Import demand elasticity and exporter responses to anti-dumping duties

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Abstract

When an anti-dumping duty is imposed, a foreign exporting firm can either pay the duty or stop dumping by increasing the price of its product. An importing country’s welfare depends on the foreign firm’s decision. This paper presents a model of anti-dumping investigation which shows that the exporter’s response crucially depends on the elasticity of import demand. The firm is less likely to increase the price when the demand is more elastic. Theoretical prediction is supported empirically by relating product-level US import demand elasticities (estimated by Broda and Weinstein, 2006) and exporting firms’ reactions to duties inferred from a dataset on U.S. anti-dumping investigations during 1980-1995.

JEL categories: D21, F13, L10

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1. Introduction

Anti-dumping duties are often singled out as an especially harmful non-tariff barrier to trade. They are usually larger than import tariffs and, unlike geographical non-tariff barriers, a result of trade policy and thus avoidable. Not surprisingly, anti-dumping measures have been on the agenda of multilateral trade negotiations since the Kennedy round, but the subject has received new urgency as in the last decade developed countries substantially contributed to the increase in the number of anti-dumping cases. Early on developed countries led in the number of anti-dumping investigations. In 1995, when the WTO was formed, 77 out of 157 anti-dumping initiations were filed by the European Community, US, Canada, Australia, New Zealand, and South Korea. However, out of 208 anti-dumping petitions filed in 2008 only 49 were filed by the developed countries. At the same time Argentina, Brazil, China, India, and Turkey combined for 132 filings, and India alone filed 54. The role of anti-dumping legislation is not likely to subside anytime soon given the current trends toward multilateral tariff reduction and political demand for protection.

There is vast prior theoretical research on various aspects of antidumping. A large part of that research recognizes the importance of strategic considerations for decisions of participants in the anti-dumping process and therefore utilizes elements of game theory. Fischer (1992), Reitzes (1993), Blonigen and Prusa (2003), among others, focus on the preventive effect of anti-dumping law. They show how the mere presence of an anti-dumping law in a country induces exporters to that country to reduce the volume and raise the price of exports in order to avoid anti-dumping suits and charges. Anderson (1992, 1993) uses the notion of strategic behavior to arrive at the opposite result. He demonstrates that under some conditions the presence of an anti-dumping law induces exporting firms to increase the volume of exports. Therefore, a law may in fact increase the extent of dumping. The majority of early game-theoretic analyses of anti-dumping are thoroughly summarized in Leidy (1994).

Similarly to the previously mentioned papers, we present an exporter’s entry into a foreign market and subsequent anti-dumping investigation as a sequential game. An exporting firm’s anticipation of the second-stage outcome is incorporated in the first-period decisions. In contrast to previous research, our paper does not focus on the firm’s actions prior to anti-dumping
investigations but rather on the events that occur after its entry into the foreign market and the imposition of the anti-dumping duty.

The model predicts that the exporting firm is more likely to raise its price in response to the anti-dumping duty if import demand is less elastic. Intuitively, when demand is very elastic, an increase in the price quickly reduces profits by triggering a substantial negative quantity response. This conjecture is confirmed by an empirical exercise which matches product-level US import demand elasticities from Broda and Weinstein (2006) with exporting firms’ behavior following the initiation of an anti-dumping investigation. Firms’ reactions to duties are inferred from a dataset of U.S. anti-dumping investigations between 1980 and 1995, compiled by Bruce Blonigen.

Empirical studies on anti-dumping started to emerge as access to relevant data became available (thanks to efforts of Bruce Blonigen, Chad Bown, and Robert Feenstra). Several of these studies are especially relevant to our research. Prusa (1997) studies the effect of anti-dumping actions on trade volume and patterns by separating anti-dumping cases by duty size and finds evidence of a trade diversion effect of anti-dumping measures. He concludes that the main beneficiaries of anti-dumping policies may not be the domestic producers but the exporters in countries not named in an anti-dumping suit. Using a small sample of cases filed by the EU, Rutkowski (2007) finds a positive relation between the withdrawals of anti-dumping complaints and import price increases. He interprets this correlation as a sign of collusion between domestic and foreign firms. Blonigen and Bown (2003) apply strategic considerations to the importing country’s decision to file anti-dumping petitions and show that fear of retaliation plays a role in making countries reluctant to impose anti-dumping duties. To our knowledge the only paper that analyzes events following an anti-dumping duty is Pierce (2008) but the context of its analysis is entirely different from ours as the paper focuses on the actions by protected manufacturers in the country that imposes the duty.

A study by Blonigen and Park (2001) is the closest to our paper as it also discusses optimal pricing behavior in the presence of uncertainty in anti-dumping ruling. The study demonstrates empirically that the likelihood of observing a decrease in the extent of dumping and therefore of anti-dumping duties is higher when the foreign firms expect low probability of anti-dumping enforcement. We explore firms’ pricing decisions further. According to our view, exporters set
their prices strategically, and their choice of prices depends, among other things, on the elasticity of demand for imports.

