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Robert W. Staiger

Frank A. Wolak

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ABSTRACT

We consider the effects of antidumping law when utilized by competitive domestic petitioners against a foreign monopolist. The foreign monopolist must set capacity before the realization of random foreign demand, but can reduce the cost of holding excess capacity in periods of slack foreign demand by dumping on the domestic market. With the introduction of antidumping law in the domestic market, domestic firms are shown to file suits in periods of sufficiently slack foreign demand, reducing the volume of imports directly in such periods. Moreover, this occasional filing activity raises the cost to the foreign monopolist of holding excess capacity and, in so doing, results in a scaling back of foreign capacity. Thus, the volume of imports is generally reduced by the introduction of domestic antidumping law, even in periods where no suit is filed. Finally, we consider self-enforcing agreements between the domestic industry and the foreign monopolist that take the form of a promise by the domestic industry not to file in exchange for a promise by the foreign monopolist to export no more than a pre-specified amount. We show that these agreements narrow the range of demand states over which suits are filed to only the softest states of demand, and lead to greater foreign capacity, hence partially mitigating both the direct and indirect impact of antidumping law on trade volume.

Robert W. Staiger
Stanford University
Department of Economics
Encina Hall
Stanford, CA 94305-6072

Frank A. Wolak
Stanford University
Department of Economics
Encina Hall
Stanford, CA 94305-6072

I. Introduction

The belief that foreign cartels will use world markets as a "dumping ground" for their excess capacity lies at the heart of the rationale for existing antidumping laws throughout the world. Viner (1966, p. 242) observes, for example, that the first antidumping legislation adopted in the U.S., as contained in Sections 800-801 of the Revenue Act of 1916, was largely a reaction to the alleged dumping threat posed by the highly cartelized and heavily protected German industries of the period. Inspired by the concern that these industries would regularly unload their excess industrial capacity on the competitive U.S. market, the intent of the law was to protect U.S. firms from the "unfair competition" resulting from such practices. Nor were these concerns necessarily without foundation. The cyclical dumping of foreign excess capacity on domestic markets is what Viner, in his classic taxonomy, termed "long-run" or "continuous" dumping to "maintain full production from existing plant facilities without cutting [foreign] prices" (p. 23). Moreover, Viner concludes that of the 10 types of dumping included in his taxonomy of motives, it "is probable that this is the most prevalent type of dumping." (p. 28)[1]

While the critical role played by the existence of cartels or cartel-like behavior in the evolution of antidumping law is widely noted, the

[1] As an illustration, Viner quotes from the Report of the United States Industrial Commission (USIC) of 1901, which we reproduce here: "A few exporters indicate that prior to 1898 prices were lower abroad than at home, and that this condition was brought about in order to keep a stable market in this country, and as one establishment puts it, 'We want the foreign market to cut our price in, so as not to disturb the domestic market.' 'Naturally enough,' says one correspondent, 'when American mills or factories are short of orders and trade is at a low ebb, they sell in foreign markets at cheaper rates in order....to keep their men employed and their works running.'" (USIC, 1901, p. 729)

effect of such laws on the performance of cartels and on their dumping activity is less well understood.[2] In Staiger and Wolak (1989), we explore this issue in the case where antidumping law is made available to one member of a tacit international cartel. In that paper we find that antidumping law can become a tool for enforcing collusion. Specifically we show that, by filing an antidumping suit against the foreign firm in periods of sufficiently soft demand, the domestic firm can dampen the foreign incentive to defect from any collusive price and, in so doing, allow a greater degree of collusion to be sustained in equilibrium than would be possible absent the suit. Moreover, since filing induces the desired equilibrium behavior, antidumping suits filed by one cartel member against another will generally not end in the imposition of duties.

In the present paper we explore the effects of antidumping law when utilized by competitive domestic petitioners against a foreign monopolist. This structure captures the stylized setting discussed above which gave rise to the enactment of antidumping laws in the early 20th century. Moreover, the results here, in which petitioners are competitive, can be contrasted with those in Staiger and Wolak (1989), in which petitioners have substantial market power, to draw out the implications of domestic market structure and conduct for the workings of domestic antidumping law.

The setting we choose for the present analysis is one in which a foreign monopolist facing stochastic market demand in a segmented foreign market chooses capacity in each period before market demand uncertainty is resolved. Once foreign market demand is observed, the foreign monopolist

[2] The impact of antidumping law on firm behavior in a noncooperative setting has been explored recently by Dixit (1988), Ethier (1988), Gruenspecht (1988), and Prusa (1988).

sets foreign market price and makes foreign market sales subject to its capacity constraints. Any "excess" capacity not used for foreign market sales can be sold in the competitive domestic market at market clearing prices. Within this setting, equilibrium typically has the foreign firm carrying "excess" capacity in low-demand states, which it then "dumps" on the domestic market. This set-up captures in a simple way the cyclical excess capacity central to the phenomenon of cyclical dumping, and it is with respect to this excess capacity that domestic antidumping law has its impact.

Specifically, as in Staiger and Wolak (1989) where petitioners are non-competitive, we find that the introduction of domestic antidumping law in this setting is likely to lead to the filing of domestic antidumping suits in periods of sufficiently soft demand. However, in contrast to the case where petitioners are non-competitive, antidumping suits filed by competitive domestic firms lead generally to the imposition of antidumping duties. This distinction arises because in the former case domestic firms file because the <u>threat</u> of antidumping duties alters the foreign firm's incentives off the equilibrium path and, through this, the equilibrium level of imports; in the latter case, filing occurs because the <u>actual</u> duties that follow reduce the level of imports directly. Thus, while excess capacity associated with unexpectedly soft demand leads to the <u>filing</u> of antidumping suits whether petitioners are competitive or not, the <u>outcome</u> of those suits depends critically on the degree of market power held by the petitioner, reflecting a fundamental difference in the role played by antidumping suits in the two cases.

We also find that such filing behavior leads to lower foreign capacity, since domestic antidumping suits raise the cost to the foreign firm of carrying "excess" capacity in low-demand states. Thus, the presence of domestic antidumping law leads to generally lower foreign export volume, even in periods when no antidumping suit is filed. We conclude that, to the extent dumping on the domestic market takes the form of unloading excess capacity when foreign demand is unexpectedly low, the impact of antidumping law will not be limited to periods in which suits are actually filed and duties imposed.[3]

Finally, we examine the impact of self-enforcing agreements between the foreign monopolist and the domestic industry which take the form of a promise by the former to export no more than a specified amount in exchange for a promise by the latter not to file a suit. This kind of arrangement between firms is likely to arise in repeated play as a way to economize on filing costs. We find that such arrangements tend to reduce the range of soft foreign demand states over which domestic dumping suits will be filed and to increase the foreign capacity choice, hence leading to greater foreign export volume over ranges of soft and strong foreign demand states. The presence of a self-enforcing arrangement of this kind does not, however, change our basic finding that competitive domestic firms will file against a foreign monopolist, if at all, only in periods of sufficiently soft demand, and that, in contrast to petitions filed by noncompetitive firms, such suits generally result in the imposition of duties.

The remainder of the paper is devoted to making these points. The model in the absence of antidumping law is presented in section II. After providing a brief description of the salient features of U.S. antidumping

[3] A similar observation is made in Hillman and Katz (1986).

law in section III, section IV introduces antidumping law into the domestic country and explores its impact on equilibrium behavior. Finally, section V summarizes our findings and contrasts them with those derived in Staiger and Wolak (1989) where petitioners are taken to possess market power.

II. The Model in the Absence of Antidumping Law

Basic Assumptions

We consider an infinitely repeated model of a single industry in which production and sales take place in a domestic and foreign market.[4] In the domestic market, demand (D) is a deterministic linear function of price (P) and given by

(1) $D = \alpha - \beta P.$

Demand in the foreign market is stochastic and given by

(2) $D^* = \alpha^* - \beta P^*$

with D^* denoting foreign demand and P^* denoting foreign price, and with α^* an i.i.d. random variable whose distribution function $F(\alpha^*)$ has full support on the interval $[\underline{\alpha}^*, \overline{\alpha}^*]$ with $\overline{\alpha}^* > \underline{\alpha}^* > 0$.

Our goal is to examine the use of antidumping law by competitive domestic firms against collusive foreign exporters. We therefore take as given the existence of an asymmetry in market structure between the domestic

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[4] Infinite repetition becomes important only when we consider self-enforcing agreements in section IV.

and foreign industries.[5] Specifically, we assume that there are many small domestic firms who behave competitively in the domestic market, while in the foreign market there is a single monopolist. All domestic firms share a common linear homogeneous domestic technology which exhibits constant long run (before capacity is installed) marginal costs and constant short run (after capacity is installed) marginal costs up to capacity. The foreign firm possesses a (possibly but not necessarily linear homogeneous) foreign technology which also exhibits constant long run marginal costs and constant short run marginal costs up to capacity. Finally, the foreign market is taken to be segmented from the domestic market by prohibitively high import barriers. Thus, while domestic firms cannot sell in the (segmented) foreign market, the foreign firm does have access to the domestic market. Without loss of generality, we set all state-invariant domestic trade impediments to zero. For now we also assume that no antidumping law exists in the domestic country, so that foreign access to the domestic market is completely unimpeded.

At the beginning of any period, before the period's state of demand is revealed, the foreign firm must build capacity facing per-unit capacity costs r^*, with K^* denoting its capacity choice.[6] Once capacity is set, the period's foreign demand realization is revealed. The foreign firm sets its price P^* for the (segmented) foreign market and makes deliveries (subject to capacity constraints) at a short run marginal cost of C^*. We

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[5] See Staiger and Wolak (1989) for a treatment of the effects of domestic antidumping law in the symmetric (international duopoly) case.

