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Split Decisions in Antidumping Cases*

Meredith A. Crowley

Abstract

This paper provides a rationale for "split decisions" in antidumping cases. A split decision occurs when the U.S. government simultaneously investigates multiple countries for dumping the same product but imposes antidumping duties on only a subset of these countries. In the U.S., 76% of antidumping petitions filed between 1980 and 2004 involved two or more countries accused of dumping the same product. Among these multi-country investigations, roughly 30% concluded with a split decision in the final stage of an investigation. The model in this paper shows that selectively applying antidumping duties against foreign countries that are selling increased quantities of imports at a price below long run average total cost improves the importing country's welfare. Imperfectly competitive firms in different countries face stochastic demand and are subject to capacity constraints. As a result, foreign firms dump when they face weak demand in their own markets. In response to the shift in a foreign country's export supply, the importing country's optimal rent-shifting tariff against the foreign country with weak demand increases while its optimal tariff against other countries falls. This paper suggests an economic rationale behind the differential treatment afforded to different countries accused of dumping.

KEYWORDS: antidumping, imperfect competition, trade policy

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1 Introduction

Over the last twenty years, antidumping policy has emerged as a significant trade impediment around the world. Gallaway, Blonigen and Flynn (1999) estimate antidumping and countervailing duty laws as one of the costliest programs restraining US trade with a net welfare cost in 1993 of $4 billion. A question that has perplexed economists is: why do governments pursue antidumping policies? While a consensus has emerged among economists (see Blonigen and Prusa's survey, 2003 and Zanardi's history of dumping, 2006) that antidumping policy has little or nothing to do with predatory pricing or unfair behavior by foreign firms, economists are still trying to determine if there is any economic purpose behind antidumping policy.

This paper begins with the observation that not all countries investigated for alleged dumping suffer the same fate. For example, in the final phase of a US investigation into alleged dumping by firms in China, Germany, Japan and South Korea, the US Department of Commerce (USDOC) concluded that firms in all countries were guilty of dumping polyvinyl alcohol in the US market. However, the German firm was not subject to a US antidumping duty because another US government agency, the US International Trade Commission (USITC), concluded that unlike the Chinese, Japanese and Korean firms, the German firm did not threaten to materially injure competing US producers.[1] In explaining its reasoning behind this split decision, the US International Trade Commission focused on foreign firms' production capacity, inventories, and the stability of foreign demand.

> The availability of unused production capacity in the subject countries [Japan and Korea] provides subject producers in Japan and Korea the capability to substantially increase their exports to the United States... Inventories in the United States of subject imports from Japan and Korea increased sharply from 2001 to 2002, both in absolute levels and relative to the (increased) quantity of imports. The subject producers also maintain substantial quantities of inventories.[2]

[1] See USITC investigations 731-1014, 1015, 1016 and 1017. Singapore was also listed in the initial dumping petition, but the government abandoned its inquiry into dumping by Singaporean firms on the grounds that imports of polyvinyl alcohol from Singapore were negligible.

[2] USITC, June 2003, p. 33.

In contrast to the threat inherent in large amounts of unutilized capacity and high inventories in Japan and Korea, the US found that the German firm posed no threat of material injury to US firms because

> The sole German producer of PVA [polyvinyl alcohol], Kuraray Germany, has little unused capacity available to increase its exports to the United States... The record also indicated that Kuraray Germany has stable home market demand and well-established export markets elsewhere in Europe. We consequently find that the available data on capacity do not indicate a likelihood that Kuraray Germany will substantially increase its exports to the United States... [Moreover] The quantity of U.S. inventories of German PVA declined from 2001 to 2002, as did the quantity of inventories of subject merchandise held in Germany by Kuraray Germany.[3]

Interestingly, the case of polyvinyl alcohol in 2003 is not unique. The historical record of US antidumping investigations over the last twenty five years contains numerous examples of split decisions that fit the following basic pattern. First, more than one country was found guilty of dumping during the US Department of Commerce's final dumping determination. Second, at least one country found guilty of dumping was exempt from an antidumping duty on the grounds that it did not materially injure or threaten to materially injure competing US firms. Third, the products that fit this pattern tend to be in industries where production is concentrated among relatively few producers, like steel and chemicals.[4]

In this paper, I develop a model to explain the phenomenon of split decisions in antidumping cases. The model is motivated by the facts presented above and by the empirical findings of Crowley (2009) that economic weakness in a foreign industry is associated with an increase in the probability of US antidumping protection.[5] Imperfectly competitive firms in different countries face stochastic demand and are subject to capacity constraints. As a result, a

[3]USITC, June 2003, p. 34-5.

[4]For example, Carbon Steel Wire Rod in 1983 (Investigations TA-731-157, 158, 159, and 160), Titanium Sponge in 1983 (Investigations TA-731-161 and 162), Oil Country Tubular Goods in 1984 (Investigations TA-731-191, 192, 193 and 194), Sulfanilic Acid in 1992 (Investigations TA-731-560 and 561), Cold-Rolled Carbon Steel Sheet in 1992 (Investigations TA-731-597 though 611, inclusive), Silicomanganese in 1993 (Investigations TA-731-671, 672, 673, and 674) and Stainless Steel Wire in 1997 (Investigations TA-731-769 though 775, inclusive) are just some of the products whose investigations followed this basic pattern.

[5]Crowley (2009) examines data on US antidumping investigations between 1980 and 2001 and finds that after controlling for other factors that likely drive industry filing and

foreign firm dumps, that is, prices below average total cost, when it faces weak demand in its own market. Dumping occurs because the foreign firm's profit-maximizing strategy is to equate marginal revenue in all markets it serves. In response to this shift in a foreign country's export supply, the importing country's optimal rent-shifting tariff against that country increases. Interestingly, firms in foreign markets that are not experiencing a negative demand shock also lower their prices below the average total cost of production, but their level of exports *falls* in the face of increased competition in the importing country's market. The model in this paper shows that selectively applying antidumping duties to firms that are selling *increased* quantities of imports at a price below long run average total cost improves the importing country's welfare. In contrast, because the export supply of firms in competing foreign countries shifts inward, the optimal rent-shifting tariff against these foreign countries falls. While many useful theories have been put forward to explain different aspects of antidumping policy, this is the first paper that I am aware of in which differences in economic shocks in foreign economies can explain the differential treatment afforded to different countries accused of dumping.[6] Moreover, the paper contributes to our understanding of antidumping policy more generally by showing that governments may have an incentive to increase tariffs in response to adverse foreign economic shocks. In order to reform antidumping policy, economists must first understand the incentives that firms and governments face under the current law in an environment of economic uncertainty.[7]

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government decisions, a one standard deviation fall in the growth of employment in a foreign economy's manufacturing industry (a measure of the strength of demand) increases the joint probability that the US industry will file an antidumping petition and the US government will impose a preliminary (temporary) antidumping measure by a factor of 3 to 10, depending on the exact model specification. Further, she finds that a one standard deviation fall in foreign employment growth doubles to quadruples, depending on specification, the joint probability that a petition will be filed and a final (long-lasting) antidumping measure will be imposed.

