

Free Riders Among the Rent-Seekers: A Model of Firm Participation in Antidumping Petitions

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Abstract

This research expands upon the current literature on the political economy of trade policy by developing and estimating a model of rent-seeking in the presence of free riding incentives. Specifically, a model of firm participation in antidumping petitions is estimated using a panel of petition filings and outcomes between 1980 and 1996. The empirical results support conclusions from previous theoretical studies of the free rider problem in collective actions that larger (those with more firms) and more concentrated industries have a harder time overcoming the free rider problem. The results also confirm the common belief that the level of trade protection awarded to industries is significantly influenced by political factors, including the number of firms that choose to participate in a petition for protection. After estimating the parameters of the model, I simulate the impact of changes in antidumping law on the level of protection in the United States.

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1 Introduction

Trade protection differs from other forms of rent-seeking in that all firms within an industry benefit from the imposition of a tariff but only those firms that lobby for protection have to bear the costs, thus resulting in a free rider problem. Despite the explosion of theoretical research on the political economy of trade protection, the difficulty of finding reliable data has made it hard to test most of these theories empirically. As a result, we are not much closer to showing why some industries overcome the free rider problem to be awarded trade protection at a significant cost to the economy as a whole, while others choose not to lobby for protection. This paper develops and estimates a model of the firm decision to participate in lobbying efforts in an attempt to study this very issue.

Data on U.S. antidumping petition filings provide a unique opportunity to empirically test the phenomenon of free riding in rent-seeking activities and, more specifically, how this phenomenon effects the level of trade protection in an economy. Any group of firms or workers can file a petition requesting that antidumping tariffs be imposed on specific products from specific foreign countries. The petition asserts that these products are being imported at less than “normal” or “fair” value, and are causing or threaten to cause injury to the domestic industry.¹ If the petition is approved, the government imposes a tariff, or antidumping duty, on the products in question. The petition may fail to reach a final government determination if the foreign and domestic industry negotiate an “out-of-court” settlement agreement that benefits both parties.²

¹“Normal” value is defined as either the price in the foreign country or the average cost in the foreign country. Thus, antidumping law is intended to combat both predatory pricing and price discrimination. It should be noted, however, that a growing body of literature challenges the government’s assertion that antidumping laws combat unfair trade, suggesting that the decision to file an antidumping petition is purely a rent-seeking activity.

²Between 1980 and 1996, approximately 20 percent of all antidumping petitions were either terminated or suspended prior to the government reaching a final determination. Suspended cases are those in which the government negotiates an outcome with the foreign industry to increase its price or reduce its exports in exchange for the petition being withdrawn. Terminated petitions are those that are withdrawn without a government-sanctioned agreement. There is strong evidence that the foreign and domestic industry are

Although other papers have studied an industry's propensity to file for antidumping protection, this research is unique in its direct empirical estimation of a model of rent-seeking by firms and its focus on the free riding phenomenon.³ This is also the first research that empirically studies the ability of an industry to reach a settlement agreement with their foreign competitors.⁴ The empirical results demonstrate the extent to which free riding hampers bargaining in collective actions. Unlike other studies of antidumping protection, the structural model estimated here can be used to conduct counterfactual experiments to determine how changes in antidumping law will effect the level of protection in the United States.

The model presented below assumes that the expected benefits of filing an antidumping petition, which accrue to all firms within an industry, include both the change in profits that result from the government imposing a tariff and those that result from the domestic industry reaching a settlement agreement with the foreign industry. Only those firms that participate in the petition pay the significant legal costs associated with filing the petition, therefore firms are tempted to free ride off of other firms in the industry. Firms choose to participate in the petition only because the expected amount of protection increases as the number of firms participating increases.

The model is estimated using Maximum Simulated Likelihood (MSL) with a panel of antidumping petitions filed between 1980 and 1996. Simulation techniques are used to allow for unobserved heterogeneity across industries and countries, and to address data challenges that arise in the structure of the model. Following estimation, the parameters of the model are used to predict the effect of changes in antidumping law on the level of trade protection in the United States.

reaching an unofficial agreement in the case of terminated petitions. Throughout the course of this research, I treat both suspended and terminated petitions as those that are "settled."

³Research that studies an industry's propensity to file antidumping petitions include Krupp [1994], Staiger and Wolak [1994], Sabry [2000], Feinberg and Hirsch [1989] and Herander and Pupp [1991].

⁴Staiger and Wolak [1994] compare the returns from a settled petition versus one which reaches a final government determination, but they do not study which industries are more likely to reach a settlement agreement.

The empirical results confirm that larger (those with more firms) and more concentrated industries have a harder time overcoming the free rider problem. The results also reaffirm the common belief that the level of trade protection awarded to industries is significantly influenced by political factors, including the number of firms that choose to lobby for protection.⁵ Counterfactual experiments offer strong evidence that changing firm incentives to participate in rent seeking activities even slightly will dramatically effect the level of trade protection in an economy.

The rest of the paper is organized as follows. In the next section I discuss the economic model. Section 3 provides a brief description of the data used in estimation. Sections 4 and 5 discuss the estimation procedure and results respectively. The final section concludes.

2 The Model

In this section, I present a model of firm participation in an antidumping petition, in which the firm weighs the costs of participation with the private benefits.

The assumptions of the model are as follows. At the beginning of every period, each industry realizes Ω opportunities to file for antidumping protection against an individual country. The number of opportunities depends on such factors as the pricing decisions of foreign firms and the growth in imports from the country. When an opportunity presents itself, each firm within the industry must decide whether it wants to participate in the antidumping petition.

Petitions result in one of three possible outcomes. The domestic industry may reach a settlement agreement with the foreign industry prior to the government reaching a final decision regarding the case, thus resulting in the domestic industry withdrawing its petition in exchange for a payoff from the foreign industry. If the foreign and domestic industry fail to reach a settlement agreement then the petition continues on to the final investigation stage. At the end of the investigation, the government either makes an affirmative final

⁵Although this is a common belief among economists, the empirical evidence for this belief has been fairly weak. See, for example, Hansen and Prusa [1997] and Finger, Hall and Nelson [1982].

decision about the petition and imposes a dumping margin or tariff of τ^* on all imports of the specific good from the targeted country, or makes a negative determination and dismisses the petition. In making the decision to file a petition, the firm considers the probabilities of each of these outcomes occurring, the payoffs associated with each possible outcome, and the costs of filing the petition. I discuss these factors in turn.

