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Antidumping Policy Under Imperfect Competition: Theory and Evidence

Meredith A. Crowley

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Meredith A. Crowley*
Federal Reserve Bank of Chicago
mcrowley@frbchi.org

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Abstract

In this paper, I develop and test a model of dumping among imperfectly competitive firms in different countries that face stochastic demand. In the theoretical model, I show that foreign firms dump when they face weak demand in their own markets. I then show that an antidumping duty can improve an importing country's welfare by shifting some of the dumping firm's rents to the home country. I test this model using data on US antidumping cases from 1979 to 1996. Empirically, I find evidence that the US government is more likely to impose protection when demand in foreign countries is relatively weak.

JEL Codes: F12, F13

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1 Introduction

Over the last twenty years, antidumping policy has emerged as a significant trade impediment in the developed world. Between 1980 and 2002, US industries filed 1005 requests for antidumping protection. European industries filed 632 petitions for antidumping protection between 1980 and 1997. While not all petitions result in antidumping duties, their success rate is generally high. In June 2002, the US had 256 antidumping duties in place while the EU had 171. Less transparent outcomes of antidumping investigations, like price undertakings and suspension agreements, constitute an additional barrier to trade. The use of antidumping policy is clearly having an effect on trade in the developed world. Moreover, since the establishment of the WTO in 1995, antidumping policy has been growing in popularity among developing countries: South Africa had 98 antidumping duties in place in June 2002, Mexico had 60 and Brazil had 47.

The 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) that antidumping policy has little or nothing to do with predatory pricing or unfair behavior by foreign firms, economists are still trying to determine the economic purpose of antidumping policy. In this paper, I examine governments' use of antidumping policy in imperfectly competitive markets. In a theoretical model, I show that governments facing stochastic foreign demand can use antidumping policy to improve domestic welfare. In this model with a stochastic export supply, a contingent antidumping duty equal to the margin of dumping improves the importing country's welfare by shifting rents from a foreign firm to the home country. Thus, the first contribution of this paper is that it proposes an economic welfare rationale for antidumping law.

The paper's second contribution is that it empirically analyzes the proposed hypothesis. I test the theory by estimating the US government's decision rule of whether or not to impose antidumping protection. Using data on US antidumping cases filed against 18 industrialized countries between 1979 and 1996, I find support for the hypothesis that importing countries impose antidumping duties when foreign demand is relatively weak.

This paper contributes to the theoretical literature that focuses on dumping in imperfectly competitive markets (Dixit, 1988; Gruenspecht, 1988; Prusa, 1992; Staiger and Wolak, 1992; Reitzes, 1993; and Blonigen and Park, 2001) and the empirical literature that examines the determinants of antidumping protection (Hansen, 1990; Moore, 1992; Baldwin and Steagall, 1994; Staiger and

Wolak, 1994; Hansen and Prusa, 1996, 1997; and Knetter and Prusa, 2003).

The theoretical model follows Ethier (1982) and Staiger and Wolak (1992)[1] by modeling weak foreign demand as the driving force behind dumping. In this paper, a domestic and a foreign firm 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 states of demand in the home and foreign countries, a negative demand shock in the foreign country induces dumping, i.e. an import surge and a price below the average cost of production. I show that the antidumping policy specified in US and GATT law, setting the antidumping duty equal to the margin of dumping, improves the importing country's welfare relative to free trade.

The theoretical model improves on the existing literature by carefully 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 cost.[2] Second, many foreign firms choose to dump when they face antidumping duties rather than raise their prices in order to eliminate the duty.[3] Third, antidumping policy is modeled as a welfare-improving response to dumping[4]. This contrasts with much of the previous literature (Staiger and Wolak, 1992; Reitzes, 1993; Blonigen and Park, forthcoming) which analyzes the introduction of antidumping policy into models in which antidumping duties are neutral or welfare-reducing.

The empirical novelty of this paper is that it examines whether country-specific foreign economic shocks are an important determinant of a government's decision to impose an antidumping duty. In the dataset, there are many instances in which the domestic industry files petitions against multiple countries for the same product on the same day. Because the government often finds some countries guilty of dumping and some innocent in these instances, this variation is a useful source

[1]Ethier (1982) examines dumping induced by stochastic demand in a perfectively competitive market in which the welfare effects of antidumping policy are indeterminate. Staiger and Wolak (1992) model a foreign monopolist selling in an imperfectly 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.

[2]Gruenspecht (1988) utilizes this definition of dumping, but his model can only be applied to industries in which learning-by-doing is important. Reitzes (1993) models dumping as international price discrimination.

[3]Because an exporting firm has the power to reduce or eliminate its own duty by restricting its own exports, many papers (Prusa, 1992; Reitzes, 1993; Blonigen and Park, forthcoming) conclude that an exporting firm will cease dumping to avoid an antidumping duty.

[4]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) and Reitzes (1993) find that antidumping policy can be welfare-improving in dynamic models of imperfect competition. A distinction with my work is that my hypothesis is empirically testable.

of identification of the foreign economic shock. Previous empirical research on the determinants of the outcome in an antidumping case has emphasized political factors (Hansen, 1990; Moore, 1992; Hansen and Prusa, 1997), specific aspects of the legal/bureaucratic institutional framework (Hansen and Prusa, 1996; Blonigen, 2003) or economic factors (Moore, 1992; Baldwin and Steagall, 1994; Staiger and Wolak, 1994; and Knetter and Prusa, 2003). The approach here builds on the previous papers on economic factors and tries to identify if a weakening of foreign demand plays any role in the government's decision. As a policy issue, it is evident that non-economic factors have become prominent in antidumping determinations; this research tries to quantify the contribution of economic factors which we may suppose to be important from a welfare-maximizing perspective.

Knetter and Prusa (2003), which estimates a negative binomial model of the frequency with which domestic firms file antidumping petitions, is unique in this literature in that it examines the importance of foreign economic factors. They find that filings increase when the domestic currency appreciates but that foreign country GDP growth appears unrelated to the number of filings. Knetter and Prusa's methodology differs from mine because their empirical work addresses the question, "what leads domestic firms to seek protection?" whereas my paper focuses on the question, "what leads a domestic government to impose protection?" In my empirical work, I jointly estimate two binary models, a selection equation that models the domestic industry's decision to file a petition and a decision equation for the government. Estimates from my first stage selection equation are consistent with Knetter and Prusa's findings regarding the exchange rate. However, the novel empirical contribution of my paper is that I find that the government is more likely to impose protection when foreign demand is relatively weak.

Section 2 outlines the theoretical model. Section 3 presents the empirical model. Section 4 describes the data. Section 5 presents the empirical results and section 6 concludes.

2 The Model

There are two countries in the world, a foreign exporting country and a domestic importing country (called home).[5] 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 the foreign market is closed. Let q denote the home firm's output, q^* denote the

[5] An earlier working paper version, Crowley, Feb 10, 2003, presents similar results for a three country model.

output that the foreign firm sells in its own market, and M denote imports into the home country from the foreign firm.

Inverse demand in the home country is given by $p(q, M)$ and demand the foreign country is given by $p^*(q^*)$. In order to derive a precise analytic relationship between demand shocks and the antidumping duty, I assume that inverse demand in both countries is linear and stochastic[6], $p(q, M) = a-(q+M)$ and $p^*(q^*) = a^*-q^*$, for the home county and the foreign country, respectively, where a and a^* are iid random variables.[7]

Let k (k^*) denote the home (foreign) firm's capacity. The cost of installing one unit of capacity is $\theta > 0$. Therefore, the total cost of building a plant with capacity k (k^*) is given by $c(k, \theta) = \theta k$ ($c(k^*, \theta) = \theta k^*$). 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.