[6]Blonigen and Bown (2003) investigate a different, but important, margin of cross-country variation in antidumping policy, industry filing behavior. In an empirical analysis of US antidumping activity between 1980 and 1998, they find that the US industries are less likely to request antidumping protection against countries that have more capacity to retaliate against a US antidumping duty. The focus of the current paper is cross-country variation in the government's application of antidumping duties.

[7]A growing literature in (Bagwell and Staiger, 1999; Horn, 2006; Horn and Mavroidis, 2003, 2004, 2006, 2007, 2009) is directed toward trying to understand if the many of the trade laws in existence today are founded in a sound economic rationale. This paper attempts to explain the economic variables and forces that are codified into antidumping law in order

This paper contributes to the theoretical literature that focuses on dumping in imperfectly competitive markets (Brander and Krugman, 1983; Dixit, 1988; Gruenspecht, 1988; Prusa, 1992; Staiger and Wolak, 1992; Reitzes, 1993; Veugelers and Vandenbussche, 1999; Pauwels, Vandenbussche and Weverbergh, 2001; Vandenbussche and Wauthy, 2001; Blonigen and Park, 2004). The theoretical model follows Ethier (1982) and Staiger and Wolak (1992)[8] by modeling weak foreign demand as the driving force behind dumping. In this paper, a domestic and foreign firms play a two-stage game in which they install capacity in the first stage and produce and sell their output in the second stage. Because firms must install capacity before they learn the state of foreign demand, a negative demand shock in one foreign country induces an import surge from that country and a fall in the price below the long run average total cost of production. I show that the country-specific application of antidumping duties against countries which are both dumping and causing materially injury improves the importing country's welfare relative to free trade.[9]

The theoretical model improves on the existing literature by matching some important features of dumping and antidumping policy. First, the majority of antidumping cases in the US and EU rely on a definition of dumping as pricing below average total cost.[10] Second, many foreign firms choose to dump when they face antidumping duties rather than raise their prices in order to eliminate the duty.[11] Third, country-specific antidumping duties emerge as a

to help us understand when the law is or is not effective in achieving a social/economic objective.

[8]Ethier (1982) examines dumping induced by stochastic demand in a perfectly competitive market in which the welfare effects of antidumping policy are indeterminate. Staiger and Wolak (1992) model a foreign monopolist selling in a perfectly competitive domestic market. They use their model to conduct a positive analysis of the existing US antidumping law on the behavior of the foreign monopolist. In their model, because the domestic market is perfectly competitive, there is no national welfare gain (specifically, no increase in domestics firms' profits) from the imposition of an antidumping duty. Thus, it is unclear why the government would impose an antidumping duty.

[9]However, the antidumping duty is not a fully optimal trade policy. For an analysis of the welfare of import tariffs and export subsidies in a strategic model of imperfect competition without capacity constraints, see the seminal contribution of Brander and Spencer (1985).

[10]Clarida (1996) presents estimates from a variety of sources that the definition of dumping as pricing below the average total cost of production is used in about 2/3 of US antidumping cases.Gruenspecht (1988) utilizes this definition of dumping, but his model can only be applied to industries in which learning-by-doing is important.

[11]Because an exporting firm has the power to reduce or eliminate its own duty by restricting its own exports, some papers (Prusa, 1992; Blonigen and Park, 2004) suggest that an exporting firm should cease dumping to avoid an antidumping duty.

welfare-improving response to dumping increased imports.[12] Thus, the model provides an explanation for split decisions that is consistent with the government's stated reasoning in the polyvinyl alcohol case. Moreover, the model offers an explanation for why most cases do not end with a split decision. If both countries simultaneously experience recessions, then both would engage in dumping that causes injury to the domestic industry.[13] The finding that antidumping duties improve welfare contrasts with much of the previous literature (Staiger and Wolak, 1992; Vandenbussche and Wauthy, 2000; Blonigen and Park, 2004) which analyzes the introduction of antidumping policy into models in which antidumping duties are neutral or welfare-reducing.

Section 2 describes the antidumping process in the US and presents evidence on the frequency of split decisions. Section 3 outlines the model. Section 4 examines dumping under free trade. Section 5 analyzes the government's tariff response to dumping. Section 6 concludes.

2 Split Decisions in the U.S. Antidumping Process

Antidumping investigations in the US proceed through a two stage process. In the preliminary phase, the US International Trade Commission determines whether or not dumped imports from accused countries are causing or threatening to cause injury to the domestic import-competing industry and the US Department of Commerce simultaneously determines the existence and magnitude of dumping by each country. If both agency findings are affirmative, a preliminary (temporary) antidumping duty is imposed on imports from that country. If the injury determination is negative, the investigation against that country terminates and no duty is imposed. In the final phase, the two agencies make a second determination about the existence and magnitude of dumping and a second injury determination with both decisions usually benefitting from

[12]This contrasts with Dixit (1988) who was the first to show that antidumping policy is welfare-reducing in a model of oligopolistic competition. Gruenspecht (1988) finds that antidumping policy can be welfare-improving in dynamic models of imperfect competition. Veugelers and Vandenbussche (1999) analyze how antidumping regulations affect the formation of cartels and find that antidumping duties increase welfare when the competitive structure of an imperfectly competitive market is invariant to the existence of antidumping regulations.