Our empirical analysis reveals a statistically significant negative relation between absolute import demand elasticity and the exporter’s decision to stop or reduce dumping. A doubling of the import demand elasticity reduces the probability of a price increase by the foreign exporter by about 5 percentage points. This finding is novel, as this aspect of the exporter’s decisions has not received much attention in prior literature.

Our paper contributes to the anti-dumping literature in several ways. First, it enhances the understanding of the motivation and factors affecting exporters’ responses to anti-dumping duties. Notably, Anderson (1992) points out the need to understand what makes foreign firms choose to restrict exports in response to an anti-dumping investigation as an important direction for further studies of anti-dumping process. Our study makes a step in that direction. We focus on the import demand elasticity as a determinant of exporters’ decision to increase prices, which can be achieved either directly or by voluntarily reducing exports. Second, the elasticity of demand for imports already figures prominently into the outcome of the anti-dumping investigation and the size of the duty because the elasticity is related to the extent of injury to the domestic industry and the import-reducing effect of a duty. In this paper we focus on the previously unexplored effect of the import demand elasticity on exporters’ responses to the duties. Third, better understanding of exporters’ motivation and their likely responses to AD duties may help improve the accuracy of anti-dumping policies conducted by importing countries, which would in turn have a positive effect on their welfare. As Gallaway et al. (1999) demonstrate, the welfare effect of anti-dumping duties can be quite substantial, more so when exporters respond by raising their prices.

The next section presents our theoretical model and establishes our main theoretical result. The empirical section follows. In the conclusion we summarize our findings and discuss their implications.
2. Theoretical model

In our model, there are two countries, call them Home and Foreign. A monopolist firm located in Foreign sells its good in the Foreign market at price $V$ and exports the good to Home market at constant marginal cost $C$. The Home demand is assumed to have a constant price elasticity $\alpha$, and is given by $Q = AP^{-\alpha}$.

All the parameters specified above are common knowledge. Parameter $A$ in the demand equations is set to 1, which does not lead to loss of generality.

We find it instructional to present the sequence of events analyzed by our model as a dynamic game. The game tree, presented in Figure 1, borrows heavily from Anderson (1992, 1993). For the purpose of our analysis, we reduce it to a two-period game. In period 1, the Foreign firm chooses its initial price for the Home market, $P_1$, earning profit

$$\pi_1 = (P_1 - C)P_1^{-\alpha}$$

(1)

After the first-period price is observed, an anti-dumping investigation against the firm may be initiated. The likelihood of initiation depends on several factors, not all of which can be observed empirically. Because of that limitation, we model initiation as a probabilistic event. The probability of an anti-dumping suit against the firm, $\rho(P_1)$, is increasing in the difference between the “reference value” $V$, equal to the price the Foreign firm charges in the Foreign market, and the price it charges in the Home market, $P_1$:

$$\frac{d\rho}{dP_1} < 0 \text{ if } P_1 < V, \quad \rho(P_1) = 0 \text{ if } P_1 = V.$$ 

Given the first-period price, $P_1$, with probability $(1 - \rho(P_1))$ there is no anti-dumping investigation, and the game ends. In this case, the firm’s price and profit in period 2 are the same as in period 1, i.e., $P_2 = P_1$ and

$$\pi_2 = \pi_1 = (P_1 - C)P_1^{-\alpha},$$

(2)

---

1 Analyzing decisions of a monopolistic exporting firm allows us to abstract from the possible strategic aspects of early stage price setting (Anderson 1992, 1993) and focus on the firm’s reaction to a request to raise its price later in the game.

2 The list of relevant factors includes the volume of imports, the size of the perceived injury to the Home industry, the strength of the Home industry lobby, etc.

3 We find this acceptable since our focus is on the firm’s response to the AD verdict and not on the Home country’s decision to start an investigation.

4 In our model we chose to adopt this most common approach of setting the reference value equal to the price the Foreign firm charges in the Foreign market. Other, more elaborate approaches to calculating $V$ also exist. The exact approach used in each particular anti-dumping case is not important for our results.
An anti-dumping investigation occurs with probability $\rho(P_1)$. Once subject of an investigation, the firm has several choices: it can either adjust its price immediately and have the investigation suspended, or it can wait for the outcome of the investigation. In our analysis, we assume an investigation always results in a ruling against the exporting firm. After the ruling is announced, the firm can either leave the market or pay the duty and stay. If the firm stays, then it also has the option of adjusting its price to $P_2 > P_1$ later in the game, and attempting to eliminate or reduce future sanctions by requesting an anti-dumping case review. The demand relationship is assumed to stay the same in both periods, therefore the new quantity the firm is able to sell is

5 Relaxing this assumption complicates the analysis but does not change the qualitative comparative static results.
\( Q_2 = P_2^{-\alpha} \), but if the newly chosen price \( P_2 \) stays below the reference value \( V \), then for each unit sold in that market the firm has to pay the Home government a duty in the amount of \((V - P_2)\).\(^6\)

Depending on the relationship between \( P_2 \) and \( V \), the firm’s profit is

\[
\pi_{2d} = (P_2 - C - (V - P_2))P_2^{-\alpha} \text{ if } P_2 \leq V \text{ (continued dumping).} \quad (3d)
\]

\[
\pi_{2v} = (P_2 - C)P_2^{-\alpha} \quad \text{if } P_2 \geq V \text{ (avoiding the duty).} \quad (3v)
\]

The foreign exporter seeks to maximize its profit over the two periods, \( \Pi = \pi_1 + \delta E(\pi_2) \), where \( \delta \) is the discounting factor.