The timing of the game is as follows.

1. In the first stage, the home firm and the foreign firm simultaneously choose capacities, k and k^*.

   After capacity has been installed, all firms learn the states of demand, a and a^*.

2. In the second stage, the firms simultaneously choose output. The home firm chooses an amount of output to sell on the home market, q, given the realization of demand, a, its level of installed capacity, k, and imports, M. The foreign firm chooses the amount of output it will sell in its own market, q^*, and in the home market, M, given the realization of demand, a^*, its capacity, k^*, and the sales of the home firm, q.

2.1 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^*. The home firm's problem is to maximize total revenue, $TR =$

[6]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.

[7]The demand parameters $a \in \{\bar{a}, Ea, \underline{a}\}$ and $a^* \in \{\bar{a}^*, Ea^*, \underline{a}^*\}$ are discrete symmetric random variables that satisfy the following assumptions: (1) $\underline{a} - \theta > \frac{5}{4}(Ea - \underline{a})$ and (2) $\bar{a} - \theta - \frac{5}{9}(Ea - \theta) < \frac{1}{3}(Ea^* - \underline{a}^*)$. These assumptions guarantee that demand shocks are sufficiently small that no firm holds excess capacity in equilibrium and that a negative shock in the foreign country is sufficiently large to generate dumping.

$p\big(q, M; a\big)q$, with respect to sales, q, subject to $q \leq k$. Taking first order conditions yields the home firm's second-stage best response to its opponent's import-sales for an arbitrary k.

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

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.

The foreign firm's problem is to maximize total revenue, $TR^* = p^*\big(q^*; a^*\big)q^* + p\big(q, M; a\big)M$, with respect to output in its own market, q^*, and in the home country's market, M, subject to the constraint $q^* + M \leq k^*$. Taking first order conditions yields the following best-response functions for the foreign firm for an arbitrary capacity k^*.

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

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

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

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

where

$$\pi(k, k^*; a, a^*) = p(q, M; a)q - \theta k$$

and where $q(\cdot)$ is given by (1) and $M \leq k^*$. 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 $k = a - M$. 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 $k > a - M - \theta$, profits are negative, so a capacity choice in the range of $k \geq a - M$ is never a best response. Thus, I restrict my attention to capacity choices $k < a - M$. Proofs of these observations are in appendix A. Taking the derivative of (4) with respect to k over the range $k < a - M$ and solving yields the home firm's capacity best response to the import-sales choices of the foreign firm.

$$k = \frac{1}{2}(Ea - \theta - E(M)) \tag{5}$$

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

$$k = \frac{1}{2}(Ea^* - \theta) + \frac{1}{2}(Ea - \theta - E(q + M)) \tag{6}$$

Because the cost of capacity installation is strictly positive for all firms ($\theta > 0$) and by the restrictions on $\underline{a}^*$, 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 firm:

$$\begin{aligned} k &= \frac{1}{3}(Ea - \theta) && (7) \\ k^* &= \frac{1}{3}(Ea - \theta) + \frac{1}{2}(Ea^* - \theta) && (8) \end{aligned}$$

Having solved for the second-stage best response functions for each firm as a function of arbitrary capacity levels k and k^*, imposing the equilibrium capacity choices, (7) and (8), yields the subgame perfect equilibrium sales strategies in terms of the underlying cost and demand parameters.

$$\begin{aligned} q &= \frac{1}{3}(Ea - \theta) && (9) \\ M &= \frac{1}{4}(a - \theta) + \frac{1}{12}(Ea - \theta) + \frac{1}{4}(Ea^* - a^*) && (10) \end{aligned}$$

2.2 Dumping under free trade

Proposition 1 *Dumping and Injury. A negative demand shock in the foreign country leads the foreign firm to sell its exports in the home country's market at a "dumped" price which is below its* *long run average cost of production. The margin of dumping, the difference between the long run average cost and the price, increases as demand in the home country weakens and as demand in the foreign country weakens. Further, the sale of dumped goods causes 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 cost of production, i.e., $p(q, M) < LRAC$. Substituting in the equilibrium sales functions of both firms and the per-unit capacity installation cost of θ implies dumping will occur when foreign demand is weak ($a^* = \underline{a}^*$) for any realization of domestic demand, a, if $\underline{a}^*$ satisfies $\bar{a} - \theta - \frac{5}{9}(Ea - \theta) < \frac{1}{3}(Ea^* - \underline{a}^*)$ and a satisfies $a - \theta > \frac{5}{4}(Ea - \underline{a})$. The dumping margin is decreasing in the demand parameters of both countries, $\frac{\partial(LRAC-p)}{\partial a} < 0$ and $\frac{\partial(LRAC-p)}{\partial a^*} < 0$.

Market share for the home firm is the fraction of its sales in its own market $MS = \frac{q}{q+M}$. Taking the derivative of market share with respect to a^* yields $\frac{\partial MS}{\partial a^*} = \frac{4(Ea-\theta)}{[3(a-\theta)+5(Ea-\theta)+3(Ea^*-a^*)]^2} > 0$. Thus, a negative demand shock in the foreign country implies a fall in the home firm's market share.

Finally, $\frac{\partial p}{\partial a^*} > 0$ and, for all $a \in \{\bar{a}, Ea, \underline{a}\}$ and $a^* \in \{\bar{a}^*, Ea^*, \underline{a}^*\}$, 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 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 the foreign firm's long run average cost, the price remains above its marginal cost of production.

Proposition 2 *Dumping and welfare. Dumping by the foreign firm 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 the second-stage ($W = CS(q, M; a, a^*) + TR(q, M; a, a^*)$). Taking the derivative of welfare with respect to the foreign country's demand parameter, a^*, yields $\frac{dW}{da^*} = -1[\frac{1}{4}(a - \theta) + \frac{1}{3}(Ea - \theta) + \frac{1}{4}(Ea^* - a^*)] < 0$ for all negative foreign demand shocks ($a^* < Ea^*$). 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 terms of trade improvement from the perspective of the importing country, it improves welfare.

2.3 An antidumping duty

After capacity has been installed,[8] but before the random variables a and a^* have been realized, the government announces its antidumping policy, τ^{AD}, a country-specific retroactive tariff subject to administrative review.[9] Under US law, if a foreign firm is found (1) to have increased its imports into the home country, (2) to be selling its imports at a price below long-run-average-cost, and (3) to be causing injury to the import-competing firm, it faces the following antidumping duty.

$$\tau^{AD} = \max\{0, LRAC - p(\cdot)\} \tag{11}$$

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 2.1 and the firms will install the equilibrium capacities given by (7) and (8). In the second stage of the game, the home firm's problem is identical to its problem in section 2.1. However, the foreign firm maximizes total revenue less the cost of the antidumping duty, $TR^* = p^*\big(q^*; a^*\big)q^* + p\big(q, M; a\big)M - \tau^{AD}M$, with respect to output in its own market, q^*, and in the home country's market, M, subject to the constraint $q^* + M \leq k^*$. Solving the second-stage best response functions simultaneously yields the home firm's second-stage sales (9) and the foreign firm's equilibrium second-stage sales as a function of the antidumping duty.

$$M = \frac{1}{4}(a - \theta) + \frac{1}{12}(Ea - \theta) + \frac{1}{4}(Ea^* - a^*) - \frac{1}{4}\tau^{AD} \tag{12}$$

[8]In an earlier working paper version, Crowley, Feb 10, 2003, I analyzed the full model with an endogenous capacity choice and obtained qualitatively similar results.