[13]Empirically, the large number of cases in which there are no splits in the decision can be attributed to the high correlation of business cycles across countries. Crowley (2009) finds evidence of this using 3 digit industry level data on consumption and employment.

additional time to collect and analyze data. If both decisions are affirmative, final (long-lasting) antidumping duties are imposed against specific countries.[14]

Table 1 presents summary information on the material injury determinations in the final stage of the 1121 antidumping investigations against specific countries conducted by the US International Trade Commission between 1980 and 2004. 862 of these investigations proceeded to the final stage. These country-specific petitions are aggregated into 353 multi-country cases involving a product imported from one or more countries.[15] The first column lists the number of countries included in an antidumping case involving a specific product. The second column lists the number of countries involved in a case against a product.

The third column counts the number of antidumping cases in which *every* individual country named as part of the antidumping case was found *guilty* (affirmative) of causing or threatening to cause material injury to the domestic industry during the final phase of the case. The fourth column counts the number of cases in which *all* countries involved in an investigation were found *not guilty* (negative) of causing or threatening material injury. The final column lists the number of cases in which the final injury determination was split across countries with one or more countries found not guilty of injury while others were found guilty of causing or threatening to cause material injury to the domestic import-competing industry.

From table 1 a few key observations emerge. First, cases involving multiple countries are common. 47.6% (168/353) of cases involved two or more

[14]A detailed description of the current antidumping process and a brief history of the evolution of US antidumping law since 1916 can be found in the *Antidumping and Countervailing Duty Handbook* published by the US International Trade Commission (2007). Although US trade law has been revised a number of times since 1980, the antidumping process is largely unchanged with one important exception. Beginning in 1984, the rule to cumulate imports from all countries listed in a petition during the injury investigation led to super-additivity in USITC decisions and a 20-30% increase in the probability of protection (Hansen and Prusa, 1996). However, as Hansen and Prusa (1996) note, "the ITC always makes its decisions on a country-by-country basis, even if imports from a set of countries are cumulated." Thus, while there is a methodological bias toward affirmative determinations of injury, it is still possible for split determinations to occur. Practice in the European Community is less clear. Tharakan, Greenaway and Tharakan (1998) find that a cumulation rule in the EC led to large increases in affirmative determinations.

[15]All data come from the Global Antidumping Database Version 3.0 maintained by Chad Bown. Antidumping investigations involving multiple products with different outcomes are split into two investigations whenever reported as such in the database. In this table, withdrawn and terminated investigations are recorded as negative determinations. However, an alternative classification that simply drops investigations that were withdrawn or terminated from the dataset presents a qualitatively similar picture of split decisions.

Table 1: Final Injury Determinations by the USITC: 1980-2004

No. of countries named in case	Number of cases	Affirm. Cases	Negative Cases	Split Cases
1	185	116	69	0
2	71	47	17	7
3	29	17	8	4
4	22	10	7	5
5	8	1	4	3
6	13	5	5	3
7	6	2	2	2
8	7	2	3	2
9	4	1	2	1
11	2	1	0	1
12	3	1	1	1
15	2	0	0	2
20	1	0	0	1
Total	353	203	118	32

countries accused of dumping the same product. Second, of cases involving more than one country, split injury determinations are a regular outcome. In 19.0% of cases, the determination was split with some countries found guilty of material injury and others found not guilty. Finally, in over 50% of cases in which the final injury determination split across countries, *all* the countries were found guilty of dumping the product in the US.[16] This is an interesting and important distinction. Although all firms may be selling at less-than-fair-value, only a subset of firms selling at less-than-fair-value are causing harm. A model of split decisions needs to capture this distinction.

While table 1 provides interesting information on the frequency of split decisions, it does not offer any insight into why split decisions are rendered. Data on industry-level consumption growth can serve as a proxy for the

[16]An alternative way of counting observations is to use the number of country-product investigations conducted by the USITC. From table 1, the number of antidumping country-product investigations between 1980 and 2004 is the sum of the product of the first and second columns. When we count country-product investigations, split decisions account for a larger share of all investigations. 78.5% of country-product investigations that made it to the final stage involved more than one country and, of these, 30.9% resulted in split final injury determinations.

strength of demand in a market and are available for most countries accused of dumping into the US from 1980-2001 through the World Bank's Trade, Production and Protection database. Interestingly, an examination of cases that resulted in split decisions turns up the following: the correlation between the magnitude of the antidumping duty and the growth of consumption in the foreign market in the year before the US case was filed is negative, -0.0344 and -0.0003 for preliminary and final duties, respectively. This suggests that weak demand for a product in the exporting country's own market might be the driving force behind injurious dumping in these cases.

3 The Model under Free Trade

There are three countries in the world, two foreign countries (denoted a and b) and one domestic country (called home). There is one firm in each country, markets are segmented, and the goods produced in each country are perfect substitutes. For simplicity, I assume the home market is open to imports, but both foreign markets are closed. Let $q \geq 0$ denote the home firm's output, $q^i \geq 0$ denote the output that the firm in foreign country $i = a, b$ sells in its own market, and $m^i \geq 0$ denote imports from firm i into the home country.

Inverse demand in the home country is given by $p(q, m^a, m^b)$ and demand in each foreign country i is given by $p^i(q^i)$. In order to derive a precise analytic relationship between the foreign demand shock and the antidumping duty, I assume that inverse demand in each country is linear, $p(q, m^a, m^b) = a-(q+m^a+m^b)$ and $p^i(q^i) = a^i-q^i$, for the home and foreign countries, respectively.[17] To analyze the country-specificity of the government's antidumping policy, I assume demand in one foreign country is stochastic and demand in the other foreign country and in the home country is deterministic. Without loss of generality, suppose $a^a \in \{\bar{a}^a, Ea^a, \underline{a}^a\}$ is a discrete, symmetric, iid random variable.[18]

Let k denote the home firm's capacity and let k^i denote the capacity of the firm in country i. The cost of installing one unit of capacity is θ where

[17] More generally, my results about the desirability of an antidumping policy will depend on the convexity of demand. The critical condition will be that the marginal revenue curve be steeper than the inverse demand curve.

[18] The parameter a^a satisfies the following: $\underline{s} < \underline{a}^a < \bar{s}$ where $\underline{s} = Ea^a - \frac{5}{2}\theta$ and $\bar{s} = Ea^a - \frac{5}{4}(a-\theta)$. The assumption on $\underline{s}$ guarantees that demand shocks are sufficiently small that no firm holds excess capacity in equilibrium (sales and imports are always positive) and that on $\bar{s}$ guarantees a negative shock in the foreign country a is sufficiently large to generate dumping.

