

Antidumping, the Terms of Trade, and WTO Dispute Settlement^{†,‡}

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Abstract

This paper empirically examines how governments make trade policy adjustments under a self-enforcing trade agreement in the presence of economic shocks. Using data on US antidumping (AD) policy formation between 1995-2003, we find that US antidumping policy is consistent with the “managed trade rule” predicted by Bagwell and Staiger (1990). Estimates of an empirical model of US antidumping indicate that the likelihood of a US antidumping duty is increasing in the size of the unexpected import surge and decreasing in the elasticities of export supply and import demand. This suggests that time variation in US trade policy is consistent with a model in which the US government temporarily raises its tariff above the WTO’s contractual level in order to “manage” the terms of trade pressure associated with an unexpected import surge. We then empirically examine how the US’s trading partners in the WTO respond to US antidumping actions. After controlling for factors such as retaliation capacity and the expected cost and benefit to a WTO dispute, we find that trading partners are *less* likely to file WTO challenges over “cooperative” US AD duties that are imposed under terms-of-trade pressure.

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1 Introduction

For decades, theorists of international commercial policy have modeled how the incentive to affect the terms of trade influences the formation of trade policy.¹ Long thought to be a simple intellectual curiosity that had little relationship to how governments actually set their trade policies, the terms-of-trade theory has recently become the center of a number of empirical papers providing evidence that the motive does matter for trade policy formation.

Broda, Limão and Weinstein (2008) provide two pieces of evidence broadly consistent with the theory. First, they estimate disaggregate foreign export supply elasticities and find that countries that are not members of the World Trade Organization (WTO) systematically set higher tariffs on goods that are supplied inelastically. Second, for a WTO member like the US, they find that trade barriers on products not covered by the WTO agreement are significantly higher when the US has more market power. In a separate setting, Bagwell and Staiger (2006) focus on a set of countries newly acceding to the WTO between 1995 and 2005 in order to examine whether the terms-of-trade motive affects their accession tariff cut commitments. They find evidence consistent with the theory of the importance of the terms-of-trade effect; the tariff to which a country negotiates is further below its non-cooperative level, the larger is its non-cooperative import volume.

Our paper contributes to this empirical literature by examining whether the terms of trade affects time-varying trade policies. In particular, we study whether the terms-of-trade motive affects how countries adjust their trade policies over time in response to trade volume shocks. The earlier empirical literature has examined whether the terms-of-trade motive affects the country's *tariff level* (Broda, Limão and Weinstein, 2008) or the magnitude of a country's one-off *tariff reduction* when moving from a non-cooperative policy to a trade agreement (Bagwell and Staiger, 2006). We focus on whether the motive affects WTO member countries' time-varying *upward adjustments* to their trade policies in the face of economic shocks.

To give our exercise context, it is important to note that while trade agreements like the WTO

¹Irwin (1996) provides a full account of the intellectual history of the theory, which he finds dates back at least to Robert Torrens in the early nineteenth century. For more recent treatments, see the seminal work of Johnson (1953-1954) and for integration into the theory of trade agreements, see Bagwell and Staiger (1990, 1999).

do impose an upper limit on a member country's permissible applied tariff, there are important exceptions to WTO rules which allow countries to raise their import-restricting policies above those upper tariff limits under certain conditions. The most prevalent exception used by developed countries and a number of middle income developing countries is the antidumping (AD) import-restricting policy, which thus serves as the basis for our empirical analysis.² In particular, one major contribution of this paper is to provide a first examination of the empirical relationship between the terms of trade motive and antidumping policy.

The basic intuition behind our empirical approach follows the theoretical model of Bagwell and Staiger (1990), a repeated game in which two countries trade in the presence of unanticipated trade volume shocks. Bagwell and Staiger model a self-enforcing trade agreement as the set of cooperative tariffs that countries can support over time.³ Consider the role of potential terms of trade gains, embodied by the size of the import demand and export supply elasticities, on a country's incentive to raise its tariff. Bagwell and Staiger show that the incentive for a country participating in a trade agreement to raise its tariff due to potential terms of trade gains is greater when import volumes are larger than expected. In the presence of a positive import volume shock, a self-enforcing agreement to maintain low tariffs cannot be sustained in sectors with low import demand or export supply elasticities - either the cooperative tariff supported by the trade agreement will rise or one country will unilaterally defect from the agreement and impose a higher tariff.

We empirically evaluate the Bagwell and Staiger (1990) model's ability to explain changes to a country's trade policy over time. In particular, we examine the extent to which an antidumping use can be understood as an increase in a cooperative trade policy - i.e., increasing the tariff above a trade agreement's contractual level in order to "manage" the terms of trade pressure so as to

²Many developing countries undertake binding commitments at the WTO that are significantly above the applied tariff rates that they impose in practice, and they are able to make trade policy adjustments over time by simply changing their applied rates. Thus we do not focus our empirical analysis on such countries here.

³Below we also appeal to extensions of this theoretical model found in Bagwell and Staiger (2003). To our knowledge, the only attempt to test implications of the Bagwell and Staiger (1990) approach are Prusa and Skeath (2002), which is much different than the exercise we undertake here, especially in that they do not look to formally model the impact of terms of trade motives for antidumping use.

prevent itself from defecting from the agreement in the face of positive import volume shocks.⁴

Is such an empirical relationship likely in the case of antidumping? Consider the scatter plot of figure 1 in which the number of US antidumping measures imposed between 1995 and 2005 in an industry are plotted against the industry's export supply elasticity faced by the US. The horizontal axis takes the export supply elasticity for a 4-digit product-group from Broda, Limão and Weinstein (2008), and the vertical axis uses the number of final antidumping measures imposed by the US within each 4-digit product group over the eleven year period. The figure suggests that US antidumping policies are concentrated in product categories for which the export supply is relatively inelastic. Because antidumping duties can only be imposed in the presence of increased imports or a threat of increased imports, this figure suggests that the US could be using antidumping policy to increase its trade barriers cooperatively in response to the terms of trade pressure that would otherwise cause it to defect from the agreement in the face of positive import volume shocks. Thus, the first question our formal econometric analysis addresses is whether US use of AD policy can be characterized as an effort to respond to such terms-of-trade pressure in the face of import volume surges.⁵

While a substantial literature examines a country's use of antidumping policies in response to macro-economic or industry-level economic fluctuations (e.g., Feinberg, 1989; Knetter and Prusa, 2003; Irwin, 2005; Crowley, 2008), ours is the first to examine the relationship among industry-level economic fluctuations in importing and exporting economies, bilateral trade flows, micro trade elasticities, and time-varying trade policies in the context of a theoretical framework in which countries participate in a self-enforcing trade agreement in order to internalize welfare-reducing terms-of-trade externalities.

In the second part of our analysis, we turn to examine the functioning of the WTO trade agreement under such a cooperative setting. In particular, suppose under the WTO regime that antidumping duties arise in sectors in which export supply elasticities are low and import volumes

⁴Since we are doing this year-by-year, in extensions we can also examine whether shocks predict the *removal* of imposed antidumping measures as well.

⁵What follows below are preliminary results. We have the data and in future revisions will be extending the analysis to other AD-using countries as well.

are unexpectedly high. Therefore, the use of antidumping policy is consistent with a cooperative increase in import protection to prevent defection from the agreement under pressure to exploit the terms of trade. How should and do affected trading partners respond to US imposition of new AD?

An initial glance at the data of WTO trading partner's response to US imposition of new AD suggests that trading partners certainly do not always view US use of AD as cooperative. Of the less than 200 US AD measures imposed between 1995 and 2006, over 60 of them were formally challenged for removal by trading partners at WTO dispute settlement (Bown, 2007).⁶ And these figures do not even take into account potential "extra-WTO" challenges to these new US AD policies that would take place under foreign country's own antidumping policies, for instance. Therefore, there is substantial variation across imposed US AD duties as to which AD measures trading partners consider cooperative and which ones they do not that we can exploit in our analysis.

The theory of Bagwell and Staiger (1990) implies that the response of WTO members to a US antidumping duty will vary according to the variables that determine the potential terms-of-trade gains to the US as well as the expected costs and benefits to trading partners formally responding. Suppose a WTO member views its own trade policy and that of the US as cooperative policies in a self-enforcing trade agreement. In this model, the partner interprets a US antidumping duty imposed in response to a positive trade volume shock as a *temporary* effort to mitigate the economic pressure to defect. Thus, the partner "accepts" the US policy because the discounted present value of cooperation exceeds the discounted present value of challenging the policy. In this vein, a new US antidumping duty that is justified by these terms-of-trade forces is acceptable, whereas any new US antidumping duty that has little relation to terms-of-trade forces (e.g. trade volume, trade elasticities) is unacceptable. The latter would simply be a deviation from the agreement and, consequently, we would expect trading partners to be more likely to challenge it for removal at the WTO.

