SIEPR Discussion Paper No. 08-34

Vertical Integration and Trade Protection: The Case of Antidumping Duties

By
Maya Cohen-Meidan
Stanford University

March 2009

Stanford Institute for Economic Policy Research
Stanford University
Stanford, CA 94305
(650) 725-1874

Vertical Integration and Trade Protection: The Case of Antidumping Duties

Maya Cohen-Meidan*

March 2009

Comments are welcomed

Abstract

This paper analyzes the interaction of trade policy with the vertical structures of foreign firms exporting goods to the United States, focusing on the case of antidumping duties. I use a model that incorporates both vertical structure and the dynamics of U.S. antidumping duties to show that the policy has a notably different impact on vertically integrated and non-integrated foreign firms. I then successfully test the theoretical predictions using data on 489 antidumping cases. In particular, I find that non-integrated firms are more likely than vertically integrated firms to exit the U.S. market following the imposition of duties, and less likely to pass the duties on to consumers for certain products. My empirical findings also indicate that antidumping duties oscillate between low and high levels - a previously unnoticed, surprising and most-likely unintended consequence of the design of U.S. antidumping policy that is nevertheless predicted by my model.

*I am deeply grateful to Robert Staiger, Jon Levin and Frank Wolak for their continuous guidance, invaluable advice and encouragement. I would also like to thank Ran Abramitzky, Bruce Blonigen, Nick Bloom, Tim Bresnahan, Liran Einav, Doireann Fitzjerald, Bob Hall, Nir Jaimovich, Jakub Kastl, Kalina Manova, Shaun McRae, Jee-Hyeong Park, Alan Sykes, Alejandrina Salcedo, Michelle Tertilt, Yaniv Yedid-Levi, Joanne Yoong, and seminar participants at Stanford University, University of Oregon, the Anderson school of management at UCLA and the Managerial Economics and Strategy Group at the London School of Economics. I am grateful to Michael Shor for sharing his extensive knowledge and insights regarding U.S. Antidumping laws. I thank the B.F. Haley and E.S. Shaw Fellowship and John M. Olin Program in Law and Economics for financial support.

1 Introduction

Antidumping duties are aimed at protecting domestic industry from the sale of imports at less than a "fair" value. As illustrated by Figure 1, the number of countries with antidumping laws has increased dramatically in the last two decades. This increase is correlated with the rise in World Trade Organization (WTO) membership. Because members of the WTO must limit the use of import tariffs, they have come to rely on antidumping duties.[1] In the United States alone, there were 280 antidumping measures in force as of July 2005.[2] Gallaway, Blonigen, and Flynn (1999) estimated the annual net welfare cost of U.S. antidumping and countervailing duties to be $4 billion using 1993 data.

The same period has also seen a sharp increase in the integration of firms across country borders. Intra-firm trade made up 37% of U.S. imports in 1982, increasing to 52% in 2000.[3] Though this development has been widely noted by economists, little attention has been paid to the impact of increased international integration on trade policy.

I argue that the increasing share of intra-firm trade has important implications for the outcomes of antidumping policy. Intra-firm transactions pose a particular challenge for antidumping duties and similar trade policies that target foreign export prices. Specifically, when the foreign producer is vertically integrated with the domestic importer, the export price is an internal transfer price, which the foreign producer can manipulate. In response to this possibility, U.S. antidumping law treats foreign producers that are vertically integrated with their domestic importers - henceforth *integrated* foreign producers - differently than foreign producers that are not integrated with the U.S. importer - henceforth *non-integrated* foreign producers. As a consequence of this different treatment, the incentives of foreign producers facing antidumping actions differ by their vertical structure. I construct a dynamic pricing model to formalize these claims for U.S. antidumping duties. I then test the predictions of the model using comprehensive data on antidumping duties in the United States. I find that the vertical structure of foreign producers with their domestic importers has a stark impact on the response to antidumping duties. These findings indicate that accounting for firm vertical structure is an important ingredient in developing a more complete understanding of the impacts of antidumping policy on import prices and import volumes, and consequently on the incomes and employment of import-competing factors as well.

The model I develop incorporates both vertical structure and the dynamics of U.S. antidumping duties. Here the institutional details play a key role. For a non-integrated foreign producer, the antidumping duty is based on the difference between the assessed "fair-value" price (roughly, the producer's home market price) and the producer's U.S. export price in the prior period. The duty is paid by the importer. For an integrated foreign producer, the antidumping duty is based on the difference between the fair-value price and the producer's U.S. consumer price in the prior period, with

[1]See Prusa (2005) for a discussion of antidumping proliferation.

[2]WTO, Report of The Committee on Antidumping Practices, November 2005 (G/L/758).

[3]Bureau of Economic Analysis, Total U.S. Trade in Goods and Intrafirm Trade in Goods, 1977-94. `https://www.bea.gov/international/datatables/0297iid/table1.htm` and Bernard, Jensen, and Schott (2005)

the duty paid by the producer. The retroactive calculation of the duties creates a feedback loop from past pricing behavior to current duty adjustments.

An immediate implication of these rules is that if an integrated and a non-integrated producer each face the same duty level and each make pricing decisions that ultimately lead to identical U.S. consumer prices, then the non-integrated producer will face a higher antidumping duty in the following period. The first prediction of my model is thus that, all else being equal, an antidumping duty will have a bigger effect on profitability, and will thus be more likely to induce exit from the market, for a non-integrated foreign producer.

A second, subtler prediction of the model concerns the dynamics of duty adjustment. I show that imposing antidumping duties generates one of two outcomes for integrated foreign producers: either they cease dumping immediately, or else their duties oscillate over time until they converge to steady-state dumping. The behavior of non-integrated foreign producers depends on the shape of the consumer demand curve. If consumer demand is *sufficiently convex*, a non-integrated producer either ceases dumping immediately, or sets export prices so that duties oscillate and ultimately converge to steady-state dumping. If consumer demand is *not too convex*, the non-integrated producer sets export prices so that duties monotonically decrease to a steady-state, with or without dumping.

These different dynamics arise because of the incentives provided by the feedback-loop nature of antidumping duties. An integrated foreign producer can choose the U.S. consumer price directly, and hence faces a simple tradeoff. Specifically, a higher duty today acts as a cost shifter, and provides a static incentive to raise the U.S. consumer price, leading in turn to a lower duty tomorrow. The result is oscillation of duties and prices over time. The non-integrated foreign producer, by contrast, cannot choose the U.S. consumer price directly, but it can influence the U.S. consumer price indirectly under the retroactive nature of U.S. antidumping law by manipulating its foreign export price over time. As a consequence, for a non-integrated foreign producer, the static incentive created by a higher duty today depends on the curvature of consumer demand - this is because the duties are paid by the independent importer and hence act as a demand shifter. If a higher duty creates a static incentive to raise price, the result is oscillation, otherwise the model predicts monotonic convergence to a steady state.

The third prediction of the model concerns the steady-state incentives to pass duties on to consumers. I show that, the higher the elasticity of demand at or around steady-state, the more the U.S. consumer price of the integrated foreign producer responds to duty changes. Intuitively, since higher demand elasticity implies lower price margins over marginal costs, the U.S. consumer price of the integrated foreign producer responds more to duty (cost) changes when demand is more elastic. The reverse is true for the non-integrated foreign producer: when demand is more elastic, the non-integrated foreign producer has to change its export price by less to achieve the desired level of demand. As a result, foreign export prices and U.S. consumer prices respond less to duty changes around steady-state when demand is more elastic there.

In order to test these three predictions, I construct a detailed dataset of all U.S. antidumping duties imposed between 1980 and 1995. The data support the model's first prediction, showing that non-integrated firms are almost twice as likely as integrated firms to exit the U.S. market once antidumping duties are imposed.

Second, the data indicate that U.S. antidumping duties tend to oscillate over time for both integrated and non-integrated foreign producers. This confirms the model's prediction for integrated producers and is also consistent with its prediction for non-integrated producers, under the assumption that demand is sufficiently convex. This result is interesting because it runs counter to assumptions in earlier theoretical work. It also contradicts a "naive" expectation that firms will respond to antidumping duties by increasing their prices to the fair-value price. My empirical findings hence identify a previously unnoticed, surprising and most-likely unintended consequence of the design of U.S. antidumping policy that is nevertheless predicted by my model. These non-fundamental reasons for price oscillation suggest the potential for welfare losses, although my data do not allow me to assess that directly.