We proceed with an observation we find interesting and important. (All the proofs are in the Appendix.)

**Proposition 1:** Suppose the exporting firm sets the price at the short-run profit maximizing level and the demand for its good stays constant. Then, if an anti-dumping duty is levied on this firm’s product, the firm is always better off raising the price and avoiding the duty than keeping the price constant and paying the duty.

It is, however, a well-established empirical fact that some firms choose to pay the duty and keep their prices unchanged. This can happen when firms set their initial prices above the short-run profit maximizing level. The most common-sense reason for that, which is also the most relevant in the context of our paper, is the firms’ attempt to reduce the probability of an anti-dumping investigation or to avoid it entirely. Other reasons may include experimenting with prices in the presence of uncertainty about demand parameters and pricing errors resulting from unexpected currency fluctuations.

In order to determine the firm’s optimal price path, we solve the game by backward induction. Once the game reaches the second period and the firm is subject to an anti-dumping investigation, it picks the \( P_2 \) that maximizes its second period profit, and that decision is not affected by the firm’s choices in period 1. In period 2, the firm needs to maximize

\[ \pi_2 = \max \{ \pi_{2d}, \pi_{2v} \} \] with respect to \( P_2 \). When \( \pi_{2d} < \pi_{2v} \), the price choice is trivial.

\(^6\) For simplicity, anti-dumping duties in our model are assumed to be non-retroactive. This assumption does not affect our most important results. The need to pay duties retroactively (for past as well as future import shipments) will induce more firms to leave the market and therefore not appear in the dataset we use but our analysis still applies to all those firms that remain.
Lemma. A firm that prefers to avoid paying the duty will set its price at $P_2 = V$.

In this case the firm’s profit is $\pi_{2v} = (V - C)V^{-\alpha}$.

If the firm prefers to keep its price below the reference value, then the price that solves its first-order profit-maximizing condition, $\frac{\partial \pi_{2d}}{\partial P_2} = P_2^{1-\alpha} (\alpha (C + V) - 2P_2 (\alpha - 1)) = 0$, is

$$P_2^* = \frac{\alpha (C + V)}{2(\alpha - 1)},$$

and the maximized value of the firm’s profit is

$$\pi_{2d} = (2P_2^* - C - V)(P_2^*)^{-\alpha} = \left(\frac{C + V}{\alpha - 1}\right)^{1-\alpha} \left(\frac{\alpha}{2}\right)^{-\alpha}.$$

The firm’s expected profit over the two periods is

$$\Pi = \pi_1 + \delta E(\pi_2)$$

$$= (P_1 - C)P_1^{-\alpha} + \delta(1 - \rho(P_1))(P_1 - C)P_1^{-\alpha} + \delta\rho(P_1)\text{Max} \left\{ (V - C)V^{-\alpha}, \left(\frac{C + V}{\alpha - 1}\right)^{1-\alpha} \left(\frac{\alpha}{2}\right)^{-\alpha} \right\}$$

Thorough analysis of (6) could allow us to gain a better understanding of the factors underlying the variety of price paths implemented by exporting firms. We save this task for future work and focus on the fact that when a firm faces an anti-dumping duty threat, its second-period price choice is independent of prior events and strongly depends on the demand elasticity.

Proposition 2.

When faced with an anti-dumping suit, the exporting firm sets its second-period price at

$P_2 < V$ and pays a positive anti-dumping duty if and only if $\alpha > 2 / (1 - C/V)$. Otherwise, it sets $P_2 = V$.

This is the main theoretical result of our paper. It suggests a correlation between the elasticity of demand a firm is facing and the firm’s optimal actions. Simply put, the more elastic the demand for the firm’s product, the more likely it is to set the price at $P_2 < V$ and pay a duty.
The same simple result can be illustrated graphically. Figure 2 introduces the approach we are using in our graphical analysis throughout this paper. The demand curve facing the firm is labeled $P(Q)$. For $P \geq V$, the firm’s profit trivially equals the area of the solid box bound by the demand curve, the marginal cost curve, and the quantity of output.

The $P < V$ case is slightly more complex since the firm’s marginal cost $C$ is augmented by the duty paid, equal to $(V-P)$. For this range of prices, we find it instructional to also plot the value of the $P - (V-P)$ expression, shown by the downward-sloping dashed line. It is trivial to see that for each relevant quantity, this curve has twice the slope of the demand curve.

The addition of the new curve allows us to illustrate the profit of the firm under this more complex scenario. For any $P < V$, the quantity the firm is able to sell is given by the intersection of the price level with the demand curve and profit is the dashed gray box bound by the marginal cost curve, the quantity produced, and the $P - (V-P)$ curve.