$\theta > 0$. Therefore, the total cost of building a plant with capacity k (k^i) is given by $c(k, \theta) = \theta k$ ($c(k^i, \theta) = \theta k^i$). Each unit of capacity can be used to produce one unit of output. The marginal cost of production is constant and, for simplicity, is normalized to zero. I assume $a > \theta$, $a^b > \theta$ and $\underline{a}^a > \theta$ to rule out uninteresting cases of non-negative or zero sales and imports.

The timing of the game is as follows.

1. In the first stage, the home firm and the foreign firms simultaneously choose capacities k, k^a and k^b.
   After capacity has been installed, all firms learn the state of demand in foreign country a.
2. In the second stage, the three firms simultaneously choose output. The home firm chooses an amount of output to sell on the home market, q, given its level of installed capacity, k, and imports from the foreign firms. Each foreign firm i chooses the amount of output it will sell in its own market q^i and in the home market m^i given its capacity k^i, the output of the home firm (q), imports from foreign firm $j \neq i$ (m^j), and for firm a the realization of demand in its own market a^a.

3.1 The Subgame Perfect Nash Equilibrium

Working backwards, consider the home firm's problem in the second stage of the game for arbitrary capacity levels, k and k^i. The home firm's problem is to maximize total revenue, $TR = p\big(q, m^a, m^b\big)q$, with respect to sales, q, subject to $q \leq k$. Taking first order conditions yields the home firm's second-stage best response to imports for an arbitrary k.

$$q(m^a, m^b; k) = \min\{k, \frac{a - m^a - m^b}{2}\} \tag{1}$$

The first term within the brackets in (1) is the home firm's best response when its capacity constraint binds; the second term is its best response when its capacity constraint does not bind. When the home firm's capacity constraint does not bind, the home firm will produce and sell a quantity equal to one-half of the residual demand in the home market.

Each foreign firm maximizes total revenue, $TR^i = p^i\big(q^i; a^i\big)q^i + p\big(q, m^i, m^j\big)m^i$, with respect to two arguments, output in its own market, q^i, and in the home country's market, m^i, subject to the constraint $q^i + m^i \leq k^i$. The problems of firm a and firm b are identical with the exception that the total revenue of foreign firm a depends directly on the random foreign demand parameter

a^a through its effect on the price in country a's market. Taking first order conditions yields the following best-response functions for each foreign firm for an arbitrary capacity k^i.

$$q^i = \min\left\{\left[\frac{k^i}{2} + \frac{a^i}{4} - \frac{(a - q - m^j)}{4}\right], \frac{a^i}{2}\right\} \tag{2}$$

$$m^i = \min\left\{\left[k^i - q^i\right], \frac{a - q - m^j}{2}\right\} \tag{3}$$

Each foreign firm maximizes total revenue by simultaneously choosing q^i and m^i such that it equates marginal revenue across its own market and the importing country's market. When firm i's capacity constraint binds, it allocates half of its capacity to producing for its own market (the home country's market). It then adjusts this figure upwards (downwards) in proportion to the strength of demand in its own market and adjusts this figure downwards in proportion to the strength of the residual demand it faces in the home country's market.

Continuing backwards, in the first stage of the game, each firm chooses a capacity to maximize expected profits. The home firm's problem is:

$$\max_k E_{a^a}\left\{\pi(k, k^a, k^b; a^a)\right\} \tag{4}$$

where

$$\pi(k, k^a, k^b; a^a) = p(q + m^a + m^b)q - \theta k$$

where $q(\cdot)$ is given by (1), $q^i + m^i \leq k^i$ for $i = a, b$. Note that if the home firm's second stage capacity constraint were to bind, then the first stage profit function would not be differentiable at $k = a - m^a - m^b$. At this point, two observations simplify the analysis of the home firm's capacity choice problem. First, it is never a best response to install excess capacity in the first stage; the home firm's capacity constraint must bind ($k = q$). Second, for all $k > a - m^a - m^b - \theta$, profits are negative, so a capacity choice in the range of $k \geq a - m^a - m^b$ is never a best response. Thus, I restrict my attention to capacity choices $k < a - m^a - m^b$. See appendix A for proofs of these observations. Taking the derivative of (4) with respect to k over the range $k < a - m^a - m^b$ and solving yields the home firm's capacity best response to the import-sales choices of the foreign firms.

$$k = \frac{1}{2}(a - \theta - E(m^a + m^b)) \tag{5}$$

The capacity choice problem of each foreign firm is similar although its objective is to maximize expected profits in both its own market and the home country's market.[19] Solving the maximization problem of each foreign firm yields the capacity best responses.

$$k^i = \frac{1}{2}(Ea^i - \theta) + \frac{1}{2}(a - \theta - E(q + m^j)) \tag{6}$$

Because the cost of capacity installation is strictly positive for all firms ($\theta > 0$) and by the restrictions on $\underline{a}^a$ (see footnote 19), the capacity best response functions imply that the firms' capacity constraints will bind in the second-stage of the game. Solving the capacity best responses simultaneously yields the subgame perfect Nash equilibrium capacity choices of the home firm and the foreign firms:

$$k = \frac{1}{4}(a - \theta) \tag{7}$$

$$k^i = \frac{1}{4}(a - \theta) + \frac{1}{2}(Ea^i - \theta) \text{ for } i = a, b \tag{8}$$

Imposing the equilibrium capacity choices, (7) and (8), on the second-stage best response functions for each firm yields the subgame perfect equilibrium sales strategies in terms of the underlying cost and demand parameters.

$$q = \frac{1}{4}(a - \theta) \tag{9}$$

$$m^a = \frac{1}{4}(a - \theta) + \frac{4}{15}(Ea^a - a^a) \tag{10}$$

$$m^b = \frac{1}{4}(a - \theta) - \frac{1}{15}(Ea^a - a^a) \tag{11}$$

[19] As with the home firm, if firm i's second stage capacity constraint were to bind, the first stage expected profit function would not be differentiable at $k^i = Ea^i + a - q - m^j$. As with analysis of the home firm's problem, two observations simplify the analysis of firm i's problem. First, in expectation, installing excess capacity is never a best response, firm i's capacity constraint must bind ($k^i = E(q^i + m^i)$). Second, for all $k^i > Ea^i + a - q - m^j - 2\theta$, expected profits are negative, so a capacity choice in the range of $k^i \geq Ea^i + a - q - m^j$ is never a best response. Thus, analysis of firm i's problem can be restricted to capacity levels $k^i < Ea^i + a - q - m^j$.