[6] Alternatively, the foreign monopolist could set capacity once and for all at the beginning of the initial period, without changing the nature of any of the results.

set C^* to zero for simplicity. The sales of the foreign firm in the foreign market are then given by

$$q^*(\alpha^*;K^*,P^*) = \min\,[K^*,D^*(\alpha^*;P^*)].$$

With K^* and P^* chosen, the foreign firm has implicitly determined its capacity for export to the domestic market, given by

$$x^*(\alpha^*;K^*,P^*) = K^* - q^*(\alpha^*;K^*,P^*).$$

Observing foreign export capacity for the period, competitive domestic firms now choose capacity for sales in the domestic market facing per-unit capacity costs r, with domestic industry capacity denoted by K.[7] Individual domestic firms are assumed to be identical, and the capacity of each domestic firm is taken to be small. Domestic firms then face short run marginal costs of C (up to capacity). We set C to zero for simplicity. We also assume that domestic long run marginal cost lies between foreign long run and foreign short run marginal cost, or

(3) $C^* + r^* > C + r > C^*$.

As will become clear shortly, this assumption ensures that the domestic market will be viewed by the foreign monopolist as a "dumping" ground for

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[7] The relative flexibility of domestic as compared to foreign capacity decisions can be viewed either as reflecting the sequenced nature of foreign and domestic market sales, or as reflecting less substantial capital requirements of the small competitive domestic firms.

its "excess" capacity. Finally, with foreign export capacity and domestic production capacity now set, domestic and foreign firms simultaneously set prices and make deliveries (up to capacity) in the domestic market. In modeling the capacity-constrained price game of the final stage, we follow Kreps and Scheinkman (1983) and adopt the (efficient) rationing rule that consumers buy first from the cheapest supplier and that income effects are absent.

Thus we model the foreign monopolist as setting capacity in the face of foreign demand uncertainty, and then choosing its price for foreign market sales once demand uncertainty is resolved. Competitive domestic firms then take the foreign export capacity (implied by the residual foreign capacity after foreign sales are made) as given when choosing domestic production capacity and, once their capacity decisions are made, set prices simultaneously with the foreign exporter for sales in the domestic market. We close this subsection by fixing foreign export capacity x^* and solving for the equilibrium in the remaining stages of the game.

We will assume throughout that domestic demand is not "too" inelastic at $P = C+r \equiv \bar{P}$ in the sense that

$$(4) \quad \bar{\eta} \geq \bar{s}^*(x^*)$$

where $\bar{\eta}$ is the elasticity of domestic demand evaluated at $\bar{P}$ and $\bar{s}^*(x^*) \equiv x^*/D(\bar{P})$ is the domestic market share of the foreign monopolist at $\bar{P}$ given its domestic market sales of x^*. We also assume that the domestic market is "large" relative to foreign export capacity in the sense that

(5) $D(\bar{P}) > x^*$

for x^* in the relevant range. The exact relevance of (4) and (5) will become clear shortly.

Fixing x^* in the range given by (5), suppose that domestic entry yields a domestic capacity $\hat{K}(x^*)$ given by

(6) $\hat{K}(x^*) = D(\bar{P}) - x^*$.

$\hat{K}(x^*)$ is strictly positive by (5), and is simply the residual domestic demand (net of foreign exports) at domestic price $\bar{P}$. In the final stage of the game, the foreign firm and the many domestic firms then play a capacity-constrained price-setting game in the domestic market.

We now establish that, given $\hat{K}(x^*)$ and x^*, all foreign and domestic firms will name $\bar{P}$ in equilibrium. Note from (6) that, by naming $\bar{P}$, each firm can sell its entire (domestic market) capacity. Thus, no firm has an incentive to shave its price below $\bar{P}$ (firms are capacity constrained at $\bar{P}$ and can not sell any more). Neither would any firm wish to unilaterally raise its price above $\bar{P}$ since, by (4), any firm that unilaterally raises its price and sells less will reduce its revenue but not its costs (short run marginal costs are zero).[8] Finally, for any $P \neq \bar{P}$ it is readily established that a unilateral move toward $\bar{P}$ will raise profits. Thus, for any x^* satisfying (5), domestic entry yielding $\hat{K}(x^*)$ will have all firms naming $\bar{P}$ and selling their entire capacity in the resulting equilibrium.

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[8] Nothing would change if foreign short run marginal costs C^* were strictly positive, provided that condition (4) were strengthened accordingly.

Moreover, since domestic firms sell all capacity at a price equal to (long run) unit cost, the equilibrium zero profit condition required by free domestic entry is satisfied at $\hat{K}(x^*)$, so that $\hat{K}(x^*)$ represents an equilibrium domestic capacity choice in the penultimate stage of the game (given x^*).

In the Appendix, we rule out the existence of any additional equilibrium domestic capacity choices. We are thus left with $\hat{K}(x^*)$ as the unique equilibrium domestic capacity choice given x^*, and $\bar{P}$ as the equilibrium domestic price. Finally, note from (3) that the equilibrium domestic price $\bar{P}$ is larger than short run marginal costs for foreign exports but is not sufficient to cover their long run marginal costs. Hence, from the perspective of the foreign firm, the domestic market represents a location where "excess" capacity can be sold at a constant price ($\bar{P}$) which covers short run but not long run marginal costs. With this established, we now turn to an analysis of foreign firm decisions in detail, and return our focus to the domestic firms with the introduction of domestic antidumping law in the next section.

The Foreign Monopoly Problem

In the previous subsection, we characterized equilibrium behavior in the domestic market as a function of foreign export capacity x^*. To complete the description of equilibrium in the absence of antidumping law, we now consider the problem faced by the foreign monopolist, i.e., the determination of foreign export capacity x^*. Facing uncertain foreign demand, the foreign monopolist must first choose capacity K^*. Once K^* is in place, the foreign demand uncertainty is resolved, and the foreign monopolist must then set P^* for foreign market sales up to capacity, with any excess capacity (x^*) to be sold on the domestic market at the domestic market price of $\overline{P}$.

To find choices of K^* and P^* that maximize expected profits of the foreign firm, we first consider the foreign monopoly price as a function of α^* assuming that foreign capacity is in place and does not bind for foreign market sales, and that the chosen foreign price exceeds the domestic market price $\overline{P}$. Unconstrained short run monopoly profits, i.e., revenue, given a realization of α^* and foreign capacity K^* are

$$(7)\quad R^*(\alpha^*;P^*) = P^*\cdot D^*(\alpha^*;P^*) + \overline{P}\cdot[K^*-D^*(\alpha^*;P^*)].$$

The foreign monopolist's unconstrained short run monopoly price is given by the first order condition of (7) as[9]

$$(8)\quad P^*(\alpha^*) = \frac{\alpha^*+\beta^*\overline{P}}{2\beta^*}.$$

On the other hand, if instead capacity K^* binds in the foreign market, then the foreign profit-maximizing price is given trivially by

$$(9)\quad P^*(\alpha^*;K^*) = \frac{\alpha^*-K^*}{\beta^*}.$$

With this, we can now write down foreign market sales, $q^*(\alpha^*;K^*)$, and exports to the domestic market, $x^*(\alpha^*;K^*)$, as

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[9] The assumption that $P^*(\alpha^*) > \overline{P}$ for $\alpha^*\epsilon[\underline{\alpha}^*,\overline{\alpha}^*,]$ reduces to the restriction that $\underline{\alpha}^* > \beta^*\overline{P}$.

(10) $q^*(\alpha^*;K^*) = \min\,[K^*;D^*(\alpha^*;P^*(\alpha^*))]$

(11) $x^*(\alpha^*;K^*) = K^* - q^*(\alpha^*;K^*)$.

Finally, expected monopoly profits as a function of K^* are given by

$$(12)\quad E\pi^*(K^*) = \int_{\underline{\alpha}^*}^{\overline{\alpha}^*} \{P^*(\alpha^*;q^*(\alpha^*;K^*))\cdot q^*(\alpha^*;K^*) + \overline{P}\cdot x^*(\alpha^*;K^*)\}dF(\alpha^*) - r^*K^*.$$

Before considering the choice of K^* that maximizes $E\pi^*(K^*)$, note from (2) and (8) that, with subscripts here and throughout the paper denoting derivatives, $D^*_{\alpha^*}(\alpha^*;P^*(\alpha^*)) = 1/2$ so that $D^*(\alpha^*;P^*(\alpha^*))$ is monotonically increasing in α^*. Thus, for any nonnegative K^* there exists an $\tilde{\alpha}^*(K^*)$ at which foreign capacity becomes binding for foreign market sales, defined implicitly by

$$D^*(\tilde{\alpha}^*;P^*(\tilde{\alpha}^*)) = K^*,$$

such that

$$q^*(\alpha^*;K^*) = \begin{cases} K^* & \text{for } \alpha^* \geq \tilde{\alpha}^*(K^*) \\ D^*(\alpha^*;P^*(\alpha^*)) & \text{for } \alpha^* < \tilde{\alpha}^*(K^*) \end{cases}$$