More formally, in the second part of the paper we empirically develop a model to examine the

⁶While challenging an imposed AD measure is quite a common subject for WTO trade disputes, the frequency of challenges to US measures is an order of magnitude facing any other WTO member country.

consistency of the data with this interpretation of foreign WTO challenges to US-imposed AD. Our initial result does suggest a strong, positive *bivariate* relationship between the predicted probability of US AD use driven by the terms-of-trade motive and WTO challenges. Nevertheless, this potential paradox is resolved and the sign on this simple bivariate relationship is reversed once we introduce other control variables that capture the costs and benefits to the trading partner of WTO dispute settlement use. In particular, once we control for heterogeneity in costs to the foreign exporter for the failure to litigate a particular case (Maggi and Staiger, 2008) and differences in the foreign country’s retaliation capacity (Bown 2004a,b), there is evidence that foreign countries are *less* likely to challenge US AD measures at the WTO that are associated with higher terms-of-trade driven forces.⁷ Thus, once we control for expected costs and benefits to the trading partner of a WTO dispute, we find that foreign countries are less likely to challenge US AD measures that “manage” import surges under terms of trade pressure. As we describe in section 5.2, these results are robust to extensions of the model in which the action space of a foreign country is expanded to include an additional “extra-WTO” policy response to US AD imposition via the country’s own (reciprocal) antidumping policy.

The rest of this paper then proceeds as follows. Section 2 presents a brief description of the theoretical literature on AD formation, and in particular the insights from the Bagwell and Staiger (1990, 2003) repeated game approaches to modeling such trade policy changes as a function of export supply and import demand elasticities in the face of economic shocks and a terms-of-trade motive. In section 3, we provide our empirical model on AD formation, and we discuss how we apply the model to the case of antidumping use by the United States and the available data needed. Section 4 presents our estimates of a relationship between these theory-driven variables and US use of antidumping over the 1995-2003 period. In section 5 we take the analysis one step further

⁷The second part of the paper fits into a budding literature examining determinants of use of the WTO dispute settlement forum, and in particular differences in relative use between developed and developing countries. Consistent with the results we provide, much of the systematic differences can be explained by expected political-economic determinants. See, for example, Horn, Mavroidis and Nordstrom (2005), Bown (2004, 2005a, 2005b) and Busch, Reinhardt, and Shaffer (2008). Nevertheless, one shortcoming of this literature that the current paper ultimately seeks to remediate is that the formation of the policies that are actually challenged may be endogenously affected by the dispute settlement process.

by examining whether WTO trading partners view US AD duties as acts of “cooperative” trade policy adjustment or as defections from the trade agreement by estimating a model of challenges to US AD at the WTO. Finally, section 6 concludes.

2 The Theoretical Literature on Antidumping Duty Formation and the Terms of Trade

To what extent do countries use antidumping (AD) as a short-run tariff change to manage the pressure to take advantage of shocks that create potential terms-of-trade gains? To what extent is the use of AD under such a motive acceptable to trading partners under a trade agreement?

Bagwell and Staiger (1990) proposed that trade policy interventions by countries facing unexpected import surges could be understood within the framework of a dynamic repeated game in which countries participate in a self-enforcing trade agreement. In their model, two countries playing a repeated game characterized by a terms of trade driven prisoner’s dilemma could support a welfare-improving equilibrium of lower “cooperative” tariffs with the threat of infinite reversion to the Nash equilibrium of the stage game. They showed that the lowest cooperative tariff that can be supported at any time fluctuates in response to unexpected changes in import volumes. In response to a positive import volume shock, the lowest cooperative tariff that can be supported rises. Because the importing country’s terms of trade gains from deviating from the agreement are higher when import volumes are larger, it becomes infeasible to support the tariff originally negotiated under the trade agreement. In these circumstances, the cooperative tariff supported by the trade agreement rises for the duration of the import surge.

In developing an empirical model of US antidumping duty formation within the framework of US participation in the WTO, we are guided by the testable predictions of the Bagwell and Staiger model. An importing country’s incentive to defect from a self-enforcing trade agreement is increasing in the terms of trade gain the country would receive from raising its tariff. According to equation (28) of Bagwell and Staiger (1990), the incentive to defect is increasing in the size of the import volume shock and is decreasing in the export supply and import demand elasticities. The

model thus provides an explanation for intertemporal and cross-sectional variation in trade policy changes by a member of the trade agreement. With regard to intertemporal variation, a given sector may have low export supply and import demand elasticities, but the model of self-enforcing trade agreements predicts that we should only observe increases in the tariff when the volume of imports in that sector rises unexpectedly. Cross-sectionally, if two sectors simultaneously experience unexpected import surges of the same size, the model predicts that the tariff increase will be larger in the sector with less elastic export supply and import demand. Furthermore, temporary increases in trade protection will be larger when import surges are more “unusual.” Equations (19) and (20) of Bagwell and Staiger (1990) together imply that the magnitude of the tariff increase is greater for sectors in which import surges are uncommon. For import surges of the same size in two different sectors, the magnitude of the tariff increase will be larger in the sector with the lower *variance* of imports.

To investigate whether countries use AD policy to capture terms-of-trade gains, we develop the following expression for changes in a country’s tariff from equations (19), (20), and (28) of Bagwell and Staiger (1990). We refer to the following as the “WTO managed trade rule”:

$$\Delta\tau_{ikt} = f\left(\frac{1}{\sigma_{Mik}(\eta_{xk} + \eta_{mk})}[M_{ikt} - E(M_{ikt})]\right) \quad (1)$$

where $\Delta\tau_{ikt}$ is the change in the US’s tariff against imports from i in industry k under antidumping policy, σ_{Mik} is the standard deviation of imports from country i in industry k , η_{xk} is the elasticity of export supply facing the US in industry k , η_{mk} is the elasticity of import demand in industry k , M_{ikt} is imports into the US from country i in industry k at time t , and $E(M_{ikt})$ is the expected value of imports from country i in industry k at time t .

To summarize the implications of Bagwell and Staiger (1990) for our approach, the incentive to temporarily raise one’s tariff is higher if

1. imports are larger than expected,
2. the volatility (standard deviation) of imports is low,

3. the export supply elasticity is low, and
4. the import demand elasticity is low.

In applying this model to antidumping policy, we proceed in two steps. We first estimate empirical models of (1) on a panel of US imports to determine if the US's use of antidumping policy is broadly consistent with the predictions. In section 3 we describe the model and the underlying data sources, and in section 4 we describe the results. Since our results indicate evidence that US AD formation is consistent with the theory of self-enforcing trade agreements, then the second step is to assess the response of WTO members to changes in US policy under the "WTO managed trade rule." Before describing the estimation approach that we ultimately adopt to address this issue in section 5, we first discuss the underlying theory.

Assessing foreign challenges to US AD policy is potentially informative about the relevance of the terms-of-trade motive for AD formation. In equilibrium, if US AD policy is always set under a "WTO managed trade rule" so that any tariff increase is *cooperative*, we would never observe a challenge to US policy in the WTO dispute settlement body. Thus, our approach is to treat the estimated "WTO managed trade rule" as a policy rule that provides information as to whether or not a specific observation of antidumping policy is *justified* under the economic circumstances predicted by the Bagwell and Staiger (1990) theory. We use the empirical model described above to predict the likelihood that an antidumping duty is imposed against country i industry k in year t . If the predicted probability that the US will impose an antidumping duty for ikt is high, then we interpret an individual antidumping policy against ikt as consistent with the "WTO managed trade rule" and, thus, less likely to be challenged at the WTO.

We therefore assess determinants of foreign challenges to US AD policy by estimating a second policy rule which we call "Foreign response to US antidumping policy" in section 5. This second rule is a binary rule in which the US's trading partners can either accept a US tariff increase passively or challenge the US policy in the WTO's dispute settlement body by filing a WTO dispute. The foreign trading partner will challenge the US policy rule if the discounted present value of filing a WTO dispute less the cost of filing the dispute is larger than the value of passively accepting the

tariff change. If the US’s trading partners view a US policy change as an increase in the cooperative tariff that is consistent with the “WTO managed trade rule,” then we expect to observe the trading partner passively accepting the policy change. If however, the trading partner views a US policy change as a non-cooperative defection from the WTO agreement (for example if the predicted probability of an antidumping duty against ikt under the “WTO managed trade rule” is very low, or alternatively if the height of the antidumping duty is perceived as too high, or the duration of the duty is too long), then we expect the policy to be challenged at the WTO.

As a final robustness check, we also estimate an augmented “Foreign response to US antidumping policy” which expands the set of possible responses by a US trading partner to include extra-legal unilateral retaliation against the US through an increase in the trading partner’s own tariffs under its own antidumping policy.

Appendix B provides a rough sketch of the stage game and brief descriptions of the value functions of each player.

3 Empirical Model of Antidumping Duty Formation

In this section, we present our empirical models of US antidumping duty formation to determine if the US is using antidumping policy in a manner intended to capture terms of trade gains as hypothesized by Bagwell and Staiger (1990 and 2003).

3.1 Empirical Models of Duty Formation

We estimate two different empirical models of antidumping duty formation against country i in industry k in year t : (1) a binary model (probit) of whether or not an antidumping duty was imposed by the US and (2) a censored regression (tobit) of the magnitude of the antidumping duty imposed by the US.