I also confirm the other component of the model's second prediction: the potential for firms to immediately cease dumping once antidumping duties are imposed. Because revocation of the duties takes time, this requires a careful analysis of the data to determine when dumping ceased. Taken together, the findings confirm the model's second prediction for integrated foreign producers. The findings also confirm the second prediction for non-integrated foreign producers, provided that one accepts the assumption that demand is sufficiently convex.

Finally, I examine the two components of the third prediction: that a higher elasticity of demand at steady-state makes the integrated producer's U.S. consumer prices more responsive to duty changes, but makes non-integrated producers' prices less responsive to duty changes. I approach this examination in two ways. First, I presume that steel has higher demand elasticity than other intermediate products in my data, while finished products have lower demand elasticities. I find that U.S. consumer prices of integrated foreign producers responded more to duty changes for steel than for other goods. I also find that U.S. consumer prices of integrated producers responded less to duty changes for finished products than for other goods, while the prices of non-integrated foreign producers responded more for finished products.[4]

However, the classification of products in my data into these categories may be too broad and thus inaccurate. Hence, I make another attempt at assessing the impact of higher demand elasticities on the pass-through of antidumping duties. In particular, I use Broda and Weinstein (2006)'s estimates of (import) demand elasticities to define a binary variable that equals 1 for products with "high" demand elasticities. I find that the prices of non-integrated foreign producers responded less to duty changes when demand elasticity was high, while the prices of integrated foreign producers responded more. To the extent that my measure of high demand elasticity is accurate, these findings confirm the third theoretical prediction.

The paper's findings contribute to the literatures on antidumping duties and the role of multina-

[4]I classify the products in the data into four mutually exclusive commodity groups: steel, chemicals, finished products (including food) and all other intermediates.

tionals in international trade. The theoretical model I consider builds on work by Blonigen and Park (2004), who were the first to analyze the dynamics of pricing for a non-integrated foreign producer faced with antidumping duties. But they do not examine the dynamic time path of antidumping duties over time, nor do they consider the distinction between integrated and non-integrated foreign firms. By contrast, the distinction between integrated and non-integrated foreign firms is central to my work: extending the model to consider vertically integrated firms gives rise to a new set of theoretical and empirical predictions that I am able to test successfully. Taken together, the two papers suggest that a number of aspects of the empirical data on antidumping duties can be well explained by a simple and consistent optimal pricing model.

Less directly, the paper relates to a large literature on antidumping duties and their impact on import volumes, domestic production and prices (e.g. Finger (1981), Herander and Schwartz (1984), Salvatore (1987), Staiger and Wolak (1994), Harrison (1991), Blonigen and Haynes (2002) and Prusa (1997)).

Although this paper is among the first to relate vertical structure to the effects of trade policy, there has been substantial recent work on the broader role of vertical structure in trade patterns (e.g. Grossman and Helpman (2002), Antràs and Helpman (2004) and Antràs and Helpman (2008), and recent empirical papers by Antràs (2003) and Nunn and Trefler (2008)). This literature strives to understand the implications of the rise of multinational firms for the world economy. My paper is part of a small and growing literature on the implications of multinationals for trade policy (Ornelas and Turner (2008a), Ornelas and Turner (2008b), Antràs and Staiger (2008) and Díez (2008)). One nice feature of antidumping duties for examining the interaction of trade policy and vertical structure is that they highlight the potential for differing treatment of different types of producers. My theoretical findings indicate why this might have real consequences, and the empirical results suggest that indeed there are some differences in the response of integrated and non-integrated producers to antidumping duties.

The rest of the paper is organized as follows. In Section 2 I briefly explain U.S. antidumping policy and highlight the main characteristics of the process. The design of antidumping policy is incorporated into the theoretical model that is developed and discussed in Section 3. Section 4 describes the data used in this paper. The predictions of the model are tested in Section 5 and Section 6 offers conclusions and discussion of future research.

2 U.S. Antidumping Procedures

This section describes how the U.S. government calculated and assessed antidumping duties throughout the data period of 1980 to 1995, during which there were no major changes to U.S. antidumping duty law or to the method of calculating the duties. The exposition highlights how the method of calculating duties differs for vertically integrated and non-integrated foreign producers.

2.1 U.S. Antidumping Procedure for Non-Integrated Foreign Producers

Antidumping investigations are usually initiated by domestic producers' submitting a petition. Two government agencies are involved in the investigation. The Department of Commerce determines whether the product was "dumped," i.e. whether the product was sold in the United States for less than "fair-value." The International Trade Commission determines whether the imports under investigation caused or may cause a "material injury" to the domestic industry.

The determination of dumping by the Department of Commerce is an extremely involved process. For a foreign producer that is not vertically integrated with the domestic importer (non-integrated foreign producer), the dumping margin is defined as the percentage difference between the "fair-value" price and the foreign producer's export price. The dumping margin hinges upon Commerce's fair-value price determination. In principle, the fair-value price is based on the consumer price of the foreign firm's product in its own market. However, if Commerce determines that these sales are inadequate (e.g. quantities are "too small" or prices are "too low"), the fair-value price is instead based on the firm's third-country sales or on "constructed value." Constructed value is calculated using various costs related to the firm's production and sales in the United States, and requires extremely detailed data from the foreign producers. If Commerce deems the information supplied by the foreign firm unsatisfactory, it can resort to instead using the "best information available." The "best information available" often uses information supplied by domestic petitioners, which is unfavorable for the foreign firm, generally resulting in high duty margins.

Antidumping duties are imposed only if both final determinations are positive: if Commerce finds dumping and the International Trade Commission finds material injury.[5] The entire investigation is limited by legislation to last no more than 10 to 14 months. If the investigation ends in a positive determination, the foreign producer is assessed a duty equal to the dumping margin calculated by Commerce, but remains free to choose its own price.

In every subsequent year, any interested party can ask Commerce for a review of the duties.[6] An interested party might be a foreign firm subject to duties, one of the original petitioners, or another U.S. firm. Commerce publishes a revised duty level at the end of the review. If no party asks for a review, the duty remains unchanged from its previous level. An antidumping order can be terminated if three consecutive reviews find no dumping by the foreign producer. The duty can also be revoked upon lack of interest from the domestic industry or (since 1995) through "Sunset reviews," which occur every five years starting from the original order date.

Since antidumping duties are based on past prices, they necessarily lag after actual prices. Antidumping duties for the non-integrated foreign producer are based on the difference, during the months of the investigation or review period, between the producer's *foreign export price* and its fair-value price.

[5] In some instances the foreign firm can reach an agreement with Commerce to raise its price voluntarily, in which case the investigation is terminated. A terminated investigation can be reopened at any time. In practice, very few terminated investigations are reopened.

[6] Until 1985, the reviews were automatically performed on a yearly basis.

The antidumping duty rate for a non-integrated foreign producer in period t is:

$$\text{Non-integrated antidumping duty}_t = \frac{\text{fair-value price}_{t-1}}{\text{foreign export price}_{t-1}} - 1 \tag{1}$$

Total duty payments are calculated by multiplying the duty rate (as a percentage) by the value of the imported goods. Under U.S. law, the domestic importer is liable for all duty payments. The importer usually deposits cash, a bond or another security to cover estimated duty payments on all subsequently imported merchandise. The deposit is based on the most recent duty rate. When an administrative review takes place, an updated duty rate is calculated retroactively, based on actual prices during the review period. The importer is then reimbursed or charged for the difference between past estimated payments and the payment due based on the review's outcome.

2.2 U.S. Antidumping Procedure for Integrated Foreign Producers

Most aspects of antidumping policy are identical for integrated and non-integrated foreign producers. There are, however, two important exceptions.

The first is how the dumping margin is calculated. For an integrated foreign producer, the export price is an internal transfer price and is not used in the calculation of the duty. Since the integrated firm sells directly to U.S. consumers, the antidumping duty for the integrated foreign producer is based instead on the difference between its *U.S. consumer price* and its fair-value price.[7] The antidumping duty for an integrated foreign producer in period t is thus:

$$\text{Integrated antidumping duty}_t = \frac{\text{fair-value price}_{t-1}}{\text{U.S. consumer price}_{t-1}} - 1 \tag{2}$$

Two things should be noted when comparing equation (2) with equation (1). First, the numerators are identical: although the fair-value price is perhaps arbitrary, it does not depend on the vertical structure of the foreign producer. Second, the denominators are different: each expresses the price at which the product leaves the hands of the foreign producer upon reaching the United States. For a non-integrated foreign producer, the denominator is the foreign export price. For an integrated producer, it is the U.S. consumer price.