Explicit calculation yields

$$\tilde{\alpha}^*(K^*) = 2K^* + \beta^*\overline{P}.$$

Thus, $F(\tilde{\alpha}^*(K^*))$ is the ex-ante probability that K^* will not bind in the foreign market. Clearly it is not optimal to choose K^* such that $F(\tilde{\alpha}^*(K^*)) = 1$ since, as established in the previous subsection, sales on the domestic market cover short run but not long run marginal costs for the foreign monopolist. Thus, $\tilde{\alpha}^*(K^*) < \overline{\alpha}^*$ in the relevant range of K^*, and (12) can be rewritten as

$$(13)\quad E\pi^*(K^*) = \int_{\tilde{\alpha}^*(K^*)}^{\overline{\alpha}^*} P^*(\alpha^*;K^*)\cdot K^* dF(\alpha^*) +$$

$$\int_{\underline{\alpha}^*}^{\tilde{\alpha}^*(K^*)} (P^*(\alpha^*)\cdot D^*(\alpha^*;P^*(\alpha^*)) + \overline{P}\cdot x^*(\alpha^*;K^*))dF(\alpha^*) - r^*K^*.$$

The first and second order conditions of (13) are then given by

$$(14)\quad E\pi^*_{K^*}(K^*) = \int_{\tilde{\alpha}^*(K^*)}^{\overline{\alpha}^*} \left(\frac{\alpha^* - 2K^*}{\beta^*}\right)dF(\alpha^*) + F(\tilde{\alpha}^*(K^*))\cdot\overline{P} - r^* = 0$$

$$E\pi^*_{K^*K^*}(K^*) = -\frac{2}{\beta^*}\,[1 - F(\tilde{\alpha}^*(K^*))] < 0.$$

Thus, with second order conditions globally met, expression (14) implicitly determines the unique foreign capacity choice K_0^*, and through

(8), (10), and (11), foreign export supply to the domestic market as a function of α^*.

We conclude this section with a summary of equilibrium industry behavior in the absence of antidumping law. In periods of high foreign demand, $(\alpha^* > \tilde{\alpha}^*(K_0^*))$, the foreign monopolist sells its entire capacity on the foreign market at the market clearing price, while domestic production expands to satisfy the entire domestic market at a price equal to domestic unit cost. In periods of sufficiently low foreign demand, $(\alpha^* < \tilde{\alpha}^*(K_0^*))$, the foreign monopolist sells its unconstrained short run monopoly quantity $D^*(\alpha^*;P^*(\alpha^*))$ in the foreign market and exports its excess capacity to the (lower price) domestic market, while domestic production contracts to accommodate the import surge and maintain domestic price equal to domestic unit cost. In the next sections we introduce antidumping law into the domestic country. Our goal is to ask whether (and when) antidumping suits would be filed by the competitive domestic industry, and to characterize the impact of antidumping law on the volume of foreign exports.

III. U.S. Antidumping Law

Before introducing antidumping law into the formal model, we provide a brief discussion of current U.S. antidumping law. While antidumping law in the U.S. has a long and complex legislative history, we abstract from much of this and focus here on three features of current U.S. law that are important for our results.

The first concerns the legal definition of dumping, which must be clarified in order to determine whether and when dumping occurs in the model of the previous section (absent domestic antidumping law). Foreign dumping is defined in the Trade and Tariff Act of 1984 as pricing at "less than fair value" in the domestic market. The crucial issue is how "fair value" is measured. Under "normal circumstances," fair value would be measured by prevailing prices in the foreign market. Hence, evidence of price discrimination across international markets is sufficient (though not necessary) under U.S. law to establish that dumping has occurred. With this view of its legal definition under current U.S. law, it is clear from the analysis of the previous section that dumping by the foreign monopolist occurs in the domestic market (at least in the absence of antidumping duties) whenever the foreign monopolist exports, i.e., whenever $\alpha^* < \tilde{\alpha}^*(K^*)$, since the foreign firm makes sales in the domestic market at a price $(\overline{P})$ which is below that prevailing in the foreign market $(P^*(\alpha^*))$. Thus, absent antidumping law, the foreign monopolist "dumps" whenever it exports to the domestic market.

Having reviewed the legal definition of dumping, the second aspect of U.S. antidumping law important for our purposes concerns the conditions under which dumping activity is "actionable," i.e., the conditions under which a dumping finding will lead to the imposition of antidumping duties. According to U.S. law, a determination must first be made that "material injury" or the "threat of material injury" due to imports is present in the petitioning industry before antidumping duties can be imposed as a remedy for dumping activity. Whether measured by a loss of market share or output, injury to the domestic industry will be associated with the dumping that occurs in this model. Moreover, the threat of injury due to imports--as measured by domestic profit losses--is present in the petitioning industry since, with domestic production decisions for the period made at the time of filing, domestic profits are decreasing in imports and will thus fall unless duties are forthcoming. Hence, the dumping that occurs in the model of the previous section will be actionable.[10]

The final aspect of U.S. antidumping law that is relevant for our modeling purposes concerns the nature of antidumping duties and the period over which they are imposed. While the final determination of an antidumping suit may easily take six months to a year from the initial filing date, antidumping duties reflecting the "dumping margin" can be applied retroactively to potentially all foreign shipments subsequent to the date the antidumping petition was filed.[11] This leads to a natural specification of the antidumping remedy as a duty equal to the dumping margin and applied to all foreign imports during the period in which a successful suit is filed. However, it is important to point out that U.S. law provides for the imposition of antidumping duties on domestic importers rather than on foreign exporters. Moreover, exporters are allowed to

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[10] Of course, the "material" standard must be met in the injury determination as well, which in this case boils down to a requirement that α^* lie sufficiently below $\tilde{\alpha}^*(K^*)$. Since this plays no essential role in our analysis, we ignore it. A related point concerns whether the dumping that occurs in this model would be viewed as so-called "technical dumping" under the law and thus "inactionable." Technical dumping refers to a situation in which foreign exporters dump only to "meet the price" of domestic competition. While this description fits our model, it is only the prompt exit of domestic firms in periods of low foreign demand that stabilizes the domestic price in the presence of foreign dumping. Thus, it is unlikely that the dumping activity we have characterized in the model would be viewed as "technical" in nature. For a brief discussion of the notion of technical dumping and one case in which it was used, see Dale (1980, p. 58).

[11] A finding that there are "massive" imports of the relevant product over a "relatively short period" allows dumping duties to be applied retroactively 90 days prior to the preliminary dumping determination.

reimburse importers for dumping duties only on imports which were purchased and exported before specified dates in an ongoing antidumping proceeding.[12] In practice the result is not surprisingly a reduction in the ability of the foreign exporter to find willing importers on goods against which a dumping order is outstanding (see Dale, 1980, p. 86). In the homogenous good model we consider here, the foreign exporter will find no willing importers for goods with nonreimbursable duties. Thus, past some critical (within period) point in time, the foreign monopolist will be precluded from exporting to the domestic market when an antidumping proceeding is ongoing. To capture this effect simply, we assume that no goods can be successfully exported by the foreign monopolist when faced with an antidumping suit.[13]

IV. The Impact of Domestic Antidumping Law

With the above discussion of current U.S. antidumping law in mind, we turn now to an evaluation of the impact of antidumping law in the model of the previous sections. We do so in two stages. In the first subsection, we assume that the foreign monopolist and domestic firms do not tacitly or explicitly strike agreements which dictate rules of acceptable behavior for the foreign firm in exchange for an agreement by the domestic industry not

[12] Specifically, reimbursement of dumping duties is only allowed when the goods in question were purchased prior to a notice of withholding of appraisement and were exported prior to a determination of sales at less than fair value. (Dale, 1980, p. 105, note 42).

[13] While we model the "rationing" aspect of antidumping law in an ad hoc manner, our results are not sensitive to reasonable alternative specifications. For example, nothing would change if exports were limited to an amount $\bar{x} > 0$ under a suit, or if instead a fraction $\lambda<1$ of foreign export capacity $x^*(\alpha^*)$ could be successfully exported under a suit. The important property is that the discrepency between export capacity and actual exports under the suit increase with export capacity.

to file suits. Such arrangements, which can potentially make both foreign and domestic firms better off by economizing on filing costs, are considered in the second subsection.

Antidumping Suits in the Absence of Agreements

We assume that the timing of the game is unchanged from the previous sections except that domestic firms now have an option to file, at a cost $F>0$ per unit of domestic capacity, an antidumping suit against the foreign monopolist after domestic firm capacity (entry) is determined but prior to the final (price-setting-in-the-domestic-market) stage of the game.[14] We abstract from free-rider issues by assuming the presence of an "industry association" in the competitive domestic industry. As noted above, we also abstract for now from the possibility of agreements between the foreign monopolist and the domestic industry which take the form of a promise by the foreign firm to export only a fraction of its entire export capacity in exchange for an agreement from the domestic industry not to file a suit. Thus, for now, the domestic industry is assumed to (correctly) infer that the foreign monopolist will attempt to export its entire export capacity in each period.

We now consider the filing decision of domestic firms, still taking foreign export capacity x^* as given. Domestic firms must in any period weigh the industry costs of filing (FK) against the benefits of the

[14] The assumption that filing costs are constant per unit of domestic capacity is made to assure that as domestic industry capacity gets small, the costs of filing a suit do not become prohibitively high. One way to interpret the assumption is that filing a convincing suit against the foreign monopolist becomes less costly as foreign dumping behavior becomes more extreme. Alternatively, the costs of organizing the industry to file a suit are likely to increase with industry size.

antidumping suit which take the form of increased domestic industry profits. With foreign export capacity and domestic production capacities for the period set at the time the decision to file must be made, the impact of filing on domestic industry profits is given by

$$(15)\quad \Delta\pi(x^*,K,F) = [P(K) - F - P(K+x^*)]K$$

$$= (x^*/\beta - F)\cdot K.$$

The domestic industry will file if and only if $\Delta\pi(x^*,K,F) \geq 0$ which, using (15), amounts to the condition that

$$(16)\quad x^* \geq \beta F = \hat{x}^*.$$

Thus, antidumping suits will be filed against the foreign monopolist in any period for which foreign export capacity is sufficiently large.

