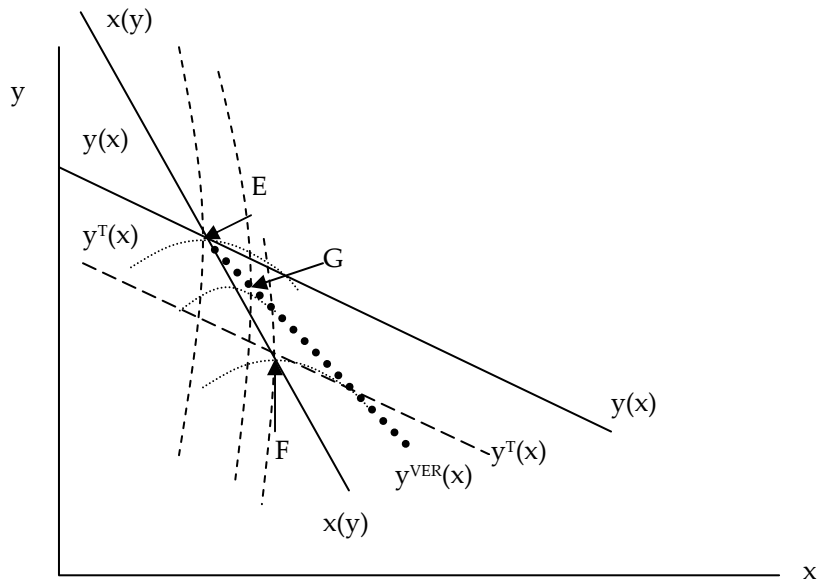

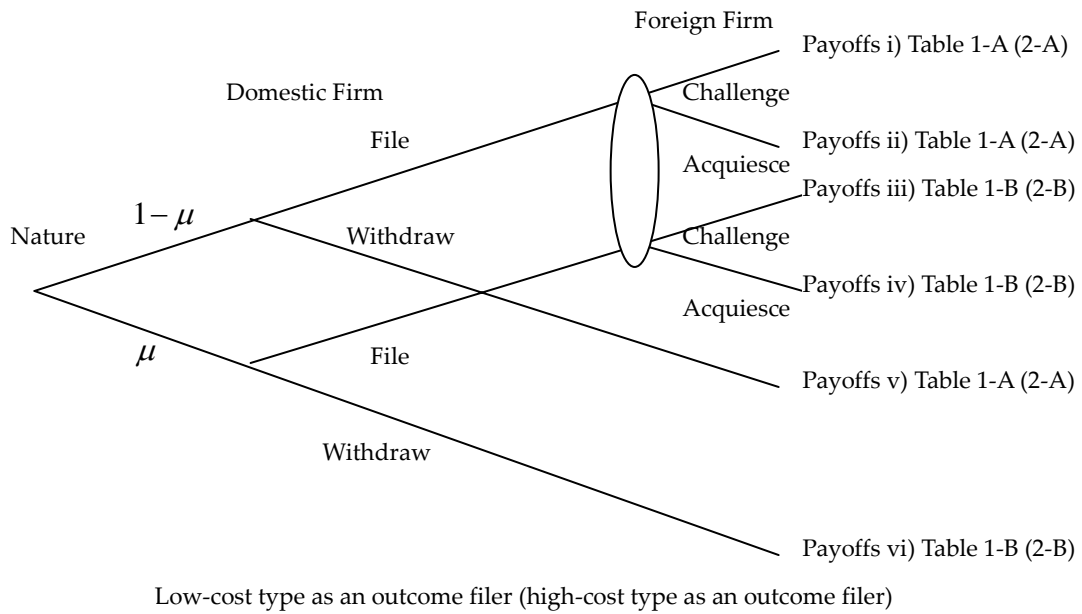Fig.2. Reaction curves with antidumping duties and a VER

Foreign Firm

Domestic Firm

Payoffs i) Table 1-A (2-A)

Challenge

File

Payoffs ii) Table 1-A (2-A)

Acquiesce

Payoffs iii) Table 1-B (2-B)

$1-\mu$

Challenge

Nature

Withdraw

Payoffs iv) Table 1-B (2-B)

Acquiesce

μ

File

Payoffs v) Table 1-A (2-A)