In the binary model, the US government makes a decision of whether or not to impose an antidumping duty according to a latent measure of the potential benefits to the US of imposing a tariff against country i in industry k . The latent measure d_{ikt}^* is unobserved, but takes the form

$d_{ikt}^* = \beta' x_{ikt} + \varepsilon_{ikt}$ where i denotes the foreign country accused of dumping, k denotes the industry in which dumping is alleged to occur, and t denotes the time period in which the complaint is filed by the US industry. The variables included in x_{ikt} are a measure of the import growth into the US from foreign country i in industry k in year $t - 1$, the standard deviation of imports from country i in industry k over the sample period, the export supply elasticity facing the US in industry k , the US import demand elasticity in industry k , the bilateral real exchange rate between the US and country i at $t - 1$ (measured in foreign currency over US dollars) and, in some specifications, measures of US and foreign industry size at time $t - 1$.

The US imposes an antidumping duty according to the rule:

$$d_{ikt} = \begin{cases} 1 & \text{if } d_{ikt}^* > 0 \\ 0 & \text{if } d_{ikt}^* \leq 0 \end{cases} \quad (2)$$

Assuming $\varepsilon_{ikt} \sim N(0, 1)$, then the likelihood is

$$L = \prod [\Phi(\beta' x_{ikt})]^{d_{ikt}} \prod [1 - \Phi(\beta' x_{ikt})]^{1-d_{ikt}} \quad (3)$$

where Φ is the standard normal cdf.

Marginal effects derived from coefficient estimates obtained from maximizing the log of the likelihood (3) are reported in table 2. Maximum likelihood estimates from the tobit model of the magnitude of US antidumping duties are reported in table 4.

3.2 Data used to estimate antidumping duty formation

We estimate the empirical model of US antidumping duty formation on a panel dataset constructed from three primary data sources: (1) the industry k foreign export supply elasticities facing the US from Broda, Limão, and Weinstein (2008), (2) the World Bank's Trade, Production and Protection Data (Nicita and Olarreaga, 2007) and (3) the Global Antidumping Database (Bown, 2007). Annual bilateral real exchange rates in foreign currency per US dollar come from the USDA Economic Research Service. Summary statistics for all variables in the dataset are reported in table 1.

The World Bank's Trade, Production and Protection Data provides information on output, imports, exports, and employment for 28 3 digit ISIC Rev. 2 manufacturing industries from 1980-2004 for 86 developed and developing economies. Supplements to the TPP dataset provide bilateral imports and exports for 28 3 digit ISIC Rev. 2 manufacturing industries as well as import demand elasticities. In the analysis, the EU is treated as a single country in which an antidumping measure imposed against any union member is recorded as a policy measure against the EU.

The US files in the Global Antidumping Database provide detailed information on the date a petition was filed, the identity of the country accused of dumping, tariff line information on the products involved, the outcome of the investigation and the magnitude of any final antidumping duty imposed by the US against country i .

4 Empirical results on antidumping duty formation

The empirical results reported in tables 2-4 provide strong evidence that US imposes antidumping duties in a manner consistent with the theoretical model of Bagwell and Staiger (1990). Table 2 reports that US trade policy changes are more likely the greater the potential terms of trade gains. In table 4 our estimates show that the magnitude of antidumping duties imposed by the US are decreasing in the elasticity of export supply facing the US. As the export supply becomes less elastic, the magnitude of the antidumping duty imposed by the US increases.

Table 2 presents estimates of the binary model of the US government's decision to impose a final antidumping measure against country i in industry k in year t . Estimates are presented as marginal effects in which a one-unit increase in a variable is associated with an incremental increase in the probability that the US will impose an antidumping duty.

Column 1 presents results for the basic specification of the model. A one-unit increase in the growth of bilateral imports from country i in industry k in the year before an antidumping petition is filed is associated with an increase in the probability of an antidumping measure of 0.07%. This positive relationship between imports and antidumping duties is consistent with the terms of trade theory that hypothesizes that the benefit of raising a tariff to exploit terms-of-trade gains is

increasing in the size of the import surge. Proceeding down column 1, we find that antidumping duties are less likely when import flows are highly volatile. A one-unit increase in the standard deviation of imports from country i in sector k is associated with a fall in the probability of an antidumping measure of 0.36%. Turning to the elasticity of export supply, consistent with the theory of optimal tariffs, we find that the likelihood of imposing a tariff in industry k is decreasing in the export supply elasticity in industry k . As export supply becomes more elastic, the US becomes less likely to impose an antidumping duty. Finally, we find that the US government is more likely to impose an antidumping duty in a sector in which US import demand is less elastic.

Column 2 presents estimates for a model in which we instrument for the lagged value of import growth from country i industry k at time $t - 1$ (which although predetermined, could be endogenous to expected trade policy changes) with lagged measures of industry-level consumption and employment growth in the US and the exporting country. Appendix table 1 presents estimates of our simple model of bilateral trade flows at the industry level. Overall, import growth into the US is procyclical with respect to US consumption growth in industry k and countercyclical with respect to consumption growth in the foreign country's industry from which the imports originate. When we substitute the model's predicted value of lagged bilateral import growth for actual lagged bilateral import growth into from the binary model of antidumping duty formation, the standard error of the coefficient on import growth increases sufficiently that the instrumented variable is not a statistically significant determinant of antidumping duties. However, the signs and magnitudes of all other variables of interest are essentially unchanged.

Column 3 presents estimates in which we utilize a measure of import growth tightly linked to that in the theoretical model of Bagwell and Staiger (1990). In this specification, we measure the US import surge from country i industry k at time $t - 1$ as the difference between the actual bilateral growth of imports and the growth of imports predicted by the model of bilateral trade flows in specification (4) of appendix table A. Because the Bagwell and Staiger model predicts that the incentive for a country to raise its tariff is increasing in the difference between actual and expected trade volume, we expect the sign on this variable to be positive and find that it is. The magnitude of the marginal effect of a change in this variable on the likelihood of an antidumping

duty is almost the same as that in specification (1).

Specification 4 adds additional controls to the basic specification in column (1). Previous studies (Staiger and Wolak, 1994; Crowley, 2008) have utilized the employment of the US industry as a proxy for the industry's political economic strength and have found that antidumping duties are more likely in industries with high employment. Crowley (2008) finds the likelihood of a US antidumping duty is increasing in the logged level of employment in a foreign country's industry. Interestingly, we find that after controlling for the elasticity of export supply, the probability of a US antidumping duty is decreasing in the US industry's employment.

Finally, specification 5 uses another alternative measure of the import surge facing the US. Previous studies on antidumping in the US (Staiger and Wolak, 1994; Crowley, 2008) have found that the lagged import penetration ratio (imports from country i industry k divided by domestic output of industry k) is a good predictor of antidumping activity. Substituting lagged import penetration by country i in industry k for lagged bilateral import growth, we find that the likelihood that an antidumping duty will be imposed is strongly increasing in import penetration. When the binary model of antidumping duty formation utilizes import penetration, the marginal effects of changes in trade elasticities on the probability of an antidumping duty being imposed are similar in magnitude to those of specification (1).

Table 3 quantifies the key results of table 2 in terms of their economic significance. In table 3, we report the predicted probability that the US will impose an antidumping duty in response to a one standard deviation change in the explanatory variables. We begin by observing that antidumping duties are rarely used. The last two rows of table 3 present statistics on the infrequent use of antidumping duties in the sample of data used to estimate the binary model for each specification. The last row reports the number of observations in the estimation sample while the second to last row reports the probability of an antidumping duty being imposed in that sample. For the sample in specification (1), antidumping duties were imposed against only six-tenths of one percent of country-industry-year observations.

How would a change in the magnitude of an explanatory variable affect the probability of a duty being imposed? Beginning with specification (1), a one standard deviation increase in the

growth of lagged bilateral imports would increase the probability of an antidumping duty only slightly, from 61 hundredths of a percent to 67 hundredths. Similarly, a one standard deviation reduction in the volatility of imports is associated with only a modest increase in the likelihood of an antidumping measure. Interestingly, in accordance with terms of trade motivations for tariff-setting, a one-standard fall in the elasticity of export supply roughly doubles the probability that an antidumping duty would be imposed by the US government from 6 tenths of a percent to 1.2%. Finally, we observe that a one standard deviation fall in the US import demand elasticity increases the likelihood of an antidumping measure by a factor of roughly 1.25.

Proceeding across columns (2) through (5), results are quantitatively similar to those in column (1). Regardless of specification, a lower elasticity of export supply increases the probability of an antidumping duty significantly. For example, in the specification with the tightest link to the theoretical model of Bagwell and Staiger, specification (3), a one standard deviation reduction in the export supply elasticity increases the likelihood of an antidumping duty by almost 80%. In summary, the binomial model of antidumping duty formation suggests that terms of trade motives are important in explaining the time variation in US trade policy.