A second difference between integrated and non-integrated foreign producers is in the liability for duty payments. In principle, the duty is always paid by the importing entity. An integrated foreign producer is thus liable for duty payments, while the independent domestic importer (and not the foreign producer) pays the duty in the absence of integration.[8,9]

The theoretical model that follows examines how the design of antidumping policy affects foreign producers' responses when duties are imposed. It offers several predictions that are tested empirically in a later section.

[7] 19 USCS §1677a.

[8] 19 CFR §353.26.

[9] Since 1998, the independent foreign producer can also pay the duties under certain circumstances. This change is not analyzed here due to data limitations.

3 Theory: Pricing in The Presence of Antidumping Policy

The theoretical model developed here examines pricing behavior of integrated and non-integrated foreign producers in the presence of antidumping duties. I first present a static pricing model that provides basic intuition for the differences between the two. Next, I introduce a dynamic model that takes into account that present antidumping duties are calculated based on past prices. I compare both the dynamic equilibrium path and the steady-state of the dynamic model, with the static model, to shed light on how the dynamics of duty policies affect the incentives and the behavior of foreign producers.[10]

3.1 Setup

I assume that the import sector is fully competitive and that the foreign producer is a monopoly (with no strategic interactions) facing an infinite horizon.[11] For simplicity, the importer's sole function is distribution, assumed to incur zero cost. The foreign producer has constant marginal costs equal to c. Domestic demand is represented by $D(p)$, where p is the (U.S.) consumer price. I assume the following:

(A1) D is continuous, twice-differentiable, and strictly decreasing on $[0, \overline{p}]$ where $D(\overline{p}) = 0$.

(A2) The foreign firm has an incentive to dump, i.e., optimal price in the absence of antidumping policy is less than the fair-value price.

I also assume that all second order conditions necessary for profit maximization hold.

In each period t, a non-integrated foreign producer sets foreign export price p_t^* and the importer determines the U.S. consumer price p_t. An integrated foreign producer sets the U.S. consumer price p_t directly.

As noted in Section 2.1, the fair-value price is, in principle, based on the foreign firm's home-market price. I denote the fair-value price as FV_t. Below, I assume that the foreign market price is given by $FV_t = FV$ for all periods t.[12]

3.2 Static Model of The Effects of Antidumping Duties on Pricing

In this section, I abstract from the dynamic component of the policy by assuming that the antidumping duty is based on current prices (rather than past prices). Hence, for now, I drop the time subscript t.

[10] In Appendix B, I consider the model with retroactive adjustments made between the original duty assessed and the actual duty calculated and prorated for that period. I show that qualitatively, the incentives and the behavior of foreign producers do not change with the addition of adjustment payments. In particular, the testable predictions of the model are unaltered.

[11] As in Blonigen and Park (2004), I use partial equilibrium analysis.

[12] Gallaway, Blonigen, and Flynn (1999) note several reasons why the majority of price changes affecting antidumping duties in the review process occur within domestic (U.S.) price and not foreign price. The primary reason is the discretion of Commerce to discard "below-cost" foreign market sales or replace foreign market price with third-country price or constructed value. Thus, even if the foreign producer lowers foreign market price there is no guarantee that the duty will be reduced. In general, antidumping policy is aimed at encouraging foreign firms to increase their U.S. price, not to reduce their own home market price which has no effect on the U.S. marke. (p.219-220)

Using equations (1) and (2) (both without the time subscript) and the notation above, I can explicitly express the static antidumping duty as:

$$\tau = \begin{cases} \frac{FV}{p^*} - 1, & \text{if the foreign producer is non-integrated and } p^* \leq FV; \\ \frac{FV}{p} - 1, & \text{if the foreign producer is integrated and } p \leq FV; \\ 0, & \text{Otherwise.} \end{cases} \quad (3)$$

Under the assumption that antidumping duties are based on current prices, the duty for the non-integrated foreign producer is equal to the percentage difference between its foreign export price and its fair-value price. By contrast, the duty for the integrated foreign producer is equal to the percentage difference between its current U.S. consumer price and its fair-value price.

3.2.1 Non-Integrated Foreign Producers and Domestic Importers

Consider the optimal price choice for the non-integrated foreign producer. Since the import sector is fully competitive, the consumer price p must equal the marginal costs of the importer. Recall from section 2.1 that the domestic importer pays the duties in the absence of vertical integration. Using equation (3), it follows that the U.S. consumer price is:

$$p = (1+\tau)p^* = \begin{cases} \frac{FV}{p^*}p^* = FV, & p^* \leq FV; \\ (1+0)p^* = p^*, & \text{Otherwise.} \end{cases} \quad (4)$$

Equation (4) indicates that, in the static setting considered here, dumping by the non-integrated foreign producer has no impact on U.S. consumer price. Note that the foreign producer will never set its export price above the fair-value price. By definition, antidumping duties are zero for prices equal to or higher than fair-value price. But when duties are zero then, by (A2), profits are decreasing for prices equal to or higher than fair-value. Consequently, it is never optimal to set the export price above the fair-value. To see dumping's lack of impact on consumer price, denote the non-integrated producer's optimal export price, assuming static antidumping duties, by $\overline{p_N^*}$. Since $\overline{p_N^*} \leq FV$, the non-integrated foreign producer will never find it optimal to reduce its export price below fair-value. From equation (4) it follows that, even if export price is set below fair-value, U.S. consumer price will remain unchanged at $p = FV$, and demand will be fixed at $D(FV)$. Lowering export price will merely create a transfer from the foreign producer to the U.S. government. Hence, we have:

Proposition 3.1 *The static optimal export price of the non-integrated foreign producer with antidumping duties equals the fair-value price:* $\overline{p_N^*} = FV$.

In the static model, it is never optimal for the non-integrated foreign producer to dump in the presence of antidumping duties, since setting prices below fair-value cannot affect the level of the U.S. consumer price.

3.2.2 Integrated Foreign Producers

I now consider the optimization problem that faces an integrated foreign producer, whose export price is an internal transfer price (cf. Section 2.2) and whose U.S. consumer price is used instead of the export price to calculate its duty margin, as in equation (3):

$$\tau = \begin{cases} \frac{FV}{p} - 1, & \text{if } p \leq FV; \\ 0, & \text{Otherwise.} \end{cases}$$

Using the expression above and rearranging, we get

$$p = \begin{cases} \frac{FV}{1+\tau}, & \text{if } p \leq FV; \\ p, & \text{Otherwise.} \end{cases}$$

However, from (A2) we know that the integrated foreign producer will never set the U.S. consumer price above fair-value (because profits are decreasing in prices at or above the fair-value price). Hence we can focus our attention on the first case of the equation above:

$$p = \frac{FV}{1+\tau}, \text{ for } p \leq FV. \tag{5}$$

As equation (5) indicates, the integrated foreign producer can set its U.S. consumer price below fair-value, at the cost of paying higher antidumping duties. Intuitively, if demand is sufficiently elastic at the fair-value price, the foreign producer can profit by undercutting the fair-value price and absorbing the duty it would incur. On the other hand, antidumping duties increase an integrated foreign producer's costs, so its optimal price will be higher than the optimal price without antidumping policy. Denote the optimal U.S. consumer price of the integrated foreign producer with static antidumping duties by $\overline{p_I}$, and let $\hat{p_I}$ denote the integrated producer's optimal static U.S. consumer-price in the absence of antidumping policy. The above argument can be formalized as follows:

Proposition 3.2 *The static optimal price of the integrated foreign producer with antidumping duties is equal to the fair-value price, $\overline{p_I} = FV$, only if consumer demand at the fair-value price is not too elastic. Otherwise, $\hat{p_I} < \overline{p_I} < FV$.*

Proof See Appendix A

Propositions 3.1 and 3.2 highlight a principal difference in the response of integrated and non-integrated foreign producers to antidumping duties. The latter has no control over U.S. consumer price in this scenario. The integrated foreign producer, however, maintains full control over its U.S. consumer-price, and can choose the price that maximizes its profits.

3.3 Dynamic Model of The Effects of Antidumping Duties on Pricing

I now add dynamics to the model introduced in the previous section. I focus on the retroactive calculation of U.S. antidumping duties, and ignore retroactive adjustment-payments. In Appendix B, I demonstrate that accounting for these payments does not alter the main predictions.