2.1 Benefits from the Imposition of a Dumping Duty

Prior to filing a petition, each firm within the industry observes the unconditional expected value of the tariff determination that would be made by the government if the petition is filed. Define a value τ as the sum of two terms, G and $g(N)$. Here G is the impact of economic and political characteristics of the industry and country under investigation on the government's decision, while $g(N)$ is a monotonically increasing function of the proportion of firms that choose to participate in the petition (N). A positive value of τ indicates an affirmative determination by the government in which a tariff of τ is imposed, while a negative value of τ indicates a negative determination by the government or a tariff of 0. The unconditional expected value of the tariff (τ^*) is thus defined as

$$\tau = G + g(N) \tag{1}$$

$$\tau^* = \begin{cases} \tau, & \text{if } \tau \geq 0 \\ 0, & \text{otherwise.} \end{cases}$$

Intuitively, the expected value of the tariff increases with the number of firms that participate in the case because more firms can impose more political pressure on the government agencies and, hence, force a higher level of protection.⁶

A successful antidumping petition will result in an increase in profits for all firms within that industry. Prior to filing, the expected change in profits accruing to firm i when the antidumping petition reaches the final stage of investigation is equal to the sum of three

⁶The expected level of protection might increase with the number of participating firms for reasons other than those associated with the political influence of the petitioning industry. Government agencies are required to reject those petitions that do not have the support of at least 50 percent of the industry.

terms:

$$B_{\tau i}(N) = \alpha(N) + \eta + \xi_{\tau i}. \quad (2)$$

The sum of the first two terms, α and η , represent the average value to the industry of the government imposing an unconditional expected tariff of τ^* on imports of the good in question from the targeted country. The first term, α , represents the portion of expected benefits that can be attributed to factors that are widely observed by the general public, such as the size of the U.S. market or the expected tariff determination. I assume that this value increases with the number of firms who choose to file for antidumping protection, N , for reasons discussed above. In contrast, the second term, η , represents the portion of expected benefits that is known only to firms within the domestic industry. In particular, this value is unobserved by the foreign industry.⁷ The η term includes factors such as private information the domestic industry has about potential growth in the market or future cost changes.

The final term, $\xi_{\tau i}$, represents profits specifically accruing to firm i when an expected tariff of τ^* is imposed by the government. For example, if firm i produces a large portion of the product targeted by the antidumping petition, then its expected benefits from the petition are higher than other firms within the same industry.

2.2 Benefits from a Settlement Agreement

Both the foreign and domestic industry would ideally like to undertake a settlement agreement in which the foreign industry agrees to make a lump sum payment to the domestic industry in exchange for the domestic industry dropping its antidumping petition.⁸ The lump sum payment directly benefits the domestic industry and allows the foreign industry to avoid

⁷As will become apparent in the next section, I need to make this assumption in order to calculate the benefits that accrue to the industry under a settlement agreement.

⁸In reality, a settlement offer may take the form of the foreign industry agreeing to increase its price by a certain amount or reduce its level of exports to the United States. The domestic industry is indifferent between offers of this nature and a cash transfer from the foreign industry. It should be noted, however, that the type of offer does alter the effect of the settlement agreement on social welfare. For example, by definition, an antidumping duty is designed to raise import prices which leads to a loss in consumer surplus. However, a lump-sum payment may or may not result in an increase in import prices.

paying tariff revenue to the U.S. government. In a world of perfect information, both the foreign and domestic industry could predict the tariff that would be set by the government and calculate the optimal transfer that maximizes the total net benefits of the agreement to both the foreign and domestic industry. In reality, the foreign and domestic industry have private information about how a tariff will impact their profits, and this asymmetric information will influence the likelihood of reaching a settlement agreement and the transfer finally agreed upon.⁹

To estimate the probability of reaching a settlement agreement and the expected benefits of such an agreement, consider a simple bargaining model in which the foreign industry makes a take-it-or-leave-it offer to the domestic industry of $\hat{\eta}$. The benefits accruing to firm i under a settlement agreement can be written as the sum of two terms:

$$B_{Si} = \hat{\eta} + \xi_{Si}. \quad (3)$$

The first term, $\hat{\eta}$, is the average value of the lump sum transfer from the foreign to the domestic industry under the settlement agreement. The final term, ξ_{Si} , represents profits specifically accruing to firm i when an agreement is reached.

The foreign industry knows that the domestic industry will agree to any $\hat{\eta}$ in which the domestic industry's average expected benefits from the settlement agreement exceed the average benefits from proceeding to a final government decision. In a world of perfect information, the foreign industry could set $\hat{\eta}$ such that $\alpha + \eta = \hat{\eta}$, and an agreement always would be reached. However, recall that only the domestic industry observes η , the second component of benefits that accrue to the domestic industry when a tariff is imposed on foreign imports. The foreign industry knows only that η has distribution $F(\eta)$. When choosing $\hat{\eta}$, therefore, the foreign industry must consider the effect of $\hat{\eta}$ on both its profits and the probability of reaching a successful settlement agreement. The foreign industry

⁹The bargaining model included here is similar to those developed by Prusa [1992] and Panagariya and Gupta [1998], which suggest that the foreign and domestic industry would always be better off under a negotiated outcome rather than allowing an antidumping petition to reach a final government determination. Panagariya and Gupta [1998] show that any asymmetric information, such as different beliefs about the probability of a successful final outcome, can reduce the likelihood of a negotiated outcome.

chooses $\hat{\eta}$ by maximizing its expected change in profits due to the antidumping petition.

When making an offer, the foreign industry calculates the probability of reaching a successful settlement agreement, π^* , as the probability that the average benefits to the domestic industry from the settlement agreement are greater than those when the case reaches a final government decision, or $Pr(\hat{\eta} \geq \alpha + \eta)$. Using the distribution of η , this probability can alternatively be expressed as:

$$\pi^*(\hat{\eta}) = F(\hat{\eta} - \alpha). \quad (4)$$

Note that the probability of reaching an agreement is increasing in the value of the settlement offer made by the foreign industry.

Define B_τ^* as the foreign industry's expected change in profits that results from the antidumping petition reaching a final government decision, and B_S^* as the foreign industry's expected change in profits that results from reaching a successful settlement agreement with the domestic industry. These values can be expressed as:

$$B_\tau^* = \alpha^*(N) \quad (5)$$

$$B_S^* = \eta^* - \hat{\eta}. \quad (6)$$

In these equations, α^* denotes the change in foreign industry profits when an expected antidumping duty of τ^* is imposed upon its imports. The η^* term represents benefits accruing to the foreign industry when the case is settled which are unobserved by the domestic industry. For example, the foreign industry undoubtedly has better information about how its pricing decisions would change if a tariff is imposed. The domestic industry knows only that η^* has distribution $F^*(\eta^*)$.

Based on this specification, the foreign industry chooses $\hat{\eta}$ by maximizing the expected change in profits that occurs due to the petition, U^* , which consists of the probability of reaching a settlement agreement and the possible outcomes of the petition. In other words:

$$\max_{\hat{\eta}} U^*(\hat{\eta}) = \pi^*(\hat{\eta})B_S^*(\hat{\eta}) + [1 - \pi^*(\hat{\eta})]B_\tau^*(N). \quad (7)$$

The optimal $\hat{\eta}$ is implicitly defined by foreign industry's first order condition:

$$\frac{\partial \pi^*}{\partial \hat{\eta}}(B_S^* - B_\tau^*(N)) - \pi^*(\hat{\eta}) = 0. \quad (8)$$

Once a settlement offer is made, the domestic industry knows with certainty whether or not the case will be successfully settled. However, when making the decision to file for antidumping protection, the domestic industry must estimate the probability of reaching an agreement and the expected benefits conditional on reaching a successful agreement. Because the domestic industry does not observe η^* , the probability of reaching a settlement agreement is calculated using the probability of getting a satisfactory offer based on the distribution of η^* . Once again, the probability of reaching a successful settlement agreement is the probability that the average benefits to the domestic industry of settling are greater than forcing the petition to a final government decision. This is the probability that the settlement proposal, which is a function of η^* , is greater than some threshold value, or:

$$\pi(N) = \Pr[\widehat{\eta}(\eta^*) \geq \alpha(N) + \eta]. \quad (9)$$

The foreign industry's offer $\widehat{\eta}$, which is implicitly determined by Equation [8], is a monotonically increasing function of η^* , therefore Equation [9] is equivalent to the probability that η^* is above a threshold value $\bar{\eta}$ such that the foreign firm's settlement offer is accepted by the domestic industry.¹⁰