In the subgame perfect Nash equilibrium, the home firm produces an output equal to its entire capacity (7). This is equal to the home firm's equilibrium sales in a simultaneous Cournot game with three identical players. Firm a sets its import sales equal to sales in a simultaneous Cournot game, then increases its sales into the home country when demand in its own market is weak and decreases its sales into the home country when demand in its own market is strong. The strength of demand in country a's market also affects the equilibrium import-sales of firm b. In the face of weak demand in country a and a surge of imports from firm a, firm b reduces its import-sales to the home country.

4 Dumping under Free Trade

Proposition 1 *Dumping and Material Injury.*[20] *A negative demand shock in country a leads firm a to increase its exports to the home country and to sell its exports in the home country's market at a "dumped" price which is below its long run average total cost of production. The margin of dumping, the difference between the long run average total cost and the price, increases as demand in the foreign country weakens. Further, the sale of "dumped" goods causes material injury to the home country's firm by reducing its profits and market share.*

Proof: Dumping is defined as selling in the home country's market at a price below one's long run average total cost of production, i.e., $p(q, m^a, m^b) < LRATC^i$, where LRATC is the per unit cost of capacity installation plus marginal cost.[21] Substituting in the equilibrium sales functions of all firms,

[20] "Material injury" is defined in US Code 1677 (7)(A) as "harm which is not inconsequential, immaterial or unimportant." Material injury analyses by the USITC include an examination of the changes in import volumes from source countries, and "all relevant economic factors which have a bearing on the state of the industry," including market share and profits. Surprisingly, many cases are filed against countries whose imports to the US declined in the year prior to the antidumping investigation. Real import data on manufactured goods (available at the 4 digit SIC classification for 732 of the 987 cases filed between 1980 and 2001) shows that 30% of cases were filed against countries with negative import growth.

[21] Under the Trade Act of 1979 and the GATT of 1994, "dumping" is selling a good at a price below "fair value." These laws require the US DOC to define "fair value" as the price of the good in the firm's home market. If no home market price is available, the DOC is instructed to use the price of the good in third country markets. Finally, if no third country price is available, the DOC must construct "fair value" as the foreign firm's average total cost of production. Because home market and third market prices can be thrown out in

the per-unit capacity installation cost of θ, and utilizing the normalization of marginal cost equal to zero, implies dumping will occur when foreign demand is weak ($a^a = \underline{a}^a$). The dumping margin is decreasing in the demand parameter of country a, $\frac{\partial(LRATC^a - p)}{\partial a^a} < 0$.

Market share for the home firm is the fraction of its sales in its own market $MS = \frac{q}{q+m^a+m^b}$. Taking the derivative of market share with respect to a^a yields $\frac{\partial MS}{\partial a^a} = \frac{20(a-\theta)}{[15(a-\theta)+4(Ea^a-a^a)]^2} > 0$. Thus, a negative demand shock in the foreign country implies a fall in the home firm's market share.

Finally, $\frac{\partial p}{\partial a^a} > 0$ and, for all $a^a \in \{\bar{a}^a, Ea^a, \underline{a}^a\}$, the home firm's capacity constraint binds in the second-stage of the game so that $q = k$. Thus, for the home firm, a negative demand shock in the foreign country implies that the profits of the home firm fall. QED.

Intuitively, the foreign firm in country a dumps when it experiences a negative demand shock because it maximizes its total revenue by equating marginal revenue across markets. This means it must shift some sales to the importing country when demand in its own market is weak. Although this increase in sales causes the price in the importing country to fall below firm a's long run average total cost, the price remains above its marginal cost of production.

Interestingly, although in this Cournot model the firm in country b is also selling at a dumped price, it is not causing material injury to the domestic firm because it reduces its exports to the home country in the face of an adverse demand shock in country a. Thus, it could not be subjected to an antidumping duty under US or GATT law. Moreover, country b will not be accused of dumping if demand in the country a market is strong. While a positive demand shock in country a will lead the firm in country b to *increase* its exports to the home country's market, the price in the home country will be above long run average total cost whenever country a's demand is strong (see the proof of proposition 1).

Proposition 2 *Dumping and welfare. Dumping by the firm in country a improves the welfare of the importing country.*

Proof: Define welfare of the importing country after capacity has been installed as the sum of consumer's surplus and the home firm's profits in

favor of a price based on "constructed cost" if it can be shown that the home market and third market prices don't provide a full recovery of costs plus a "reasonable" profit, the majority of antidumping cases in the US and the EU rely on a pricing below average total cost definition of dumping (Clarida, 1996; Macrory, 1989; and Messerlin, 1989).

the second-stage ($W = CS(q, m^a, m^b; a^a) + TR(q, m^a, m^b; a^a)$). Taking the derivative of welfare with respect to country's a demand parameter a^a yields $\frac{dW}{da^a} = \frac{-1}{5}[\frac{1}{2}(a-\theta) + \frac{1}{5}(Ea^a - a^a)] < 0$ for all negative foreign demand shocks ($a^a < Ea^a$). Thus, as the size of a negative demand shock, and hence, the margin of dumping increases, the home country's welfare improves. QED.

This result is consistent with earlier findings like Dixit (1988). Because dumping is simply a reduction in the price of an imported good, it improves welfare.

5 Policy Interventions

5.1 An Optimal Contingent Tariff

Building on the game from the previous section, the government now announces a tariff policy before firms install capacity. The timing is as follows: First, the government announces a contingent tariff schedule in which the tariff imposed against each country depends on the realized state of demand in country a, $\tau^i(a^a)$. Second, firms install capacity. Third, demand in country a is realized. Finally, the government collects tariffs and firms sell output.

Working backwards, in the final stage of the game, the home firm's problem is to maximize total revenue. Because the home firm is not subject to the tariff, its objective is unchanged from that described in section 3 and its best response to imports for an arbitrary capacity level, k is given by (1).