Finally, in table 4 we present additional evidence that potential effects of the terms of trade are an important consideration of the US when it implements antidumping duties. We find, consistent with the Bagwell and Staiger model, that the *size* of duties imposed by the US government are decreasing in the elasticity of export supply. The magnitude of the duty imposed when a country is found to be guilty of dumping is increasing as export supply becomes more inelastic. The results across all specification are broadly consistent with those in the binary model of antidumping duty formation. However, in the censored regressions, the measure of bilateral import growth is not a statistically significant determinant of the size of the duty except when the lagged measure of import penetration is used. This is not surprising as we might expect that the size of an import surge would affect the likelihood of a duty being imposed, but the elasticities of import supply and export demand would be the key determinants of the size of the tariff.

Turning to the estimates in table 4, we find that the effects on the size of the duty of the variability of imports, the export supply elasticity and the import demand elasticity have the expected

sign across all five specifications. In specification (1), the coefficient on the standard deviation of imports can be quantified as indicating that a one standard deviation fall in the standard deviation of imports increase the magnitude of the final antidumping duty by 0.2 percentage points. This is a moderate, but not insignificant increase relative to the mean duty in the sample of 0.14 %. Proceeding down column (1) to our key variable of interest, the maximum likelihood coefficient on the elasticity of export supply of -0.789 can be reinterpreted as a marginal effect on the size of the duty of -0.004. This means that a one standard deviation fall in the elasticity of export supply would be associated with an increase in the antidumping duty of 0.8%. This is a more than a five fold increase relative to the sample mean of 0.14%. The effect of a reduction in the import demand elasticity is smaller than that of the export supply elasticity; a one standard deviation fall in the import demand elasticity is associated with 0.1 percentage point increase in the magnitude of the duty. It appears that in setting the size of an antidumping duty, an inelastic export supply has a quantitatively larger impact than an inelastic import demand elasticity, although both are significant and move in the direction predicted by the theory. Specifications (2)-(5) indicate that the basic results are robust to the choice of the measure of bilateral import growth and to the inclusion of explanatory variables on domestic and foreign industry size.

Lastly, in specification (1), the lagged log level of the bilateral real exchange rate is not a statistically significant determinant of the size of the duty. However, in specifications (2), (3) and (5), a real appreciation of the US dollar is associated with a higher antidumping duty. Quantitatively, the effect is small, a one standard deviation increase in the variable increases the magnitude of the antidumping duty by only 0.06 percentage points. However, the direction of the effect is in line with previous work by Knetter and Prusa (2003), Feinberg (2005), Jallab, Sandretto, and Gbakou (2006), and Crowley (2008) all of whom find that the probability of an antidumping duty is higher when the real dollar appreciates.

In summary, a large literature has explored the determinants of antidumping protection. This paper is the first to examine the relationship between antidumping duties and variables associated with a terms of trade motivation for temporary protection. We find that in the US, antidumping duties are more likely, and the magnitude of the duties imposed are larger, when the elasticity

of export supply is more inelastic. Thus, a trading partner of the US could reasonably interpret US temporary trade restrictions under the antidumping statute on average as following a “WTO managed trade rule” similar to that proposed in Bagwell and Staiger (1990). This finding raises the question: how do the US’s trading partners respond to changes in US trade policy made under a “WTO managed trade rule”? Do they quietly tolerate these temporary changes in trade policy as part of a self-enforcing agreement, or do they view these changes as defections from the agreement that must be legally challenged in the WTO dispute-settlement forum or unilaterally and extra-legally punished through retaliatory antidumping tariffs? We investigate these questions next.

5 Foreign Challenges to AD formation - WTO Dispute Settlement and AD Retaliation

5.1 Estimating an empirical model of WTO dispute settlement

The results of the last section indicate substantial evidence from the United States’ use of antidumping consistent with the Bagwell and Staiger (1990, 2003) theory of a cooperative trade policy change as part of a dynamic, repeated game between countries. Part of the motive for countries to use antidumping trade policy can be interpreted as a cooperative increase in import barriers in response to the terms-of-trade motive.

Nevertheless, if government use of antidumping policy is part of a cooperative, repeated game, how are we to rationalize ex post challenges to newly imposed antidumping measures through WTO dispute settlement? A separate, and thus far unaddressed phenomenon in the data is that many of these newly imposed “cooperative” measures are subsequently challenged by trading partners via WTO dispute filings that ultimately seek their removal. Between 1995 and 2006, for example, at least ten different WTO members challenged nearly 60 out of the roughly 200 different US antidumping measures imposed.

When viewed from the perspective of Bagwell and Staiger (1990, 2003), one explanation for the WTO disputes is that certain US antidumping actions were not viewed by the trading partner

as a cooperative increase in the import-restricting policy. Instead, the dispute arises because the trading partner found that the US antidumping policy was an act of “defection” from the overall agreement that thus merits a retaliatory response. In this case, the trading partner seeks WTO authorization to retaliate against the US “defection.”⁸ Using the model predictions of the estimated “WTO managed trade rule,” we assess whether US AD measures associated with a higher *predicted* probability of a AD formation are *less* likely to face WTO challenges. Put differently, are the US AD actions that result in WTO disputes challenges the ones in which the US imposed a new trade restriction that was not justified under the “WTO managed trade rule”?

To examine this question empirically, we estimate determinants of a model of the foreign exporter’s choice of whether to challenge a US-imposed antidumping duty through a formal dispute at the WTO.⁹ We estimate a binomial probit model on a sample of 91 US antidumping duties imposed against WTO members between 1995-2003. While we describe the full range of explanatory and control variables as we run through the model estimates below, here it is important to highlight one important feature of the data used for this portion of the estimation. The data in this empirical exercise is more disaggregated relative to what we have used thus far. For example, while the last section focused on antidumping policy formation at the 3-digit industry level k , most of the variables in this section will be defined at the level of the 6-digit Harmonized System (HS) product h that is typically at issue in an antidumping investigation. The product h 6-digit HS data for foreign exports is taken from *Comtrade*. The data on the US use of antidumping as well as WTO challenges and foreign use of antidumping is again taken from the Global Antidumping Database (Bown, 2007). Note that table 5 presents summary statistics of the variables used in the estimation.

Table 6 presents the estimates of marginal effects of the binomial probit model in which the dependent variable takes on a value of one if the exporter i issues a formal legal challenge at the

⁸In an extension of the model presented in the next subsection below, we also allow for this potential retaliation to occur either through a WTO dispute or through a retaliatory antidumping measure of the country’s own.

⁹We build in part from the estimation exercise undertaken in Bown (2005). By foreign exporter, of course, we refer to the combined ability of the exporting industry and its government to coordinate the mounting a formal WTO dispute legal challenge since only governments have standing in WTO disputes.

WTO to the US antidumping duty imposed against country i 's exports of product h and is zero otherwise.

Column 1 of table 6 presents our simplest specification that focuses solely on the predicted probability of a US antidumping measure, where this determinant is generated from the model presented in the last section. Paradoxically, specification 1 indicates evidence of a *positive* bivariate relationship between these variables. This is at odds with our prior interpretation of the Bagwell and Staiger (1990, 2003) framework. When we do not control for anything else in the estimation, we find imposed US duties associated with a higher predicted probability of an AD measure are more likely to be challenged through a WTO dispute. By itself this effect is also sizable - a one standard deviation increase from the mean value of the predicted probability of AD almost doubles the predicted probability of a WTO dispute challenge from 0.27 to 0.49.

Nevertheless, the potential paradox of a positive relationship quickly changes once we introduce other control variables into the estimation. In particular, specification 2 introduces three other control variables. First is the exporting country's capacity to impose retaliatory trade restrictions against the US at WTO, as measured by the log of the value of total US exports sent to the foreign country.¹⁰ The sign is positive as expected, and is consistent with much prior evidence from other samples of data stemming from different trade policy decisions (e.g., Bown 2004a,b) that finds that foreign retaliation capacity matters. While the WTO is a rules-based organization, a necessary condition for one trading partner to enforce another's WTO commitments - e.g., in this case remove or revise a US imposed antidumping measure that is inconsistent with WTO rules - is that the country has the capacity to retaliate by threatening new import restrictions against US exporting industries. One important theory motivating this empirical regularity stems from the underlying interpretation of the WTO's guiding principle of reciprocity provided by Bagwell and Staiger (1999).

The second and third variables introduced into specification 2 control for the expected costs and benefits to foreign exporters of product h adversely affected by the US antidumping policy

¹⁰The qualitative pattern to the results in specification 2 and the result of the table hold when we substitute share of total US exports sent to the foreign country in for the log value of US exports.

that would be associated with a potential dispute. As motivation, here we draw from the theory of Maggi and Staiger's (2008) model of WTO dispute settlement. One prediction that comes out of their model is that when the costs of a dispute fall disproportionately on the exporter relative to the importer, the importer will be more likely to engage opportunistically in the first place by imposing a WTO-inconsistent measures that will lead to a dispute. In our cross-sectional empirical analysis with a common importer, it is reasonable to assume that the litigation cost to the US to defending a challenge is similar across all AD measures it has imposed. Therefore, one implication of this theory for our empirical analysis across a cross-section of heterogenous exporters is that exporter litigation costs are high, and thus in equilibrium WTO disputes will only arise in instances in which the benefits to the exporter from successful resolution to a dispute (i.e., the opportunity cost of failing to litigate at the WTO) are high.