2.3 The Firm's Decision to Participate

Given the payoffs and probabilities described above, the expected rewards to firm i when an antidumping petition is filed are defined by:

$$U_i(N) = \pi(N)B_{Si} + [1 - \pi(N)]B_{\tau i}(N). \quad (10)$$

A petition is filed if at least one firm in the industry decides to participate actively in the petition. All firms in the industry benefit from the imposition of a tariff in the case of a successful antidumping petition or a transfer from the foreign industry in case of a settlement

¹⁰More specifically, $\widehat{\eta}$ is a monotonically increasing function of η^* as long as the foreign industry's second order condition holds. A sufficient condition for this to be true is that both the foreign industry and the average domestic industry prefer to settle the case than continue on to a final government decision given the offer $\widehat{\eta}$.

agreement, but only those firms that participate in the petition process must contribute to the significant costs. Costs of filing a petition are primarily fixed, and include payments to lawyers, economists, and other consultants to prepare petitions that can be hundreds of pages, testimony to present before the ITC, and responses to comments of opponents of the petition. I allow the costs of participating C_i to consist of two terms. The first term, $\kappa(N)$, represents the average cost of participating in the petition. This value is decreasing in the number of firms that decide to contribute because the high fixed costs are divided amongst a larger group of firms. The second term, ξ_{C_i} , allows contributions to vary across firms.¹¹

The high cost of actively participating in the petition may encourage some firms to free ride on others willing to bear these costs. However, as noted above, the expected level of protection awarded due to the petition increases with the number of firms participating in the case, N , because the industry can apply greater political pressure on government agencies. Therefore each firm must compare its private benefits, or the increase in the expected benefits of the petition that would arise if it joined the case, to the per firm costs when deciding whether or not to contribute to the antidumping petition. Approximating the increase in the expected benefits when an additional firm joins the petition as the marginal change (denoted by Δ), firm i 's expected net benefits of participating can be written as:

$$A_i^* = \Delta[\pi(N)B_{S_i} + (1 - \pi(N))B_{\tau_i}(N)] - C_i(N). \quad (11)$$

Each firm has a strategy, A_i , denoted by (0,1), where “0” represents no contribution to the antidumping petition and “1” represents contribution to the case. The strategy vector for the game, A , is an $(I \times 1)$ binary vector, where I is the number of firms in the industry. A pure strategy equilibrium occurs when holding the choices of all other firms fixed, all firms choosing to participate have positive expected net benefits of participating and those that do not participate would realize negative expected net benefits. Defining N^* as the equilibrium number of firms participating in the petition, a Nash equilibrium pure strategy vector must

¹¹For example, ξ_{C_i} allows larger firms or those with in-house counsel to pick up a larger share of costs. It also allows firms to recruit additional firms to participate in the petition at no cost in order to increase the level of protection.

satisfy:

$$A_i = \begin{cases} 1, & \text{if } A_i^*(N^*) \geq 0 \\ 0, & \text{otherwise} \end{cases} \quad \text{for all } i$$

where

$$N^* = \sum_{i=1}^I A_i. \quad (12)$$

To assure the existence of a pure strategy equilibrium, I make the assumption that the expected net benefits of participating, $A_i^*(N)$, are increasing in the number of firms participating in the petition.¹²

One of the problems with equilibrium models of this nature is that there may be multiple Nash equilibria, specifically due to tipping behavior. For example, if the costs of filing a petition are extremely high then there may exist one equilibrium in which nobody chooses to participate in the petition and a second equilibrium in which multiple firms in the industry choose to participate and split the costs of the petition. However, there is a unique equilibrium that Pareto dominates all other equilibria.¹³ Intuitively, because the returns to the petition are increasing in the total number of firms participating, all firms benefit when more firms choose to join the petition.

3 Data

I compiled data on 157 countries and 447 four-digit 1987-SIC industries in the manufacturing sector for the years 1980 through 1996. These years were chosen to avoid discontinuities that could result from the major change in the administration of antidumping law in 1980 and the change from the Standard Industrial Classification System to the North American Industry Classification System in 1997. Sources include U.S. Bureau of the Census surveys, including the Annual Survey of Manufacturers and Economic Census, as well as the

¹²Other models that have similar characteristics include Berry's [1992] model of entry and Gowrisankaran and Stavins' [1999] model of network externalities. These models also need to make assumptions about the monotonicity of benefits or profits in order to ensure a Nash equilibria.

¹³The proof is available from the author upon request.

NBER's U.S. Import and Export Data and the World Bank. Variables include the value of domestic shipments, imports and exports, costs of production, and measures of industry concentration. To avoid selection bias, it is important to include all U.S. trading partners and industries within the manufacturing sector in the estimation of the model.¹⁴

Between 1980 and 1996, U.S. industries filed a total of 795 antidumping petitions. As noted earlier, approximately 20 percent of the cases filed during the sample period were either terminated or suspended. Of the remaining cases, the government made affirmative decisions in slightly over half of the remaining cases. The average dumping margin imposed during the period was 49.4 percent. The average number of firms participating in a particular petition was 33, although the majority of petitions were filed by one to five companies. This translates to an average participation rate of approximately one-third of the firms in an industry.

Sixty-eight countries had at least one case filed against them between 1980 and 1996. However, over 60 percent of all antidumping petitions were filed against the top ten targets of antidumping petitions, including Japan, China, Germany, Taiwan, Korea, and Brazil. Not surprisingly, the leading targets also rank as the United States' most important trading partners during the period and are primarily highly industrialized countries. The average dumping margin imposed upon these countries varies considerably; for example, the average antidumping duty imposed upon China is nearly twice that of other countries.¹⁵

Of the 450 domestic industries, 121 filed at least one antidumping petition during the sample period. Most antidumping petitions, however, are filed by a small group of extremely price-sensitive industries. The steel works industry filed by far the most petitions at 197, followed by the steel pipe and tube industry and the ball bearings industry. Most of the

¹⁴The all-inclusive nature of the dataset presented a number of problems. For example, there were approximately 500 missing values in the country-specific data which were filled in using a simulation technique developed in Lavy, Palumbo and Stern [1998]. A complete description of the dataset is available from the author upon request.

¹⁵Critics of the antidumping regulations charge that dumping margins in cases involving non-market economies such as China are inherently biased because in cost-based analysis the government uses costs in a comparable third market rather than costs in the non-market economy itself.

antidumping petitions filed between 1980 and 1996 were against intermediate products rather than consumer goods.

4 Empirical Specification and Estimation Issues

This section first discusses the empirical specification adopted, and then outlines the estimation strategy. Simulation techniques used to overcome unique problems in the course of estimation are described in Section 4.3.

4.1 Specification

Recall that at the beginning of every period, each industry realizes a fixed number of opportunities to file for antidumping protection against country k . Define Ω_{kjt} as the number of opportunities industry j has to file for antidumping protection against country k in period t . Let λ_{kjt} denote the rate at which these opportunities arise. I assume that the distribution of Ω_{kjt} given λ_{kjt} is Poisson with parameter λ_{kjt} , where $\ln \lambda_{kjt} = X_{Fkt}\beta_F + \ln \zeta_{kj}$. Here, X_{Fkt} includes characteristics about country k in period t that may effect the pricing decisions of foreign firms. The term ζ_{kj} is a gamma-distributed error with parameter θ associated with the unobserved factors about industry j in country k that may effect the rate of opportunities.