For each foreign firm, the objective is to maximize total revenue, less the realized cost of the tariff, $TR^i = p^i(q^i; a^i)q^i + p(q, m^i, m^j)m^i - \tau^i(a^a)m^i$ subject to the constraint $q^i + m^i \leq k^i$. Because sales in the firm's own market are not subject to the tariff, its best response function for own market sales are the same as in section 3 and is given by (2). Taking the first order condition with respect to imports and solving yields

$$m^i = \min\left\{\left[\frac{k^i}{2} - \frac{a^i}{4} + \frac{(a - q - m^j - \tau^i)}{4}\right], \frac{a - q - m^j - \tau^i}{2}\right\} \tag{12}$$

Continuing backwards, the home firm and the foreign firms install capacity given the government's contingent tariff schedule. The home firm's maximization problem is identical to that in the absence of any tariff policy and its capacity best response is given by (5). However, the foreign firms' profit maximization problems reflect the expected costs of the tariffs.

$$\max_{k^i} E_{a^A}\Big\{\pi^i(k^i, k, k^j; a^a)\Big\} \tag{13}$$

where

$$\pi^i[k^i, k, k^j; a^a] = p^i\big(q^i; a^i\big)q^i + p\big(q + m^i + m^j\big)m^i - \tau^i(a^a)m^i - \theta k^i$$

Similar to the case of free trade, it is never a best response for firm i to choose a capacity level $k^i > Ea^i + a - q - m^j - 2\theta - E\tau^i$ because expected profits are negative for capacity choices in this range. Thus, I restrict my analysis to capacity choices in the range $0 \leq k^i \leq Ea^i + a - q - M^j - 2\theta - E\tau^i$. Taking the first order condition of (13) with respect to k^i over this range yields the foreign firms' capacity best responses in the presence of a tariff policy. Solving the home and foreign capacity best responses simultaneously yields the Nash equilibrium capacity choices in terms of the expected tariffs.

$$k = \frac{1}{4}(a - \theta + E\tau^a + E\tau^b) \tag{14}$$

$$k^i = \frac{1}{2}(Ea^i - \theta) + \frac{1}{4}(a - \theta + E\tau^j - 3E\tau^i) \tag{15}$$

The increase in the cost of selling in the home market places the foreign firms at a cost disadvantage relative to the home firm and leads them to reduce their capacities. The home firm takes advantage of the reduction in foreign capacities induced by the tariff and increases its capacity relative to the level under free trade. So, as in Staiger and Wolak (1992), the presence of an antidumping policy reduces the foreign firms' expected exports to the home market even when an antidumping duty is not imposed.

Imposing the equilibrium capacity choices on the output and import best response functions, (1), (2) and (12), and solving, yields the equilibrium sales in the final stage of the game in terms of the realized tariffs.

$$q = \frac{1}{4}(a - \theta + E\tau^a + E\tau^b) \tag{16}$$

$$m^a = \frac{1}{4}(a - \theta) + \frac{4}{15}(Ea^a - a^a) - \frac{4}{15}\tau^a + \frac{1}{15}\tau^b - \frac{3}{10}E\tau^a \tag{17}$$

$$m^b = \frac{1}{4}(a - \theta) - \frac{1}{15}(Ea^a - a^a) - \frac{4}{15}\tau^b + \frac{1}{15}\tau^a - \frac{3}{10}E\tau^b \tag{18}$$

Comparing the Nash equilibrium sales of a foreign firm in the presence of tariffs (17) and (18) to sales under free trade (10) and (11), we see that the

foreign firms reduce their sales to the home market as their respective tariffs increase and increase their exports as their opponents' tariffs increase. This matches the empirical findings of Prusa (2001) that imports from countries not named in antidumping petitions increase when duties are imposed on competing import sources.

Finally, in the first stage of the game, the government's problem is to choose tariff schedules, $\tau^a(a^a)$ and $\tau^b(a^a)$, to maximize social welfare, the sum of consumer's surplus, producer's surplus and tariff revenue.

$$\max_{\tau^a,\tau^b} CS\big(q, m^a, m^b\big) + \pi\big(q, m^a, m^b; k\big) + \tau^a m^a + \tau^b m^b \tag{19}$$

Taking the first order conditions with respect to τ^i for $i = a, b$ and solving simultaneously yields the government's contingent tariff schedule for imports from each country.

$$\tau^a = \frac{3}{14}(a-\theta) + \frac{1}{15}\big(Ea^a - a^a\big) \tag{20}$$

$$\tau^b = \frac{3}{14}(a-\theta) - \frac{1}{15}\big(Ea^a - a^a\big) \tag{21}$$

In the event of a negative demand shock in a foreign market ($a^a = \underline{a}^a$), the welfare-maximizing tariff against country a rises; the government wants to increase the optimal tariff for rent-shifting reasons. As demand in country a weakens (a^a falls), the import-sales capacity of firm a increases. Although the increase in output sold in the home market causes the price to fall, as long as the capacity constraints of all three firms bind, the increase in import-sales by firm a will increase firm a's total revenue. The government can capture some of firm a's increased revenue with an increase in its tariff. Moreover, because country b's export supply curve shifts inward in the face of weak demand in country a, the government's optimal rent-shifting tariff against imports from country b actually declines when country a experiences a negative demand shock. Thus, the government would like to set a tariff policy that treats countries differently according to their export supply schedules.

Summarizing the above results yields the following proposition.

Proposition 3 *The home government's welfare-maximizing response to a negative foreign demand shock in one country is an increase in its optimal rent-shifting tariff against imports from that country.*

5.2 An Antidumping Duty

In this section, I examine the welfare properties of an antidumping duty whose magnitude is equal to the margin of dumping. Having shown in the previous section that a tariff policy will cause foreign firms to install less capacity and will cause the home firm to install more capacity, I simplify my analysis of welfare in this section by assuming that the government announces its antidumping policy after capacity has been installed.[22]

The timing of the game is as follows.

1. In the first stage, the home firm and the foreign firms do not anticipate the government's antidumping policy announcement and simultaneously choose capacities k, k^a, and k^b.
2. The government surprises the firms by announcing its antidumping policy, τ^{ADi}.
   After capacity has been installed and firms learn of the government's antidumping policy, the state of demand in country a is realized.
3. In the final stage, the firms simultaneously chooses sales for each market given the government's antidumping policy and the state of demand in country a.

In equilibrium, because the firms do not anticipate that the government will institute an antidumping policy, the problem they face in the first stage of the game is identical to that in section 3 and the firms will install the capacities given by (7) and (8).