Of course, domestic capacity decisions anticipate fully the incentives to file an antidumping suit once capacities are set, and free domestic entry requires zero domestic profits in each period, regardless of whether or not a suit is filed. Thus we have domestic capacity as a function of foreign export capacity $\hat{K}(x^*)$ determined in equilibrium in the presence of domestic antidumping law by

$$(17)\quad \hat{K}(x^*) = \begin{cases} D(\overline{P}) - x^* & \text{for} \quad x^* < \hat{x}^* \\ D(\overline{P}+F) & \text{for} \quad x^* \geq \hat{x}^* \end{cases}$$

Using (6), (16), and (17), it follows that, conditional on foreign export capacity x^*, the filing of antidumping suits serves to support a larger domestic industrial capacity in times of high foreign export capacity $(x^* \geq \hat{x}^*)$ than would exist absent domestic antidumping law.

Finally, with equilibrium behavior in the domestic market in the presence of antidumping law now characterized as a function of foreign export capacity, we turn to equilibrium determination of foreign export capacity in the presence of domestic antidumping law. We first define expected foreign revenues in the presence of domestic antidumping law. For $\alpha^* \epsilon [\tilde{\alpha}^*(K^*), \overline{\alpha}^*]$, there are no exports to the domestic market, so foreign revenues for α^* in this range are

$$R^*(\alpha^*;K^*) = P^*(\alpha^*;K^*) \cdot K^*.$$

Next we denote $\hat{\alpha}^*(K^*)$ as the value of α^* at which exports reach the critical level $\hat{x}^*$, defined implicitly by

$$x^*(\hat{\alpha}^*;K^*) = \hat{x}^*$$

with $x^*(\cdot)$ given by (11) and $P^*(\alpha^*)$ given by (8). Explicit calculation yields

$$\hat{\alpha}^*(K^*) = 2(K^* - \hat{x}^*) + \beta^* \overline{P}.$$

Note that $\hat{\alpha}^*(K^*) = \tilde{\alpha}^*(K^*) - 2\hat{x}^*$. Thus, for $\hat{x}^* > 0$, $\hat{\alpha}^*(K^*) < \tilde{\alpha}^*(K^*)$. Then for $\alpha^* \epsilon (\hat{\alpha}^*(K^*), \tilde{\alpha}^*(K^*))$, we have $0 < x^*(\alpha^*;K^*) < \hat{x}^*$, so that excess foreign capacity is exported to the domestic market, but not in sufficient quantities to trigger the filing of a domestic antidumping suit. Thus, for

α^* in this range,

$$R^*(\alpha^*;K^*) = P^*(\alpha^*)\cdot D^*(\alpha^*;P^*(\alpha^*)) + \overline{P}\cdot x^*(\alpha^*;K^*).$$

For α^* below $\hat{\alpha}(K^*)$, domestic firms will file an antidumping suit and the foreign monopolist will be precluded from exporting to the domestic market in that period unless it chooses to lower the foreign price below $P^*(\alpha^*)$ to keep

$$x^*(\alpha^*;K^*) = \hat{x}^*,$$

in which case no antidumping suit will be filed. We denote the associated foreign price under the former (suit acceptance) strategy by $\dot{P}^*(\alpha^*)$ and under the latter (suit-avoidance) strategy by $\hat{P}^*(\alpha^*;K^*)$ and note that

$$\dot{P}^*(\alpha^*) = \alpha^*/2\beta^*$$
$$\hat{P}^*(\alpha^*;K^*) = \hat{x}^*/\beta^* + P^*(\alpha^*;K^*)$$

To determine the range of α^*s over which each pricing strategy will be chosen, we define the difference in the revenue associated with each as

$$\Gamma^*(\alpha^*;K^*) \equiv R^*(\alpha^*;K^*,\hat{P}^*(\alpha^*;K^*)) - R^*(\alpha^*;\dot{P}^*(\alpha^*))$$

and note that the foreign monopolist will avoid a suit and set foreign price at $\hat{P}^*(\alpha^*;K^*)$ for any $\alpha^*\epsilon[\underline{\alpha}^*,\hat{\alpha}^*(K^*)]$ for which $\Gamma^*(\alpha^*;K^*) \geq 0$. To establish the range of α^*s for which $\Gamma^*(\alpha^*;K^*) \geq 0$, we note that

$$\Gamma^*_{\alpha^*}(\alpha^*;K^*) = [K^* - \hat{x}^* - \alpha^*/2]/\beta^*; \qquad \Gamma^*_{\alpha^*\alpha^*}(\alpha^*;K^*) = -1/2\beta^*$$

so that $\Gamma^*(\alpha^*;K^*)$ is (globally) concave in α^* and reaches its maximum value of $\overline{P}\hat{x}^*$ at

$$\overset{\square}{\alpha}^*(K^*) = 2(K^* - \hat{x}^*).$$

Further, it is easily shown that $\Gamma^*(\hat{\alpha}^*(K^*);K^*) > 0$. Thus, to determine the range of α^*s over which $\Gamma^*(\alpha^*;K^*) \geq 0$ and the foreign monopolist pursues a suit-avoidance strategy, we need only find an $\dot{\alpha}^*(K^*) < \hat{\alpha}^*(K^*)$ defined implicitly by

$$\Gamma^*(\dot{\alpha}^*;K^*) = 0.$$

Explicit calculation yields

$$\dot{\alpha}^*(K^*) = 2(K^* - \hat{x}^*) - 2\sqrt{\beta * \overline{P}\hat{x} *} \; .$$

Together with the properties of $\Gamma^*(\alpha^*;K^*)$, we then have that for $\alpha^* \epsilon [\dot{\alpha}^*(K^*), \hat{\alpha}^*(K^*)]$, the suit-avoidance price $\hat{P}^*(\alpha^*;K^*)$ will be chosen and foreign revenues will be given by

$$R^*(\alpha^*;K^*) = \hat{P}^*(\alpha^*;K^*) \cdot D^*(\alpha^*;\hat{P}^*(\alpha^*;K^*)) + \overline{P}\hat{x}^*.$$

Finally, for $\alpha^* \epsilon [\underline{\alpha}^*, \dot{\alpha}^*(K^*$ the foreign monopolist sets $\dot{P}^*(\alpha^*)$, the domestic industry files a suit, and foreign revenues are given by

$$R^*(\alpha^*;K^*) = \dot{P}^*(\alpha^*)\cdot D^*(\alpha^*;\dot{P}^*(\alpha^*)).$$

Collecting expressions over the various ranges of α^*, we can now define foreign monopoly revenues as

$$(18)\quad R^*(\alpha^*;K^*) = \begin{cases} P^*(\alpha^*;K^*)\cdot K^* & \text{for } \alpha\epsilon[\tilde{\alpha}^*(K^*),\overline{\alpha}^*] \\ P^*(\alpha^*)\cdot D^*(\alpha^*;P^*(\alpha^*)) + \overline{P}\cdot x^*(\alpha^*;K^*) & \text{for } \alpha\epsilon[\hat{\alpha}^*(K^*),\tilde{\alpha}^*(K^*)] \\ \hat{P}^*(\alpha^*;K^*)\cdot D^*(\alpha^*;\hat{P}^*(\alpha^*;K^*)) + \overline{P}\cdot\hat{x}^* & \text{for } \alpha\epsilon[\dot{\alpha}^*(K^*),\hat{\alpha}^*(K^*)] \\ \dot{P}^*(\alpha^*)\cdot D^*(\alpha^*;\dot{P}^*(\alpha^*)) & \text{for } \alpha\epsilon[\underline{\alpha}^*,\dot{\alpha}^*(K^*)] \end{cases}$$

and expected foreign monopoly profits as

$$(19)\quad E\pi^*(K^*) = \int_{\underline{\alpha}^*}^{\overline{\alpha}^*} R^*(\alpha^*;K^*)dF(\alpha^*) - r^*K^*.$$

The first and second order conditions of (19) are given by

$$(20)\quad E\pi^*_{K^*}(K^*) = \int_{\tilde{\alpha}^*(K^*)}^{\overline{\alpha}^*} \left(\frac{\alpha^*-2K^*}{\beta^*}\right) dF(\alpha^*) + \int_{\dot{\alpha}^*(K^*)}^{\hat{\alpha}^*(K^*)} \left(\frac{\alpha^* - \beta^*\overline{P} - 2(K^*-\hat{x}^*)}{\beta^*}\right)dF(\alpha^*)$$

$$+[F(\tilde{\alpha}^*(K^*)) - F(\dot{\alpha}^*(K^*))]\overline{P} - r^* = 0$$

$$E\pi^*_{K^*K^*}(K^*) = -\frac{2}{\beta^*}\{[1-F(\tilde{\alpha}^*(K^*))] + [F(\hat{\alpha}^*(K^*)) - F(\dot{\alpha}^*(K^*))]$$

Expression (20) implicitly defines the expected profit maximizing foreign capacity choice in the presence of domestic antidumping law, K_1^*, provided that the second order condition is met. The second order condition holds if the distribution of demand shocks satisfies

$$(21)\quad [F(\overset{\square}{\alpha}^*(K^*)) - F(\dot{\alpha}^*(K^*))] > [\overset{\square}{\alpha}^*(K^*) - \dot{\alpha}^*(K^*)]f(\dot{\alpha}^*(K^*)),$$

an assumption we maintain throughout. Condition (21) implies that the density $f(\alpha^*)$, associated with $F(\alpha^*)$, tends to rise in α^* over the range $\alpha^* \epsilon [\dot{\alpha}^*(K^*), \overset{\square}{\alpha}^*(K^*)]$. This condition will be met, for example, by any symmetric unimodal distribution, provided that in equilibrium the foreign monopolist sets capacity K_1^* at a level at which it does not <u>expect</u> to dump more than $\hat{x}^*$ on the foreign market, i.e. will only dump more than $\hat{x}^*$ if the realization of α^* is below its expected value. Clearly, this must be the case provided that the prevailing domestic market price $\overline{P}$ lies sufficiently below the foreign monopolist's long run marginal costs. As such, any symmetric unimodal distribution will satisfy (21) provided that equilibrium dumping margins are sufficiently large.