Figure 3 demonstrates the effect of demand elasticity on the firm’s optimal response to an AD action. It is easy to see that the higher the demand elasticity and the flatter the demand curve, the less likely the firm is to raise its price even in the presence of an AD threat.

In the next section, we test this theoretically established correlation empirically. We expect an increase in the exporting firm’s price following the initiation of an AD investigation to occur more often in cases when the demand elasticity is low.
Figure 2. Graphical representation of Foreign exporter profits in the Home market (no domestic supply, only Home demand for imports is shown).
Figure 3. Elasticity of demand and firm’s decision to raise the price.

Panel a. Low demand elasticity – Raising the price to $V$ generates greater profit.
Panel b. High demand elasticity – Keeping the price low and paying the duty generates greater profit.
3. Empirical analysis

In this section, we estimate the probability of a foreign firm’s action to reduce or eliminate AD duties as a function of the import demand elasticity. The probability of raising the price to the reference value is determined by the probability that the resulting latent profit \( \pi_2 \), exceeds the latent profit from dumping and paying the duty \( \pi_{2d} \). Proposition 2 establishes that for any given set of parameters there is a threshold demand elasticity above which the exporter prefers to pay the duty instead of raising the price. That threshold elasticity is determined by the product- and firm-specific parameters \( C \) and \( V \). The theory models the incentive of a particular firm exporting a particular product. To reflect product and firm variation in our data we introduce corresponding indices \( k \) and \( i \). Exporting firms in our data are also identified by the country of origin \( m \). The time dimension is reflected by index \( t \). The firm-product threshold elasticity can be rewritten to reflect the dimensions of the data in the following way:

\[
\alpha_{ikmt} = 2 \left( 1 - \frac{C_{ikmt}}{V_{ikmt}} \right)^{-1}
\]

(7)

Generally the distribution function of \( \alpha_{ikmt} \) is not known. Every product-firm pair has a different threshold value of the import demand elasticity, which depends on the cost, industry structure, and reference value applied during the anti-dumping investigation. To formulate the probability model, we need to assume a proper distribution function

\[
F \left( \delta_0 + \delta_1 \ln \alpha_{ikmt} + \delta_2 \left( \ln \alpha_{ikmt} \right)^2 + \delta_3 X_{ikmt} \right)
\]

where the \( \delta \)'s are coefficients and \( X_{ikmt} \) is a vector of distribution function shifters. The quadratic term is included to allow for the possibility of a diminishing effect of the elasticity on the probability of a price increase. In the absence of detailed information about firm characteristics we take advantage of the multi-dimensionality of our data and rely on fixed effects to control for country-, industry-, and year-specific cost shifters. This produces the following specification of the probability function:

\[
Pr \left( \left( \pi_{2v} \right)_{ikmt} > \left( \pi_{2d} \right)_{ikmt} \right| \alpha_k, X_{ikmt} = F \left( \delta_0 + \delta_1 \ln \alpha_k + \delta_2 \left( \ln \alpha_k \right)^2 + \delta_3 X_{ikmt} \right)
\]

(8)
where \( (\pi_{2v})_{dmt} \) is the profit of the firm if it sets its price at the reference value, \( V \), and \( (\pi_{2d})_{dmt} \) is the maximum profit of the firm if it sets its price below \( V \) (and therefore continues to engage in dumping). Assuming that \( F(.) \) is a standard normal distribution function produces the commonly used Probit model. The linear and logit probability models can be formulated in a similar manner. Our results are robust to the choice of the probability function.

Even without information about the exact joint distribution of all other firm-specific parameters we still know that a larger elasticity is more likely to exceed the threshold. This is the basis of our identification strategy. We expect a robust negative relationship between the absolute demand elasticity and import price increases in response to an anti-dumping duty.

Data

The data on antidumping cases comes from the Bruce Blonigen’s dataset. The data contain detailed information about all US anti-dumping cases that were initiated between years 1980 and 1995. Relevant to our model, every case contains information about the product categories covered by the case, the size of the initial and revised anti-dumping duties, and whether the review was automatic or requested by foreign or domestic firms.

The dataset contains 1183 case-firm observations. In 630 of them the decision is listed as affirmative and therefore a duty was imposed. In 47 cases the anti-dumping investigation was suspended. These 677 case-firm combinations constitute our sample. The number of foreign firms per case differs. For 167 of the cases, only one firm is listed. At the other extreme, case number 731722 against Chinese honey producers lists 28 firms.

Import demand elasticities have been estimated by Broda and Weinstein (2006). Using the Feenstra (1994) methodology they provide estimates of elasticities for US imports for the period of 1972-1988 and 1990-2001. The time period is split due to a change in product classification. In order to preserve detail of the data we merge the elasticities with the anti-dumping data by the product code and classification reported in the data.