[9]Under US and GATT law, the magnitude of an antidumping duty is equal to the margin of dumping. In the majority of antidumping cases in the US and EU, the margin of dumping used is the difference between the long run average cost of production and the price in the importing country's market. See Clarida, 1996; Macrory, 1989; and Messerlin, 1989. 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 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.

Substituting the equilibrium second-stage sales, (9) and (12), into the definition of the government's antidumping duty (11), yields the following expression for the equilibrium antidumping duty.

$$\tau^{AD} = \max\{0, \frac{1}{5}(Ea^* - a^*) + \frac{1}{3}(Ea - \theta) - \frac{3}{5}(a - \theta)\} \tag{13}$$

The antidumping duty will be positive if the foreign country experiences a sufficiently large negative demand shock (i.e., $\underline{a}^*$ satisfies $\bar{a} - \theta - \frac{5}{9}(Ea - \theta) < \frac{1}{3}(Ea^* - \underline{a}^*)$). Moreover, the magnitude of the antidumping duty increases as demand in the home country weakens. Direct calculation shows that, for all $a \in \{\bar{a}, Ea, \underline{a}\}$, if $a^* = \underline{a}^*$, the profit-maximizing strategy of the foreign firm is to dump. See figure 1 for a graphical explanation of this.

The left graph of figure 1 presents the residual demand curve the foreign firm faces in the importing country's market. The right graph presents the demand the foreign firm 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 foreign firm 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, the foreign firm faces "normal demand" (the bold line beginning at Ea^*) when realized demand takes its expected value and "weak demand" (the bold line beginning at $\underline{a}^*$) when realized demand is low. The thin horizontal line, LRAC, 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 the foreign firm makes its capacity installation decision, it chooses to install capacity $k^* = M(Ea^*) + q^*(Ea^*)$. $M(Ea^*)$ and $q^*(Ea^*)$ 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 ($M(\underline{a}^*)$ and $q^*(\underline{a}^*)$) such that its capacity constraint binds and the marginal revenue across the two markets is equal and is greater than zero. Graphically, this implies that imports rise relative to their "normal" level ($M(\underline{a}^*) > M(Ea^*)$) and that the price in the home market falls below the long run average cost of production.

If a foreign firm faces an antidumping duty equal to the margin of dumping, would it prefer to dump and pay the duty or to voluntarily restrict its exports in order to avoid the duty? Interestingly, figure 1 also shows us that in this model for $a^* = \underline{a}^*$ the foreign firm will not 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. 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. Thus, the firm can do better by dumping and paying the duty than it can by voluntarily restricting its exports.

To conclude this section, I analyze the welfare properties of the antidumping duty that is allowed under US and GATT law.

Proposition 3 *An antidumping duty equal to the margin of dumping improves the home country's welfare over a policy of free trade.*

Proof: Welfare is the sum of consumer's surplus, the home firm's profits, and tariff revenue in the second-stage ($W = CS(q, M, ; a, a^*, \tau) + TR(q, M; a, a^*, \tau) + \tau M$). Let τ^* be the optimal, country-specific, rent-shifting tariff as a function of a^*. Under the assumption that demand in the home country is linear, $W(\cdot)$ is monotonically increasing in τ for $0 \leq \tau < \tau^*$. Direct calculation shows that with τ^{AD} given by (13) and $\tau^* = (Ea - \theta) + 3(a - \theta) + (Ea^* - a^*)$, it follows that $0 \leq \tau^{AD} < \tau^*$. QED.

3 Empirical Model

The theoretical model discussed in the previous section predicts that a welfare-maximizing government will impose an antidumping duty when foreign demand is weak. The empirical model in this section tests the theory by relating the state of demand in an exporting country to the importing country's decision of whether or not to impose protection. In estimating the government's decision rule of whether to impose protection, the empirical model must control for a selection problem that is not part of the theoretical model. The government does not decide whether to impose protection for a random sample of industries. Rather, in every period, an industry[10] chooses whether to

[10] I use the term "industry" to refer to a firm or group of firms that files a petition for antidumping protection. In the US, a petition for protection may be brought on behalf of a firm or group of firms that represent the domestic industry.

apply to the government for antidumping protection. Failing to account for this selection yields inconsistent estimates of the government's decision rule. To consistently estimate the government's decision rule, I follow Van de Ven and Van Praag (1981), and jointly estimate two binary models - a model of industry self-selection into the antidumping process and a model of the government's decision to protect - to obtain consistent estimates of the government's decision equation.

More formally, the empirical model is a two stage process. In the first stage, in every period an industry makes a binary decision to file for protection or not to file. In the second stage, if an industry has filed for protection, the government makes a binary decision to protect or not.

In the second stage, the government's latent measure of injury and dumping d^*_{ijt} is unobserved, but takes the form $d^*_{ijt} = \beta' x_{ijt} + \varepsilon_{ijt}$ where i denotes the industry in which dumping is alleged to occur, j denotes the foreign country accused of dumping, and t denotes the time period in which the complaint is filed. The variables in x_{ijt} are described in detail in the next section. In brief, this vector includes a measure of the state of aggregate demand in both the accused foreign country and in the importing country and lagged measures of injury to the importing country's industry. Although I do not observe the latent measure of injury and dumping, I observe the importing government's decision of whether ($d_{ijt} = 1$) or not ($d_{ijt} = 0$) to impose antidumping protection conditional on an industry filing for protection.

$$d_{ijt} = \begin{cases} 1 & \text{if } d^*_{ijt} > 0 \\ 0 & \text{if } d^*_{ijt} \leq 0 \end{cases} \tag{14}$$

Assuming $\varepsilon_{ijt} \backsim N(0,1)$, then the likelihood for the selected sub-sample is

$$L = \Pi\Big[\Phi(\beta' x_{ijt})\Big]^{d_{ijt}} \Pi\Big[1 - \Phi(\beta' x_{ijt})\Big]^{1-d_{ijt}} \tag{15}$$

where Φ is the standard normal cdf.

An antidumping case is only considered by the government if a domestic industry chooses to file a petition for protection. If an industry's decision to apply for protection and the government's decision to grant protection are correlated, then estimates of β will be inconsistent.

In the first stage, the industry's latent measure of selection, y^*_{ijt}, is unobserved, but takes the form $y^*_{ijt} = \gamma' z_{ijt} + \nu_{ijt}$, where z_{ijt} is a vector of macro variables and industry characteristics that are predetermined at time t, $E(\nu_{ijt}|z_{ijt}) = 0$, and $V(\nu_{ijt}|z_{ijt}) = 1$. Further, the error, ν_{ijt}, is assumed to be uncorrelated across time, but may be correlated across industries.

The industry's decision to petition ($y_{it} = 1$) can be written

$$y_{ijt} = \begin{cases} 1 & \text{if } y^*_{ijt} > 0 \\ 0 & \text{if } y^*_{ijt} \leq 0 \end{cases} \tag{16}$$

Assuming that the errors from stage 1 and 2 are distributed bivariate normal with correlation coefficient ρ , variance 1, and CDF $\Phi(\cdot)$, then the expectation of the government's latent variable in the second stage can be written:

$$E(d^*_{ijt}|x_{ijt}, y^*_{ijt} > 0) = E(\beta' x_{ijt}|x_{ijt}, \nu_{ijt} > -\gamma' z_{ijt}) + \rho \frac{\phi(-\gamma z_{ijt})}{\Phi(\gamma' z_{ijt})} \tag{17}$$

and the government's latent variable is given by:

$$d^*_{ijt} = \beta' x_{ijt} + \rho \frac{\phi(-\gamma z_{ijt})}{\Phi(\gamma' z_{ijt})} + \tilde{\varepsilon}_{ijt} \tag{18}$$

where $E(\tilde{\varepsilon}_{ijt}|y^*_{ijt} > 0) = 0$ and $E(\tilde{\varepsilon}^2_{ijt}|y^*_{ijt} > 0) = 1 - \rho^2 \lambda_{ijt}(-\gamma' z_{ijt} - \lambda_{ijt})$ and where $\lambda_{ijt} = \phi(-\gamma' z_{ijt})/\Phi(\gamma z_{ijt})$.