In our empirical model, we use two different variables to capture for the opportunity costs to the exporter for failing to initiate a dispute, both of which show up in specification 2 with the expected sign. Each variable is derived from data on the underlying foreign exports of the product h that is the target of the US antidumping measure. The first variable is simply the value of lost access to the US export market in product h due to the antidumping restriction.¹¹ The larger (more negative) the loss of US market access to the foreign exporter, the higher the opportunity cost of not litigating, and the more likely the exporter will overcome the fixed cost of filing a WTO dispute and initiate a challenge.

The opportunity cost to the exporter for failing to litigate may also involve a second channel that we refer to as the "terms of trade spillover" to third markets. We therefore include an additional variable to address the concern that the US antidumping measure can also negatively impact the exporters' profits associated with sales of product h to third markets. This negative impact can occur via at least two avenues. The first avenue is simply through the negative terms-of-trade externality - i.e., for an unchanged level of import demand in the rest of the world (ROW) for product h , a shift in foreign's export supply toward this market (due to sales shut out of the US

¹¹Specifically we measure this as the log of absolute value of difference between AD-affected product exports of h to US between $t + 1$ and $t1$, where t is the year of the US imposed AD.

market caused by the US AD) will reduce the exporter's terms-of-trade in those markets as well, through a "trade deflection" result (Bown and Crowley, 2006, 2007). A second and reinforcing avenue may be through the same ROW engaging in policy learning. Because WTO rules mandate that the US must notify to the world (via the WTO) a new imposition of AD, a new US AD in product h reduces the fixed cost to the government in ROW of collecting information necessary to ultimately impose its own new import restriction on product h from foreign.¹²

The positive estimate of the "terms of trade spillover" variable from specification 2 in table 6 is consistent with both avenues. The larger is the foreign exporter's affected product h exports to ROW as a share of its total exports of h , the more likely is the foreign exporter to challenge the US antidumping measure on h at the WTO.

While the estimates of these other determinants of the foreign decision to challenge a US antidumping measure at the WTO all have the theoretically-predicted sign in column 2, inclusion of these variables does cause the sign on the predicted probability of AD variable to switch from positive to negative. And the size of the effect is also economically significant - the same one standard deviation increase from the mean value of the predicted probability of AD now *reduces* the model's predicted probability of a WTO dispute challenge from 0.17 to 0.05. And note furthermore from column 3 the evidence that these three newly introduced determinants do affect the WTO dispute decision independently of the predicted probability of AD variable. Failing to include the predicted probability of AD variable into the estimation in specification 3 decreases the *size* of the marginal effect of each estimate, a result suggesting an endogeneity bias that deserves additional attention in future work.¹³ When we drop the predicted probability of AD variable, the impact is a slight change in the estimated marginal effects on the other variables of interest.

How do we interpret the negative sign of this estimated marginal effect of the predicted AD

¹²Maggi (1999) explores alternative implications of the WTO performing an information dissemination role as a multilateral institution.

¹³I.e., the failure to include the predicted probability of AD variable into the estimation of the WTO challenge determination leads to smaller estimates of the retaliation and exporter cost variables that may be statistically significant. In the next stage of revisions we will attempt to jointly estimate the "WTO managed trade rule" and the "Foreign Response to US antidumping policy" rule to allow for feedback at both stages.

variable, once we include these other determinants in specification 2? Once we control for countries with retaliation capacity being more likely to file trade disputes against the US, and US AD actions that impose larger market access costs on the exporter and which have the potential to spillover into third markets as being more likely for foreign to challenge with a trade dispute, a higher predicted probability of AD formation is less likely to be challenged at the WTO. Put differently, US defections from the “WTO managed trade rule” (as measured by a lower predicted probability of AD) are more likely to be challenged once we control for other determinants of DSU utilization - the opportunity costs to an exporter of not challenging a US AD (measured by lost market access to the US and concern for the terms-of-trade cost to spread to third markets) and the exporter’s capacity to retaliate.

The remainder of the specifications of table 6 present robustness checks on these results. In column 4 we add a control variable for the size of the US antidumping duty. It is important to recognize that many legal rulings in DSU cases that involve challenges to AD may mandate that the AD-imposing country (in this case, the US) go back and re-do a certain element of its investigation procedure to make the AD measure WTO consistent. Therefore, foreign exporters may be more likely to challenge low US antidumping duties in the hope that a WTO ruling for recalculation of the size of the dumping margin will lead to a new duty which is below the *de minimus* threshold in which case there is an additional effect - not only is the size of AD reduced but it has to be removed. The evidence of the negative sign on the marginal effect for this variable is consistent with this theory. In specification 5 we add an indicator variable for the US antidumping measures imposed on foreign firms from EU member states, to control for the fact that the EU may have a higher propensity to litigate for unobservable reasons. The sign on this estimated effect is positive, and the qualitative pattern to the other estimates is unchanged.

In specification 6, we drop all observations in which the exporting country government imposed an AD measure on US exporters in the same 4-digit industry k within the prior three years. We drop these observations because they *all* resulted in the exporter failing to challenge the US AD measure at the WTO and are thus perfect predictors of no dispute. This result is also consistent with a theory that part of the US use of antidumping is driven by its own retaliatory concerns in

industries in which it has been the recent target of foreign antidumping abroad. Furthermore, in such instances, foreign countries may not challenge new US measures because the US antidumping is simply part of a new cooperative equilibrium of more restrictive trade policies imposed by both sides. Nevertheless, eliminating these observations from the estimation does not change the pattern to our underlying variables of interest.

In specification 7, we drop all observations in which the exporting country was China.¹⁴ Despite China being the largest target of the US use of antidumping, an indicator for China is also a perfect predictor of not filing a WTO dispute. Note, however, that China did not file any DSU challenges to antidumping during this time period, despite being the largest target of all foreign countries' use of antidumping, and it was mostly inactive in all areas of primary WTO litigation.¹⁵ Given that its use of WTO dispute settlement was so limited and this may be due to a number of reasons unrelated to antidumping, it is arguably important to control for a unobservable China-specific effect. Nevertheless, when we exclude the Chinese observations from the estimation, the results on the remaining variables of interest are largely unchanged. The only modification is the coefficient on the size of the antidumping duty imposed is no longer significant, a result that is not surprising given that China is typically hit with antidumping duties that can be orders of magnitude larger than those imposed on other exporters of the same product.

To examine the economic significance of the estimated effects, once again consider specification 5 and note that the predicted probability of a WTO dispute is 0.286 when the model is estimated at the means of the underlying data. Each of the statistically significant effects is also economically sizable. A one standard deviation change away from the mean value of the underlying variable increases the model's predicted probability of the exporter filing a WTO dispute, *ceteris paribus*, by 0.456 (DSU retaliation capacity), 0.714 (lost market access), 0.290 (terms-of-trade spillover), and 0.152 (antidumping duty).

¹⁴Of course we have already dropped all US-imposed antidumping measures prior to 2002 during the era in which China was not a member of the WTO and therefore could not use the DSU. Specification 7 drops US antidumping measures imposed against China during 2002 and 2003 as well.

¹⁵For a further discussion, see Bown (forthcoming).

5.2 Estimating an empirical model of WTO disputes, foreign AD retaliation, or no response

As a final exercise, in this section we present the results of an expanded empirical model in which we allow the exporter one additional policy response to a newly imposed US antidumping duty. We expand the exporter’s choice set to include responding with its own retaliatory antidumping policy against the US in the same 4-digit industry k . The motivation for this exercise stems from the results and conjecture of Bown (2005), that an important contributor to why foreign countries do not challenge US AD through the WTO is because they have an alternative and relatively direct channel to obtain redress - i.e., their own use of antidumping against the US in the same sector.¹⁶

Table 7 presents our empirical results of the marginal effects estimates of the three choice multinomial logit model. The left column presents the estimates of the determinants of the exporter’s choice to challenge the imposition of a new US antidumping import restriction through formal litigation at the DSU. The middle column presents estimates of the determinants of the choice to respond via subsequently imposing a same-industry antidumping (or safeguard) measure of its own within the next two years after the US imposed AD in year t . Finally, the right column presents estimates of the determinants of the choice not to respond with any WTO dispute challenge or antidumping retaliation at all. The determinants are the same variables used in the binomial probit estimates (see table 6) of the last section, with one addition. In the multinomial logit model we also allow for the exporter’s capacity to retaliate with a same-industry antidumping measure to affect its choice. We capture this industry-level retaliation capacity with the log level of US exports of 4-digit industry k sent to the foreign country in $t - 1$. The higher the value of US exports in the same industry, the more likely we expect the foreign country to directly respond by imposing its own antidumping retaliation.