Under these assumptions, the unconditional distribution of Ω_{kjt} can be written as a negative binomial random variable. In other words, the probability of industry j realizing $\hat{\omega}$ opportunities to file for antidumping protection against country k in period t can be written as:

$$\Pr(\Omega_{kjt} = \hat{\omega}) = \frac{\Gamma(\theta + \hat{\omega})}{\Gamma(\hat{\omega} + 1)\Gamma(\theta)} \left(\frac{e^{X_{Fkt}\beta_F}}{e^{X_{Fkt}\beta_F} + \theta} \right)^{\hat{\omega}} \left(1 - \frac{e^{X_{Fkt}\beta_F}}{e^{X_{Fkt}\beta_F} + \theta} \right)^{\theta}. \quad (13)$$

The average benefits associated with the government imposing a dumping margin on country k to foreign and domestic firms in industry j are respectively defined by

$$\begin{aligned} \alpha_{kjt}^* &= -\tau_{kjt}^* \exp(X_{Bkjt}^* \beta_B^*) \\ \alpha_{kjt} &= (\tau_{kjt}^* + \gamma \tau_{kjt}^{*2}) X_{Bkjt} \beta_B \end{aligned} \quad (14)$$

where X_{Bkjt}^* and X_{Bkjt} include industry characteristics that effect the value of benefits and τ_{kjt}^* is the unconditional expected dumping margin.¹⁶ Characteristics contained in X_{Bkjt}^* include such variables as the value and growth of the industry's exports to the United States and the total size of the U.S. market. The domestic counterpart, X_{Bkjt} , includes these variables in addition to others such as a proxy of the average markup by the domestic industry. One would expect, for example, that the domestic industry's benefits, and the cost to the foreign industry, would increase with the value of targeted imports. The parameter γ allows for the possibility of diminishing marginal returns from the value of the dumping margin. Intuitively, if the dumping margin increases beyond a certain level, all imports from country k would be eliminated; increasing the dumping margin beyond this level would result in no additional benefits to the domestic industry.¹⁷

The expected dumping margin imposed upon imports from country k , τ_{kjt}^* , depends upon the decisions of government agencies. The domestic industry forms expectations about this τ_{kjt}^* according to

$$G_{kjt} = X_{Gkjt}\beta_G + \omega_{kjt} \quad (15)$$

$$\omega_{kjt} \sim iid N(\mu_w, \sigma_w^2)$$

Variables in X_{Gkjt} include economic factors that government agencies are required to consider under the antidumping statute when making their decisions, such as the change over the period of investigation in domestic industry shipments and capacity utilization. Also included in X_{Gkjt} are political factors that may influence government decisions, such as the total size of the industry as measured by employment. The error term ω_{kjt} captures influences on government decisions that are unobserved by the econometrician.

To complete the specification of the benefits of filing an antidumping petition, I assume

¹⁶The specification for foreign benefits was chosen to ensure that the foreign industry experiences a loss when a dumping margin is imposed, as suggested by theory.

¹⁷ This general specification could apply to a variety of market structures. For example, Herander and Pupp [1991] use the small country and perfect competition assumption to derive the change in producer surplus due to a dumping margin as $\tau REV(1 + \frac{1}{2}\varepsilon\tau)(\%IMP)$, where REV is the value of domestic sales, ε is the elasticity of domestic supply, and $\%IMP$ is the percentage of total imports affected by the government's decision.

that the firm-specific benefits and private-information terms used to determine the lump sum payment in the event of a settlement agreement are distributed according to

$$\begin{aligned}(\xi_{\tau j} - \xi_{Sj}) &\sim iid N(0, \sigma_{\xi}^2) \\ \eta_{kjt} &\sim iid N(0, \sigma_{\eta}^2) \\ \eta_{kjt}^* &\sim iid N(0, \sigma_{\eta^*}^2).\end{aligned}$$

Next I specify the cost of participating in the antidumping petition. There is no data regarding how much it costs to file an antidumping petition. Therefore, I assume that the average cost of participating in the petition, κ , is defined by

$$\kappa = X_{Ckjt}\beta_C + c(N) + \nu_k. \quad (16)$$

In this equation, X_{Ckjt} includes a constant that captures the average cost of filing an antidumping petition across industries. It also includes industry-specific variables such as the number of firms in the industry and the concentration-ratio to capture the theoretical prediction that coordination costs are higher in larger and less-concentrated industries. The term $c(N)$ is a decreasing function of the number of firms participating in the case. The random variable ν_k allow costs to vary by country. For example, it may be less expensive to collect information about production in a country with a low-cost of living or more stringent tax regulations. This random variable and the firm-specific portion of costs are distributed according to

$$\begin{aligned}v_j &\sim iid N(0, \sigma_v^2) \\ \xi_{Cj} &\sim iid N(0, \sigma_{\xi_C}^2).\end{aligned}$$

4.2 Estimation Strategy

The parameters of the model are estimated using maximum simulated likelihood (MSL). The likelihood contribution of industry j and country k in period t is defined by one of two possible outcomes: either the industry chooses to file one or more petitions against country k or not. Define F_{kjt} as an indicator variable that equals 1 when industry j files

at least one petition against country k in period t , Ψ_{1kjt} as the likelihood contribution when industry j fails to file an antidumping petition against country k , and Ψ_{2kjt} as the likelihood contribution when the industry files one or more petitions. Then conditional on the unobserved country- and industry-specific factors, the likelihood function can be expressed as:

$$L = \int_{\omega} \int_{v} \int_{u} \int_{\xi} \prod_t \prod_j \prod_k [\Psi_{1kjt}]^{(1-F_{kjt})} [\Psi_{2kjt}]^{F_{kjt}} f_{\xi}(\xi) f_u(u) f_v(v) f_{\omega}(\omega) d\xi du dv d\omega. \quad (17)$$

Recall that Ω_{kjt} is the number of opportunities industry j has to file an antidumping petition against country k in period t , and the probability of observing a specific number of opportunities is defined by equation [13]. Define N_{okjt}^* as the observed number of firms participating in opportunity o . Therefore when no petition is filed, the likelihood contribution is the joint probability that, while Ω_{kjt} opportunities existed, no firms chose to participate in these opportunities. This is written as

$$\Psi_{1kjt} = \prod_{o=1}^{\hat{o}} \int_{\eta} \Pr(N_{okjt}^* = 0) f(\eta) \partial\eta \Pr(\Omega_{kjt} = \hat{o}). \quad (18)$$

The contribution of an industry that files at least one petition, Ψ_2 , includes the probability of observing the outcome of the petition. More specifically, it includes the probability of observing the industry reaching or not reaching a settlement agreement and, conditional on not reaching a settlement agreement, the probability of observing a particular decision by the U.S. government. Define P_{kjt} as the number of petitions actually filed by industry j against country k in period t , and S_{okjt} as an indicator variable that equals 1 when case or opportunity o is settled. The likelihood contribution when a petition is filed is defined by:

$$\begin{aligned} \Psi_{2kjt} = & \prod_{o=1}^{P_{kjt}} [\Pr(S_{okjt} = 0 | N_{okjt}^*) \Pr(\tau_{okjt}^* = \tau | N_{okjt}^*)]^{(1-S_{okjt})} \\ & [\Pr(S_{okjt} = 1 | N_{okjt}^*)]^{S_{okjt}} \int_{\eta} \Pr(N_{okjt}^*) f(\eta) \partial\eta \\ & \prod_{o=P_{kjt}+1}^{\hat{o}} \int_{\eta} [\Pr(N_{okjt}^* = 0)] f(\eta) \partial\eta \Pr(\Omega_{kjt} = \hat{o}). \quad (19) \end{aligned}$$

In brief, when a case is filed by $N^* > 0$ firms, that case may either reach a final government decision as expressed in line 1, or be settled prior to reaching the final stage of the investigation as expressed in line 2. The final line consists of those opportunities in which no firms chose to participate, similar to what is captured in equation [18].