Renormalizing d^*_{ijt} so that the variance of the censored error, $\tilde{\varepsilon}_{ijt}$, is equal to one, allows us to derive the likelihood for the full model as:

$$L = \Pi \Big[\Phi(\beta' x_{ijt}, \gamma' z_{ijt}, \rho) \Big]^{d_{ijt} y_{ijt}} \Pi \Big[\Phi(-\beta' x_{ijt}, \gamma' z_{ijt}, \rho) \Big]^{(1-d_{ijt}) y_{ijt}} \Pi \Big[\Phi(-\gamma' z_{ijt}) \Big]^{1-y_{ijt}} \tag{19}$$

Coefficient estimates obtained from maximizing the log of the likelihood (19) are reported in tables 2-7.

As a robustness check, I estimate the government's decision rule (14) under the assumption that $\rho = 0$. That is, that the errors from the first and second stage are uncorrelated. These estimates are reported in the first columns of tables 2 through 5.

4 Data

I estimate the empirical model using a panel dataset constructed from three different data sources: (1) the OECD's Main Economic Indicators, (2) the NBER Trade and Manufacturing Databases, and (3) the US Antidumping Database. Summary statistics for all variables in the dataset are reported in Table 1.

The focus of the empirical work is to quantify the role that foreign demand shocks play in the government's decision to impose an antidumping duty. Unfortunately, disaggregated internationally comparable measures of industry output are not readily available. However, data on annual and seasonally adjusted quarterly real GDP is available over the sample period for a number of industrialized countries and serves as a rough proxy for foreign demand.[11] For each country accused of dumping, I calculate the average or trend GDP growth rate from 1978 (or earliest year available for the series, if later) to 2000. I then calculate the deviation from trend growth (actual growth - trend growth) in the foreign country. A negative measure of this variable implies GDP growth (and, by assumption, aggregate demand) in the accused country is below its long run trend; a positive value implies GDP growth is above average. An alternative measure, the change in the growth rate of GDP, was used in some specifications. This measure has the advantage that it doesn't assume that industries and the government can correctly forecast trend GDP growth over long time horizons, but it has the disadvantage that it will have negative values when a country is coming off the peak of the business cycle and positive values when a country is emerging from a recession or slowdown. If antidumping cases are filed and decided when GDP growth is simply weaker than trend, this measure will not yield significant results. To control for the strength of US demand, I calculate the same variables (deviation in trend growth and change in the growth rate) using US GDP growth.

Because the industry data used in the selection equation are only available annually, the GDP measures used in the selection equation are annual deviations from annual trend growth and changes in the annual growth rate. For the government's decision equation, I utilize information on the timing of antidumping petitions and include the quarterly deviation from trend quarterly growth

[11] The lack of high-quality GDP data for developing and non-market economies means that they must be omitted. The final sample of countries includes Australia, Austria, Belgium, Canada, Finland, France, Germany/West Germany, Italy, Japan, Korea, Mexico, Netherlands, New Zealand, Norway, Spain, Sweden, Switzerland, and the United Kingdom.

and the change in quarterly growth rate in the quarter in which the petition was filed. The government typically makes its final decision in antidumping cases two to six months after a petition is filed. Thus, it is reasonable to assume that the government has information about the state of foreign demand in foreign countries at the time of filing when it makes its final decision.

The NBER Trade and Manufacturing Databases provide data on imports, shipments, prices, employment, real capital stock and value added for about 450 manufacturing industries. US manufacturing imports from 1979 to 1994, disaggregated to 1972 4 digit SIC codes, came from the NBER Trade Database, disk 1. This dataset was augmented with manufacturing imports in 1987 4 digit SIC codes for 1995 and 1996 from Schott's "US Multilateral Manufacturing Imports and Exports by SIC4 (1987 revision), 1989 to 2001." All data were concorded to 1987 4 digit SIC codes using the industry concordance provided by the NBER-CES Manufacturing Industry Database. Data on US manufacturing industries from 1979 to 1996 came from the NBER-CES Manufacturing Industry Database. Nominal values of imports and shipments (a measure of domestic output) were deflated to real 1987 dollars using industry specific price indices.

Industry characteristics used to estimate the selection equation include measures that may affect an industry's propensity to file but are thought to be unrelated to the government's injury criteria as well as measures of injury. Some industries may be more likely to file for protection than others. For example, large industries may be better able to assume the large legal fixed cost of filing a petition. Industries in which the level of imports relative to total domestic consumption is high may be more familiar with trade protection policies and thus, more likely to file. The vertical structure of an industry may matter; industries that are further downstream may file more petitions because they are more sensitive to industry price changes. Thus, a measure of industry size, the level of employment; the real import penetration ratio (real imports/(real imports + real domestic shipments)); and a proxy for the vertical structure of an industry, the value-added to output ratio are used to estimate the selection equation. The selection equation also includes three measures of injury which US law suggests should be important to the government's decision; the capacity utilization rate (real shipments/real capital stock), the percent change in the import penetration ratio and the change in employment. Because the current values of industry specific variables and the choice of whether to petition for protection may be endogenous, I use lagged values of these variables in z_{ijt}.

Data on antidumping cases from 1979 through 1995 (TA-731-001 through TA-731-739) come from the US Antidumping Database compiled by Blonigen at the University of Oregon. The US Antidumping Database provides data on all antidumping petitions filed between 1979 and 1995, the date the petition was initiated, the petitioning industry's 4 digit 1987 SIC code, the products involved and the country accused of dumping. This dataset is augmented to include cases through the end of 1996 (through case TA-731-759).[12] The final outcome in an antidumping case is affirmative (a duty is imposed) or negative (a duty is not imposed) in only about 80% of cases. The remaining 20% of cases are "suspended" or "terminated" before the government renders a decision. Previous research (Prusa, 1992; Staiger and Wolak, 1994) shows that suspensions and terminations have a trade-restricting impact similar to an antidumping duty. However, the government doesn't explicitly decide the outcome in these cases. I take two approaches to classifying suspensions and terminations. First, I omit cases that ended in a suspension or termination from the sample used to estimate the full model. Results under this assumption are reported in Tables 2 and 3. Second, I assume that they are identical to antidumping duties and estimate the model under the assumption that $d_{ijt} = 1$ if the outcome is an antidumping duty, a suspension or a termination. These results are reported in Tables 4 and 5.

Lastly, because the steel industry is a particularly prominent user of antidumping duties, I estimate the model separately for steel[13] and non-steel industries. Results for these two sub samples of the data are reported in Table 6 and 7.

5 Empirical Results

Tables 2, 4 and 6 report the estimates of the parameters in the model of the government's decision under industry self-selection, β, γ and ρ.[14] Overall, I find support for the hypothesis that the US government is more likely to impose protection when foreign demand is weak.

Estimates reported in table 2 utilize a sample that defines the binary dependent variable as affirmative (antidumping duty) and negative (no duty). Estimates in table 4 utilize a sample that includes observations on suspension and termination agreements and defines the binary dependent

[12] I am indebted to Tom Prusa for providing data on the more recent antidumping cases and to Chad Bown for providing the corresponding 1987 4 digit SIC codes.

[13] Steel industries are defined as the following 4 digit 1987 SIC categories: 3312, 3313, 3315, 3316, 3317, 3321, 3322, 3324, 3325, and 3399.