Withdraw

Payoffs vi) Table 1-B (2-B)

Low-cost type as an outcome filer (high-cost type as an outcome filer)

Fig.3. Antidumping game tree

v_H

process filer (low-cost type)
outcome filer (high-cost type)

1

$v_H = v_L$

process filer (high-cost type)
outcome filer (low-cost type)

$v_H = \dfrac{e_H}{\Delta_H}$

$\Delta_H = \dfrac{2}{3} x_H \tau_M^H + \dfrac{1}{9} \tau_M^{H\,2}$

$v_L = \dfrac{e_L}{\Delta_L}$

1

v_L

$\Delta_L = \dfrac{2}{3} x_L \tau_M^L + \dfrac{1}{9} \tau_M^{L\,2}$
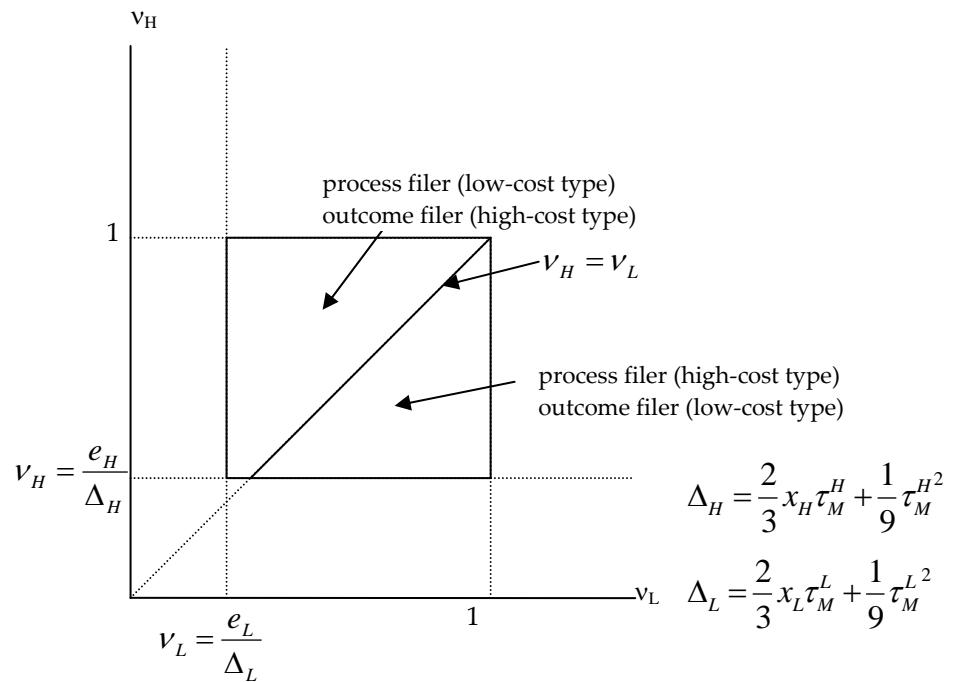
Fig.4. V_L, V_H graph for petition-related efforts
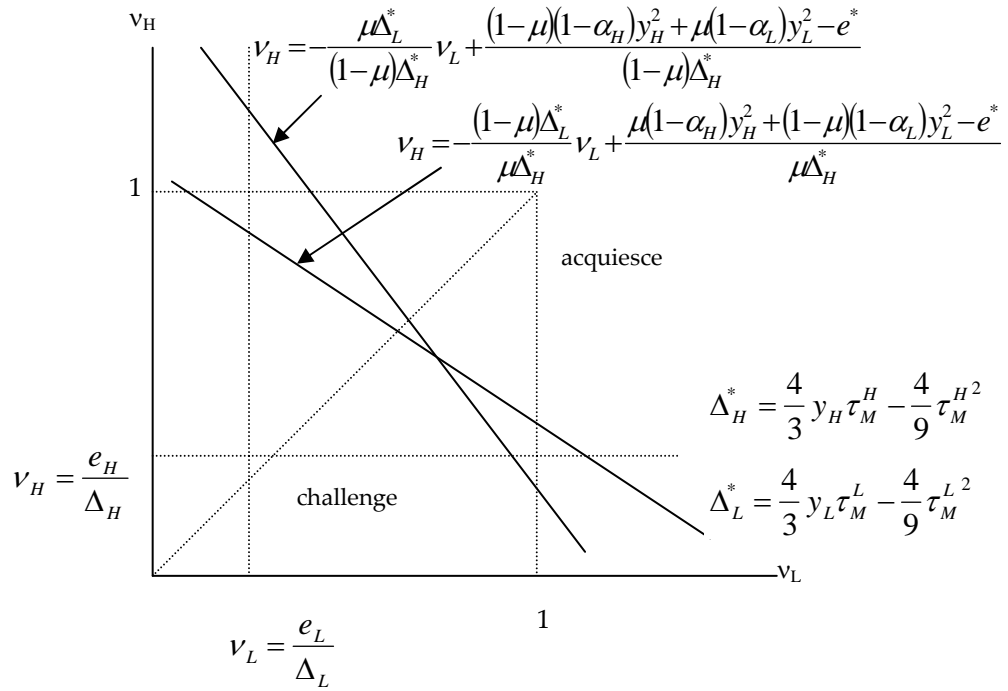
Fig.5. ν_L, ν_H graph for 'acquiesce-challenge' decision