In order to calculate the probability of observing N^* firms joining a petition, I introduce a petition-specific error ϵ_{okjt} on the net benefits of participating, where ϵ_{okjt} is an iid normally-distributed error with a standard deviation of σ_ϵ .¹⁸ With the introduction of this error, the probability that firm i will participate in an antidumping petition filed by N^* firms is defined as the probability that the expected net benefits of participating are positive, or:

$$\Pr[A_i = 1] = \Pr[A_i^*(N^*) + \epsilon \geq 0] = 1 - \Phi\left(\frac{-A_i^*(N^*)}{\sigma_\epsilon}\right). \quad (20)$$

The probability of observing an N^* firm equilibrium is the probability that ϵ_{okjt} falls within a range such that exactly N^* firms choose to participate in the petition. If I order the firms in the industry from those with the highest to lowest net expected benefits, this is equivalent to saying that while the N^{*th} firm in the market has positive net expected benefits of participating when $N^* - 1$ other firms choose to file a petition, the $(N^* + 1)^{th}$ firm would have negative net expected benefits if it joined the petition given that N^* other firms are participating. Mathematically, this probability is written as

$$\Pr(N^* = N) = \Phi\left(\frac{-A_{N+1}^*(N^* + 1)}{\sigma_\epsilon}\right) - \Phi\left(\frac{-A_N^*(N^*)}{\sigma_\epsilon}\right) \quad (21)$$

As discussed above, the model has multiple equilibria. In particular, it is often the case that there exists an equilibrium in which no firm chooses to be the sole firm filing a petition, thereby bearing all of the filing costs. As a result, the probability of observing no firms participating in a petition is higher than the probability that this is the Pareto dominant equilibrium. When I observe no firms filing a petition, I assume that this is the Pareto dominant equilibrium. Therefore, in order to avoid an upward bias during estimation, I define the probability of observing an industry choosing not to file a petition as the probability that

¹⁸ Although I considered using the density of the industry-specific errors or country-specific errors to calculate the probability of industry j filing a petition against country k , the only way to fully account for the observed data is with an opportunity-specific error.

ϵ_{okjt} falls within a range such that there exists no Pareto dominant equilibrium in which a positive number of firms choose to file a petition:

$$\begin{aligned} \Pr(N^* = 0) &= 1 - \sum_{N=1}^{I_{jt}} \Phi\left(\frac{-A_{N+1}^*(N^* + 1)}{\sigma_\epsilon}\right) - \Phi\left(\frac{-A_N^*(N^*)}{\sigma_\epsilon}\right) \\ &= \Phi\left(\frac{-A_1^*(1)}{\sigma_\epsilon}\right) \end{aligned} \quad (22)$$

The probability that a petition is settled is the probability of observing a combination of η_{okjt} and η_{okjt}^* such that the foreign industry makes an settlement offer acceptable to the domestic industry. Recall that the settlement offer $\hat{\eta}_{okjt}$ is an increasing function of the foreign industry's private information, η_{okjt}^* . Define $\bar{\eta}(\eta)$ as the threshold value of η_{okjt}^* , conditional on η , such that if $\eta_{okjt}^* \geq \bar{\eta}(\eta)$ then the foreign firm makes an acceptable settlement offer to the domestic industry and a settlement agreement is reached. Then the probability of reaching a settlement agreement can be expressed as

$$\int_{-\infty}^{\infty} [1 - \Phi\left(\frac{\bar{\eta}(\eta)}{\sigma_{\eta^*}}\right)] \frac{1}{\sigma_\eta} \phi\left(\frac{\eta}{\sigma_\eta}\right) \partial\eta. \quad (23)$$

4.3 Simulation

Simulation is used to solve a number of problems throughout the course of the estimation procedure. For example, I cannot analytically evaluate the integrals in Equation [17], which are therefore simulated using antithetic acceleration techniques as described in Geweke [1988].

Another difficulty that arises when estimating the model lies in the fact that, while the likelihood function is the product of the outcomes of each antidumping petition that the industry has the opportunity to file, I do not actually observe how many opportunities to file exist. More specifically, I cannot distinguish from the data whether the industry did not have an opportunity to file an antidumping petition or whether an opportunity to file for protection existed, but no firms chose to participate in this opportunity. Because I don't

¹⁹A closed form solution to the integral does not exist. Instead, a quadrature formula is employed to approximate the integral.

observe the number of opportunities each industry has to file for antidumping protection, I simulate this number of opportunities, Ω_{kjt} .²⁰ Details of the procedure are provided in Appendix A.

A second key piece of data I do not observe is how many firms are eligible to participate in a given opportunity. While I observe the total number of firms in industry j , antidumping petitions are filed against very specific product categories produced by country k ; these product categories are typically produced by only a subset of firms within industry j . When a petition is filed, I observe the number of firms that produce the product in question, but when an industry chooses not to file a petition the number of firms eligible to participate in opportunity o is unobserved. Therefore, I simulate this number of firms by assuming that the number of firms eligible to participate in each opportunity is a Poisson random variable, where the mean is a function of the concentration ratio in industry j and a gamma-distributed industry-specific error. Prior to simulation, I estimate a Poisson model with industry-specific random effects using the number of firms eligible to participate in petitions actually filed. The results are presented in Table [1]. I then use these coefficients to simulate the number of firms eligible to participate in a given opportunity from a Poisson distribution with the mean indicated for industry j .

Finally, the net benefits of participating in a petition (A^*) are a function of the expected value of the settlement offer conditional on reaching the settlement agreement ($\widehat{\eta}$) and the derivative of the expected settlement offer with respect to the number of firms participating in the case. Recall that $\bar{\eta}$ is defined as the threshold value of η^* such that the domestic industry will accept the foreign industry's offer and a settlement agreement will be reached. Then the conditional expected value of the settlement offer and the change in the settlement offer with respect to the number of participating firms can be written as

$$\int_{\bar{\eta}}^{\infty} \widehat{\eta}(\eta^*) f(\eta^*) \partial \eta^* \text{ and} \tag{24}$$

²⁰Between 1980 and 1996, individual industries filed anywhere from zero to 10 petitions against a specific country. Alternative specifications in which each industry has a fixed number of opportunities to file for antidumping protection would likely overestimate the free rider problem.