The model builds on Blonigen and Park (2004), with two important exceptions: (1) allowing foreign producers to be integrated with domestic importers and (2) incorporating antidumping policy's differential treatment of integrated and non-integrated foreign producers into the analysis. I refrain from making any *a priori* assumptions on the curvature of market demand, and I add an explicit analysis of the foreign producer's exit decision in the face of antidumping duties.

3.3.1 Antidumping Duties and Enforcement

Because U.S. antidumping duties are retroactive, foreign producers face a dynamic optimization problem: current prices affect future duty levels.

Let τ_t denote the antidumping duty level in period t. Let p^*_t and p_t denote the foreign export price and the U.S. consumer price in period t. Using equations (1)and (2) and the preceding notation, the duty in period t can be expressed as follows:

$$\tau_t = \begin{cases} \tau(p^*_{t-1}) = \frac{FV}{p^*_{t-1}} - 1, & \text{if the foreign producer is non-integrated and } p^*_{t-1} \leq FV; \\ \tau(p_{t-1}) = \frac{FV}{p_{t-1}} - 1, & \text{If the foreign producer is integrated and } p_{t-1} \leq FV; \\ 0, & \text{Otherwise.} \end{cases} \tag{6}$$

Before embarking on a formal analysis, it is helpful to explore how the simple static model above is affected by the introduction of retroactive antidumping duties. This exercise allows me to point out exactly how the retroactive duties impact the behavior of non-integrated versus integrated foreign producers, compared to duties in the static model. The comparison provides important insights into the complex dynamic problem foreign producers face.

For non-integrated foreign producers, consumer price equals the marginal cost of the importer. Using (6), we can write:

$$p_t = (1+\tau_t)p^*_t = \begin{cases} \frac{FV}{p^*_{t-1}} p^*_t = FV \frac{p^*_t}{p^*_{t-1}}, & p^*_{t-1} \leq FV; \\ p^*_t, & \text{Otherwise.} \end{cases} \tag{7}$$

Once retroactive antidumping duties are introduced, the U.S. consumer price no longer equals the fair-value price for $p^* < FV$. This contrasts with the static model above, where antidumping duties cause the U.S. consumer price always to be equal to the fair-value price. With retroactive antidumping duties, the domestic consumer price is a function of the ratio of the current export price to the previous export price ($\frac{p^*_t}{p^*_{t-1}}$). The non-integrated foreign producer can control the U.S. consumer price through its choice of export prices over time. For example, if the non-integrated foreign producer lowers its current export price below the previous period's price, so that $\frac{p_t^*}{p_{t-1}^*} < 1$, then the current domestic consumer price will be less than fair-value, as (7) indicates.

By contrast, when the foreign producer is integrated, we have:

$$\tau_t = \begin{cases} \frac{FV}{p_{t-1}} - 1, & \text{if } p_{t-1} \leq FV; \\ 0, & \text{Otherwise.} \end{cases} \tag{8}$$

Using equation (8) above and rearranging, we get:

$$p_{t-1} = \begin{cases} \frac{FV}{1+\tau_t}, & \text{if } p_{t-1} \leq FV; \\ p_{t-1}, & \text{Otherwise.} \end{cases}$$

In the static model, the integrated foreign producer faces a trade-off between its current U.S. consumer-price and the current level of antidumping duties set by policy. When duties are retroactive, lower current consumer price entails a higher duty in the *next* period, as (9) indicates.

This discussion highlights an important difference between integrated and non-integrated foreign producers in the dynamic model. If an integrated foreign producer wishes to lower its current domestic consumer price, it must pay higher duties in the next period. By contrast, if a non-integrated foreign producer wants to lower its current domestic consumer price, it must decrease its current export price below the previous period's level.

In order to study the dynamic problem of the foreign producers, I assume that the enforcement of the initial antidumping duty is uncertain, but that once antidumping duties are imposed for the first time, their enforcement is certain from then on.[13] Since my model studies the feedback-loop mechanism of duty updates, I focus on the behavior of firms once the duties are imposed.[14] In fact, it can be shown that the optimal price of the foreign producers in all pre-duty periods is constant: if no investigation has ever occurred, or if previous investigations ended in negative determinations, the foreign producer faces the same optimization problem and keeps its price unchanged.

Given that all pre-duty periods are similar, I treat them as one period: period 0. If antidumping duties are imposed, they are in effect in my analysis from period 1 on. With uncertain initial enforcement, both integrated and non-integrated foreign producers will do more dumping initially (in period 0) than at steady-state in the presence of antidumping duties.[15]

3.3.2 The Dynamic Optimization Problem of The Non-Integrated Foreign Producer

I begin the formal analysis with the dynamic optimization problem of the non-integrated foreign producer. Given a discount factor $\delta \in [0, 1]$, the non-integrated foreign producer's optimization problem,

[13]Blonigen and Park (2004) make the same assumption. Because of the policy's design, even when Commerce finds dumping in the investigation, the enforcement of initial duties is uncertain and depends on the injury determination of the International Trade Commission. Subsequent reviews of the order do not involve a renewed injury determination.

[14]This is in contrast to Blonigen and Park (2004), who examine how initial dumping is affected by the ex-ante probability assigned to being caught.

[15]Proposition 2 in Blonigen and Park (2001) has a formal proof for the non-integrated case. The proof for the integrated case is similar.

once antidumping duties are imposed, is to find the sequence of export prices $\{p_t^*\}_{t=0}^{\infty}$ that solves:

$$\Pi(\{p_t^*\}_{t=1}^{\infty}) = \sup_{\{p_t^*\}_{t=1}^{\infty}} \sum_{t=1}^{\infty} \delta^t (p_t^* - c) D([1 + \tau(p_{t-1}^*)]p_t^*), \tag{9}$$

where FV and p_0^* are taken as given, and the U.S. consumer price equals the marginal cost of the importer.

Using the expression for τ_t from (6), we can rewrite the optimization problem (9) as:

$$\Pi(\{p_t^*\}_{t=1}^{\infty}) = \sup_{\{p_t^*\}_{t=1}^{\infty}} \sum_{t=1}^{\infty} \delta^t (p_t^* - c) D(FV \frac{p_t^*}{p_{t-1}^*}). \tag{10}$$

Since, by U.S. antidumping law, the independent importer must pay the duties in the absence of integration, the duties act as a demand-shifter for the non-integrated foreign producer.

As described in the previous subsection, the ratio of current to past export price ($\frac{p_t^*}{p_{t-1}^*}$) affects the current U.S. consumer price. Since the previous export price determines the current duty level, the ratio of current to past export price is determined by the impact of the current duty on the optimal export price. Recall that marginal profits equal the derivative of the profit function by the export price p_t^*. The relation between the optimal export price and the current duty can thus be assessed by taking the derivative of marginal profits with respect to $\tau(p_{t-1}^*)$:

$$\frac{\partial^2 \Pi}{\partial p_t^* \partial \tau_t} = (2p_t^* - c)D' + p_t^*(p_t^* - c)[1 + \tau(p_{t-1}^*)]D''. \tag{11}$$

The sign of the derivative in (11) equals the sign of the derivative of the optimal export price by the duty.[16] The derivative in (11) also indicates that the curvature of the demand function will determine whether the optimal export price is increasing or decreasing in the duty. If demand is not too convex (i.e. $D'' < \frac{-D'(2p_t^* - c)}{p_t^*(p_t^* - c)[1+\tau(p_{t-1}^*)]}$), then derivative in (11) is negative, and so the optimal export price decreases in the duty.[17] If demand is sufficiently convex then the optimal export price increases in the duty. These conditions characterize the relation between present and future prices.

The assumption that the marginal profits are decreasing in the duty is illustrated in Figure 2(a): the profits decrease *more* in the export price when the duties are higher. When the duty level increases, so does the cost of raising the export price: thus, the non-integrated foreign producer never increases its export price in response to an increase in duties, nor does it decrease its export price in response to a decrease in duties.

Consequently, a *higher* past export-price will lead to a further *increase* in current export price so the U.S. consumer price equals $p_t = FV \frac{p_t^*}{p_{t-1}^*} > FV$. Similarly, a lower past export price will lead to an even lower current export price so the U.S. consumer price equals $p_t = FV \frac{p_t^*}{p_{t-1}^*} < FV$ in this case.