Broda and Weinstein’s elasticity estimates do not exactly match our theoretical model, which assumes a monopolistic exporter. Since individual firms’ demand elasticities are not available, we rely on import demand elasticities for the whole product category. Using the data despite this limitation requires us to make several assumptions. First, our identification relies on sufficient variation across product categories. Second, we assume that the amount of variation across firms
within a product category is small relative to the variation across product categories. Third, we assume that the firm-level and market-level (i.e. product-category) elasticities are positively correlated. Better data would allow us to investigate this assumption more thoroughly primarily through accounting for the number of importing firms per product category.

Every anti-dumping case is associated with a number of corresponding product categories. In order to merge the data on anti-dumping cases with the elasticities we perform the following procedure. First, we attempt to match the two datasets directly by product category. This is the cleanest match and it produces 1,807 case-firm-product observations. Second, for those anti-dumping cases that failed to match in the first step due to a different number of trailing zeros, we gradually remove the trailing zeros from their product code and match those entries with the dataset on elasticities. This step increases the number of observations to 1,821. Finally, for those cases that did not match in the first two steps, we reduce the number of digits in the anti-dumping set’s product category and match it with corresponding median elasticities from Broda and Weinstein (2006). In other words, if an 8 digit product category does not have a matching elasticity we reduced the number to 7 digits and match it to the median elasticity for the 7 digit category. Then we repeat this step for 6 digits and so forth. This last step is based on the assumption that elasticities within an aggregated category are more correlated than the elasticities across aggregated product categories. As a result of the three steps, we obtain 2,314 case-firm-product observations. These include 637 unique firms identified as a particular firm in a particular ITC case. The rest of the observations come from the product dimension. Our procedure significantly increases the number of matches between the AD and elasticity data but it also relies on additional assumptions. Therefore, we verify robustness of our findings to the matching procedure. The results do not change qualitatively, but the additional matching steps slightly attenuate the effect of the elasticity on the probability of a price increase, indicating perhaps that the procedure introduces noise that is not offset by the gain in the number of observations.

Construction of the dependent variable

Our main interest is in identifying the foreign firm’s decision to either raise its price or pay the anti-dumping duty in full. We use information contained in several variables to identify the reaction of the foreign firms.
The majority of the cases in our sample involve imposition of a duty. We do not have accurate information about exporters’ pricing behavior after the imposition of duty, but the dataset contains information on revisions to the anti-dumping duty rate following an administrative review. If the revised rate is lower than the one originally imposed, we interpret it as evidence that the firm increased its price. As a result, 929 observations are classified as price increases by the exporter. Presumably, some changes in duties can result from a measurement or procedural error. Even with the same information, the calculated duty can conceivably change if it is calculated twice at different points in time. In order to reduce the influence of such errors, we experiment with different duty reduction thresholds. For example, we could count only those cases when the duty was reduced by more than a quarter as a result of an administrative review. Our findings remain robust.

Admittedly this method of inference does not guarantee that every reduction of an AD duty results from a price increase by the exporter. This is mostly because the AD rate depends not only on the pricing behavior but also on the calculated fair reference value, which can also potentially change between the original duty determination and the revision of the duty. Without information on the determinants of the change in the reference value, we assume that the time invariant elasticity of import demand is not systematically related to the change in reference value between the original determination and the revision.

The administrative review was automatic between 1980 and 1984. After 1984, administrative reviews could be requested by foreign or domestic firms. When foreign firms increase prices to avoid anti-dumping duties it is in their interest to request a review. We use dummies for each type of administrative review (foreign, domestic, or automatic). These dummies are not collinear because some reviews were petitioned by both foreign and domestic firms.

The second group of cases included in our sample are suspended cases. According to Sec. 351.208 of the Anti-dumping Duties regulation (Final Rule 62 FR 27295, May 19, 1997) of the Import Administration at the U.S. International Trade Commission,

“In addition to the imposition of duties, the Act also permits the Secretary to suspend an anti-dumping or countervailing duty investigation by accepting a suspension agreement (referred to in the WTO Agreements as an “undertaking”). Briefly, in a suspension agreement, the exporters and producers or the foreign government agree
to modify their behavior so as to eliminate dumping or subsidization or the injury caused thereby”.

Based on the above rule, we use suspension of an anti-dumping investigation as an indication that the exporter’s pricing behavior was modified to avoid the anti-dumping charge. There are 57 observations with a decision to suspend the investigation. Interpreting suspensions as compliance by the exporter is consistent with Rutkowski (2007), who empirically shows a positive correlation between withdrawals of anti-dumping complaints and import price increases.

Potentially, a case can be suspended also if the foreign firm exits the market. This would occur if an increase in the price would cause the firm to lose too much revenue. Such loss is more likely when the demand is very elastic, which is the opposite of the logic implied by our model. We experiment by excluding suspended cases from the sample. The results do not change quantitatively at the two decimal-point precision.

Identification issues

The anti-dumping database we use contains information on whether the administrative review was initiated by the domestic or the foreign petitioner. If a firm decides to increase its price to avoid the antidumping duty, the reduction in duty is not automatic. The firm needs to file a petition as an intermediate step. Since the decision to petition is related to the strategic price increase, as highlighted in our model, it reveals information about the firm’s threshold import demand elasticity. In particular, firms with higher thresholds are more likely to increase their price for any given elasticity of import demand. Therefore, if our theory is correct the decision by the exporter to petition for the administrative review is potentially a very important firm-specific proxy for the threshold elasticity. We take advantage of this information by conditioning the estimate on the petitioner type.