[14] Because the error may be correlated across industries or countries, I report robust standard errors clustered on industry-country groups.

variables as protection (duty, suspension or termination) and no protection (no duty). As coefficient estimates from binary models are difficult to interpret directly, tables 3, 5, and 7 report the marginal effects of a one-unit increase in a covariate on the probability of protection for tables 2, 4, and 6 respectively. In table A1, I presents some statistics on the predictive power of the model.

In table 3, the top panel reports the marginal effect of a one-unit increase in a covariate on the probability of an affirmative government decision to impose an antidumping duty given that a petition for protection has been filed. The bottom panel of table 3 reports the marginal effect of a one-unit increase in a covariate on the probability of filing a petition. For example, in column 2, the coefficients on the foreign GDP growth variables can be interpreted as: a one unit increase in GDP growth in a foreign country above trend increases the probability that the domestic industry will file a petition against that country by slightly more than 1 percentage point. Given that a petition has been filed against that country, a one-unit increase in foreign GDP growth above trend reduces the probability that the government will impose an antidumping duty by about 5.5 percentage points. Thus, having a weaker economy seems to reduce the probability that a country will face an antidumping investigation but, for those countries that are subject to investigations, having a weaker economy increases the probability that imports from that country will face American trade protection. The result with regard to the decision to file a petition and the strength of foreign demand is a little surprising. In their work on the rate of filing of antidumping petitions, Knetter and Prusa (2003) found no relationship between foreign GDP growth and the filing rate. One way to interpret my results is to argue that domestic industries may make their decision to file primarily on industry-specific measures of performance and injury and, consequently, file petitions somewhat indiscriminately against all major exporters of their product. In the second stage in which the government makes its decision, the government may consider the state of foreign demand relevant. This could help to explain why the government often splits its decision and finds some countries guilty of dumping and others innocent when multiple petitions are filed against numerous countries for the same product on the same day.

Overall, the bottom panel of table 3 indicates that a petition for protection is more likely when foreign demand is relatively strong, domestic demand is relatively weak, import penetration is high, capacity utilization is low, the level of employment in the industry is high, the ratio of value added to output is low, employment is falling, and the dollar is strong. While these economic variables are all significant determinants of filing, they are able to explain only a small part of the decision to file. In terms of magnitudes, a one standard deviation change to each of these variables has only a small effect on the probability of a petition being filed. Using the coefficients in column 2, a one standard deviation increase in foreign GDP growth increases the probability of protection by 0.02 percentage points, a one s.d. decrease in US GDP growth increases the probability of protection by 0.01 percentage points, a one s.d. increase in the level of import penetration increases the probability of protection by 0.02 percentage points, a one s.d. fall in the capacity utilization rate increases the probability of protection by 0.2 percentage points, a one s.d. fall in the level of employment increases the probability of protection by 0.06 percentage points, a one s.d. fall in the value added to output ratio increases the probability of protection by 0.05 percentage points, a one s.d. fall in the change in employment increases the probability of protection by 0.01 percentage points, and a one s.d. appreciation of the dollar increases the probability of protection by 0.01 percentage points.

The top panel of table three indicates that while the statutory measures of injury are important determinants of who files for protection, they do not have any additional impact on the government's decision to protect. The coefficient estimates on these variables are not significantly different from zero. Interestingly, among those cases that have been filed, the government is more likely to grant protection when growth in the foreign country is relatively weak and growth in the US is relatively strong. It appears that the government is punishing countries who are trying to export their weakness to the US and is willing to assist industries that are doing poorly when the overall US economy is relatively strong. As in the selection equation, while the GDP growth variables are significant determinants of the government's decision in antidumping cases, they are able to explain only a small fraction of the total variability in the dependent variable. A one s.d. fall in foreign GDP growth increases the probability of an antidumping duty by 0.05 percentage points and a one s.d. increase in US GDP growth increase the probability of protection by 0.06 percentage points. Lastly, inclusion of a country dummy for Japan improves the fit of the model. This is consistent with previous research (Moore, 1992; Hansen and Prusa, 1996, 1997) that looks at the political bias against certain countries in US antidumping cases.

As a final point, a χ^2 test on the statistical significance of ρ, the correlation between ε_{ijt} and ν_{ijt}, cannot reject the hypothesis that $\rho = 0$. Although the macroeconomic environment and industry characteristics matter in determining who files for protection, controlling for selection doesn't substantively alter the coefficients of the government's decision rule.

The results in table 5, which uses the binary dependent variable of protection (antidumping duty, suspension, or termination) and no protection (no duty), are qualitatively similar to those in table 3. However, when the binary dependent variable includes suspended and terminated cases, the coefficient on deviations in US GDP growth is no longer statistically significant in the government's decision equation. Further, one measure of injury, the capacity utilization rate, is statistically significant. When suspended and terminated cases are included, is seems that among those industries with relatively low capacity utilization that have filed for protection, the government is more likely to protect the relatively healthy industries with higher capacity utilization rates. Given that an industry has filed for protection, a one s.d. increase in capacity utilization increases the probability of protection by 0.08 percentage points.

Table 6 reports separate estimates for steel and non-steel industries. Table 7, which reports marginal effects for these estimates, shows that the probability of protection for non-steel industries increases as foreign demand weakens. However, for steel industries, the coefficient on the state of foreign demand is not statistically significantly different from zero.

In closing, I do not report estimates that utilize the alternative measure of the state of foreign demand, the change in the growth rate. In all specifications that used this alternative measure, the coefficient estimate on the change in the growth rate of foreign GDP was not statistically significant from zero.

6 Conclusion

This paper has shown 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 welfare through 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.

To test the hypothesis that importing countries impose antidumping duties on dumped imports caused by weak foreign demand, I examined US antidumping cases from 1979-1996. I found evidence that the US government is more likely to impose antidumping protection when foreign GDP growth is relatively weak.

While this paper demonstrates that antidumping duties could improve the welfare of an importing country, it remains a puzzle why the GATT permits the use of these import restraints. Although antidumping policy can improve the welfare of the importing country, in a symmetric model the use of antidumping duties by both countries would reduce worldwide welfare.

Appendix A: Characterization of the Subgame Perfect Nash Equilibrium

Proofs used in solving for the first stage capacity

Observation: $q = k$

Proof: Suppose $k = q + \epsilon$. Then $\pi = (a - (q + M))q - \theta(q + \epsilon)$. 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: $k > a - M - \theta$ **is never a best response for the home firm**