With foreign monopoly capacity K_1^* defined implicitly by (20), we can now summarize the equilibrium behavior of foreign and domestic firms in the presence of domestic antidumping law. The foreign monopolist sells its entire capacity in the foreign market for $\alpha^* \epsilon [\tilde{\alpha}^*(K_1^*), \overline{\alpha}^*]$. For lower foreign demand realizations with $\alpha^* \epsilon (\hat{\alpha}^*(K_1^*), \tilde{\alpha}^*(K_1^*))$, the foreign monopolist sets its unconstrained monopoly price in the foreign market and dumps its excess foreign capacity on the domestic market, but not in sufficient quantities to trigger the filing of an antidumping suit by domestic firms. For foreign demand realizations that are lower still, with $\alpha^* \epsilon (\dot{\alpha}^*(K_1^*), \hat{\alpha}^*(K_1^*)]$, the foreign monopolist reduces its foreign price below the unconstrained monopoly price to assure that its export capacity does not trigger the filing of an antidumping suit by domestic firms. Finally, for sufficiently low foreign demand realizations with $\alpha^* \epsilon [\underline{\alpha}^*, \dot{\alpha}^*(K_1^*)]$, the foreign monopolist reverts to unconstrained monopoly pricing in the foreign market and faces an antidumping suit filed by domestic firms.

Finally, to compare the foreign capacity choice in the presence of domestic antidumping law to that in its absence, we evaluate the first order condition for the foreign monopolist's problem in the absence of domestic antidumping law at the optimal foreign capacity choice in the presence of the law K_1^*. Using (14) and (20), $E\pi^*_{K^*}(K^* = K_1^*)$ reduces to

$$E\pi^*_{K^*}(K^* = K_1^*) = - \int_{\dot{\alpha}^*(K_1^*)}^{\hat{\alpha}^*(K_1^*)} \left(\frac{\alpha^* - \beta^*\overline{P} - \overset{\square}{\alpha}^*(K_1^*)}{\beta^*}\right) dF(\alpha^*) + F(\dot{\alpha}^*(K_1^*)) \cdot \overline{P}$$

which, using the definitions of $\hat{\alpha}^*(K^*)$, $\overset{\square}{\alpha}^*(K^*)$, and $\dot{\alpha}^*(K^*)$, is strictly positive. Thus, $K_1^* < K_0^*$; the introduction of domestic antidumping law leads the foreign monopolist to scale back its capacity choice.

We conclude that the presence of antidumping law has an impact on the volume of foreign exports even when suits are not filed; foreign export volume is strictly lower in the presence of domestic antidumping law than in its absence for all $\alpha^* \epsilon [\underline{\alpha}^*, \tilde{\alpha}^*(K_0^*)]$. Nevertheless, the actual filing of suits and imposition of duties occurs only in low foreign demand states

$\alpha^* \epsilon [\underline{\alpha}^*, \dot{\alpha}^*(K_1^*)]$, and is associated with large foreign excess capacity.

This is summarized in Figure 1, where foreign export volume is plotted against realizations of α^*. The solid line represents foreign export volume in the absence of domestic antidumping law. For $\alpha^* \epsilon [\tilde{\alpha}^*(K_0^*), \overline{\alpha}^*]$, foreign demand is sufficiently strong to eliminate excess foreign capacity completely, and foreign exports are zero. For $\alpha^* \epsilon [\underline{\alpha}^*, \tilde{\alpha}^*(K_0^*))$, trade volume rises monotonically as α^* falls with $x^*_{\alpha*}(\alpha^*) = -1/2$; the fall in $P^*(\alpha^*)$ which accompanies the fall in α^* mitigates the otherwise one-for-one negative relationship between α^* and trade volume. With the introduction of domestic antidumping law, foreign capacity falls $(K_1^* < K_0^*)$, and thus so too does $\tilde{\alpha}^*(K^*)$. Since for $\alpha^* \epsilon [\tilde{\alpha}^*(K_1^*), \overline{\alpha}^*]$ the strength of foreign demand is sufficient to eliminate exports, trade volume has been reduced as a result of the existence of the law over the range $\alpha^* \epsilon [\tilde{\alpha}^*(K_1^*), \tilde{\alpha}^*(K_0^*))$ as depicted by the dashed line in Figure 1, even though no suits are filed nor duties levied for α^* in this range. The same is true over the range $\alpha^* \epsilon [\hat{\alpha}^*(K_1^*), \tilde{\alpha}^*(K_1^*))$, where trade volume is now falling as α^* rises at the same rate as without the law, i.e., $x^*_{\alpha*}(\alpha^*) = -1/2$. For $\alpha^* \epsilon [\dot{\alpha}^*(K_1^*), \hat{\alpha}^*(K_1^*))$, trade volume is again flat in the presence of domestic antidumping law, as the foreign monopolist adjusts its foreign price below the unconstrained foreign monopoly price to maintain exports at a level just below that which would trigger a suit by domestic firms. Finally, for $\alpha^* \epsilon [\underline{\alpha}^*, \dot{\alpha}^*(K_1^*))$ dumping suits are actually filed, duties are levied, and exports are precluded.

Self-Enforcing Agreements

In the previous subsection we maintained the assumption that domestic firms correctly infer that the foreign monopolist will attempt to export to the domestic market its entire export capacity in any period. Within this setting, we have shown that the existence of domestic antidumping law will reduce the volume of exports over a wide range of foreign demand realizations, even though antidumping suits will be filed and duties levied only in periods of sufficiently soft foreign demand. A natural question, however, is why antidumping suits should be filed at all in this model, since the equilibrium that results is clearly Pareto dominated by an equilibrium without filing. In particular, if the foreign monopolist could convince the domestic industry that its exports would never exceed $\hat{x}^*$, regardless of its export capacity, then the domestic industry would find it never in its interest to file (by (16)), while the foreign monopolist would gain, even given K_1^*, by no longer having to distort its foreign price to avoid antidumping suits over the range $\alpha^* \epsilon [\dot{\alpha}^*(K_1^*), \hat{\alpha}^*(K_1^*)]$, and by being able to export $\hat{x}^*$ rather than zero over the range $\alpha^* \epsilon [\underline{\alpha}^*, \dot{\alpha}^*(K_1^*)]$.

In this subsection we explore the extent to which self-enforcing agreements of this type between the foreign monopolist and the domestic industry alter the circumstances under which antidumping suits will be filed and ask how trade volume will be affected by the possibility of such arrangements. We consider the most-cooperative equilibrium that is sustainable by the threat to forever revert to the noncooperative play characterized in the previous subsection if any player is observed to cheat on the agreement. The agreement takes the form of a promise from the foreign firm to export a pre-specified amount as a function of α^* in exchange for a promise from the domestic industry not to file in that period. The most-cooperative agreement puts this kind of arrangement in place over the widest sustainable range of α^*s.[15]

In any self-enforcing arrangement of this type between the foreign monopolist and domestic firms, each party to the agreement must in each period find that cooperating today and preserving the agreement into the future is preferable to taking the one-time gain from defection and thereafter playing noncooperatively. But the free-entry conditions in the domestic industry ensure that domestic firms make zero profits in the future whether the future involves cooperative or noncooperative play. Thus, in order for domestic firms to willingly cooperate, i.e., not file antidumping suits, they must be given no one-time gain from defecting from the agreement and filing a suit. Thus, by (16) the domestic incentive constraint requires that foreign exports be limited to an amount no greater than $\hat{x}^*$ in any period for which the agreement is in force.

It is clear that there is nothing to gain from such an agreement for $\alpha^* \epsilon [\hat{\alpha}^*(K^*), \bar{\alpha}^*]$, since the foreign monopolist's unconstrained exports are less than $\hat{x}^*$ in this range of α^*s. Moreover, even when the agreement to restrict exports to $\hat{x}^*$ is binding, the foreign monopolist would choose to sell its entire remaining capacity $(K^* - \hat{x}^*)$ on the foreign market provided that $\alpha^* \epsilon [\overset{\square}{\alpha}^*(K^*), \hat{\alpha}^*(K^*)]$, since marginal revenue on the foreign market

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15 Our focus on the most-cooperative equilibrium sustainable by the threat of infinite Nash reversion can be justified on the grounds that communication among foreign and domestic firms is protected from U.S. antitrust proceedings under the Noerr-Pennington Doctrine (see Prusa, 1988). Thus, coordination on the most-cooperative equilibrium could occur the first time a suit was filed.

evaluated at $K-\hat{x}^*$ is $[\alpha^*-2(K^*-\hat{x}^*)]/\beta^*$, which is strictly positive for $\alpha^*\epsilon(\overset{\square}{\alpha}^*(K^*),\ \hat{\alpha}^*(K^*)]$ and zero at $\overset{\square}{\alpha}^*(K^*)$. Thus, for $\alpha^*\epsilon[\overset{\square}{\alpha}^*(K^*),\hat{\alpha}^*(K^*)]$, the foreign monopolist will choose to set the foreign price at $\hat{P}^*(\alpha^*;K^*)$ as long as its exports must be limited to $\hat{x}^*$, even if it is not constrained to sell the amount $K^* - \hat{x}^*$ in the foreign market.