Our model is predicated on the exporter’s market power, which may be very weak in industries with high import demand elasticities. Industries with extremely high elasticity of demand pose two potential problems for identification of our model. First, there is very little room to maneuver with prices and profits when the elasticity is high. The exporters could behave as price takers and price increases could be driven more by changes in world prices, exchange rates, and costs than with the strategic considerations described in our model. Second, there is a possible non-linearity in the way that the import demand elasticity relates to the firm’s threshold
elasticity if the distribution of the threshold values has very flat tails. If the import demand elasticity surpasses the threshold for all firms at some point, additional increases in elasticity will not bring about the same changes in the expected probability of a price increase. Separating the two empirically is nearly impossible due to data limitations. In order to mitigate the issue, we estimate all specifications on samples conditioned on sufficiently low values of the demand elasticities and by introducing a quadratic term to allow for a possible tapering off of the elasticity effect. To preview our results, both remedies turn out to be econometrically important. First, we find that very large values of the import demand elasticity reduce the significance of the elasticity effect. Second, the effect of the quadratic term of the log-elasticity is statistically significant, revealing a diminishing effect of the import demand elasticity at large values.

There is limited room to use the time dimension of the data for identification. First, the firms appear in the anti-dumping dataset only when they are subject of an AD investigation. Second, time variation in elasticities is hard to identify. Due to data limitations, time variation in trade flows and prices is used to identify the elasticities. We assume that the import demand elasticities are time invariant, with the exception of the change in product classification from the Tariff Schedule of the United States, Annotated (TSUSA) to the Harmonized System (HS) in 1989. Broda and Weinstein’s elasticities are estimated separately for each classification and therefore capture some of the time variation. About a quarter of the total number of observations is from the time when TSUSA was used to classify the goods. In addition to using classification-specific elasticities, we include a year effect as well as country-year effects in some specifications.

Another potential identification issue may arise from the mismatch between the unit of observation and the theoretical decision making unit. Every observation in our dataset corresponds to a particular firm exporting a particular product to the US. The decision by the same firm in cases that involve several products may be correlated for two reasons. First, the cost factors may be correlated. Second, the administrative review is case-firm specific. The ITC makes a decision on a firm, not a product. In order to allow for possible correlation of the error terms, we calculate standard errors clustered by firm.

Results

We estimate specification (8) with conditional maximum likelihood Probit. The results of the estimation are reported in Table 1. Specification (1) does not include any controls and the effect
of the elasticity is not significant at conventional levels. Specifications (2) through (6) include petitioner dummies and progressively increase the detail of fixed effects. Specifications (3) and (4) include separate dummies for industries and countries. Specification (5) includes industry and country dummies simultaneously, and specification (6) adds a set of year dummies. Industries are defined according to the Section headings of the Harmonized Tariff Schedule of the United States and the Schedule 1 through 7 headings of the Tariff Schedule of the United States. As we add more controls the number of usable observations diminishes.

First and foremost, the main conclusion from Table 1 is that the qualitative prediction of the theoretical model holds. There is a negative, statistically significant, and robust relationship between the absolute import demand elasticity and the probability that the exporter increases the price and stops dumping. Second, the magnitudes of the estimates are significant. The magnitudes are reported as coefficients of the Probit regression. Table 1 reports the percentage of correctly classified outcomes as a measure of predictive accuracy. The outcome is classified as predicting the price increase if the predicted probability exceeds 0.5.

The total effect of the elasticity varies with the elasticity because of the quadratic term in the regression. We explore the significance of the total effect by testing $H_0: \hat{\delta}_1 + 2 \hat{\delta}_2 \ln(\alpha_k) \geq 0$. The table reports the share of observations for which the total effect is statistically significantly negative at 95% confidence level. The effect of the foreign petitioner dummy is positive throughout, consistent with our view that exporting firms are more likely to petition for review after they increase their prices.
Table 1. Foreign firms’ response to anti-dumping duties and import demand elasticity.