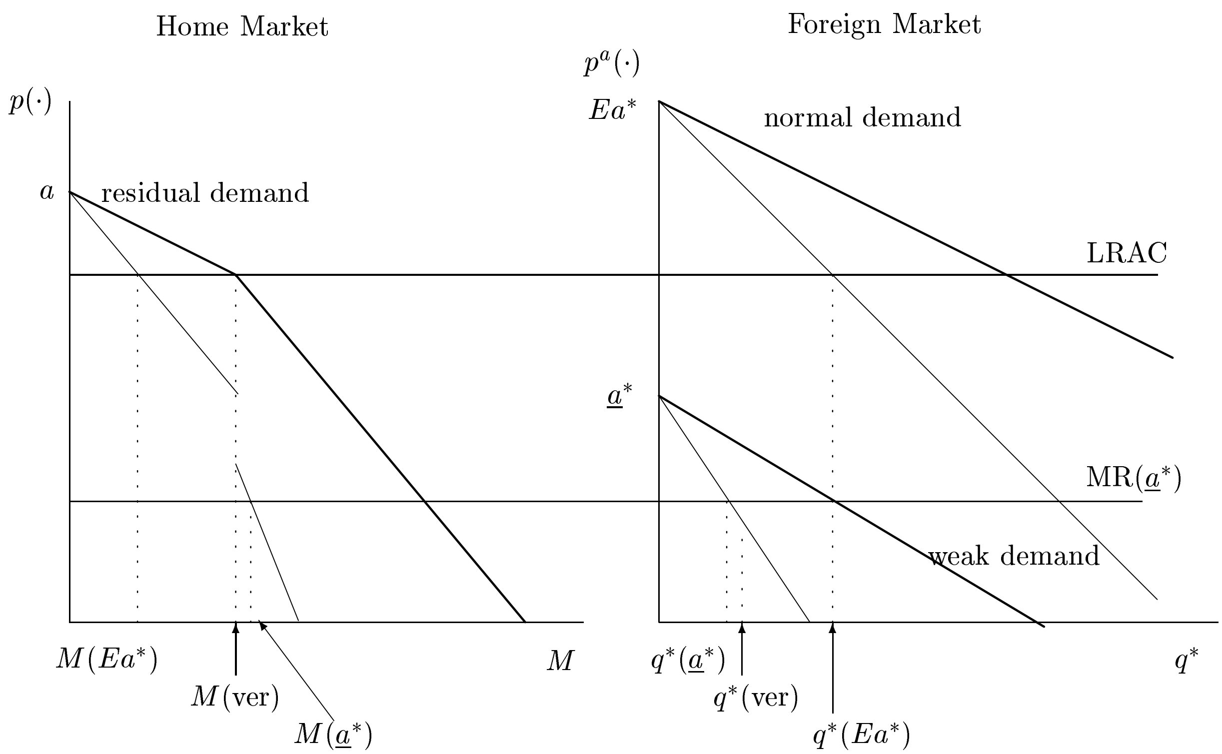
Proof: Suppose $k > a - M - \theta$. Then, in the second stage, for $q = k$ or $q < k$, profits are negative, $\pi < 0$. So the firm could do better by choosing $k = 0$ or $k = a - M - \theta$ because both choices yield zero profits. So $k > a - M - \theta$ is never a best response.

Appendix B: Predictive power of the model

Table A1 provides statistics on the model's performance. The four columns correspond to four different specifications. Columns 1 and 2 are identical except that column 2 omits all covariates related to domestic and foreign GDP growth. Similarly, columns 3 and 4 are identical with the exception that column 4 omits variables related to GDP growth.

Overall, the predictive power of the model is a modestly better than a random coin toss. This is not surprising as the predictive power of binary models is generally weak when there are a large number of zeros in the dependent variable. In this dataset, there are a large number of responses of "don't file" (or zero) in the selection equation. Interestingly, the diagnostics in this table do demonstrate that the inclusion of domestic and foreign GDP data does improve the model's predictive power quite substantially. When these data are included, the model correctly predicts the outcome in 59-61% of cases. When these variables are omitted, the model's predictions are correct only 53% of the time.

Figure 1: Dumping under antidumping policy



A binding capacity constraint implies:

$k^* = q^*(Ea^*) + M(Ea^*)$

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

$k^* = q^*(\text{ver}) + M(\text{ver})$

where ver=Voluntary Export Restraint

Table 1: Summary Statistics - Means and Standard Deviations

Prob(duty=1)	.564
	(.496)
Prob(protection=1)	.472
	(.500)
Dev. Quart. For GDP growth_t	-.0009
	(.0089)
Dev. Quart. US GDP growth_t	-.0023
	(.0096)
Δ employment_{t-1}	-.219
	(4.78)
% Δ import pen_{t-1}	.164
	(2.77)
capacity utilization_{t-1}	2.69
	(1.60)
Japan dummy	.051
	(.221)
$\ln(\text{exrate})_t$	-1.68
	(2.65)
Dev. Ann. For GDP growth_t	-.0008
	(.0208)
Dev. Ann. US GDP growth_t	-.0023
	(.0197)
import penetration_{t-1}	.124
	(.141)
employment_{t-1}	39.25
	(53.93)
val_add / output_{t-1}	.496
	(.127)
Dev. Mean exchange rate_t	.020
	(.422)
Total obs.	134112

Table 2: Maximum Likelihood Coefficient Estimates for AD duty or No duty

Decision equation: 1=Ad duty, 0=no duty				
Dev. Quart. For GDP growth$_t$	-14.09*	-14.36*	-14.28*	-12.72
	(8.25)	(8.26)	(8.10)	(8.02)
Dev. Quart. US GDP growth$_t$	16.61**	17.84**	15.14*	13.98
	(8.36)	(8.88)	(8.98)	(8.98)
Δ employment$_{t-1}$	-.00109	-.00314	-.00366	-.00425
	(.00631)	(.00780)	(.00774)	(.00775)
% Δ import pen$_{t-1}$	.343	.392	.344	.314
	(.427)	(.424)	(.423)	(.416)
capacity utilization$_{t-1}$	.096	.081	.045	.028
	(.092)	(.141)	(.140)	(.136)
Japan dummy	.340*	.627**	.383*	
	(.218)	(.178)	(.220)	
ln(exrate)$_t$	-.057*		-.059*	-.095***
	(.033)		(.033)	(.026)
Constant	-.422***	-.577	-.734	-.841
	(.164)	(.616)	(.619)	(.605)
Selection equation: 1=industry petitions, 0= no petition				
Dev. Ann. For GDP growth$_t$	-	2.95***	2.88***	2.91***
	-	(.62)	(.62)	(.63)
Dev. Ann. US GDP growth$_t$	-	-1.96**	-1.95***	-1.95**
	-	(.96)	(.96)	(.96)
import penetration$_{t-1}$	-	.494***	.495***	.497***
	-	(.084)	(.084)	(.084)
capacity utilization$_{t-1}$	-	-.365***	-.366***	-.366***
	-	(.034)	(.034)	(.034)
employment$_{t-1}$	-	.0029***	.0029***	.0029***
	-	(.0002)	(.0002)	(.0002)
val_add / output$_{t-1}$	-	-1.02***	-1.02***	-1.02***
	-	(.13)	(.14)	(.14)
Δ employment$_{t-1}$	-	-.0075***	-.0075***	-.0075***
	-	(.0012)	(.0012)	(.0012)
% Δ import pen$_{t-1}$	-	-.039	-.039	-.040
	-	(.025)	(.025)	(.025)
Dev. Mean exchange rate$_t$	-	-.070*	-.074*	-.075*
	-	(.040)	(.040)	(.041)
constant	-	-1.78***	-1.79***	-1.79***
	-	(.09)	(.09)	(.09)
$\rho = corr(\varepsilon_{ijt}, \nu_{ijt})$	-	.078	.135	.189
	-	(.264)	(.266)	(.260)
log likelihood				
full model	-221.88	-2286.00	-2278.23	-2279.77
Total obs.	341	134039	134039	134039
Robust Standard Errors in Parentheses				