TABLE 1

Poisson Model Estimates of the Number of Firms in an Industry

Variable	
Constant	3.633*
	(0.15)
Concentration Ratio	-0.019*
	(0.003)
Gamma shape parameter	0.654*
	(0.080)

Standard errors are in parentheses. Asterisks indicate those parameters significant at the 5 percent significance level.

$$\int_{\bar{\eta}}^{\infty} \frac{\partial \hat{\eta}(\eta^*)}{\partial N^*} \hat{\eta}(\eta^*) f(\eta^*) \partial \eta^*. \quad (25)$$

Unfortunately, closed form solutions do not exist to either the expected settlement offer or the derivative of the expected settlement offer. I therefore calculate these expected values using simulation techniques to approximate the indefinite integrals.²¹

5 Results

The parameters associated with the opportunity to apply for protection are given in Table [2]. In all tables, the (asymptotic) standard errors are given in parentheses. According to the parameter estimates, the average number of opportunities an industry has to file against a specific country in a given year is 0.55, with a standard deviation of 0.86. The rate at which opportunities arise is higher for more developed, faster growing countries and for

²¹Specifically, I use a variant of Simpson’s Rule, or the trapezoid rule, to approximate the integrals. The method deviates from Simpson’s Rule in that I must define a value for infinity in order to calculate the value of the approximation. This should result in a close enough approximation as long as “infinity” is sufficiently large. Throughout the course of the estimation procedure, I define infinity as six-times the standard deviation of η^* .

TABLE 2

Parameter Estimates: Opportunity to Apply for Protection

Variable	
Constant	-1.951*
	(0.015)
Growth in GNP	0.645*
	(0.149)
GNP per capita (in thousands)	0.015*
	(0.001)
Growth in exchange rate	-0.051*
	(0.014)
Total imports (in billions)	0.022*
	(0.001)
θ : Gamma shape parameter	0.983*
	(0.041)
$\bar{\Omega}$: mean number of opportunities	0.551
σ_{Ω}^2 : variance of the number of opportunities	0.859

Standard errors are in parentheses. Asterisks indicate those parameters significant at the 5 percent significance level.

those countries that are more important sources of U.S. imports. These results are consistent with the characteristics of the leading targets of antidumping petitions.

Not surprisingly, the parameter estimates show that the number of opportunities increases with a depreciation of a country's currency relative to the dollar.²² Intuitively, exchange rate depreciation can result in a fall in import prices; the fall in prices gives U.S. industries the opportunity to file more antidumping petitions.

The parameters associated with the level of protection awarded by the government are

²²I calculate the growth of the exchange rate using the dollars per unit of foreign currency exchange rate. Thus, a positive growth rate actually represents a depreciation of the currency relative to the dollar.

given in Table [3]. Among the many economic factors the government must consider in making its decision, I include the growth in domestic shipments and capacity utilization rate, as well as the market share of the country under investigation. A fall in domestic shipments or the capacity utilization rate of the industry is one indication that the domestic industry has been injured. The larger the market share of the country under investigation, the more likely it is that imports from this country contribute to the injury of the domestic industry. The estimates are consistent with earlier studies of the determinants of antidumping decisions in that only the market share of the targeted countries proves to be significant.²³ This may be due to the fact that the government agency that determines whether an industry has been injured uses a wide variety of economic criteria to make injury determinations, and shipments and capacity utilization are not as important as other variables such as profit levels or domestic prices. The estimates also reveal that Chinese industries face higher antidumping duties than industries in other countries, but not whether this is due to a bias in antidumping regulations or pricing decisions on the part of Chinese firms. On average, petitions filed against Chinese industries result in dumping duties approximately 19.1 percent higher than those filed against other countries.

The degree of political influence on the outcomes of antidumping petitions has been widely studied in the past, with mixed results. For example, Finger, Hall and Nelson [1982] found no evidence of political influence on the size of the dumping margins but some evidence that the size of the industry can influence whether protection is awarded at all. While Moore [1992] found evidence that the size of the industry has a positive influence on whether protection is awarded, Hansen and Prusa [1996,1997] found no evidence that either the size or the concentration of the industry effected outcomes. In contrast, I find some evidence that political factors have a significant impact on the level of protection. The expected dumping duty increases with the size of the industry, as measured by domestic employment.

Critical to the development of the model, the proportion of firms participating in the case has a significant positive effect on the level of protection, albeit with a diminishing rate of return. On average, an industry that increases the percentage of firms participating in

²³See, for example, Hansen and Prusa [1996] and [1997].

its case from 25 to 50 percent increases its level of protection by 5.9 percent, while those that increase the participation rate from 50 percent to 100 percent only realize an additional boost in the dumping margin of 3.7 percent.

Parameter estimates associated with the domestic and foreign industry's benefits from the imposition of a dumping margin are presented in Table [4].²⁴ Column 2 of Table [4] presents the parameters associated with domestic benefits and column 3 presents the those associated with the foreign industry's benefits.

Most of the parameter estimates associated with the benefits accruing to the domestic and foreign industry from the imposition of a dumping margin are significant at the five percent level and have a reasonable economic interpretation. The parameter estimates suggest that domestic firms within high-growth industries have more to gain from a dumping margin which restricts the level of imports than others. Results also suggest that the domestic industry benefits increase with the total value of imports and their average profit margin. In contrast, the results suggest that the foreign industry is hurt more when the dumping margin is imposed upon larger, faster growing industries.²⁵

As predicted by Panagariya and Gupta's [1998] theoretical model, the most important determinant in a domestic industry's ability to reach a settlement agreement with their foreign competitors is the level of asymmetric information. A one standard deviation increase in the amount of private information held by the domestic industry (η) decreases the probability of reaching a settlement agreement 56.9 percent. However, the parameter estimates suggest that other characteristics of the industry may also effect the likelihood of a settlement agreement. Most significantly, for each million dollar increase in the size of the domestic market the probability of reaching a settlement agreement increases by one percentage point. The domestic industry is slightly less likely to reach a settlement agreement

²⁴Data limitations prevent me from separately identifying firm-specific errors for both costs and benefits. The specification presented here arbitrarily fixes the standard deviation such that $\exp(\sigma_\varepsilon)$ equals 2.0, or σ_ε equals 7.4.

²⁵Recall that I specify the foreign industry's change in benefits as $B_1^* = -\tau^* \exp(XB)$ to ensure that the foreign industry experiences a loss when a dumping margin is imposed. Therefore, a positive parameter estimate indicates that the loss suffered by the foreign industry increases with the variable under consideration.

TABLE 3

Parameter Estimates: Expected Dumping Duty

Variable	
Growth in domestic shipments	-0.207 (0.207)
Growth in capacity utilization rate	-0.093 (0.184)
Market share of country under investigation	3.538* (0.419)
Domestic employment (in 1,000s)	0.001* (0.0002)
Four-firm concentration ratio	0.116 (0.089)
Country is China	0.535* (0.076)
Proportion of firms participating	1.027* (0.036)
Proportion ²	-0.504* (0.014)
μ_ω : Mean	-0.563* (0.044)
σ_ω : Standard deviation	0.738* (0.026)

Standard errors are in parentheses. Asterisks indicate those parameters significant at the 5 percent significance level.