The following equations appear in Fig.5:

$$\nu_H = -\frac{\mu\Delta_L^*}{(1-\mu)\Delta_H^*}\nu_L + \frac{(1-\mu)(1-\alpha_H)y_H^2+\mu(1-\alpha_L)y_L^2-e^*}{(1-\mu)\Delta_H^*}$$

$$\nu_H = -\frac{(1-\mu)\Delta_L^*}{\mu\Delta_H^*}\nu_L + \frac{\mu(1-\alpha_H)y_H^2+(1-\mu)(1-\alpha_L)y_L^2-e^*}{\mu\Delta_H^*}$$

acquiesce

$$\Delta_H^* = \frac{4}{3}y_H\tau_M^H - \frac{4}{9}\tau_M^{H\,2}$$

$$\nu_H = \frac{e_H}{\Delta_H}$$

challenge

$$\Delta_L^* = \frac{4}{3}y_L\tau_M^L - \frac{4}{9}\tau_M^{L\,2}$$

$$\nu_L = \frac{e_L}{\Delta_L}$$

Fig.6. Intersection of graphs

The following equations appear in Fig.6:

$$\nu_H = -\frac{\mu\Delta_L^*}{(1-\mu)\Delta_H^*}\nu_L + \frac{(1-\mu)(1-\alpha_H)y_H^2+\mu(1-\alpha_L)y_L^2-e^*}{(1-\mu)\Delta_H^*}$$

$$\nu_H = -\frac{(1-\mu)\Delta_L^*}{\mu\Delta_H^*}\nu_L + \frac{\mu(1-\alpha_H)y_H^2+(1-\mu)(1-\alpha_L)y_L^2-e^*}{\mu\Delta_H^*}$$

pooling

semi-separating

separating

$$\nu_H = \nu_L$$

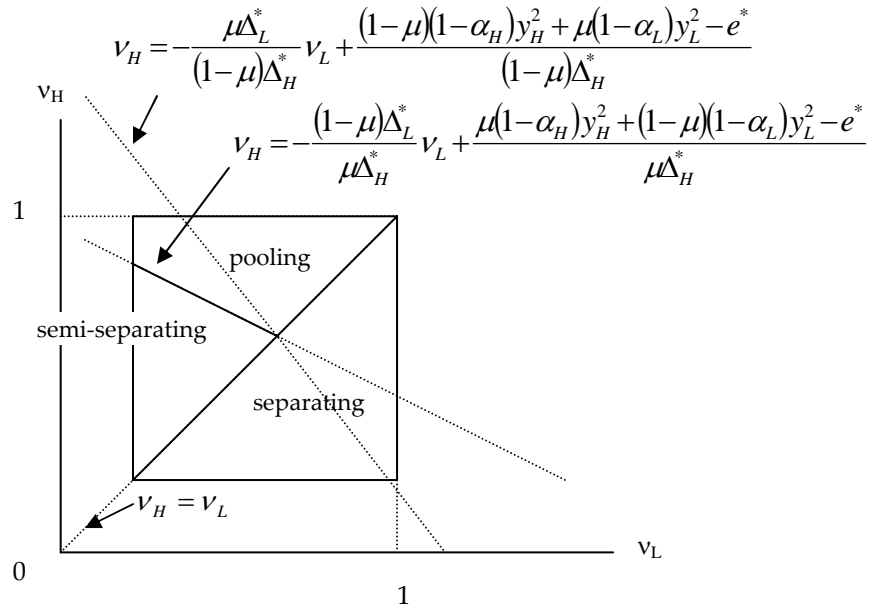[1] Antidumping is a typical form of administered protection relying on non-political, legal instruments. See Krueger (1996) for related discussion.