<table>
<thead>
<tr>
<th>Specification</th>
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<th>(3)</th>
<th>(4)</th>
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<tbody>
<tr>
<td>Import demand elasticity, $\ln(\alpha_k)$</td>
<td>-0.061</td>
<td>-0.45</td>
<td>-0.418</td>
<td>-0.36</td>
<td>-0.611</td>
<td>-0.709</td>
</tr>
<tr>
<td></td>
<td>[0.173]</td>
<td>[0.195]**</td>
<td>[0.188]**</td>
<td>[0.164]**</td>
<td>[0.186]***</td>
<td>[0.198]***</td>
</tr>
<tr>
<td>$\ln(\alpha_k)^2$</td>
<td>0.012</td>
<td>0.085</td>
<td>0.085</td>
<td>0.069</td>
<td>0.118</td>
<td>0.137</td>
</tr>
<tr>
<td></td>
<td>[0.028]</td>
<td>[0.035]**</td>
<td>[0.036]**</td>
<td>[0.032]**</td>
<td>[0.035]***</td>
<td>[0.038]***</td>
</tr>
<tr>
<td>Controls:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foreign review petitioner</td>
<td>0.829</td>
<td>0.999</td>
<td>0.597</td>
<td>0.835</td>
<td>0.651</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[0.298]***</td>
<td>[0.299]***</td>
<td>[0.269]**</td>
<td>[0.313]***</td>
<td>[0.368]*</td>
<td></td>
</tr>
<tr>
<td>Domestic review petitioner</td>
<td>-0.17</td>
<td>-0.976</td>
<td>-0.166</td>
<td>-0.729</td>
<td>-1.017</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[0.315]</td>
<td>[0.282]***</td>
<td>[0.335]</td>
<td>[0.294]**</td>
<td>[0.391]***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[0.444]***</td>
<td>[0.559]***</td>
<td>[0.462]***</td>
<td>[0.673]***</td>
<td>[0.994]***</td>
<td></td>
</tr>
<tr>
<td>Country fixed effects</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Industry fixed effects</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Year fixed effects</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Correctly classified, %</td>
<td>57.7</td>
<td>83.1</td>
<td>88.3</td>
<td>86.3</td>
<td>90.7</td>
<td>91.5</td>
</tr>
<tr>
<td>Pseudo R-sq</td>
<td>0.00015</td>
<td>0.49</td>
<td>0.61</td>
<td>0.56</td>
<td>0.68</td>
<td>0.73</td>
</tr>
<tr>
<td>Total marginal effect negative and significant, % of sample obs</td>
<td>0</td>
<td>57</td>
<td>36</td>
<td>54</td>
<td>69</td>
<td>75</td>
</tr>
<tr>
<td>N-obs.</td>
<td>1807</td>
<td>1807</td>
<td>1577</td>
<td>1782</td>
<td>1552</td>
<td>1381</td>
</tr>
</tbody>
</table>

Notes:
1) The table reports Probit maximum likelihood estimators of the following probability function: $Pr(I_{i,t} = 1) = \Phi(\hat{\delta}_0 + \hat{\delta}_1 \ln \alpha_k + \hat{\delta}_2 (\ln \alpha_k)^2 + \hat{\delta}_3 X_{i,t})$
2) * – significant at 10%, ** – significant at 5%, *** – significant at 1%;
3) Industry fixed effects are defined by the first digit of the product classification reported in the AD dataset (i.e. HS after 1989 or TSUSA otherwise);
4) The number of observations differs across columns due to collinearity of the dummies with the fixed effects;
5) Standard errors are clustered by firm;
6) The total marginal effect is calculated as $\hat{\delta}_1 + 2\hat{\delta}_2 \ln(\alpha_k)$. 

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Marginal effects

We calculate the marginal effects of the import demand elasticity on the probability of a price increase at mean values of all other variables by country and by industry. The marginal effects are calculated as

\[
\left[ \frac{\partial \Pr (\cdot)}{\partial \ln \alpha_k} \right] = (\delta_i + 2\delta_2 \ln (\alpha_k))\phi(\delta_i)
\]

where \(\delta_i\) is the effect of all variables at their means for each country \(i\) and \(\phi(\cdot)\) is the standard normal probability distribution function. Figure 4A presents the results by industry based on the estimates of specification (6) of Table 1. The length of the bar represents the 95\% confidence interval. TS describes industries in the TS USA classification used in the earlier part of the sample and HS is for the later part of the sample. Figure 4B presents similar results grouped by the exporter country. In most cases, the marginal effects are negative and significant. For example, a magnitude of -0.05 implies that doubling the elasticity decreases the probability of a price increase by 5 percentage points. Given the large amount of variation in the elasticities of import demand in our sample, the model can attribute a substantial amount of variation in the probability of a price increase by the exporter to the import demand elasticities.
Figure 4A. The 95% confidence interval for the marginal effect of the log import demand elasticity on the probability of a price increase at mean values of the other variables, by industry.
4. Conclusions and discussion

In this paper, we argue that foreign firms, when faced with sufficiently elastic demand, prefer paying the anti-dumping to increasing their price. This finding is theoretically sound and empirically robust and the effect of the import demand elasticity is statistically and economically significant.