¹⁶Since Bown (2005) did not have access to data on the foreign use of antidumping by industry against US firms, that paper could not explicitly test this hypothesis. The indirect evidence in that paper was the US industries with larger exports to the foreign country were less likely to have their AD measures targeted for a WTO dispute. The resulting conjecture, that we confirm with evidence below, was that the foreign country was engaging in “vigilante justice” by simply using reciprocal antidumping instead of WTO dispute settlement where it had the capacity to do so.

At the medians of the data, the predicted probabilities of the exporter’s three choices based on the estimates in table 7 are 0.198 for a WTO dispute, 0.139 for antidumping retaliation, and 0.662 for no response.¹⁷ While each of the estimates’ signs on the explanatory variables are generally consistent with the theory, we focus our discussion on those determinants whose marginal effects estimates are statistically significant, and we then comment on their economic significance as well.

Consider first the variable capturing the predicted probability of AD formation. Just as in the binomial probit model in the last section, in the presence of these other control variables, there is evidence of a negative relationship between this predicted probability and the foreign decision to file a WTO challenge. Furthermore, the effect is sizable; *ceteris paribus*, a one standard deviation increase in the predicted probability of AD formation above the sample median decreases the predicted probability of a WTO dispute from 0.198 to 0.02.

Next we focus on the lost market access variable, as this is the only one of the two variables associated with foreign litigation costs from the Maggi and Staiger (2008) theory to show up as statistically significant in the multinomial choice model.¹⁸ The impact of the lost market access effect on the probability of a WTO dispute is once again economically large, as a one standard deviation increase in lost market access to the foreigner because of the US AD increases the probability of a WTO dispute from 0.198 to 0.999. Interestingly, even smaller increases in the size of lost market access are noteworthy in that they serve to increase the probability of a WTO dispute with virtually no effect on the probability of antidumping retaliation - *i.e.*, all of the action comes from a reduction in the probability of “doing nothing” at all.

Third, consider the retaliation capacity variables. For DSU retaliation capacity, the marginal effect of the estimate on the probability to file a WTO dispute is positive but marginally statistically insignificant. For the AD retaliation capacity variable, only the effect on the probability of the foreign country filing its own industry k antidumping retaliation is positive. In terms of the economic significance of the effects, a one standard deviation increase in DSU retaliation capacity increases

¹⁷This compares to the sample of raw data of outcomes which were the following 0.300 for a WTO dispute, 0.144 for antidumping retaliation, and 0.556 for no policy response.

¹⁸The impact of the “terms-of-trade spillover” to third markets on WTO dispute choice is positive, as predicted by the theory, but not statistically significant.

the probability of a WTO dispute from 0.198 to 0.546. On the other hand, a one standard deviation increase in AD retaliation capacity increases the probability of an AD retaliation from 0.139 to 0.387 with virtually no statistically significant impact on the probability of a WTO dispute. Combined these results suggest that retaliation capacity threats work in predictable ways - large (same) industry k US exports to the foreign market and relatively small overall US exports to foreign increases the probability of foreign AD as a response instead of a WTO dispute. Furthermore, this evidence is consistent with the conjecture of Bown (2005) that one important determinant for why foreign countries do not use WTO dispute settlement to challenge AD is because they have access to a separate policy to address the issue - reciprocal antidumping in the same sector.

6 Conclusion

This paper empirically examines how governments make trade policy adjustments under a self-enforcing trade agreement in the presence of economic shocks. Using data on US antidumping (AD) policy formation between 1995-2003, we find that US antidumping policy is consistent with the “managed trade rule” predicted by Bagwell and Staiger (1990).

We use the Broda, Limão, and Weinstein (2008) elasticity estimates and find that both the likelihood of a US AD as well as the size of the imposed AD duty are negatively related to the foreign export supply and the US import demand elasticities. The results are consistent with the optimal tariffs theory as well as a number of pieces of empirical evidence in the literature from other settings that the terms of trade affects trade policy formation.

Furthermore, in light of this interpretation of US AD use as a cooperative increase in trade policy, we empirically investigate determinants of which of these US AD actions are formally challenged by trading partners for removal under WTO dispute settlement. After controlling for factors such as a trading partner’s expected cost and benefit to litigation at the WTO as well as its retaliation capacity, we find that trading partners are *less* likely to file WTO challenges over US AD duties that are imposed under terms-of-trade pressure.

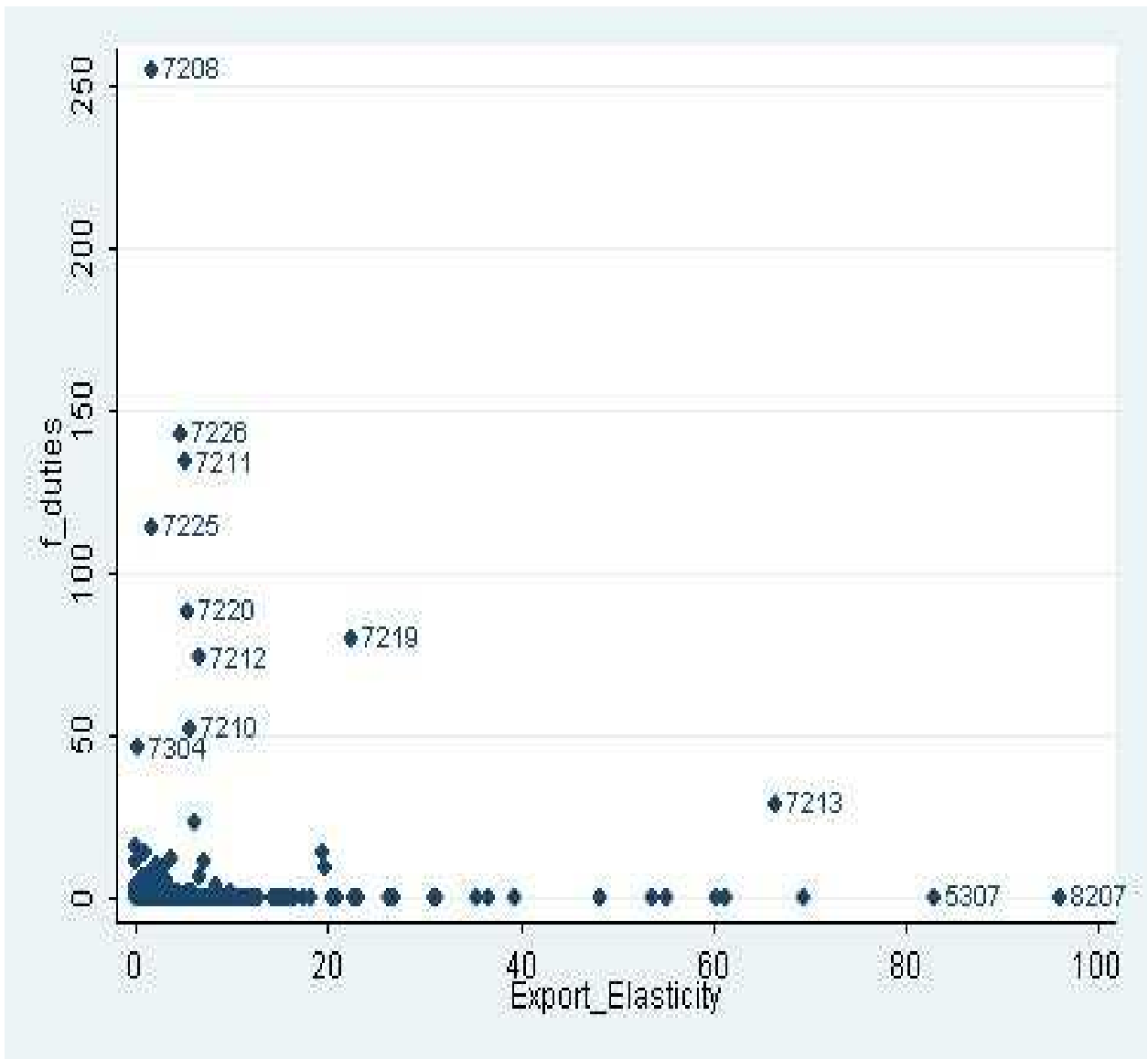


Figure 1: Number of US Antidumping Measures imposed vs. Export Supply Elasticity: 1995-2005

Table 1: Summary Statistics: US Antidumping Duty Formation

Variable	Mean	Standard Deviation	Minimum	Maximum
Dependent Variables				
AD imposed by the US against country i industry k in year t (=1) or not	0.0061	0.0778	0	1
Ln(1+AD duty) against country i industry k in year t	0.0015	0.0306	0	1.576
Explanatory Variables				
Measures of bilateral import growth				
Growth of imports_ikt-1	0.103	0.890	-2	2
Instrument for growth of imports_ikt-1	0.116	0.127	-0.505	0.639
Actual growth_ikt-1 – predicted growth of imports_ikt-1	-0.001	0.794	-2.505	2.378
Import penetration_ikt-1	0.004	0.035	0	1.995
Standard deviation of imports_ik	1.044	0.776	0.065	5.341
Trade elasticities				
Export supply elasticity	0.691	2.045	0.001	10.999
Import demand elasticity	1.169	0.492	0.137	.537
Ln(real exchange rate)_it-1: measured as dollars/foreign currency	2.308	2.907	-2.525	10.149
Measures of industry size				
US employment_kt-1	13.030	1.118	10.193	14.555
Employment in country i industry kt-1	9.194	2.216	0.693	15.893

Notes: 19875 observations of country i exporting goods in industry k to the US between 1993 and 2004.