[2] Staiger and Wolak (1996) identify these *non-duty* effects and categorize them into the *investigation effect*, the *suspension effect*, and the *withdrawal effect*. The investigation effect refers to trade distortions brought about by antidumping investigations, the suspension effect to those induced by suspension agreements through *non-duty* channels, and the withdrawal effect to those made possible by petition withdrawals.

[3] The very threat of filing petitions might achieve the effect the actual antidumping duties would bring in. That is, the undertaking of investigation itself, with and even without any findings, may reduce the amount of imports. Both the "outcome filer hypothesis" and the "process filer hypothesis" are associated with the investigation effect. However, a completely different possibility may arise, as Anderson (1992) shows that antidumping enforcement encourages further dumping by exporters. With the rising probability of future VERs, the exporters may want to secure VER-related rents.

[4] Prusa and Skeath (2001) consider strategic motivations for antidumping filings in the absence of private information.

[5] See Staiger and Wolak (1996, p. 387) for details.

[6] Instead, Rosendorff's (1996) considers how a VER comes about in equilibrium as the outcome of a signaling game between a foreign exporter and the local government.

[7] The domestic firm has types that can be called differently. In the following, three categories of types will be used: marginal production cost, filing motivations, and willingness to bear filing expenses (costs).

[8] It can be inferred that the foreign firm may have become able to export to the domestic market because of protection which makes exporting profitable. Put differently, the assertion that "import protection is export promotion" is applicable here.

[9] The same is true of almost all the administered protection processes. See Krueger (1996, p 437) for details.

[10] This division of labor may not be faithfully upheld. In the case of the United States of America, Congress has influence on the "day-to-day" administration of antidumping law, while the Department of Commerce shows a "tendency toward advocacy rather than impartiality." See Baldwin and Moore (1991, p 273) for details.

[11] Rosendorff (1996) adopts a different assumption that the local government actively involves in the antidumping procedure. He looks into a signaling game composed of the local government and the foreign firm, asserting that "the antidumping procedure yields the unintended consequences of nontariff barriers." See Rosendorff (1996, p553).

[12] Profits decrease with the unit production cost and increase with the dumping margin. As a result, if antidumping duties are imposed, the profits of the low cost firm would increase more than those of the high cost firm. They are calculated as the difference between the counterfactual dumping-free profits and the current duopoly profits. The total benefits of antidumping petition that a petition filer with a low production cost can gain will be larger than the benefits that a petition filer with a high production cost can gain. To see why this is so, compare $\pi_H^\tau = \left(x_H + \dfrac{\tau_M^H}{3} \right)^2$ and $\pi_L^\tau = \left(x_L + \dfrac{\tau_M^L}{3} \right)^2$ where $x_H = \dfrac{A - 2c_H + c^*}{3}$, $x_L = \dfrac{A - 2c_L + c^*}{3}$, $\tau_M^H = \dfrac{3A^* - 2A - 2c_H + c^*}{6}$, and $\tau_M^L = \dfrac{3A^* - 2A - 2c_L + c^*}{6}$.

[13] Boltuck and Litan (1991, p 19) give details on how the "but for" test is carried out.

[14] Given the level of output, the market share of the low cost firm is always greater than that of the high cost firm. Yet, when it comes to the change in the market shares which is prerequisite to injury determination, which type of the domestic firm gains more as a result of the remedial actions depends on various parameters including cost competitiveness.

[15] It describes the *ex ante* probability that domestic firm's type is either an outcome filer or a process filer

[16] These type characteristics can be combined as follows: (outcome-low cost, process-low cost), (outcome-low cost, process-high cost), (outcome-high cost, process-low cost), and (outcome-high cost, process-high cost).