The potential benefit to the foreign monopolist from striking such an agreement comes for α^* in the range given by $\alpha^*\epsilon[\underline{\alpha}^*,\overset{\square}{\alpha}^*(K^*)]$. For α^* in this range, the foreign monopolist would ideally export $\hat{x}^*$ at a domestic price $\overline{P}$ and set its unconstrained foreign monopoly price in the foreign market, $\dot{P}^*(\alpha^*)$, agreeing not to export the remaining capacity $x^*(\alpha^*;K^*,\dot{P}^*(\alpha^*)) - \hat{x}^*$, which is strictly positive for α^* in this range. For a given α^* in this range, the foreign monopolist's one-time gain in defecting from the arrangement, i.e., exporting its entire export capacity $x^*(\alpha^*;K^*,\dot{P}^*(\alpha^*))$ at a price (just below) $\overline{P}$ rather than the agreed upon $\hat{x}^*$, is given by

$$(22)\quad \Omega^*(\alpha^*;K^*,\dot{P}^*(\alpha^*)) = \overline{P}\cdot[x^*(\alpha^*;K^*,\dot{P}^*(\alpha^*)) - \hat{x}^*] = 1/2[\overset{\square}{\alpha}^*(K^*) - \alpha^*]\cdot\overline{P}.$$

From (22), the foreign monopolist's temptation to cheat on the arrangement is falling monotonically in α^*. But under our assumption that the realizations of α^* are independent over time, the present discounted value to the foreign monopolist of future cooperation, which we denote by $\omega^*(\cdot)$, is independent of the current realization of α^*. This implies that, if cooperation at $\dot{P}^*(\alpha^*)$ is unsustainable over some range of α^*s, it will be low α^*s that are associated with no sustainable agreement at this foreign price. Fixing the value of $\omega^*(\cdot)$ for the moment and assuming that agreements at $\dot{P}^*(\alpha^*)$ are not sustainable over all $\alpha^*\epsilon[\underline{\alpha}^*,\overline{\alpha}^*]$, we define $\breve{\alpha}^*(K^*,\omega^*)$, the value of α^* below which agreements involving $\dot{P}^*(\alpha^*)$ can not be sustained, by

$$\Omega^*(\breve{\alpha}^*;K^*,\dot{P}^*(\alpha^*)) = \omega^*.$$

Explicit calculation yields

$$\breve{\alpha}^*(K^*,\omega^*) = \overset{\square}{\alpha}^*(K^*) - 2\omega^*/\overline{P}.$$

For $\alpha^*\epsilon[\underline{\alpha}^*,\breve{\alpha}^*(K^*,\omega^*)]$, agreements at $\dot{P}^*(\alpha^*)$ are not sustainable. However, this does not mean that cooperation need break down for α^* in this range. The foreign monopolist can pursue a cooperative suit-avoidance strategy by reducing its foreign price below $\dot{P}^*(\alpha^*)$ as α^* drops below $\breve{\alpha}^*(K^*,\omega^*)$, preventing the foreign incentive constraint from being violated. For $\alpha^*\epsilon[\underline{\alpha}^*,\breve{\alpha}^*(K^*,\omega^*)]$, the highest foreign price $\breve{P}^*(\alpha^*;K^*,\omega^*)$ that keeps the agreement at α^* in tact is defined implicitly by

$$\Omega^*(\alpha^*;K^*,\breve{P}^*) = \omega^*.$$

Explicit calculation yields

$$\breve{P}^*(\alpha^*;K^*,\omega^*) = \hat{P}(\alpha^*;K^*) + \omega^*/\beta^*\overline{P}.$$

For any α^* in this range, the foreign monopolist must choose between cooperative revenues under the suit avoidance price $\breve{P}^*(\alpha^*;K^*,\omega^*)$ given by

$$R^*(\alpha^*;K^*,\omega^*) = \breve{P}^*(\alpha^*;K^*,\omega^*)\cdot D^*(\alpha^*;\breve{P}^*(\alpha^*;K^*,\omega^*)) + \overline{P}\hat{x}^*$$

and profits under the alternative strategy of setting the foreign monopoly price $\dot{P}^*(\alpha^*)$ and facing a dumping suit, which yields revenues of

$$\dot{R}^*(\alpha^*) = \dot{P}^*(\alpha^*) \cdot D^*(\alpha^*;\dot{P}^*(\alpha^*)).$$

Defining the revenue difference under these two strategies by

$$\psi(\alpha^*;K^*,\omega^*) \equiv R^*(\alpha^*;K^*,\omega^*) - \dot{R}^*(\alpha^*)$$

it is readily established that $\psi(\alpha^*;K^*,\omega^*)$ takes its maximum value of $\overline{P}\hat{x}^*$ at $\check{\alpha}^*(K^*,\omega^*)$, that $\psi_{\alpha^*}(\alpha^*;K^*,\omega^*) > 0$ for $\alpha^* \epsilon [\underline{\alpha}^*, \check{\alpha}^*(K^*,\omega^*)]$, and that $\psi_{\alpha^*\alpha^*}(\alpha^*;K^*,\omega^*) < 0$ for all α^*. Thus, to determine the range of α^*s over which the cooperative agreement is sustainable and suits are avoided, i.e., $\psi(\alpha^*;K^*,\omega^*) \geq 0$, we need only find $\overset{\Delta}{\alpha}{}^*(K^*,\omega^*) < \check{\alpha}^*(K^*,\omega^*)$ defined implicitly by

$$\psi(\overset{\Delta}{\alpha}{}^*;K^*,\omega^*) = 0.$$

Explicit calculation yields

$$\overset{\Delta}{\alpha}{}^*(K^*,\omega^*) = \check{\alpha}^*(K^*,\omega^*) - 2\sqrt{\beta^*\overline{P}\hat{x}^*}].$$

Note that $\overset{\Delta}{\alpha}{}^*(K^*,\omega^*) < \check{\alpha}^*(K^*,\omega^*)$ but that $\overset{\Delta}{\alpha}{}^*(K^*,\omega^*) > \underline{\alpha}^*$ if and only if

$$\omega^* < K^* - \hat{x}^* - \underline{\alpha}^*/2 - \sqrt{\beta^*\overline{P}\hat{x}^*} \equiv \overline{\omega}^*(K^*).$$

Then for $\omega^* < \overline{\omega}^*(K^*)$, cooperation is sustainable with a price $\breve{P}(\alpha^*;K^*,\omega^*)$ over the range $\alpha^* \epsilon [\overset{\Delta}{\alpha}{}^*(K^*,\omega^*), \breve{\alpha}^*(K^*,\omega^*)]$, while the foreign monopolist chooses the foreign monopoly price $\dot{P}^*(\alpha^*)$ and faces dumping suits over the range $\alpha^* \epsilon [\underline{\alpha}^*, \overset{\Delta}{\alpha}{}^*(K^*,\omega^*))$.

Still treating ω^* as a parameter for the moment and assuming that $\omega^* < \overline{\omega}^*(K^*)$, we can now write down the foreign monopolist's revenues under the most-cooperative arrangement as a function of K^* (and ω^*):

$$(23)\quad R^*(\alpha^*;K^*,\omega^*) = \begin{cases} P^*(\alpha^*;K^*)\cdot K^* & \text{for } \alpha^* \epsilon [\tilde{\alpha}^*(K^*), \overline{\alpha}^*] \\ P^*(\alpha^*)\cdot D^*(\alpha^*;P^*(\alpha^*)) + \overline{P}\cdot x^*(\alpha^*;K^*) & \text{for } \alpha^* \epsilon [\hat{\alpha}^*(K^*), \tilde{\alpha}^*(K^*)] \\ \hat{P}^*(\alpha^*;K^*)\cdot D^*(\alpha^*;\hat{P}^*(\alpha^*;K^*)) + \overline{P}\hat{x}^* & \text{for } \alpha^* \epsilon [\overset{\square}{\alpha}{}^*(K^*), \hat{\alpha}^*(K^*)] \\ \dot{P}^*(\alpha^*)\cdot D^*(\alpha^*;\dot{P}^*(\alpha^*)) + \overline{P}\hat{x}^* & \text{for } \alpha^* \epsilon [\breve{\alpha}^*(K^*,\omega^*), \overset{\square}{\alpha}{}^*(K^*)] \\ \breve{P}^*(\alpha^*;K^*,\omega^*)\cdot D^*(\alpha^*;\breve{P}^*(\alpha^*;K^*,\omega^*)) + \overline{P}\hat{x}^* & \text{for } \alpha^* \epsilon [\overset{\Delta}{\alpha}{}^*(K^*,\omega^*), \breve{\alpha}^*(K^*,\omega^*)] \\ \dot{P}^*(\alpha^*)\cdot D^*(\alpha^*;\dot{P}^*(\alpha^*)) & \text{for } \alpha^* \epsilon [\underline{\alpha}^*, \overset{\Delta}{\alpha}{}^*(K^*,\omega^*)] \end{cases}$$

with expected foreign monopoly profits under cooperation then given by

$$(24)\quad E\pi^{*c}(K^*;\omega^*) = \int_{\underline{\alpha}^*}^{\overline{\alpha}^*} R^*(\alpha^*;K^*,\omega^*)\,dF(\alpha^*) - r^*K^*.$$