*** stat signif at the 1% level, ** stat signif at the 5% level, * stat signif at the 10% level

Table 3: Marginal Effects for AD duty or No duty

Decision equation: 1=Ad duty, 0=no duty				
Dev. Quart. For GDP growth$_t$	-5.60*	-5.49*	-5.15*	-4.25
	(3.29)	(3.16)	(2.92)	(2.68)
Dev. Quart. US GDP growth$_t$	6.61**	6.82**	5.47*	4.67
	(3.33)	(3.40)	(3.24)	(3.00)
Δ employment$_{t-1}$	-.00044	-.00120	-.00132	-.00142
	(.00251)	(.00298)	(.00280)	(.00259)
% Δ import pen$_{t-1}$	.136	.150	.124	.105
	(.170)	(.162)	(.153)	(.139)
capacity utilization$_{t-1}$	.038	.031	.016	.010
	(.037)	(.054)	(.051)	(.046)
Japan dummy	.158*	.240**	.138*	
	(.085)	(.068)	(.079)	
ln(exrate)$_t$	-.023*		-.021*	-.032***
	(.013)		(.012)	(.009)
Constant	-.168	-.220	-.265	-.281
	(.065)	(.236)	(.224)	(.202)
Selection equation: 1=industry petitions, 0= no petition				
Dev. Ann. For GDP growth$_t$	-	1.13***	1.04***	.97***
	-	(.24)	(.23)	(.21)
Dev. Ann. US GDP growth$_t$	-	-.75**	-.70***	-.65**
	-	(.37)	(.35)	(.32)
import penetration$_{t-1}$	-	.189***	.179***	.166***
	-	(.032)	(.030)	(.028)
capacity utilization$_{t-1}$	-	-.140***	-.132***	-.122***
	-	(.013)	(.012)	(.011)
employment$_{t-1}$	-	.0011***	.0010***	.0010***
	-	(.0001)	(.0001)	(.0001)
val_add / output$_{t-1}$	-	-.39***	-.37***	-.34***
	-	(.05)	(.05)	(.05)
Δ employment$_{t-1}$	-	-.0029***	-.0027***	-.0025***
	-	(.0004)	(.0004)	(.0004)
% Δ import pen$_{t-1}$	-	-.015	-.014	-.013
	-	(.010)	(.009)	(.008)
Dev. Mean exchange rate$_t$	-	-.027*	-.027*	-.025*
	-	(.015)	(.014)	(.014)
constant	-	-.68***	-.65***	-.60***
	-	(.03)	(.03)	(.03)
$\rho = corr(\varepsilon_{ijt}, \nu_{ijt})$	-	.078	.135	.189
	-	(.264)	(.266)	(.260)
log likelihood				
full model	-221.88	-2286.00	-2278.23	-2279.77
Total obs.	341	134039	134039	134039
Robust Standard Errors in Parentheses				

*** stat signif at the 1% level, ** stat signif at the 5% level, * stat signif at the 10% level

Table 4: Maximum Likelihood Coefficient Estimates for All Protective Outcomes

Decision equation: 1=protection, 0=no protection				
Dev. Quart. For GDP growth$_t$	-16.10**	-13.06*	-13.08*	-11.88
	(7.71)	(7.42)	(7.48)	(7.54)
Dev. Quart. US GDP growth$_t$	-3.01	7.37	5.89	5.29
	(7.01)	(7.32)	(7.53)	(7.58)
Δ employment$_{t-1}$	-.01162**	-.00243	-.00287	-.00293
	(.00506)	(.00552)	(.00561)	(.00567)
% Δ import pen$_{t-1}$	.267	.226	.207	.189
	(.371)	(.339)	(.342)	(.343)
capacity utilization$_{t-1}$	.083	.256**	.245**	.241
	(.090)	(.119)	(.121)	(.120)
Japan dummy	.338	.478***	.343*	
	(.212)	(.161)	(.197)	
ln(exrate)$_t$	-.039		-.033	-.066***
	(.031)		(.029)	(.025)
Constant	-.186	.738**	.696**	.672*
	(.158)	(.355)	(.360)	(.363)
Selection equation: 1=industry petitions, 0= no petition				
Dev. Ann. For GDP growth$_t$	-	2.84***	2.72***	2.66***
	-	(.59)	(.59)	(.60)
Dev. Ann. US GDP growth$_t$	-	-2.52**	-2.49***	-2.46***
	-	(.89)	(.89)	(.89)
import penetration$_{t-1}$	-	.576***	.576***	.577***
	-	(.079)	(.079)	(.079)
capacity utilization$_{t-1}$	-	-.390***	-.391***	-.391***
	-	(.0324)	(.032)	(.032)
employment$_{t-1}$	-	.0034***	.0034***	.0034***
	-	(.0001)	(.0001)	(.0001)
val_add / output$_{t-1}$	-	-1.18***	-1.18***	-1.18***
	-	(.13)	(.13)	(.13)
Δ employment$_{t-1}$	-	-.0087***	-.0087***	-.0087***
	-	(.0012)	(.0012)	(.0012)
% Δ import pen$_{t-1}$	-	-.042*	-.043	-.042
	-	(.027)	(.027)	(.027)
Dev. Mean exchange rate$_t$	-	-.103**	-.106**	-.106**
	-	(.047)	(.047)	(.047)
constant	-	-1.65***	-1.65***	-1.65***
	-	(.08)	(.08)	(.08)
$\rho = corr(\varepsilon_{ijt}, \nu_{ijt})$	-	-.413	-.402	-.385
	-	(.157)	(.158)	(.159)
log likelihood				
full model	-272.21	-2578.22	-2571.11	-2572.67
Total obs.	412	134112	134111	134111
Robust Standard Errors in Parentheses				

*** stat signif at the 1% level, ** stat signif at the 5% level, * stat signif at the 10% level

Table 5: Marginal Effects for All Protective Outcomes

Decision equation: 1=protection, 0=no protection				
Dev. Quart. For GDP growth$_t$	-6.33**	-2.45*	-2.53*	-2.41
	(3.03)	(1.39)	(1.45)	(1.54)
Dev. Quart. US GDP growth$_t$	-1.18	1.38	1.14	1.08
	(2.75)	(1.37)	(1.46)	(1.54)
Δ employment$_{t-1}$	-.00456**	-.00046	-.00055	-.00060
	(.00199)	(.00104)	(.00108)	(.00115)
% Δ import pen$_{t-1}$	.105	.042	.040	.039
	(.146)	(.064)	(.066)	(.070)
capacity utilization$_{t-1}$	.033	.048**	.047**	.049
	(.036)	(.022)	(.023)	(.025)
Japan dummy	.129	.090***	.066*	
	(.078)	(.030)	(.038)	
ln(exrate)$_t$	-.015		-.006	-.013***
	(.012)		(.006)	(.005)
Constant	-.073	.138**	.134**	.137*
	(.062)	(.067)	(.070)	(.074)
Selection equation: 1=industry petitions, 0= no petition				
Dev. Ann. For GDP growth$_t$	-	.532***	.526***	.542***
	-	(.111)	(.115)	(.121)
Dev. Ann. US GDP growth$_t$	-	-.473**	-.480***	-.501***
	-	(.167)	(.173)	(.181)
import penetration$_{t-1}$	-	.108***	.111***	.117***
	-	(.015)	(.015)	(.016)
capacity utilization$_{t-1}$	-	-.073***	-.076***	-.080***
	-	(.0060)	(.006)	(.007)
employment$_{t-1}$	-	.0006***	.0007***	.0007***
	-	(.0000)	(.0000)	(.0000)
val_add / output$_{t-1}$	-	-.222***	-.228***	-.240***
	-	(.024)	(.025)	(.026)
Δ employment$_{t-1}$	-	-.0016***	-.0017***	-.0018***
	-	(.0002)	(.0002)	(.0002)
% Δ import pen$_{t-1}$	-	-.008*	-.008	-.009
	-	(.005)	(.005)	(.005)
Dev. Mean exchange rate$_t$	-	-.019**	-.021**	-.021**
	-	(.009)	(.009)	(.010)
constant	-	-.311***	-.320***	-.337***
	-	(.016)	(.016)	(.017)
$\rho = corr(\varepsilon_{ijt}, \nu_{ijt})$	-	-.413	-.402	-.385
	-	(.157)	(.158)	(.159)
log likelihood				
full model	-272.21	-2578.22	-2571.11	-2572.67
Total obs.	412	134112	134111	134111
Robust Standard Errors in Parentheses				