[17] When both cost types of the domestic firm are either process filers or outcome filers, strategic actions based on informational asymmetry are ruled out at the outset.

[18] For example, suppose that the outcome filer happens to be a low-cost type and the process filer a high-cost type. This supposition makes sense when, compared with a high-cost type, a low-cost type expects a larger increase in profits (and the market share) if the dumping finding is in its favor. The opportunity cost for a low-cost type of missing an outcome-oriented antidumping petition is greater than that for the high cost firm. As long as the difference between the changes in the market shares of the high-cost and low-cost types is less than zero,

$$dS_H - dS_L = \frac{\tau_M^H(A - c_H)}{3(x_H + y_H)(x_H^\tau + y_H^\tau)} - \frac{\tau_M^L(A - c_L)}{3(x_L + y_L)(x_L^\tau + y_L^\tau)} < 0,$$ the low-cost type should opt

for a more profitable filing strategy, an outcome oriented filing strategy. On the contrary, if $dS_H - dS_L > 0$, the other supposition that an outcome filer happens to be the high-cost type and a process filer the low-cost type makes sense. Since the imposition of antidumping duties reduces imports so that $(x_H + y_H) > (x_H^\tau + y_H^\tau)$ and $(x_L + y_L) > (x_L^\tau + y_L^\tau)$, the sign of the inequality depends on cost competitiveness and antidumping tariff rates.

[19] Obviously, if the preliminary determination is negative, the process terminates. In this case, the final determination is also negative by default.

[20] Even if the investigation process starts, exporting is not hindered in the first period. However, since the duties determined in the second period are retroactively imposed on previously imported goods, they will influence the foreign firm's behavior in the first period.

[21] The GATT Article VI allows antidumping duties against unfair export behavior under certain conditions: the existence of dumping margin; material injury to domestic industries; and causal relationship between dumped imports and material injury. In the segmented-markets model, it is straightforward to establish the existence of dumping margin as long as the home and foreign demand curves have different price elasticities. The condition of material injury is nothing but a matter of showing whether the counterfactual dumping-free profits are greater than the current duopoly profits, which is obviously the case with the present model. Finally, the model is set up in such a way to satisfy the condition of causal relationship between dumping and injury. See Boltuck and Litan (1991), Murray (1991), and Palmeter (1991) for related discussion on this point.

[22] Obviously, this is a bold simplification. Reality is much different. For example, the United States Antidumping Law stipulates that antidumping protection is run by the material injury finding. Yet the United States International Trade Commission (USITC) tends to find against petitioners on material injury, but the Department of Commerce tends to find for petitioners on the dumping margin.

[23] The rates of dumping margin and antidumping duties depend on the firm types. The changes in the profits also depend on the types of the domestic firm, which makes the opportunity costs differ.

[24] For a given amount of petitioning expenses, an outcome filer would gain more than a process filer. Each type of the domestic firm chooses to be an outcome filer, because doing so is more beneficial than doing otherwise.

[25] Or it can be said that the single crossing condition (monotonicity) is satisfied.

[26] Antidumping investigations require the foreign exporters to provide massive amounts of data in the questionnaire forms within a short period of time. This cost is likely to be substantial. See Palmeter (1991, p 69) and Boltuck and Litan (1991, p 17) for details.

[27] The changes in the domestic firms' profits are compared as $\Delta_H < \Delta_L$, where

$$\Delta_H = \left(x_H + \frac{\tau_M^H}{3}\right)^2 - x_H^2 \text{ and } \Delta_L = \left(x_L + \frac{\tau_M^L}{3}\right)^2 - x_L^2 \text{ for } x_H = \frac{A - 2c_H + c^*}{3},$$

$$x_L = \frac{A - 2c_L + c^*}{3}, \quad \tau_M^H = \frac{3A^* - 2A - 2c_H + c^*}{6} \text{ and } \tau_M^L = \frac{3A^* - 2A - 2c_L + c^*}{6}.$$

[28] This suspension agreement will surely affect the profit functions. Under the assumption of Cournot competition, the suspension agreement through a VER is equivalent to the imposition of antidumping duties in terms of the effect on the profits. See, for example, Wong (1995, p557) for details. Yet they are different in other respects. The imposition of antidumping duties is not certain, nor is the dumping margin known *a priori*.