I define the government's antidumping policy as a country-specific retroactive tariff subject to administrative review.[23] If a firm in country i is found (1) to have increased its imports into the home country, (2) to be selling its

[22]This assumption simplifies the analysis. However, a fuller model in which the government announces its antidumping policy prior to capacity installation yields the same qualitative results. If the antidumping policy is announced prior to capacity installation, then the second-stage best response functions are given by (1), by (2) and (3) for the country B firm and by (12) for the firm in country A. The subgame perfect Nash equilibrium capacity choices are given by: $k = \frac{1}{4}(a-\theta) + \frac{1}{24}\tau^{AD,a}$, $k^b = \frac{1}{2}(a^b-\theta) + \frac{1}{4}(a-\theta) + \frac{1}{24}\tau^{AD,a}$ and $k^a = \frac{1}{2}(Ea^a-\theta) + \frac{1}{4}(a-\theta) - \frac{1}{24}\tau^{AD,a}$. The equilibrium antidumping duty is given by: $\tau^{AD,a} = \max\{0, \frac{8}{47}(Ea^a - a^a) - \frac{10}{47}(a-\theta)\}$.

[23]Under US and GATT law, the magnitude of an antidumping duty is equal to the margin of dumping. Most often, this is the difference between the average cost of production and the price in the importing country's market. Further, under the US's administrative review process, antidumping duties are retroactively determined by the behavior of the foreign exporting firm. Specifically, if an antidumping order is in effect, an estimated antidumping duty is paid at the time the goods enter the country. At the end of one year, the government

imports at a price below long run average total cost, and (3) to be causing material injury to the import-competing firm, it faces the following antidumping duty.

$$\tau^{ADi} = \max\{0, LRATC^i - p(q + m^a + m^b)\} \tag{22}$$

Because the cost of installing a unit of capacity is θ and the marginal cost of production is normalized to zero, the long-run-average-cost of production is simply θ. Each foreign firm knows that it will have to pay a tariff of this form if it dumps, but under administrative review the actual dumping margin is calculated after its imports have entered the country. Thus, each foreign firm can increase or decrease its own antidumping duty according to its choice of imports, m^i.

In the last stage of the game, the home firm's problem is to maximize total revenue and its best response function is given by (1). The problem of each foreign firm is to maximize total revenue under a tariff, τ^i, given by (22) above. The best response functions of the foreign firms are given by (12).

In equilibrium, the capacity constraints of all three firms will bind and the firm in country b, which faces deterministic demand in its own market, will never sell *increased* imports at a price below long run average total cost. That is, the firm in country b will never be guilty of materially injuring the domestic industry even though it will dump (sell at a price below average total cost) whenever country a experiences weak demand. Whenever country b's firm sells its output at less-than-fair-value, country b's firm will simultaneously reduce its exports and it will lose market share in the importing country's market. Thus, the antidumping duty against imports from country b will always be set at zero. The equilibrium second-stage domestic sales for the home firm are given by (9) and imports are:

$$m^a = \frac{1}{4}(a - \theta) + \frac{4}{15}(Ea^a - a^a) - \frac{4}{15}\tau^{AD,a} \tag{23}$$

$$m^b = \frac{1}{4}(a - \theta) - \frac{1}{15}(Ea^a - a^a) + \frac{1}{15}\tau^{AD,a} \tag{24}$$

Substituting the equilibrium second-stage sales (9), (23), and (24) into the definition of the government's antidumping duty (22), yields the following expression for the equilibrium antidumping duty.

conducts an administrative review in which it assesses the actual dumping margin for the previous twelve months and collects or returns any difference plus interest between the estimated and actual duty.

$$\tau^{AD,a} = \max\{0, \frac{1}{6}(Ea^a - a^a) - \frac{5}{24}(a - \theta)\} \tag{25}$$

The antidumping duty will be greater than zero whenever the firm in country a faces a sufficiently large negative demand shock ($\underline{a}^a \leq \bar{s}$). Direct calculation shows us that whenever a negative demand shock is large enough to result in dumping (i.e., $\underline{a}^a \leq \bar{s}$), the profit-maximizing strategy of firm a will be to dump. See figure 1 for a graphical explanation of this.

The left graph of figure 1 presents the residual demand curve firm a faces in the importing country's market. The right graph presents the demand firm a faces in its own market. Prices are on the y-axes and quantities are on the x-axes. In the presence of an antidumping duty that increases with the margin of dumping, the firm in country a faces a kinked residual demand curve (the kinked bold line beginning at a in the left graph). Thus, its residual marginal revenue curve is a piecewise function (the thin line in the left graph with a break at $m(ver)$) with a gap at the import-sales quantity at which price is equal to long run average cost. In its own market, firm a faces "normal demand" (the bold line beginning at $E(a^a)$) when realized demand takes its expected value and "weak demand" (the bold line beginning at $\underline{a}^a$) when realized demand is low. The thin horizontal line, LRATC, represents the long run average cost of production, which with zero marginal cost, is equal to the cost of capacity installation, θ. At the time firm a makes its capacity installation decision, it chooses to install capacity $k^a = m^a(Ea^a) + q^a(Ea^a)$. $m^a(Ea^a)$ and $q^a(Ea^a)$ are the quantities that equate the expected marginal revenue in each market to the cost of capacity installation. Recall that the cost of capacity installation is a sunk cost incurred in the first stage of the game and that the marginal cost of production is zero. As a result, when a negative demand shock occurs, in the second-stage of the game the firm chooses a quantity for each market ($m^a(\underline{a}^a)$ and $q^a(\underline{a}^a)$) such that its capacity constraint binds and the marginal revenue across the two markets is equal and is greater than zero. Although the firm from country A could sell a smaller quantity in the home country's market, earn a higher marginal revenue in the home country's market, and avoid dumping, it will not choose to do this. Any deviation away from dumping and equating marginal revenue across markets will reduce its own market profits more than it increases its profits in the home country's market. Graphically, this implies that imports rise relative to their "normal" level ($m^a(\underline{a}^a) > m(Ea^a)$) and that the price in the home market falls below the long run average total cost of production.

Turning to the home country's government, I next ask: does a country-specific antidumping duty equal to the dumping margin improve the home country's welfare?