Our results are important for better understanding of exporters’ behavior, especially so because exporters’ reaction may affect domestic welfare. At model parameter values where an exporter is indifferent between paying the duty and raising the price, the welfare effects of those two courses of action are very different. Figure 5 illustrates the effects of an anti-dumping ruling on the importer’s welfare as well as on the exporter’s rents. The figure combines our graphical approach to dumping presented earlier with conventional partial equilibrium welfare analysis. The exporter can either charge $V$ and be relieved of anti-dumping duties, or it can charge $P$ and
pay a \((V - P)\) duty for each unit shipped to Home. A price reduction from \(V\) to \(P\) by the exporting firm would generate welfare gains to Home consumers in the amount of \((a + b + c + d)\), losses to Home producers in the amount of \((-a)\), and anti-dumping duties in the amount of \((e + f + g)\). As a result, aggregate home welfare would clearly increase. Therefore, from an aggregate welfare standpoint, Home always prefers to collect the duty. The exporter’s own welfare ranking of choices available is not as trivial. As Figure 4 indicates, reducing the price from \(V\) to \(P\) would result in a change in its own welfare equal to \((h + j - c - f)\). The sign of that expression is ambiguous and depends on the shapes (and therefore elasticities) of supply and demand. In general, we can think of a situation where a small variation in Home’s calculation of the reference value, the extent of the injury, or the duty itself would lead to a substantial change in the exporter’s reaction, and therefore in Home aggregate welfare.

An intuitive implication of the above discussion is that Home prefers the duty to be paid and therefore does not want the size of the duty to be too large. Similar points have been made before. Prusa (1997) demonstrates using sample statistics that patterns of changes in the volume and value of imports following an anti-dumping investigation are clearly and strikingly different for small- and large-duty cases. Similarly, DeVault (1996) shows that the size of the duty has a non-trivial effect on the likelihood of an anti-dumping case review and other aspects of exporters’ behavior. Most notably, Gallaway et al. (1999) uses a general equilibrium model to convincingly show that the importing country’s losses are greater when the exporter raises the price.

The argumentation provided above may serve as a justification of a strategic approach to policy choice. Naturally, the importer demand elasticity cannot explain every aspect of exporters’ behavior. Due to the extremely large number and complexity of factors involved in exporters’ responses, their actions often remain a mystery. As Blonigen and Prusa (2003) concluded in their comprehensive review of existing work on anti-dumping, “Perhaps frustratingly, …this can lead to just about any combination of distorted market effects, depending on the characteristics of the strategic game being played by the firms”. Still, understanding the role of the import demand elasticity is an important step toward disentangling the numerous complex considerations involved in AD policy by investigating a previously unexplored facet of anti-dumping. This point is valid regardless of whether the Home country is concerned with aggregate welfare or any other strategic objective. It may also provide insight
useful for crafting trade policies other than anti-dumping. At the very least, there seems to be a case for including expectations of exporters’ responses into all trade policy decisions. The more accurate those expectations are, the higher the chances that trade policies will in fact achieve their goals.

Figure 5. Effect of an anti-dumping duty on importer’s welfare and foreign firm’s rents.
5. References


6. Appendix

Proof of Proposition 1.

Let the original exporter price be \( P \) and the reference value \( V = kP \), where \( k > 1 \). The firm profits in each case are given by (3d) and (3v), respectively.

The firm prefers to pay the duty when

\[
\pi_{2d} - \pi_{2v} = P^{-a} (2P - C - kP - k^{1-a} P + k^{-a} C) > 0
\]

or

\[
(2 - k - k^{1-a})P > (1 - k^{-a})C
\]

(A.1)

or

\[
(2 - k - k^{1-a})P > (1 - k^{-a})C
\]

(A.2)

Short-run profit-maximization price satisfies

\[
\frac{P}{C} = -\frac{\alpha}{1 - \alpha}.
\]

Then (A.2) can be rewritten as

\[
\frac{2 - k - k^{1-a}}{1 - k^{-a}} > \frac{1 - \alpha}{-\alpha} = \frac{\alpha - 1}{\alpha},
\]

which transforms into

\[
1 + \frac{(1 - k)(1 + k^{-a})}{1 - k^{-a}} > 1 - \frac{1}{\alpha}
\]

and

\[
(k - 1)(k^a + 1) < \frac{k^a - 1}{\alpha}.
\]

(A.3)

Note that at \( k = 1 \) the two sides of (A.3) are equal. The derivatives of both parts with respect to \( k \) are

\[
k^a + 1 + \alpha k^{a-1} (k - 1)
\]

and

\[
k^a - 1
\]

respectively. When \( k > 1 \), the first of those two expressions is always greater. Therefore the left-hand side of (A.3) will always be greater than the right-hand side, and (A.1) never holds. Q.E.D.

Proof of Lemma.

When demand stays constant between periods, then so does the short-run profit maximizing price, \( P^* \). An AD suit is filed only if \( P_1 < V \), which happens only if \( P^* < V \). The last inequality implies that

\[
\frac{\partial \pi_2}{\partial P_2} < 0 \forall P_2 > V . \text{ Therefore } \pi_2(V) > \pi_2(P_2) \forall P_2 > V . \text{ Q.E.D.}
\]

Proof of Proposition 2.

The firm prefers to pay the duty when \( \pi_2(P_2) > \pi_2(V) \). That will happen when the profit-maximizing \( P_2 \) is less than \( V \), or

\[
P_2^* = \frac{\alpha (\frac{c}{v} + 1) V}{2(\alpha - 1)} < V \text{ or } \alpha > 2/(1 - \frac{c}{v}).
\]

Otherwise, the firm always raises the price to \( V \). Q.E.D.