Contrary to 2(a), the assumption that the marginal profits are increasing in the duty is illustrated in Figure 2(b): the profits decrease *less* in the export price when the duties are higher. In this case, the

[16] Milgrom and Shannon (1994), Proposition 5.

[17] This is the assumption that Blonigen and Park (2004) make throughout their paper. It can be shown that this assumption is not necessary for the predictions they test empirically.

non-integrated foreign producer increases its export price when the duty level increases, and decreases its export price when duty level decreases.

Consequently, a *higher* past export price will lead to a *lower* current export price, so $p_t = FV\frac{p_t^*}{p_{t-1}^*} < FV$. Similarly, a lower past-export-price will lead to a higher current-export-price, so $p_t = FV\frac{p_t^*}{p_{t-1}^*} > FV$.

To analyze the optimal behavior of non-integrated foreign producers, suppose the foreign producer dumps initially (in period 0), and that antidumping duties are imposed in period 1. Once the antidumping duties are imposed, the foreign producer would like to increase its price, which is too low relative to its steady-state post-duty price.

If the optimal export price is decreasing in the duty, an increase in the current export price will entail a further increase in next period's export price, and so on, resulting in a monotonic decrease in the duties over time. This is the case analyzed in Blonigen and Park (2004). Since the ratio of current to past export price is greater than one, the U.S. consumer price will be higher than the fair-value price, starting from period 1. Once the steady-state is reached, $p_t^* = p_{t-1}^*$ and $p_t = FV$.

Alternatively, if the optimal export price is increasing in the duty, an increase in the current export price will entail a decrease in next period's export price, and so on. Whenever the current export price is higher than the previous export price, resulting in a ratio higher than one, then the U.S. consumer price will be higher than the fair-value price. When the current export price is lower than the previous export price and the ratio is thus smaller than 1, then the U.S. consumer price will be lower than the fair-value price. As a result, antidumping duties, export prices, and U.S. consumer prices will all oscillate over time in this case. Once the steady-state is reached, $p_t^* = p_{t-1}^*$ and $p_t = FV$.

Proposition 3.3 formally characterizes the dynamic pricing behavior of non-integrated firms. Its first part is identical to the analysis of Blonigen and Park (2004) and is repeated here for completeness. Its second part, though, considers an alternative assumption on demand curvature:

Proposition 3.3 *Assume there exists a unique stationary equilibrium with antidumping duties for the non-integrated foreign producer, with the associated stationary foreign export price denoted by* $p_N^{*,s}$. *If* $D(\cdot)$ *satisfies (A1)-(A2), then once antidumping duties are imposed:*

1. *If* $\frac{\partial^2 \Pi}{\partial p_t^* \partial \tau_t} < 0$, *and assuming that* $p_N^{*,s} > \hat{p_N^*}$ *(where* $\hat{p_N^*}$ *is the static optimal export price in the absence of antidumping policy, that is* $\hat{p_N^*} = \arg\max_{p^*}(p^* - c)D(p^*)$*), the non-integrated foreign producer will set its prices so that the duty decreases over time (through the review process) until reaching the steady state* $p_N^{*,s} \leq FV$. *That is,* $p_0^* \leq p_1^* \leq p_2^* \leq p_3^*$... *and* $\tau_0 \geq \tau_1 \geq \tau_2 \geq \tau_3$... *where*

period 1 indicates the first time an antidumping duty is imposed.[18]

2. *if* $\frac{\partial^2 \Pi}{\partial p_t^* \partial \tau_t} > 0$*, either the non-integrated foreign producer will cease dumping immediately after the duties are imposed, or else prices and duties will oscillate, and then converge to steady-state dumping. In the former case* $p_0^* \leq p_1^*$*,* $p_1^* \geq p_2^* = p_N^{*,s} = FV$ *and* $\tau_1 > \tau_2 = \tau_s = 0$*. In the latter,* $p_0^* \leq p_1^*$*,* $p_1^* \geq p_2^*, p_2^* \leq p_3^* ...$ *and* $\tau_1 \geq \tau_2$*,* $\tau_2 \leq \tau_3$*,* $\tau_3 \geq \tau_4$*, and so on, until steady-state dumping* $p_N^{*,s} < FV$ *is reached.*

Proof See Appendix A

If marginal profits are decreasing in the duty (part 1), then the optimal price is decreasing in the duty and prices will increase monotonically to steady-state. As a result, the duties will decrease monotonically over time. This convergence path is shown in Figure 3(a).

Alternatively, if marginal profits are increasing in the duty (part 2), then the optimal export price is increasing in the duty, leading to oscillation of prices around steady-state, as shown in Figure 3(b), point A, which illustrates the case of steady-state dumping. However, if there is no dumping at steady-state ($p_s^* = FV$), as illustrated by Figure 3(b), point B, then the optimal response of the foreign producer is to set $p_1^* > FV(> p_0^*)$. But for export prices at or above the fair-value price, the next period's duties are zero, so the continuation value is identical. As a result, the next period's optimal price response is the same for all prices at or above the fair-value price. When the fair-value price is the steady-state price, then it is equal to the non-integrated foreign producer's optimal response for prices at or above the fair-value. Consequently, dumping ceases immediately in this case.

The dynamic model contrasts with the static model since, although the steady-state *U.S. consumer price* still always equals the fair-value price in the dynamic model, the steady-state *export price* can be lower than fair-value for the non-integrated producer.[19] Since the consumer price in this case is fixed at fair-value, setting an export price below it simply means the foreign producer is transferring part of its (potential) revenues to the U.S. government as duty payment. The dynamic path can give rise to a steady-state such as this when the discount factor of the non-integrated foreign producer is low enough. Once the steady-state is reached, the low discount factor insures that the foreign producer will be unwilling to give up its current profits in order to shift to higher future profits at $p_s^* = FV$.

[18] As noted in Blonigen and Park (2004), the condition $p_N^{*,s} > \hat{p_N^*}$ guarantees that initially, the firm dumps no less than its steady state dumping level, so that once duties are imposed, they (weakly) decrease to the steady state level.

[19] Throughout the paper, I assume that the stationary equilibrium is unique. However, the existence of an equilibrium with $p_s^* < FV$ raises the possibility of multiple stationary equilibria, some of which are inefficient. As noted in Blonigen and Park (2001), this can create an unstable equilibrium in which a shock would start movement to a new equilibrium. Yet, in this paper (similar to Blonigen and Park (2004)), I focus on the unique stationary equilibrium case. Note also that when the optimal policy function is decreasing there can be no more than one stationary equilibrium so the steady-state is always unique.

Note that when the demand at the fair-value price is more elastic, it responds more to price changes there. In particular, the non-integrated foreign producer has to change its export price by less to achieve the desired impact on the domestic demand. As a result, the U.S. consumer price also responds less to duty changes around the steady-state fair-value price. If the current export price responds less to duty changes, then necessarily the current export price responds less to past export price changes. When the optimal policy function is increasing, the result is a more positive (steeper) slope near the steady-state. When the optimal policy function is decreasing, the result is a less negative (flatter) slope around the steady-state. The following proposition characterizes the non-integrated foreign producer's optimal policy function around the steady-state:

Proposition 3.4 *The more elastic consumer demand is at the fair-value price, the less the U.S. consumer price responds to duty changes around the steady-state when the foreign producer is non-integrated. When demand is not too convex, the increasing optimal-policy-function is steeper around the steady-state when demand is more elastic there. When demand is sufficiently convex, the decreasing optimal-policy function is flatter around the steady-state when demand is more elastic there.*

Proof See Appendix A

3.3.3 The Dynamic Optimization Problem of The Integrated Foreign Producer

I now turn to examine the vertical structure not considered in Blonigen and Park (2004): the dynamic optimization problem of a foreign producer vertically integrated with its domestic importer, in which a single entity produces the product abroad, determines the U.S. consumer price, and pays all duty fees. Given a discount factor $\delta \in [0,1]$, the non-integrated foreign producer's optimization problem, once duties are imposed, is to find the sequence of U.S. consumer prices $\{p_t\}_{t=0}^{\infty}$ that solves:

$$\Pi^{VI}(\{p_t\}_{t=1}^{\infty}) = \sup_{\{p_t\}_{t=1}^{\infty}} \sum_{t=1}^{\infty} \delta^t (p_t[1-\tau(p_{t-1})] - c) D(p_t), \tag{12}$$

where FV and p_0 are taken as given.