The first and second order conditions of (24) are given by

$$(25)\quad E\pi^{*c}_{K^*}(K^*;\omega^*) = \int_{\tilde{\alpha}^*(K^*)}^{\overline{\alpha}^*} \left(\frac{\alpha^* - 2K^*}{\beta^*}\right) dF(\alpha^*) + \int_{\overset{\square}{\alpha}{}^*(K^*)}^{\hat{\alpha}^*(K^*)} \left(\frac{\alpha^* - \beta^*\overline{P} - \overset{\square}{\alpha}{}^*(K^*)}{\beta^*}\right) dF(\alpha^*)$$

$$+ \int_{\overset{\Delta}{\alpha}^*(K^*,\omega^*)}^{\breve{\alpha}(K^*,\omega^*)} \left(\frac{\alpha^* - \beta^* \overline{P} - \breve{\alpha}^*(K^*,\omega^*)}{\beta^*}\right) dF(\alpha^*)$$

$$+ [F(\tilde{\alpha}^*(K^*)) - F(\overset{\Box}{\alpha}^*(K^*)) + F(\breve{\alpha}^*(K^*,\omega^*)) - F(\overset{\Delta}{\alpha}^*(K^*,\omega^*))]\overline{P} - r^* = 0$$

and

$$E\pi^{*c}_{K^*K^*}(K^*,\omega^*) = \frac{-2}{\beta^*} \{[1-F(\tilde{\alpha}^*(K^*))] + [F(\hat{\alpha}^*(K^*)) - F(\overset{\Box}{\alpha}^*(K^*))]$$

$$+ [F(\breve{\alpha}^*(K^*,\omega^*)) - F(\overset{\Delta}{\alpha}^*(K^*,\omega^*))] - [\breve{\alpha}^*(K^*,\omega^*) - \overset{\Delta}{\alpha}^*(K^*,\omega^*)] f(\overset{\Delta}{\alpha}^*(K^*,\omega^*))\} < 0.$$

Expression (25) implicitly defines the foreign capacity choice as a function of ω^* in the most-cooperative equilibrium, $K_2^*(\omega^*)$, provided that second order conditions are met. Analogous to the previous subsection, the second order condition must hold if the distribution of demand shocks satisfies

$$(26)\quad [F(\breve{\alpha}^*(K^*,\omega^*)) - F(\overset{\Delta}{\alpha}^*(K^*,\omega^*))] > [\breve{\alpha}^*(K^*,\omega^*) - \overset{\Delta}{\alpha}^*(K^*,\omega^*)] f(\overset{\Delta}{\alpha}^*(K^*,\omega^*)).$$

When $\omega^* = 0$ so that no cooperation is sustainable, (26) collapses to (21); more generally (26) is simply the analogue to (21) for all $\omega^* \geq 0$. As before, we maintain the assumption that (26) holds throughout.

Using (20) and (25), and the fact that

$$\breve{\alpha}^*(K^*,\omega^*=0) = \overset{\Box}{\alpha}^*(K^*); \quad \overset{\Delta}{\alpha}^*(K^*,\omega^*=0) = \dot{\alpha}^*(K^*),$$

it is straightforward to show that $K_2^*(\omega^*=0) = K_1^*$. Moreover, with $E\pi^{*c}_{K^*K^*}(K^*,\omega^*) < 0$, the effect of an increase in ω^* on $K_2^*(\omega^*)$ has the same sign as $E\pi^{*c}_{K^*\omega^*}(K^*,\omega^*)$, which is given by

$$E\pi^{*c}_{K^*\omega^*}(K^*,\omega^*) = \frac{2}{\bar{P}\beta^*}\{[F(\breve{\alpha}^*(K^*,\omega^*))-F(\overset{\Delta}{\alpha}{}^*(K^*,\omega^*))]-[\breve{\alpha}^*(K^*,\omega^*)-\overset{\Delta}{\alpha}{}^*(K^*,\omega^*)]f(\overset{\Delta}{\alpha}{}^*(K^*,\omega^*))\}$$

By (26), this is positive. Thus, for $\omega^* > 0$, we have

$$K^*_0 > K^*_2(\omega^*) > K^*_1.$$

Figure 2 illustrates the effect of self-enforcing agreements on equilibrium trade volume by comparing export volume in the absence of antidumping law to that in its presence without agreements and with agreements. As depicted, the direct impact of such agreements is to raise trade volume from zero to $\hat{x}^*$ over the range $\alpha^* \epsilon [\overset{\Delta}{\alpha}{}^*(K^*_2(\omega^*),\omega^*),\dot{\alpha}^*(K^*_1)]$ since antidumping suits are avoided over this region as a result of the arrangement. However, there is also an indirect effect of the agreements that works through the impact on foreign capacity choice, and this raises trade volume over the range $\alpha^* \epsilon [\hat{\alpha}^*(K^*_1),\bar{\alpha}^*(K^*_2(\omega^*))]$. Also, note that, as in the absence of agreements, any dumping suits that occur will be associated with the lowest range of α^*s.

Finally, we have treated ω^* as a parameter when in fact it is a function of the degree of cooperation. Thus, we must solve for a fixed point. Defining the present discounted value to the foreign monopolist of maintaining the agreement, as a function of ω^*, as

$$(27)\ \tilde{\omega}^*(\omega^*) = \frac{\delta}{1-\delta}\{E\pi^*(K^*_2(\omega^*);\omega^*) - E\pi^*(K^*_1)\}$$

with δ the foreign discount factor, it is readily shown that; (i)

$\tilde{\omega}^*(\omega^*=0) = 0$, (ii) $\tilde{\omega}^{*\prime}(\omega^*=0) > 1$ provided that $\bar{P}$ is sufficiently small relative to δ, and (iii) $\tilde{\omega}^{*\prime\prime}(\omega^*) < 0$ provided condition (26) holds.

By (i), one fixed point exists with $\omega^*=0$, representing continual play of the noncooperative (no agreements) game. Moreover, under conditions (i), (ii), and (iii), a unique strictly positive fixed point $\hat{\omega}^*>0$ exists with self-enforcing agreements put in place over some range of α^*s; if δ is not too large, then $\hat{\omega}^* < \overline{\omega}^*(K_2^*(\hat{\omega}^*))$ and cooperation can not be sustained over the entire range of α^*, so that suits will be filed in states of sufficiently soft foreign demand. Thus, in addition to condition (26), the existence of a unique strictly positive fixed point $\hat{\omega}^*$ consistent with the filing behavior characterized in Figure 2 requires that δ not be too large and that $\bar{P}$ be sufficiently small relative to δ, with the latter condition simply ensuring that the current payoff from defecting and exporting an additional unit to the domestic market, $\bar{P}$, is not too large relative to the weight placed on future punishment as a result of that defection.[16]

V. Conclusion

We have explored the impact of domestic antidumping law in an environment where competitive firms face dumping from a foreign monopoly during periods of low foreign demand. We find that the availability of antidumping law in the domestic industry will serve to diminish the dumping activity of the foreign monopolist generally, whether or not a suit is filed

[16] If $\bar{P}$ is sufficiently large relative to δ, then starting from $\omega^*=0$, an increase in ω^* raises the current incentive to defect faster than it raises the present value of maintaining cooperation, and no strictly positive degree of cooperation can be sustained in equilibrium.

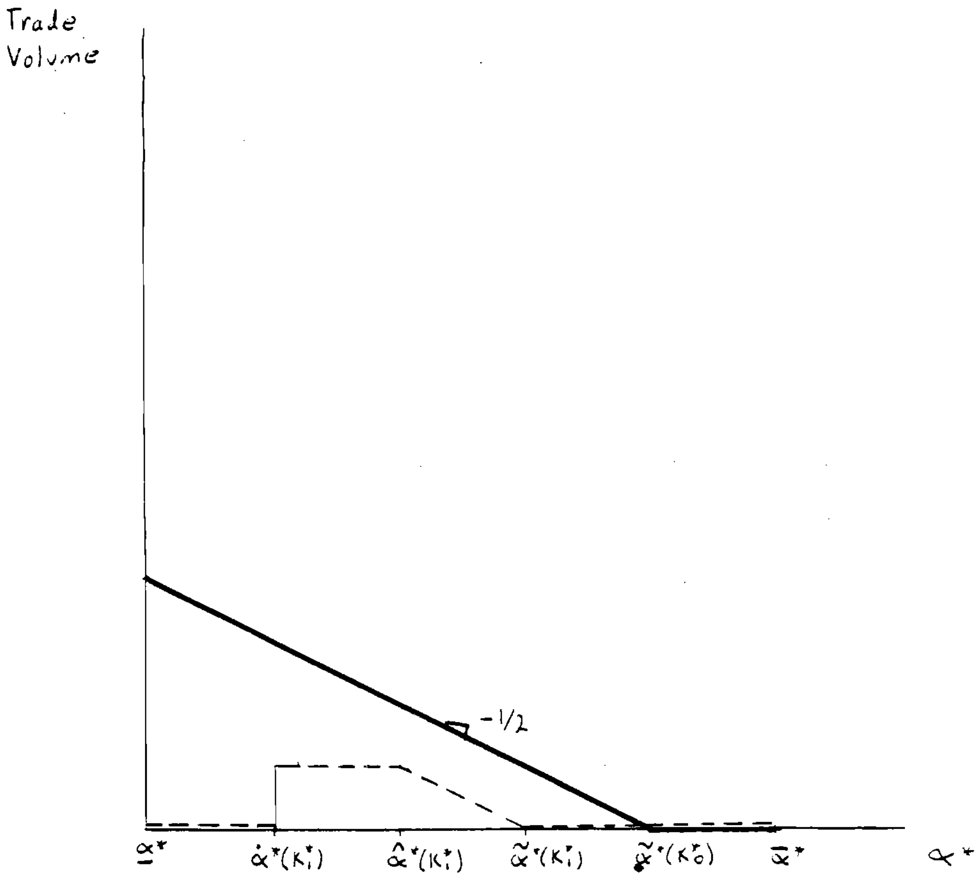
in the period. In periods of sufficiently soft foreign demand, the domestic industry will file an antidumping suit against the foreign monopolist and the resulting antidumping duties will reduce foreign export volume directly. However, in making excess foreign capacity more costly for the foreign monopolist to hold, the occasional filing activity of domestic firms leads to a reduction in foreign capacity and, through this, to a general reduction in export volume in a broad range of foreign demand states.