[29] Since $p = A - x - y$, it must be the case that $\Delta y / \Delta x < -1$ for $\Delta p = -\Delta x - \Delta y > 0$.

[30] In Figure 2, the iso-profit curve of the foreign exporter passing through G gives more profits than that through F. The iso-profit curve passing through G is on the left-hand side of the iso-profit curve passing through F.

[31] Harris (1985) and Krishna (1989) show that the quantitative restriction could change the strategic relationship between home and foreign firms in such a way to benefit both firms in the context of a Bertrand duopoly.

[32] Four cells are there in each table. Yet the two cells at the bottom are identical so that there are only three different cells (cases) in each table.

[33] In the present model, the expected change in profits affects the intensity of antidumping efforts, which is equivalent to the opportunity cost of not-filing antidumping petition in the face of foreign "import penetration" and subsequent "material injury." In this sense, petition-related efforts may be made in proportion to the "latent" material injury. Thus relating the probability of dumping determination to the level of antidumping efforts does not conflict with the standard assumption that the probability of getting antidumping protection is determined by the material injury finding.

[34] Since the difference in prices between the two segmented markets is indispensable to the finding of dumping, this assumption is not objectionable. For the probability of dumping determination depends on the level of the domestic firm's efforts to secure what is demanded for final dumping determination. The product of these efforts is used as the so-called best information available (BIA) during the investigation process. See Palmeter (1991) for related discussion.

[35] Note that the outcome filer always invests more in petition-related efforts and has a better chance of winning the case.

[36] See, for example, Fudenberg and Tirole (1991, p 327) for details.

[37] Since for the outcome filer

$$v_H\left(\frac{A-2c_H+c^*}{3}+\frac{\tau_M^H}{3}\right)^2+(1-v_H)\left(\frac{A-2c_H+c^*}{3}\right)^2-f-e_H \geq \left(\frac{A-2c_H+c^*}{3}\right)^2-f$$

and for the process filer

$$v_L\left(\frac{A-2c_L+c^*}{3}+\frac{\tau_M^L}{3}\right)^2+(1-v_L)\left(\frac{A-2c_L+c^*}{3}\right)^2-f-e_L \geq \left(\frac{A-2c_L+c^*}{3}\right)^2-f \, ,$$

the domestic firm cannot expect to gain from withdrawal when challenged by the foreign firm.

[38] What is meant by the net gain here is the difference in profits associated with 'file-challenge' and 'withdraw' strategies, not the gain in each firm's profits net of petition-related expenses.

[39] The foreign exporter's respective profit functions when it faces the two different cost types of the domestic firm are expressed as: $\Delta_H^* = \frac{4}{3}\tau_M^H\left(y_H - \frac{1}{3}\tau_M^H\right)$ $\Delta_L^* = \frac{4}{3}\tau_M^L\left(y_L - \frac{1}{3}\tau_M^L\right)$ where

$y_H = \left(\frac{A-2c^*+c_H}{3}\right)$, $y_L = \left(\frac{A-2c^*+c_L}{3}\right)$, and τ_M^H and τ_M^L are antidumping duties. Thus,

the likelihood of a pooling equilibrium will increase, if the gap between the loss due to the low-cost type and that due to the high-cost type increases given the latter.

[40] Note that $\alpha_i = \left\{\frac{m(m-2)}{m-1}+\frac{y_i}{x_i}\right\}\left\{3-m+\frac{(c_i-c^*)}{x_i}\right\}$ for $i = H, L$.

[41] Note that the counteracting efforts are inversely related to the cost of counteracting, e^*.

[42] Note that the value of α_i and the area of a pooling equilibrium become larger.

[43] See Boltuck and Litan (1991), Murray (1991), and Palmeter (1991) for related discussion on this point.

[44] Vermulst (2000, p 290) has related discussion on incidental dumping.

[45] Moreover, the formulas used are fit for determining price discrimination, not predatory pricing, so that the finding of dumping cannot expose predatory or anti-competitive intent with which competition law is concerned. Clarida (1996, p 381) provides discussion on the U.S. cases.