To characterize how the optimal U.S. consumer price responds to antidumping-duty changes, I take the derivative of marginal profits with respect to $\tau(p_{t-1})$. The sign of this derivative equals the sign of the derivative of optimal consumer price by duty:[20]

$$\frac{\partial^2 \Pi^{VI}}{\partial p_t \partial \tau_t} = -p_t D' - D(p_t) = (\eta_p(p_t) - 1) D(p_t) > 0 \tag{13}$$

[20] Milgrom and Shannon (1994), Proposition 5.

where $\eta_p(p_t)$ (i.e., demand elasticity at p_t) is always greater than 1 when the seller is a monopoly. Regardless of demand curvature, marginal profits are always increasing in the duty for the integrated foreign producer, so optimal U.S. consumer price is increasing in the duty.

Qualitatively, the impact of higher duties on the integrated foreign producer's profit function is similar to that depicted in Figure 2(b) for the non-integrated case. The mechanism is very different, however. For the integrated foreign producer, the duty is a direct cost. Because it is optimal to raise prices in response to a cost increase, the integrated producer's profits decrease less in consumer price when duties are higher.

Suppose the integrated foreign producer dumps initially (in period 0). When antidumping duties are first imposed in period 1, the integrated foreign producer faces higher costs, so its optimal response is to set a higher U.S. consumer price. In the following period, it faces a lower duty and thus sets a lower price, and so on. Because the integrated foreign producer internalizes the duty as a cost, its antidumping duties will oscillate, regardless of demand conditions.

Let p_s^I indicate the integrated foreign producer's steady-state U.S. consumer price. The proposition below parallels Proposition 3.3 and formally characterizes the optimal price path for the integrated foreign producer once duties are imposed:

Proposition 3.5 *Assume there exists a unique stationary equilibrium with antidumping duties for the integrated foreign producer, with the associated stationary U.S. consumer price denoted by p_I^s, for the integrated foreign producer. When $D(\cdot)$ satisfies (A1)-(A2), then, once the duties are imposed, either dumping ceases immediately, or prices and duties oscillate and converge to steady-state dumping ($p_I^s < FV$). In the former case, $p_0 \leq p_1, p_1 \geq p_2 = p_I^s = FV$ and $\tau_1 \geq \tau_2 = \tau_I^s = 0$. In the latter case, $p_0 \leq p_1$, $p_1 \geq p_2, p_2 \leq p_3 ...$ and $\tau_1 \geq \tau_2$, $\tau_2 \leq \tau_3$, $\tau_3 \geq \tau_4$, and so on until steady-state dumping is reached ($p_I^s < FV$).*

Proof See Appendix A

According to Proposition 3.5, the integrated foreign producer's optimal policy function is decreasing in the price, so prices oscillate towards steady-state. As in the static model, steady-state consumer price can be lower than "fair-value," if demand is sufficiently elastic at the "fair-value" price (the proof is similar to that of proposition 3.2 and not repeated here). The duty convergence path for the integrated foreign producer is qualitatively similar to the path shown in Figure 3(b) for the non-integrated case. Point A in Figure 3(b) corresponds to a steady-state with positive dumping. Point B depicts the case of a steady-state without dumping: for prices at or above the fair-value price the optimal U.S.

consumer price response is identical and equals the fair-value price when it is the steady-state, leading to immediate cessation of dumping in this case.

The model implies that oscillation of prices and duties can be observed for both non-integrated and integrated foreign producers (Proposition 3.3, part 2, and Proposition 3.5). The theory points out, however, that the reasons for the oscillation are different for non-integrated and for integrated foreign producers. In the integrated case, the oscillation occurs because the foreign producer internalizes the duty as a cost. It is independent of any specific characteristics of domestic consumer demand. In the non-integrated case, oscillation arises only if the curvature of the demand is such that the foreign producer's optimal export price is increasing in the duty. There is no reason to believe that the oscillation patterns of integrated and non-integrated foreign producers should be quantitatively similar.

Note that a higher elasticity of demand lowers the integrated firm's markup, causing its U.S. consumer price to react more to shifts in cost, and thus to changes in duty. Proposition 3.6 parallels Proposition 3.4, characterizing the optimal policy function around the steady-state for the integrated foreign producer:

Proposition 3.6 *The more elastic consumer demand at steady-state, the more the U.S. consumer price responds to duty changes, and the steeper is the integrated producer's optimal policy function around the steady-state.*

Proof See Appendix A

Comparing Proposition 3.6 and Proposition 3.4, it is clear that a higher demand elasticity at steady-state consumer price has opposite effects on the prices of integrated and non-integrated foreign producers.

3.3.4 Exit from The U.S. market After Imposition of Antidumping Duties

Thus far, I have assumed that the foreign producer continues importing to the U.S. market after the duties are imposed. Yet the foreign producer may exit the U.S. market altogether after the introduction of antidumping duties. Here I complete my analysis by examining the decision to exit the U.S. market, with an emphasis on the differences between integrated and non-integrated foreign producers.

One might expect integrated foreign producers to have sunk investments in the United States, making them less likely to exit in the presence of a negative cost shock. In the trade literature, it is customary to assume that the sunk-costs of non-integrated foreign producers are lower than those of integrated foreign producers.[21] According to this assumption, integrated foreign producers are more

[21] For example, this is the case in Antràs and Helpman (2004) for vertical integration and in Helpman, Melitz, and Yeaple (2004) for horizontal integration.

productive and are thus less likely to exit in the presence of a negative shock, since their continuation value is higher. In addition, integrated foreign producers that wish to exit the U.S. market are likely to incur higher exit costs (i.e. additional costs related to finding alternative import sources for their domestic importer, selling it, or closing it down).

However, in the case of antidumping duties, there is an additional motivation for higher U.S. exit rates of non-integrated foreign producers after the imposition of antidumping duties. Recall that for a non-integrated foreign producer, the duty is based on the difference between its fair-value price and its U.S. export price in the prior period. For an integrated foreign producer, the duty is based on the difference between the foreign producer's fair-value price and its U.S. consumer price in the prior period. Intuitively, the different calculations imply that if an integrated and a non-integrated foreign producer that face the same duty today set their prices so that the current U.S. consumer price is identical in both cases, then in the following period the duty on the integrated foreign producer will be lower. As a result, an antidumping duty has a bigger impact on the profitability of a non-integrated foreign producer, all else being equal. Thus, a non-integrated producer is more likely to exit the U.S. market after the duties are imposed.

The differences in the calculation of the duty margin for integrated and non-integrated foreign producers also imply that at the steady-state, the integrated producer maintains full control over its U.S. consumer price, whereas for the non-integrated producer, the U.S. consumer price is equal to the fair-value price, regardless of its export price. Consequently, integrated foreign producers can respond more efficiently to the duties and hence have higher profits at the steady-state. The following proposition characterizes the steady-state profits of integrated and non-integrated foreign producers, following the imposition of antidumping duties:

Proposition 3.7 *At steady-state, all else being equal, the operating profits of integrated foreign producers are no lower than those of non-integrated foreign producers.*

Proof See Appendix A

Once antidumping duties are imposed, any foreign producer that has a negative continuation value from then on will subsequently exit the U.S. market. Since steady-state operating profits of the non-integrated producer are lower, according to proposition 3.7, it is more likely than the integrated producer to leave the U.S. market once antidumping duties are introduced. This claim is formalized in the following corollary:

Corollary of Proposition 3.7 *If there are fixed costs of exporting in every period, then non-integrated foreign producers are more likely than integrated ones to leave the U.S. market once antidumping duties have been imposed.*

Proof See Appendix A

Integrated foreign producers are more efficient than non-integrated ones after antidumping duties are imposed, because they control their U.S. consumer price directly. Since the duties are paid by the domestic importer, they create a wedge between the non-integrated producer's export price and the U.S. consumer price. In my model, this wedge exists only for non-integrated producers after the imposition of antidumping duties: there is no wedge between the foreign export price and the U.S. consumer price in the absence of antidumping policy. The policy's different treatment of foreign producers according to their vertical structure leads to different exit rates from the U.S. market once duties are imposed.

4 Data

The data for this paper include all antidumping investigations against foreign producers that were initiated in the United States between 1980 and 1995. The dataset constructed here is based on the dataset of Blonigen and Park (2004), which includes initial antidumping duty levels as well as the first administrative review's duty levels (when applicable). I supplement their data with all initial or subsequent administrative reviews of these orders that occurred until May 2008.[22] The data were collected from Federal Register notices, through the Lexis-Nexis Academic Universe legal research database. Appendix C includes the names and descriptions of the variables in the data and indicates whether they were part of the original dataset or an addition.