*** stat signif at the 1% level, ** stat signif at the 5% level, * stat signif at the 10% level

Table 6: Max Likelihood Coefficient Estimates for Steel and Non-steel Industries

	Non-steel Industries		Steel Industries	
Decision equation dep var:	duty=1	protect=1	duty=1	protect=1
Dev. Quart. For GDP growth$_t$	-17.12*	-18.62**	-20.21	-9.43
	(9.21)	(8.96)	(18.93)	(15.54)
Dev. Quart. US GDP growth$_t$	11.12	12.48	39.20**	3.41
	(11.53)	(10.92)	(18.67)	(13.37)
Δ employment$_{t-1}$	-.040*	-.007	-.021	-.017***
	(.023)	(.010)	(.014)	(.007)
% Δ import pen$_{t-1}$	.646	.354	.560	-.342
	(.507)	(.434)	(1.210)	(.681)
capacity utilization$_{t-1}$	.041	.131	.749*	.854***
	(.203)	(.162)	(.427)	(.278)
Japan dummy	.846	.727***	.093	-.181
	(.204)	(.209)	(.399)	(.366)
Constant	-.230	.394	-1.324**	-.108
	(1.94)	(1.452)	(.618)	(.500)
Selection Equation:	1=industry petitions, 0= no petition			
Dev. Ann. For GDP growth$_t$	3.29***	3.26***	1.93	.718
	(.69)	(.64)	(1.92)	(1.836)
Dev. Ann. US GDP growth$_t$	-.68	-.62	-5.98***	-5.87***
	(1.11)	(1.04)	(2.36)	(1.98)
import penetration$_{t-1}$	.360***	.421***	-4.29***	-4.23***
	(.107)	(.098)	(.55)	(.53)
capacity utilization$_{t-1}$	-.293***	-.291***	-.557***	-.528***
	(.033)	(.031)	(.131)	(.120)
employment$_{t-1}$	.0017***	.0019***	.0028***	.0037***
	(.0002)	(.0002)	(.0003)	(.0003)
val_add / output$_{t-1}$	-.324**	-.341**	-8.26***	-8.55***
	(.160)	(.152)	(.72)	(.70)
Δ employment$_{t-1}$	-.0047*	-.0053*	.0075***	.0056***
	(.0027)	(.0029)	(.0027)	(.0025)
% Δ import pen$_{t-1}$	-.051	-.063*	.270**	-.205
	(.032)	(.037)	(.132)	(.147)
Dev. Mean exchange rate$_t$	-.060	-.093**	-.120	-.124
	(.044)	(.048)	(.106)	(.121)
constant	-2.27***	-2.26***	2.76***	2.82***
	(.11)	(.101)	(.51)	(.48)
$\rho = corr(\varepsilon_{ijt}, \nu_{ijt})$	-.057	-.260	.220	-.349
	(.728)	(.541)	(.474)	(.331)
log likelihood				
full model	-1769.78	-1931.70	-383.49	-468.16
Total obs.	131167	131192	2873	2920
Robust Standard Errors in Parentheses				

*** stat signif at the 1% level, ** stat signif at the 5% level, * stat signif at the 10% level

Table 7: Marginal Effects for Steel and Non-steel Industries

	Non-steel Industries		Steel Industries	
Decision equation dep var:	duty=1	protect=1	duty=1	protect=1
Dev. Quart. For GDP growth$_t$	-6.83*	-5.40**	-7.48	-2.36
	(3.67)	(2.60)	(7.01)	(4.00)
Dev. Quart. US GDP growth$_t$	4.44	3.62	14.51**	.97
	(4.60)	(3.17)	(6.91)	(3.47)
Δ employment$_{t-1}$	.016*	.002	-.008	-.004***
	(.009)	(.003)	(.005)	(.002)
% Δ import pen$_{t-1}$	.258	.103	.207	-.085
	(.202)	(.126)	(.448)	(.173)
capacity utilization$_{t-1}$	.016	.038	.277*	.221***
	(.081)	(.047)	(.158)	(.072)
Japan dummy	.338	.211***	.034	-.048
	(.081)	(.061)	(.148)	(.093)
Constant	-.092	.114	-.490**	-.025
	(.777)	(.421)	(.229)	(.128)
Selection Equation:	1=industry petitions, 0= no petition			
Dev. Ann. For GDP growth$_t$	1.31***	.95***	.72	-.24
	(.27)	(.19)	(.71)	(.54)
Dev. Ann. US GDP growth$_t$	-.27	-.18	-2.21***	-1.36***
	(.45)	(.30)	(.87)	(.53)
import penetration$_{t-1}$	.144***	.122***	-1.59***	-1.06***
	(.043)	(.029)	(.21)	(.13)
capacity utilization$_{t-1}$	-.117***	-.084***	-.206***	-.133***
	(.013)	(.009)	(.049)	(.031)
employment$_{t-1}$	.0007***	.0005***	.0010***	.0010***
	(.0001)	(.0001)	(.0001)	(.0001)
val_add / output$_{t-1}$	-.129**	-.099**	-3.06***	-2.17***
	(.064)	(.044)	(.27)	(.18)
Δ employment$_{t-1}$	-.0019*	-.0015*	.0028***	.0015***
	(.0011)	(.0008)	(.0010)	(.0006)
% Δ import pen$_{t-1}$	-.020	-.018*	.100**	.053
	(.013)	(.011)	(.049)	(.038)
Dev. Mean exchange rate$_t$	-.024	-.027**	-.044	-.032
	(.018)	(.014)	(.039)	(.031)
constant	-.91***	-.66***	1.02***	.66***
	(.04)	(.03)	(.19)	(.12)
$\rho = corr(\varepsilon_{ijt}, \nu_{ijt})$	-.057	-.260	.220	-.349
	(.728)	(.541)	(.474)	(.331)
log likelihood				
full model	-1769.78	-1931.70	-383.49	-468.16
Total obs.	131167	131192	2873	2920
Robust Standard Errors in Parentheses				

*** stat signif at the 1% level, ** stat signif at the 5% level, * stat signif at the 10% level

Table A1: Predictive power of the empirical model

Decision equation: 1=Ad duty, 0=no duty				
Dev. Quart. For GDP growth$_t$	yes	no	yes	no
Dev. Quart. US GDP growth$_t$	yes	no	yes	no
Industry injury characteristics*	yes	yes	yes	yes
Japan dummy	yes	yes	yes	yes
ln(exrate)$_t$	no	no	yes	yes
# of censored obs.	341	341	341	341
Selection equation: 1=industry petitions, 0= no petition				
Dev. Ann. For GDP growth$_t$	yes	no	yes	no
Dev. Ann. US GDP growth$_t$	yes	no	yes	no
Industry characteristics**	yes	yes	yes	yes
Dev. Mean exchange rate$_t$	yes	yes	yes	yes
Total obs.	134039	134039	134039	134039
log likelihood full model	-2286.00	2299.90	-2278.23	-2291.23
# of obs. for AD duty in data	161	161	161	161
# of obs. for no duty in data	180	180	180	180
# of obs. for AD duty correctly predicted by model	50	2	65	5
# of obs. for no duty correctly predicted by model	152	180	143	177
% of obs (AD duty and no duty) correctly predicted by model	59.24	53.37	61.176	53.53

*Industry injury characteristics = Δ employment$_{t-1}$, % Δ import pen$_{t-1}$, and capacity utilization$_{t-1}$

** Industry characteristics =import penetration$_{t-1}$, capacity utilization$_{t-1}$, employment$_{t-1}$, val_add / output$_{t-1}$, Δ employment$_{t-1}$, and % Δ import pen$_{t-1}$

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