Table 2: US Binomial Probit Model: Marginal Effect Estimates of US Imposing AD Measure

	Basic specification	Substitute instrumented import growth	Substitute actual import growth less expected growth	Add measures of industry size	Substitute import penetration
	(1)	(2)	(3)	(4)	(5)
Measures of bilateral import growth					
Growth of imports_ikt-1	0.0007*** (0.0003)			0.0001 (0.0002)	
Instrument for growth of imports_ikt-1		0.0004 (0.0023)			
Actual - predicted growth of imports_ikt-1			0.0008** (0.0005)		
Import penetration_ikt-1					0.0073*** (0.0021)
Std. deviation of imports_ik	-0.0036*** (0.0007)	-0.0026*** (0.0011)	-0.0031*** (0.0013)	-0.0006*** (0.0002)	-0.0022*** (0.0006)
Trade elasticities					
Export supply elasticity_k	-0.0031*** (0.0006)	-0.0029*** (0.0007)	-0.0028*** (0.0009)	-0.0008*** (0.0003)	-0.0032*** (0.0005)
Import demand elasticity_k	-0.0014*** (0.0004)	-0.0012*** (0.0005)	-0.0012*** (0.0005)	-0.0003*** (0.0001)	-0.0010*** (0.0003)
Ln (Real Exchange Rate)_it-1	-0.0001 (0.0001)	0.0000 (0.0001)	0.0001 (0.0001)	0.0000 (0.0000)	0.0000 (0.0001)
Measure of industry size					
US employment_ikt-1				-0.0002*** (0.0001)	
Foreign Employment_ikt-1				0.0003*** (0.0001)	
Number of Observations	19875	6701	6060	9306	18006
Log-likelihood	-691.185	-255.927	-249.316	-314.631	-581.547

Notes: Huber-White robust std errors in parentheses with ***, **, and * indicating statistical significance at the 1%, 5% and 10% levels.

Table 3: Predicted Probability of a US AD duty for a One S.D. Change in...

	Basic specification	Substitute instrumented import growth	Substitute actual import growth less expected growth	Add measures of industry size	Substitute import penetration
	(1)	(2)	(3)	(4)	(5)
One S.D. increase in measure of bilateral import growth	0.0067	0.0070	0.0083	0.0074	0.0059
One S.D. decrease in Std. Dev. Imports_ik	0.0089	0.0073	0.0100	0.0078	0.0074
One S.D. decrease in export supply elasticity_k	0.0124	0.0134	0.0138	0.0091	0.0122
One S.D. decrease in import demand elasticity_k	0.0077	0.0076	0.0083	0.0075	0.0061
Prob of a US antidumping duty in estimation sample	0.0061	0.0070	0.0077	0.0074	0.0056
Number of Observations in estimation sample	19875	6701	6060	9306	18006

Table 4: U.S. Censored Tobit Model: Maximum Likelihood Estimates of US Imposing AD Duties

	Basic specification	Substitute instrumented import growth	Substitute actual import growth less expected growth	Add measures of industry size	Substitute import penetration
	(1)	(2)	(3)	(4)	(5)
Measures of bilateral import growth					
Growth of imports_ikt-1	0.047 (0.070)			0.056 (0.108)	
Instrument for growth of imports_ikt-1		-0.707 (0.539)			
Actual - predicted growth of imports_ikt-1			0.123 (0.099)		
Import penetration_ikt-1					1.221*** (0.444)
Std. deviation of imports_ik	-0.473*** (0.101)	-0.425*** (0.122)	-0.512*** (0.148)	-0.379*** (0.129)	-0.304*** (0.08)
Trade elasticities					
Export supply elasticity_k	-0.789*** (0.201)	-0.562*** (0.201)	-0.545*** (0.2)	-0.586*** (0.162)	-0.559*** (0.172)
Import demand elasticity_k	-0.342*** (0.131)	-0.265** (0.135)	-0.266** (0.133)	-0.198* (0.113)	-0.221* (0.121)
Ln (Real Exchange Rate)_it-1	0.023 (0.014)	0.052** (0.024)	0.031** (0.015)	0.018 (0.013)	0.029** (0.013)
Measure of industry size					
US employment_kt-1				-0.177*** (0.050)	
Foreign Employment_ikt-1				0.159*** (0.030)	
Number of Observations	19875	6701	6060	9306	18006
Log-likelihood	-488.066	-200.693	-196.397	-239.267	-381.369

Notes: Huber-White robust std errors in parentheses with ***, **, and * indicating statistical significance at the 1%, 5% and 10% levels.

Table 5: Summary Statistics: Foreign Response to US AD

Variable	Mean	Standard Deviation	Minimum	Maximum
Dependent Variables				
WTO dispute (=1) or not	0.300	0.461	0	1
WTO dispute (=2), AD industry retaliation (=1), do nothing (=0)	0.744	0.894	0	2
Explanatory Variables				
Likelihood of AD measure: $\log(1+\text{Predicted probability of AD})$	0.012	0.005	0.000	0.023
DSU retaliation capacity: \log level of total US exports sent to potential respondent in $t-1$	16.766	1.869	10.119	18.890
Lost market access: \log of absolute value of difference between AD-affected product exports of h to US between $t+1$ and $t-1$	14.252	0.457	10.219	15.636
Terms-of-trade spillover: \log share of potential respondent's total US AD-affected product exports h sent to ROW	0.439	0.223	0	0.680
Antidumping duty: \log of $1+\text{US imposed AD duty on } h$	0.295	0.260	0.029	1.546
EU: indicator that exporter is an EU member	0.200	0.402	0	1
AD retaliation capacity: \log level of US exports in the same 4-digit industry k sent to potential respondent in $t-1$	8.186	3.271	0	15.858

Notes: 91 observations of US Antidumping Duties imposed between 1995 and 2003 against WTO members. [†] Scaled so that -\$1.6 billion equals zero.

Table 6: Foreign's Binomial Probit Model Response to US AD: Marginal Effects Estimates of Filing a WTO Dispute

	Dependent variable = 1 if exporting country target of US antidumping formally challenges through a WTO dispute						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Likelihood of AD measure: log(1+Predicted probability of AD)	35.944 ^{***} (11.876)	-31.306 [*] (17.986)	--	-38.518 [*] (20.290)	-67.505 ^{***} (24.292)	-81.036 ^{***} (28.703)	-75.512 ^{***} (25.035)
DSU retaliation capacity: log level of total US exports sent to potential respondent in $t-1$	--	0.231 ^{***} (0.061)	0.174 ^{***} (0.047)	0.223 ^{***} (0.064)	0.221 ^{***} (0.075)	0.272 ^{***} (0.099)	0.245 ^{***} (0.078)
Lost market access: log of absolute value of difference between AD-affected product exports of h to US between $t+1$ and $t-1$	--	-3.642 [*] (2.091)	-2.788 [*] (2.084)	-3.861 [*] (1.975)	-6.946 ^{***} (2.378)	-6.925 ^{***} (2.196)	-6.599 ^{***} (2.315)
Terms-of-trade spillover: log share of potential respondent's total US AD-affected product exports h sent to ROW	--	1.067 ^{***} (0.409)	0.903 ^{***} (0.376)	1.129 ^{***} (0.388)	1.154 ^{**} (0.480)	1.220 ^{**} (0.561)	1.352 ^{**} (0.527)
Antidumping duty: log of 1+US imposed AD duty on h	--	--	--	-0.611 ^{***} (0.230)	-0.534 (0.364)	-0.392 (0.438)	-0.270 (0.411)
EU: indicator that exporter is an EU member	--	--	--	--	0.645 ^{***} (0.196)	0.608 ^{***} (0.197)	0.631 ^{***} (0.188)
Observations: number of potentially challengeable definitive AD measures imposed against WTO members	91	91	91	90	90	83	82
Pseudo R ²	0.11	0.50	0.48	0.56	0.61	0.62	0.61
Log pseudolikelihood	-49.36	-27.47	-28.79	-24.32	-21.25	-19.80	-20.21

Notes: Marginal effects evaluated at the means of the data. Heteroskedasticity-consistent standard errors in parentheses. Also estimated with a constant term which is suppressed. Superscripts ^{***}, ^{**}, and ^{*} indicate statistically different from zero at the 1, 5 and 10% level, respectively. Specification (6) drops all observations in which the exporting country government imposed an AD measure on U.S. exporters in the same 4-digit industry within the prior three years. Specification (7) drops all observations in which the exporting country was China.