TABLE 4

Parameter Estimates: Benefits of Applying for Protection

Variable	β_{12}	β_{12}^*
Imports from target country (in millions)	$9.56x10^{-9}$	-0.001
	(0.007)	(0.001)
Growth in imports from target country		0.164*
		(0.043)
Domestic market size (in millions)	-9.294*	0.845*
	(4.646)	(0.042)
Growth in domestic market	100.403*	6.118*
	(48.479)	(0.845)
Percent markup	276.556*	
	(45.742)	
Total imports (in millions)	0.004*	
	(0.002)	
Growth in total imports	$-6.353x10^{-7}$	
	(40.319)	
Gamma	$6.862x10^{-9}$	
	(0.045)	
σ_{η} : Domestic-opportunity error standard deviation	47.419*	
	(6.457)	
σ_{η^*} : Foreign-opportunity error standard deviation		4.387*
		(2.008)
σ_{ϵ} : Opportunity error standard deviation	69.962*	
	(15.334)	

Standard errors are in parentheses. Asterisks indicate those parameters significant at the 5 percent significance level.

the higher the expected level of protection; a one percentage point increase in the expected level of protection results in a 0.3 percentage point decrease in the probability of reaching a settlement agreement. Because the level of protection is expected to increase with the number of participating firms, the free rider problem may actually result in more petitions being settled out of court.

Parameters associated with the cost of filing for protection are presented in Table [5]. The results seem to support some of the conclusions from earlier theoretical studies of the free rider problem in collective actions. For example, Magee [2002] concludes that the free rider problem becomes more severe with an increase in industry concentration when the number of firms in the industry is sufficiently large. Moreover, for a sufficiently small level of industry concentration, an increase in the number of firms in the industry makes cooperation more difficult, or exacerbates the free rider problem. The parameter estimates confirm that per firm costs, and thus the ability to overcome the free-rider problem, increase with the level of concentration and the number of firms in the industry. However, the interaction term between the level of concentration and number of firms is insignificant, suggesting that both of these variables exacerbate the free rider problem regardless of other industry characteristics.

Surprisingly, the estimates reveal that per firm costs actually increase slightly when additional firms participate, albeit at a diminishing rate. On average, the inclusion of one additional firm in a petition increases the firm's average cost of participating in the petition by 0.6 percent. This increase may be associated with increased coordination costs. Nevertheless, firms within industries filing petitions find that the marginal benefit gained from joining the petition and gaining a higher level of protection exceeds the additional costs associated with its participation.

TABLE 5

Parameter Estimates: Costs of Applying for Protection	
Variable	
Average cost	180.673* (39.362)
Concentration Ratio	38.827* (11.088)
Firms	0.012* (0.003)
Concentration Ratio * Firms	8.629×10^{-8} (0.006)
Number of Firms participating	1.314* (0.312)
Number of Firms Participating ²	-0.003 (0.003)
σ_ν : Country-specific error standard deviation	25.508* (5.649)
σ_ξ : Firms-specific error standard deviation	16.650* (3.844)

Standard errors are in parentheses. Asterisks indicate those parameters significant at the 5 percent significance level.

5.1 Specification Tests

To see how well the model fits the data, I conduct a series of chi-square goodness of fit tests.²⁶ The results from these tests indicate that the model predicts the industry’s decision to file and settle a petition, as well as the government’s decision regarding the level of protection, quite accurately.

I first test how well the model predicts the industry’s decision to file a petition.²⁷ The model slightly over predicts the number of observations choosing to file a petition during the sample period. Between 1980 and 1996, only 544, or 0.12 percent, of the observations filed at least one petition where an observation is an industry, country, year combination. In contrast the model predicts that 747 observations, or 0.17 percent of the sample, filed at least one petition during this time period. Despite this relatively small difference, I statistically reject the null hypothesis that the model correctly predicts the decision to file a petition.²⁸

To further investigate this decision, I next conduct tests to study how well the model predicts the proportion of firms filing a petition. Although I statistically reject the null hypothesis that the model predicts the same proportion of firms filing a petition as observed in the data for all ranges but the decision not to file, in general the model closely matches observed firm behavior. A closer examination of the test statistics, presented in Table [6], suggests that the model is better able to match petitions filed by more than 25 percent of the industry than those filed by a smaller proportion.

²⁶In general, for each outcome of the model I want to test, I divide the outcome into N mutually exclusive and exhaustive events. For example, to test how well the model predicts the industry’s decision to file a petition, I divide the outcome variable into two mutually exclusive events (file and not file). Test statistics are calculated for each event by first dividing the probability of observation i choosing event n into quintiles. The test statistic compares the actual number of observations to choose event n within the quintile with the predicted number, and has a χ^2 distribution with four degrees of freedom.

²⁷To avoid needless complications associated with single observations filing multiple petitions, I define my “event” as the decision of the industry to file *at least* one petition against country k in period t . The probability of the industry choosing not to file a petition is the probability that either one or more opportunities existed and no firms chose to partake in those opportunities or no opportunities existed.

²⁸In contrast, the test statistic associated with the decision not to file a petition is 0.31, therefore I fail to reject the null hypothesis that the model correctly predicts the decision not to file a petition.

TABLE 6

Chi-Square Goodness of Fit Test: Proportion of Firms Filing Petition			
Proportion Range	Actual Number	Predicted Number	χ^2 Statistic
$\frac{N^*}{Firms} = 0.00$	452,418	452,223	0.21
$0.00 < \frac{N^*}{Firms} \leq 0.25$	226	346	63.82
$0.25 < \frac{N^*}{Firms} \leq 0.50$	189	175	16.82
$0.50 < \frac{N^*}{Firms} \leq 0.75$	57	68	32.42
$0.75 < \frac{N^*}{Firms} \leq 1.00$	107	159	25.81

I next test how well the model predicts the outcome of antidumping petitions filed in the United States. As noted above, between 1980 and 1996 approximately 20.0 percent of all petitions were either terminated or suspended prior to reaching a final government decision. Of those petitions not settled, slightly over half were successful during the sample period. In contrast, the model predicts a slightly lower settlement rate of 17.4 percent of the petitions actually filed and success rate for the rest of the petitions of 47.9 percent. I fail to reject the null hypothesis that the model predicts the failure of a settlement agreement between the foreign and domestic industries at the five percent significance level, and the null hypothesis that the model accurately predicts the failure of the remaining petitions at the 1 percent significance level.

The results from a chi-square goodness-of-fit test for the level of protection awarded by the government, or τ^* , are included in Table [7].²⁹ In general, the test statistics indicate that the model is able to predict tariffs between 20 and 80 percent much more accurately than those under 20 percent or above 80 percent.

5.2 Counterfactual Experiments

One of the primary benefits of estimating a structural model of this nature is that the parameter estimates are said to be invariant to policy changes and can be used to

²⁹The test is similar to those used to test other aspects of the model in that I first divide the expected level of protection into n discrete ranges.

TABLE 7

Chi-Square Goodness of Fit Test: Tariff Rate

Tariff Range	χ^2 Statistic
$\tau^* = 0.00$	13.76
$0.00 < \tau^* \leq 0.20$	60.32
$0.20 < \tau^* \leq 0.40$	2.60
$0.40 < \tau^* \leq 0.60$	6.62
$0.60 < \tau^* \leq 0.80$	5.03
$\tau^* \geq 0.80$	23.88

conduct counterfactual policy experiments. This section discusses the results of two such experiments that may alter an industry's ability to overcome the free rider problem. The first counterfactual experiment increases the per firm cost of filing a petition, while the second increases the benefits to firms that participate in a successful petition by 10 percent.³⁰ In the discussion below, I compare the outcome of the counterfactual experiment with the outcome of the baseline simulation of the model. Outcomes of interest include the number of firms participating in each petition, as well as the outcome of the petitions.