There were 1182 foreign producers that were subject to an antidumping investigation in the data. The total number of investigations initiated during this period was 489. Of these investigations, 157 ended in a negative determination, 55 were terminated (either an agreement with the U.S. government or domestic petition withdrawal) and 277 ended in an antidumping duty order. A quarter of these orders (71 cases) were still in effect as of May 2008.

The percentage of integrated firms within each antidumping investigation outcome (positive, i.e. antidumping duties; negative; terminated) is shown in Table 1. About 30% of the firms in the data are integrated, and the proportion is similar for negative, terminated and positive (i.e. antidumping duties) investigation outcomes. Clearly, the share of integrated firms in antidumping orders is by no means negligible.

[22]Between 1995 and 2008 there were a couple of changes to U.S. antidumping policy. First, as noted in Section 2.2, since 1998 non-integrated foreign producers can choose to pay the duties instead of the domestic importers. However, in the dataset I found very few cases where the non-integrated foreign producer did so.
The second relevant change to antidumping policy is that since 1995, importer's profit margins are deducted from the U.S. consumer price of the integrated foreign producer. Note first that in the theoretical model above, this regulation has no impact since importer margins are zero to begin with. Furthermore, Lindsey and Ikenson (2002) check the actual impact of the importer-profit deduction on duty margins and find that it is relatively minor (an average of 1.2%) in their data (p.21).

4.1 General Characteristics of Antidumping Duties

In order to examine the composition of the products in my dataset, I classified them into four mutually exclusive categories:

- Steel - all steel and carbon-steel sheets, plates, nails, pipes etc., excluding steel consumer products (e.g. stainless steel cookware).
- Chemicals, minerals and metals - all chemical compounds, minerals (such as cement) and metals, excluding intermediates made from such products (e.g. acrylic yarn or iron castings).
- Finished products - all products which are not inputs into further production, including food products (e.g. microwaves, bicycles, pencils, towels, canned or frozen foods)
- Other intermediates - all products which do not fit another category (e.g. acrylic yarn, iron castings, DRAMs).

There is a relatively high proportion of steel products (about one-third) in the overall universe of antidumping investigations and orders. One fifth of the firms in the steel cases are integrated. Chemicals, minerals and metals are about 13% of all antidumping cases in the data, and the share of integrated firms in the chemicals' cases is about 30%. Finished products are 27% of the cases, and integrated firms are about 38% of these cases. All other intermediates are the remaining 20% of the cases, and 44% of the remaining cases involve integrated firms.

The first column of Table 2 includes summary statistics for the main variables in the data. The second and third columns display the statistics separately for non-integrated and integrated foreign producers. The fourth includes the results of a t-test for the equality of integrated and non-integrated means. The first four rows of the Table display data on antidumping duty levels and duty changes. Note that the duties tend to be very high: an average of 23% of value for all duties, 33% for initial duties. The difference between integrated and non-integrated average duty levels is insignificant initially. However, overall average duty levels are significantly different for integrated and non-integrated foreign producers, implying that the response to the duties may vary by vertical structure. The average level of the duties when zero-review orders are excluded is slightly lower. The average initial change in the duties is considerably negative, but still leaves the next period's duty level at about 20% on average. Initial duty changes are significantly larger for integrated foreign producers relative to their non-integrated counterparts, again indicating differences in the response to the duties by vertical structure. The difference between average duty changes of integrated and non-integrated foreign producers is insignificant, probably because of high variation in duty changes.

Figure 4 further highlights the differences in actual antidumping duty patterns for integrated and non-integrated foreign producers. The figure displays the distribution of antidumping duty changes over time (by administrative review) for non-integrated and integrated foreign producers separately. Clearly, there are distinct patterns of convergence for each type of firm. The changes in the duties are more dispersed initially for non-integrated foreign producers but converge faster. By contrast, the changes in the duties of integrated foreign producers are less dispersed initially but take longer to converge.

The sixth and seventh rows of Table 2 provide information on the use of "best information available" in the calculation of antidumping duties. Recall that best information available is used by Commerce when information provided by the foreign firm is deemed inadequate. It is often based on data provided by the domestic industry and tends to result in higher duty levels. According to the table, best information available was used in almost one quarter of non-integrated duty calculations (both initial orders and administrative reviews). The proportion for integrated foreign producers is lower, but still close to one-fifth. The proportion of integrated foreign producers that ever had best information available used in a duty calculation is over one half, higher than the corresponding proportion of non-integrated firms (45%). Note that the use of best information available affects both antidumping duty levels and antidumping duty changes over time. For this reason, I control for the use of best information available by Commerce in my empirical analysis.

The eighth row of the Table displays data on the length of antidumping duties in years: the orders last about 12 years on average, both for integrated and non-integrated foreign producers.

4.2 Characteristics of Administrative Review Requests

As mentioned in Section 2, antidumping duties can be updated through subsequent administrative reviews. The review of the order must be initiated either by domestic producers or by the foreign producer that is subject to the duties.

The last two rows of Table 2 show the proportion of domestic and foreign firms that requested an administrative review. Unfortunately, 24% of the reviews in my dataset (494 individual firm reviews) do not have data on the identity of the petitioners for the review. For the most part, the reviews that lack petitioner information are extremely complicated and involve many foreign producers.

The model presented above assumes that firms are sophisticated in that they are forward looking and understand the impact of current prices on future duties. If this is indeed the case, foreign producers should ask for an administrative review when they expect the duties to decrease, while domestic producers should ask for a review when they expect the duties to increase. Figure 5 displays box-plots of changes in antidumping duties over time (excluding outside values, for clarity) by the party that asked for the review, i.e. domestic, foreign producer or both. Indeed, the changes in the duties tend to be positive (an increase in the duty) following a domestic petition and negative (a decrease in the duty) following a foreign petition, at least for the first 10 reviews. When both parties ask for a review, there is no clear tendency, at least for the second through ninth reviews. Interestingly, it seems the duties tend to decrease when both parties ask for the first review.

The theory predicts that antidumping duties should oscillate over time for integrated foreign producers (Proposition 3.5) and either oscillate or decrease monotonically for non-integrated foreign producers (Proposition 3.3). To the extent that firms are forward looking, oscillation implies that review requests should alternate between the domestic industry (after a period of low prices) and the foreign producers (after a period of high prices). Alternatively, if prices increase monotonically to the steady-state, foreign producers should always request for reviews of the order while the domestic industry should never do so. The proportions of requests for review in Table 2's last two rows seem to support an oscillating pattern, since they are quite similar for foreign and domestic firms and less than one.

The findings support the assertion that firms are forward looking and understand the implications of antidumping policy for optimal pricing behavior. This validates the ability of the theoretical model to capture and rationalize the actual behavior of firms faced with antidumping duties.

5 Empirical Analysis

In this section I examine the model's three main testable predictions: (1) that non-integrated producers are more likely than integrated ones to exit the U.S. market once antidumping duties are imposed, (2) that, once antidumping duties are imposed, integrated foreign producers' either cease dumping immediately or their duties oscillate and converge to steady-state dumping, while the response of non-integrated foreign producers depends on the shape of the demand curve, and (3) that the varying demand-elasticities of different commodity groups affects the slopes of producers' optimal-policy functions . In each of the following three subsections, I first present my empirical findings, and then relate them to the corresponding prediction.

5.1 Exit from The U.S. Market After Antidumping Duties are Imposed

Figure 6 presents the distribution of antidumping orders by the total number of administrative reviews, for integrated and non-integrated foreign producers. Since I have no data on actual shipments by foreign producers, I use orders (both revoked and ongoing) without any administrative reviews as a proxy for foreign producer's exit from the U.S. market when antidumping duties are imposed. For revoked orders, it is plausible that zero reviews indicate that the foreign producer left the U.S. market, leading to a subsequent revocation of the order. For ongoing orders, the lack of duty revisions could potentially be the result of continuous dumping rather than U.S. exit, if the foreign producer simply keeps its price unchanged. Yet an antidumping order can be kept in place even if the foreign producer no longer exports to the United States. Indeed, most unreviewed ongoing orders in my data are of this "inactive ongoing" type: I examined several Federal Register records for ongoing orders without any reviews and found that imports by the affected companies fell by 97% or more, following the imposition of the duties. Such a drastic decrease in imports most likely indiacates exit from the U.S. market. According to Figure 6, the difference in exit patterns between integrated and non-integrated foreign producers is drastic: while 46% of non-integrated foreign producers left the U.S. market immediately after duties were imposed, only 26% of integrated foreign producers did the same. This difference is highly significant according to a t-test for equality of means.