Table 7: Foreign's Multinomial Logit Model Response to US AD: Marginal Effects Estimates of Filing a WTO Dispute, AD Retaliation, or Nothing

Explanatory variable	Dependent variable: Exporting country's choice of:		
	Initiating a WTO dispute challenging US AD measure (=2)	Pursuing subsequent AD/SG retaliation in the same industry k (=1)	Doing nothing (=0)
Likelihood of AD measure: $\log(1+\text{Predicted probability of AD})$	-49.789** (25.288)	-10.619 (16.285)	60.409** (24.432)
DSU retaliation capacity: \log level of total US exports sent to potential respondent in $t-1$	0.124 (0.083)	-0.028 (0.042)	-0.096 (0.081)
Lost market access: \log of absolute value of difference between AD-affected product exports of h to US between $t+1$ and $t-1$	-4.499** (1.784)	0.237 (0.050)	4.261*** (1.599)
Terms-of-trade spillover: \log share of potential respondent's total US AD-affected product exports h sent to ROW	0.847 (0.584)	-0.248 (0.225)	-0.599 (0.513)
Antidumping duty: \log of $1+\text{US imposed AD duty on } h$	-0.378 (0.364)	0.217 (0.151)	0.161 (0.330)
EU: indicator that exporter is an EU member	0.637** (0.255)	-0.157*** (0.058)	-0.481* (0.257)
AD retaliation capacity: \log level of US exports in the same 4-digit industry k sent to potential respondent in $t-1$	0.020 (0.035)	0.058** (0.027)	-0.078** (0.034)
Predicted probability of model outcome (at median values of data)	0.198	0.139	0.662
Observations: number of potentially challengeable definitive AD measures imposed against WTO members	90		
Pseudo R^2	0.44		
Log pseudolikelihood	-48.84		

Notes: Marginal effects evaluated at the medians of the data. Heteroskedasticity-consistent standard errors in parentheses. Also estimated with a constant term which is suppressed. Superscripts ***, **, and * indicate statistically different from zero at the 1, 5 and 10% level, respectively.

Appendix A: Outline of the dynamic game

In section 2 we described the Bagwell and Staiger (1990) model of self-enforcing trade agreements in which an equilibrium of low tariffs can be supported by the threat of infinite Nash reversion. Here, we provide a rough sketch of the stage game played by countries i and j .

The action space for country i playing a game with j is:

$$\tau_{ijt} = \begin{cases} AD_{ijt} = 1 \\ WTO_{ijt} = 1 \\ 0 \end{cases} \quad (4)$$

where $AD_{ijt} = 1$ is a binary decision by country i to impose a tariff, WTO_{ijt} is a binary decision by country i to file a dispute against j , and a choice 0 is a choice to not impose an antidumping duty and not to file a WTO dispute.

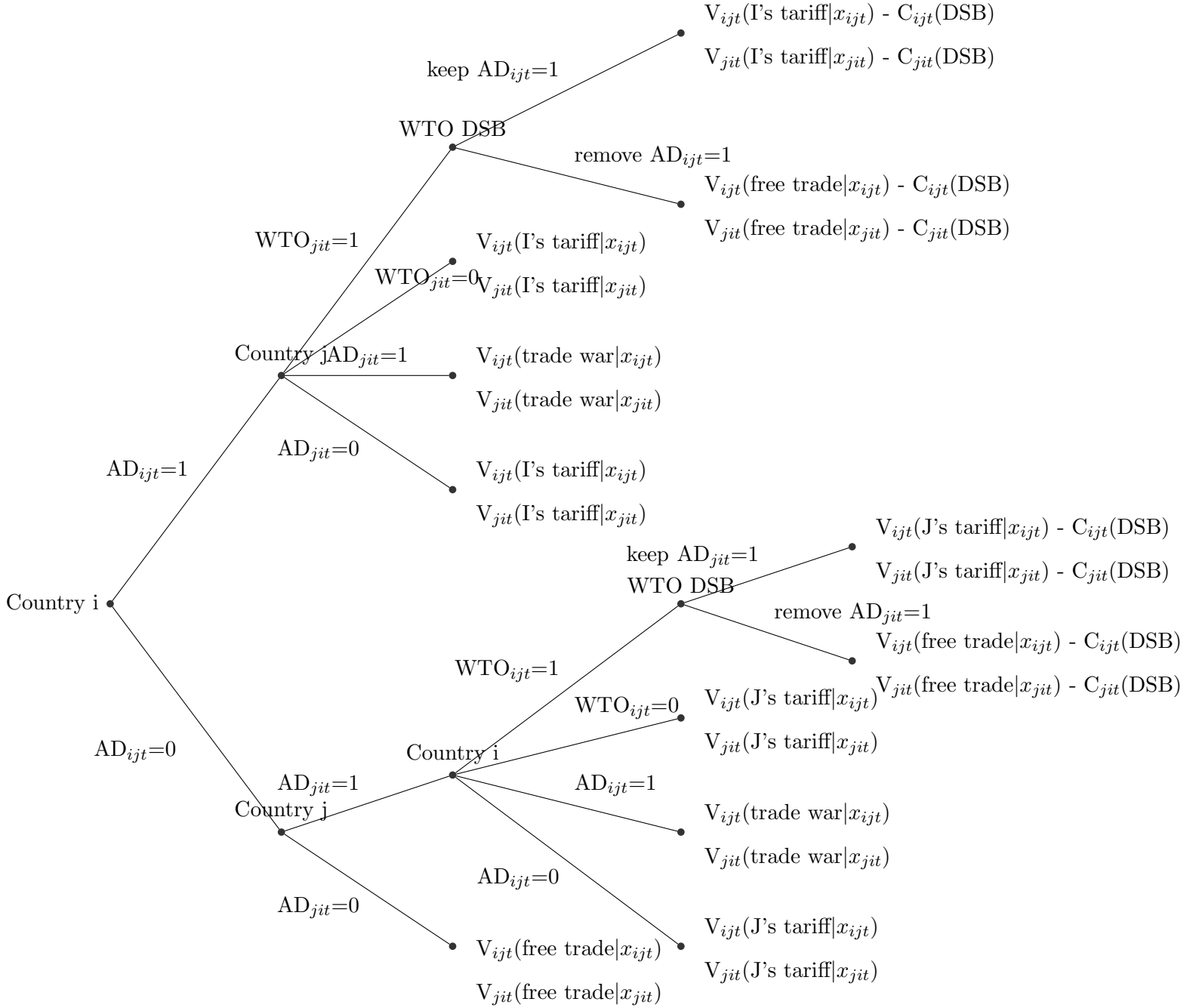
The welfare function for each player i is given by:

$$V_{ijt}(\tau_{ijt}, \tau_{jit}|x_{ijt}) = \Omega(\tau_{ijt}, \tau_{jit}|x_{ijt}) + V_{ijt+1}(\tau_{ijt+1}, \tau_{jit+1}|x_{ijt+1}) \quad (5)$$

where the value function at time t consists of a static gain from defection (the Ω function) and a continuation value V_{ijt+1} . The state variable x_{ijt} includes the long run import demand and export supply elasticities, the variance of imports, and parameters that shift the volume of imports (specifically, we examine domestic and foreign consumption and employment growth).

The payoff functions are listed in simple way on the game tree in figure 2. In estimating our empirical model of “Foreign responses to US AD,” we estimate a reduced form of country j ’s decision to respond to a US antidumping duty in which we exploit variation across countries j in the expected value and the cost of bringing a WTO dispute.

Figure 2: Stage game tree in period t



Appendix B: Estimating bilateral import growth

Bagwell and Staiger (2003) develop the business cycle implications of Bagwell and Staiger (1990) and derive conditions under which tariff increases are countercyclical. Empirically, we build on the work of Crowley (2008) who found that US antidumping policy is countercyclical with respect to the industry-level business cycle in the US's foreign trading partner.

We estimate a model of bilateral import growth in which the growth of imports into the US from country i in industry k in year t is regressed on the growth of US consumption in kt , the growth of country i consumption in kt , the growth of US employment in kt and the growth of country i employment in kt . The first lag of the predicted values from this model are used in estimating the empirical models of US antidumping formation.

Appendix Table A: Bilateral US Import Growth: 1993-2001

	Basic specific.	Add US and foreign employment growth	Add country fixed effects to column 1	Add country fixed effects to column 2
	(1)	(2)	(3)	(4)
Measures of US industry-level economic growth				
Growth of US consumption_ikt	0.681*** (0.116)	0.540*** (0.125)	0.719*** (0.117)	0.573*** (0.126)
Growth of foreign consumption_ikt-1		0.760*** (0.249)		0.864*** (0.251)
Measures of foreign industry-level economic growth				
Growth of foreign consumption_ikt	-0.074*** (0.028)	-0.091*** (0.029)	-0.089*** (0.028)	-0.103*** (0.029)
Growth of foreign employment_ikt		0.143*** (0.044)		0.123*** (0.045)
Ln (Real Exchange Rate)_it	0.001 (0.003)	0.002 (0.003)	0.036 (0.023)	0.035 (0.022)
Country fixed effects	no	no	yes	yes
Number of Observations	6625	6404	6625	6404
Adjusted R²	0.006	0.009	0.002	0.004

Notes: Huber-White robust std errors in parentheses with ***, **, and * indicating statistical significance at the 1%, 5% and 10% level

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