Proposition 4 *An antidumping duty equal to the margin of dumping improves the home country's welfare over a policy of free trade.*

Proof: Let τ^{a*} be the optimal, country-specific, rent-shifting tariff as a function of a^a. Under the assumption that demand in the home country is linear, $W(\cdot)$ is monotonically increasing in τ^a for $0 \leq \tau^a < \tau^{a*}$. Direct calculation shows that with τ^{ADi} given by (25) and $\tau^{a*} = \frac{45}{148}(a-\theta)+\frac{17}{37}(Ea^a - a^a)$, it follows that $0 \leq \tau^{ADi} < \tau^{a*}$ for all negative demand shocks in country a ($\underline{s} \leq \underline{a}^a \leq \bar{s}$). QED.

5.3 An Antidumping Duty versus a Voluntary Export Restraint

An important question to ask is: if a foreign firm faces an antidumping duty equal to the margin of dumping, would it prefer to dump and to pay the duty or voluntarily restrict its exports in order to avoid the duty? Interestingly, figure 1 also shows us that for negative demand shocks in the range $\underline{s} \leq \underline{a}^a \leq \bar{s}$, firm a will never voluntarily choose to restrict its imports in order to avoid the antidumping duty. When the firm dumps, although it must pay the extra cost of the tariff, it is able to equate its net marginal revenue across the two markets for an optimal allocation of output. If the firm voluntarily restricts its exports to the level which equates price with long run average cost ($m(ver)$), it ceases to equate marginal revenue in the two markets. Increased profits earned in the home country's market are more than offset by the losses in its own market. Thus, the firm can do better by dumping and paying the duty than it can by voluntarily restricting its exports. This suggests that firms that do choose to voluntarily restrict their exports may do so because they are able to find an outlet for their excess capacity in another market.

6 Conclusion

This paper shows that a capacity-constrained foreign firm will sell its exports at a price below average cost in the event of a negative demand shock in its own market. In response to this, an antidumping duty can improve the importing-country's welfare. Interestingly, the antidumping duty does not completely stem the tide of dumped imports, but it improves the home

country's welfare by shifting some of the dumping firm's rents to the home country. Even when faced with an antidumping duty, a foreign firm that serves more than one market will prefer an antidumping duty over a voluntary export restraint because dumping allows it to earn higher revenues in its own market.

The paper proposes an economic rationale for the US government's practice of imposing antidumping duties against some, but not all countries whose firms have been found guilty of dumping. In imperfectly competitive industries in which firms face capacity constraints, selectively imposing antidumping duties against foreign firms that face weak demand in their own markets will improve the welfare of an importing country.

Appendix A: Proofs

Proofs from section 3

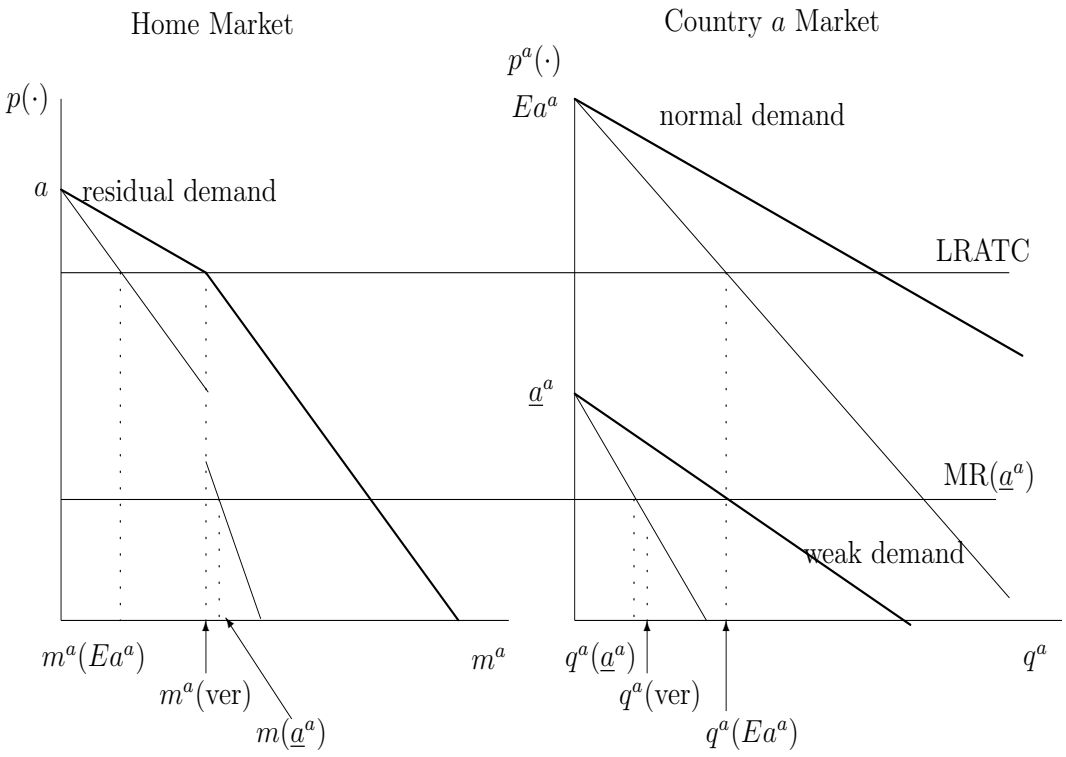
Observation: $q = k$

Proof: Suppose $k = q + \epsilon$. Then $\pi = (a - (q + m^a + m^b))q - \theta(q + \epsilon)$. Then the firm can earn strictly higher profits by choosing a smaller capacity, $k = q$ and not incurring the additional installation cost, $\theta\epsilon$. Thus, installing excess capacity is never a best response and the firm will always choose a capacity level such that the capacity constraint will bind in the second stage of the game.

Observation: $k > a - m^a - m^b - \theta$ **is never a best response for the home firm**

Proof: Suppose $k > a - m^a - m^b - \theta$. Then, in the second stage, for $q = k$ or $q < k$, profits are negative, $\pi < 0$. So the firm could do better by choosing $k = 0$ or $k = a - m^a - m^b - \theta$ because both choices yield zero profits. So $k > a - m^a - m^b - \theta$ is never a best response.

Figure 1: Dumping Under Antidumping Policy



A binding capacity constraint implies:

$k^a = q^a(Ea^a) + m^a(Ea^a)$

$k^a = q^a(\underline{a}^a) + m^a(\underline{a}^a)$

$k^a = q^a(\text{ver}) + m^a(\text{ver})$

where ver=Voluntary Export Restraint

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