As noted above, in the first experiment I increase the average per firm cost of filing a petition by 10 percent, from 180.7 to 198.8. The number of petitions filed falls dramatically to an average of just 420 petitions over the sample period, a decrease of 49.1 percent. The average number of firms participating in each petition also decreases slightly to 3.7, or 38.8 of all firms in the industry. Intuitively, as the private costs of joining the petition increase fewer firms are willing to invest in the rent-seeking activity and the free rider problem is exacerbated. Surprisingly, the distribution of case outcomes does not change significantly when the cost of filing a petition increases. For example, it continues to be the case that slightly over half of those petitions not settled out of court are successful. It is true that

³⁰In each experiment, I use the structural parameter estimates and draws of the model's errors to simulate the number of firms choosing to participate in each opportunity; if the industry chooses to file a petition, I also simulate the outcome of the petition. Choices are simulated for six draws of the error terms.

when the costs of filing a petition are higher, only those petitions with higher returns will be filed. The results from the simulation, therefore, suggest that there are often significant returns to filing a petition even when it is unsuccessful.³¹

The second experiment rewards firms that participate in successful antidumping petitions with additional, private benefits. The experiment is intended to mimic a change in U.S. antidumping law that was passed in 2000 known as the “Continued Dumping and Subsidy Offset Act,” which requires the government to distribute the tariff revenue collected due to successful antidumping petitions to the firms that supported these petitions.³² Economic theory suggests that critics of the law are correct in their charge that the law will increase the number of antidumping petitions filed in the United States. Intuitively, a policy that increases the private benefits of participating in an antidumping petition should help alleviate the free rider problem and, thus, increase the number of petitions filed.

The results of the counterfactual experiment confirm this intuition. When the private benefits to those firms participating in a successful antidumping petition are increased by 10 percent, the number of petitions filed over the sample period increases by 9.3 percent. Moreover, more firms choose to actively participate in these petitions; the average proportion of eligible firms filing antidumping petitions increases by 1.6 percentage points under the counterfactual experiment. On the whole these petitions are more successful, suggesting that not only will more petitions be filed but the total level of antidumping protection will rise when the private benefits of participating are increased. Under the experiment, the percentage of cases settled out of court falls by 1.4 points because firms only receive the additional private benefits if the government imposes a dumping margin. Of the remaining petitions, however, the percentage of successful cases increases by 5.3 percentage points and the average dumping margin increases by 12.1 percent from the baseline model. Because firms are only awarded additional private benefits when a petition is successful, and these benefits

³¹This result mirrors the results from other studies of the “investigation effects” of petitions. For example, Staiger and Wolak [1994] find that antidumping petitions reduce the flow of imports during the period of investigation by half of the reduction that would be expected if the petition is successful.

³²In September 2002, the World Trade Organization ruled that the law violates the international agreement on subsidies. However, the United States has yet to repeal the law.

increase with the dumping margin, the policy change increases the number of successful petitions filed by firms but the number of unsuccessful petitions remains the same. In total, the number of successful petitions filed by firms increases by 30.3 percent from the baseline model.

6 Conclusion

This research develops and estimates a model of a firm's decision to engage in rent-seeking activities, and more specifically antidumping petitions. The model hypothesizes that industries are able to overcome the free rider problem associated with lobbying for trade protection because firms who choose to actively lobby will receive private benefits in the form of an increase in the level of protection. The parameter estimates support this hypothesis. The results also support some of the conclusions from theoretical studies of the free rider problem in collective actions, namely that industries with more firms and those that are less competitive are less likely to overcome the free rider problem.

The results from the model confirm theoretical predictions about the distribution of trade protection in an economy. For example, parameter estimates indicate that the level of antidumping protection provided by the government is a function of both economic and political factors, as suggested by the theoretical research on the political economy of trade policy and bureaucratic decision-making. The parameter estimates also confirm that the larger the amount of private-information held by the domestic and foreign industries, the less likely these parties will be able to reach a welfare-enhancing negotiated settlement following the initiation of an antidumping investigation.

Policy experiments suggest that even small changes in antidumping law can dramatically change the number of antidumping petitions filed each year. For example, a 10 percent increase in the cost of filing a petition results in a nearly 50 percent decrease in the number of petitions filed. In contrast, increasing the private benefits of participating in a successful petition by only 10 percent increases the number of successful antidumping petitions filed by industries by slightly over 30 percent. In general, the results indicate that the level of trade

protection in an economy is strongly influenced by policies that help or hinder industries overcome the free rider problem.

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A Simulation Details

The model described in Section 2 makes a distinction between situations in which the industry has no opportunity to file against country k and situations in which an opportunity to file exists but no firms choose to actively participate in the petition. Unfortunately, I cannot distinguish between these two events in the data. Because I do not observe the number of antidumping petitions each industry has the opportunity to file against country k in period t , I need to simulate this number of opportunities. The simulator must be constructed in such a way that it guarantees that the number of opportunities each industry has to file exceeds the number of petitions actually filed by the industry in period t .

Allowing the number of opportunities to vary as I update my parameter values causes discontinuities in the likelihood function. In order to ensure that the estimation procedure is continuous in the parameter space, I keep the number of opportunities to file constant throughout the estimation procedure. As I update my parameter values, the term in the likelihood function that incorporates the probability of observing a particular number of opportunities is smoothed in the parameter space using the probability of observing those opportunities based on the initial parameter choice.

Define P_{kjt} as the number of petitions actually filed by industry j against country k . Consider the following algorithm³³:

1. Choose an initial value of the parameters, θ_o .
2. For each industry/country combination, draw a random variable ζ_o^R from a Gamma (θ_o^F) distribution, and calculate the rate at which opportunities arise $\lambda_{kjt} = \exp[X_{Fkjt}\beta_F + \ln \zeta_o^R]$.
3. For each industry, country and year combination, draw a random variable (o_{kjt}^o) from a Poisson(λ_{kj}) distribution, conditional on the fact that $o_{kjt}^o \geq P_{kjt}$. Define o_{kjt}^o as the number of opportunities industry j has to file against country k in period t .

³³This algorithm uses the multiplication method to draw random variables from a Poisson distribution. The multiplication method has been shown to be a preferred simulation method when λ_{kjt} varies for each observation.

As noted above, I keep the number of opportunities (o_{kjt}^o) constant throughout my estimation procedure. As the parameter values, θ , are updated, I calculate the probability of observing o_{kjt}^o opportunities based on the new parameter values, and smooth this probability in the parameter space using the probability of observing o_{kjt}^o based on the initial parameter values. Mathematically, this can be written as:

$$\frac{\Pr(\Omega_{kjt} = o_{kjt}^o | \theta)}{\Pr(\Omega_{kjt} = o_{kjt}^o | \theta_o)}$$

This algorithm can be interpreted as an importance sampling simulator by rewriting the probability of observing a particular number of opportunities as:

$$\Pr(\Omega_{kjt} = o | \theta) = \frac{\Pr(\Omega_{kjt} = o | \theta)}{\Pr(\Omega_{kjt} = o | \theta_o)} \Pr(\Omega_{kjt} = o | \theta_o)$$