We have also examined the possibility of tacit "suit-avoidance" arrangements between the foreign monopolist and domestic industry of a self-enforcing nature. We find that such arrangements tend to reduce the range of foreign demand realizations over which antidumping suits are filed, and to increase the volume of foreign exports over a range of low foreign demand states directly because fewer suits are filed. Moreover, such arrangements will indirectly increase trade volume over a range of high foreign demand states because of the larger foreign capacity that results. Nevertheless, if antidumping suits are filed by the domestic industry, it will still be in periods for which foreign demand is sufficiently soft.

It is interesting to compare these findings with those of Staiger and Wolak (1989) where, in contrast to the current setting, the domestic petitioner is taken to be a member of the tacit (international) cartel. There, as here, we find that domestic antidumping suits will be filed in low-demand states. However, there the domestic filing of an antidumping suit establishes the credibility of the threat to punish the foreign firm with antidumping duties <u>should</u> it defect from the collusive agreement and undercut the domestic firm. Since this threat is credible, it induces the desired (cooperative) behavior in the foreign firm. Consequently, once the domestic firm files a suit, the foreign firm is convinced not to dump, and dumping duties are never actually levied. Thus, when collusive firms file against each other, antidumping petitions never end in the imposition of duties. In contrast, we have found here that when antidumping suits are filed by competitive domestic firms against a monopolist abroad, they serve a fundamentally different purpose, and always lead to the imposition of duties. Taken together, these findings suggest that the degree of market power held by the petitioner may influence not only the nature of the effects of antidumping law but also the frequency with which antidumping petitions result in the imposition of antidumping duties.[17] We hope to pursue these and other empirical implications of these papers in future work.

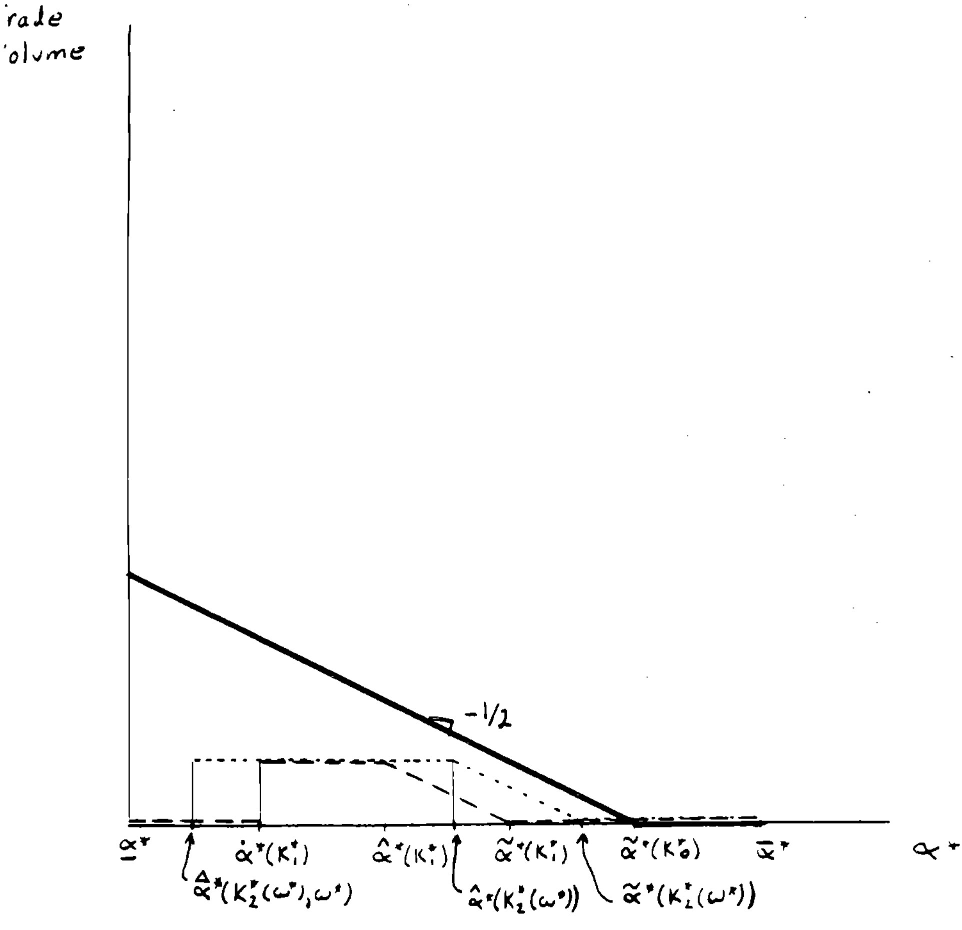
[17] See Prusa (1988) for a discussion of the empirical frequency with which antidumping suits are withdrawn and a theoretical analysis of this phenomenon in a static setting.

Figure 1



Trade Volume
-1/2
$\underline{\alpha}^*$
$\dot{\alpha}^*(K_1^*)$
$\hat{\alpha}^*(K_1^*)$
$\tilde{\alpha}^*(K_1^*)$
$\tilde{\alpha}^*(K_0^*)$
$\bar{\alpha}^*$
α^*

Figure 2



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Appendix

In this Appendix, we ask whether there are additional domestic capacity choices other than $\hat{K}(x^*)$ which could yield zero domestic profits and thus also constitute equilibrium domestic entry behavior given foreign export capacity x^*. We can rule out any $K < \hat{K}(x^*)$ as a candidate equilibrium directly, since this would lead to positive domestic firm profits. This is seen by noting that, for $K < \hat{K}(x^*)$,

$$P(K+x^*) > P(\hat{K}(x^*)+x^*) = \bar{P}$$

so that any domestic firm naming $P(K+x^*)$ is guaranteed strictly positive profits.

To rule out $K > \hat{K}(x^*)$ requires a bit more work. Any pure strategy equilibria with $K > \hat{K}(x^*)$ and $P > 0$ must have all capacity being sold so that, with $K > \hat{K}(x^*)$,

$$P(K+x^*) < P(\hat{K}(x^*)+x^*) = \bar{P}$$

and domestic firm profits would be negative. Moreover, any mixed strategy equilibria that do exist with $K > \hat{K}(x^*)$ must yield negative expected profits for domestic firms, and thus $K > \hat{K}(x^*)$ can be ruled out in equilibrium as well. To see this, suppose to the contrary that a mixed strategy equilibrium exists with $K > \hat{K}(x^*)$ and domestic firms making non-negative profits. Then the lowest price played in equilibrium by a (representative) domestic firm must be no lower than $\bar{P}$, the break-even price for a domestic firm that sells its entire capacity. Thus, equilibrium expected revenues for the foreign monopolist must be no less than $\bar{P}x^*$ (and this must be true at every price named in its equilibrium strategy), since the foreign monopolist could always name $\bar{P}$ (or $\bar{P}-\epsilon$ if domestic firms play $\bar{P}$ with positive probability) and sell its entire export capacity x^*. But this implies that neither a (representative) domestic firm nor the foreign monopolist would name a price higher than $\bar{P}$ if at that price it would be undercut by all other firms with certainty. This is because naming such a price would leave a (small) domestic firm with no sales (and hence negative profits), while the foreign monopolist in naming such a price (say P^*) would obtain revenues of

$$
\begin{aligned}
P^*[D(P^*)-K] &< P^*[D(P^*)-\hat{K}(x^*)] \\
&< \bar{P}[D(\bar{P})-\hat{K}(x^*)] = \bar{P}x^*
\end{aligned}
$$

where the inequalities follow from $P^* > \bar{P}$, $K > \hat{K}(x^*)$, and (4). We are thus left with two possibilities. Denoting $\overset{-}{P}$ and $\overset{-}{P}{}^*$, respectively, as the supremum of the support of the prices named by a (representative) domestic firm and the foreign monopolist, we must either have $\overset{-}{P} > \overset{-}{P}{}^*$ and $\overset{-}{P}$ played with positive probability by domestic firms, or $\overset{-}{P} = \overset{-}{P}{}^*$ and played with positive probability by domestic firms and possibly the foreign monopolist. But the former case can not hold in equilibrium, since any domestic firm could unilaterally shave its price below $\overset{-}{P}$ and strictly increase revenues (it sells strictly more with positive probability while the loss due to the lower price is negligible). Similarly, the latter case can not hold in equilibrium either, since any (domestic or foreign) firm would deviate from $\overset{-}{P}=\overset{-}{P}{}^*$ to a slightly lower price. Thus, a mixed strategy equilibrium with $K > \hat{K}(x^*)$ and non negative domestic profits can not exist.