These findings are consistent with the corollary of Proposition 3.7, which states that integrated foreign producers should be less likely to exit the U.S. market after antidumping duties are imposed.

5.2 Price Path by Integration Status

Table 3 presents the distribution of initial firm-specific duty changes in the data (i.e., the difference between the firm's initial duty level and its level after the first review). The first column includes all antidumping cases with one or more reviews, while the second column excludes cases where use of best information available could have affected the direction of the duty change. Since it is often based on data provided by domestic producers, best information available tends to result in high duties, and no longer reflects the foreign firm's pricing strategy. In the second column of the table, I exclude positive duty changes where best information available was used in the first review, and negative changes where it was used in the initial order.

The first column of the table indicates that duties decreased initially for 61% of antidumping cases. They remained unchanged for 18% of cases and increased for the remaining 21%.[23] Once best-information-available cases are excluded, the number of orders where duties decreased in the first review increases to 75%, with 14% remaining unchanged and 11% increasing initially.

The theoretical model predicts that initial duty change will be nonpositive when the enforcement of the duties is uncertain: if a firm assigns a low enough probability to being caught, it will initially dump more than its steady-state dumping level. Otherwise, it will set its pre-duty price equal to its steady-state dumping level. The majority of antidumping cases in the data conform with this prediction. However, 11% of the cases had their initial duty levels subsequently increased, even after I exclude cases where best information available could have affected the direction of the duty change.

Table 4 presents the distribution of firm-specific antidumping duties over time, by vertical integration. The first two rows include the percentages of firm-specific cases that had their antidumping duties increased or decreased twice or more in a row. The next two rows display the proportions of firms with monotonically decreasing or increasing duties throughout the data period. The last two rows display the same proportion, after excluding cases where use of best information available could have affected the direction of the duty change. In particular, I exclude cases where the current duty was increased after use of best information available in the current review, as well as those where the current duty decreased after its use in the previous review. About one quarter of all firms had their duties increased or decreased twice or more in a row, but less than 3% of all foreign producers had monotonically decreasing duties throughout the data period. After I control for the use of best information available,

[23] These proportions are similar to the original Blonigen and Park (2004) database.

no firm had monotonically increasing duties. While the duty oscillation in the data is not perfect, the table suggests that monotonic convergence is extremely rare.

The model predicts that the prices and duties of integrated firms should either oscillate and converge to steady-state dumping, or drop to zero immediately after the duties are imposed (Proposition 3.5). The convergence path of antidumping duties in the non-integrated case depends on the curvature of the demand function (Proposition 3.3): if demand is not too convex, non-integrated firms' duties and prices will converge monotonically to steady-state. Otherwise, non-integrated duties will oscillate and converge to steady-state dumping, or duties will drop to zero immediately. Table 4 suggests that oscillation (or at least non-monotonic duty-change) is the rule for all foreign producers. The fact that there are no cases of monotonically increasing antidumping duties (once best-information-available cases are excluded) can be taken as an additional support for the theory.

Figure 7 depicts the relation between current and past duty changes using simple scatter plots. The left panel of the figure plots current duty change on past duty change for non-integrated foreign producers while the right panel does the same for integrated foreign producers. Cases with duties higher than 100% (about 1% of the data) were excluded, for clarity . The figure also includes the corresponding regression lines. The plots suggest the existence of a negative relation between current and past duty changes, for both non-integrated and integrated foreign producers.

To further examine the patterns of duty changes over time, Table 5 presents estimates from the following regression equation of past duty-change on current duty-change:

$$\text{Duty change}_{i,t} = b_0 + b_1\text{Duty change}_{i,t-1} + b_2\text{BIA}_{i,t} + b_3\text{BIA}_{i,t-1} + b_4 X_i + e_{i,t} \tag{14}$$

where $Duty\ Change_{i,t}$ is the change in the duty for firm i between period t and period $t-1$; $BIA_{i,t}$ equals 1 whenever best information available was used in period t's review; and X_i are other time-invariant variables, which vary by specification. The Table includes four specifications, repeated separately for integrated and non-integrated foreign producers. The first has no fixed-effects. The second includes firm fixed effects, which are significant for non-integrated foreign producers. As noted by Nickell (1981), the inclusion of firm-level effects in dynamic models causes a downward-bias in the estimated coefficient on the lagged variable (i.e. the coefficient on past duty change), which is most severe for short panels. Hence, the third specification replaces the firm-level fixed effects with sector-level fixed effects (3-digit TSUSA codes), since increasing the number of observations within each group reduces the severity of the Nickell-bias. The last specification utilizes GLS estimation to account for heteroskedasticity and firm-specific autocorrelation. In all four specifications, the coefficient on past duty change is negative, significant, and less than one for both integrated and non-integrated foreign producers.[24] As expected, the coefficient on the use of best information available in the current review is positive and significant in all four specifications. The coefficient on the use of best information available in the previous review is

[24] I have also examined a specification where the Nickell-bias in the specifications with firm fixed-effects was corrected, and the standard errors were boot-strapped (Bruno (2005)'s estimator for unbalanced panels). The coefficient on past duty change was still negative, significant and less than one for both integrated and non-integrated foreign producers.

negative and mostly significant. Since the use of best information available tends to result in artificially high duties, the negative coefficient on $BIA_{i,t-1}$ is not surprising. In addition, the intercept of the regression is insignificant in most of the specifications and relatively small. When I run the same specifications pooled over all foreign producers, I reject the hypothesis that the coefficient on past duty change is the same for integrated and non-integrated foreign producers in the last specification.[25]

The oscillation scenario is born out by the coefficient on past duty change in Table 5, which is significant, negative and less than one. Since oscillation means duty changes are alternately positive and negative and convergence means the magnitude of the oscillation decreases over time, the two together imply that the coefficient on past duty change in the regression should be between zero and negative one when duties are oscillating. By contrast, monotonic convergence implies that the coefficient on past duty change in the regression should be positive.

Table 6 repeats the specifications of Table 5, using normalized duty changes. Although consecutive reviews of an antidumping order should occur annually, some reviews take longer in practice than others, leading to longer gaps between consecutive duty updates. Furthermore, if no party asks for an administrative review of the order in a certain year, the gap between two consecutive reviews can be even larger. To account for these differences, I divide each duty change by the length of the interval (in years) between the reviews. Qualitatively, the results of the normalized regressions are very similar to those of Table 5. The coefficient on past duty change is between zero and negative one, and significant in most specifications.[26] The coefficient on the use of best information available is positive and significant for the current review and negative or not significantly different than zero for the previous review. The intercept is relatively small and insignificant in most of the specifications. When I run the same specifications pooled over all foreign producers, I cannot reject the assumption that the coefficient on past duty change is the same for integrated and non-integrated foreign producers in the last specification.

Finally, Table 7 repeats the fixed-effect specifications of Table 5 with the addition of sector time-trends (3-digit TSUSA code multiplied by the year of the administrative review) to try and capture industry-wide trends which might have affected firm-specific responses. The coefficient on past duty change is still negative, significant and less than one in absolute value for both integrated and non-integrated foreign producers (and in the pooled regression as well).[27]

Overall, the empirical findings in Tables 5, 6 and 7 support the theoretical prediction that duties

[25] I also repeated these specifications using sign dummies that equal 1 when the duty change is positive and -1 when it is negative. The coefficients were qualitatively similar: significantly negative and less than one for both integrated and non-integrated foreign producers.

[26] I have also examined a specification where the Nickell-bias of the coefficient on past duty change in the specifications with firm fixed effects was corrected and the standard errors were boot-strapped (the Bruno (2005) estimator for unbalanced panels). The coefficient on past duty change was negative and less than one in the non-integrated case but positive and insignificant in the integrated case.

[27] In addition to these specifications, I also tried excluding all reviews that happened more than 5 years after the initial order was imposed. The presumption here is that unobservable industry or market conditions would remain fairly stable during a relatively shorter period of time. Again, the coefficient on past duty change is negative, (mostly) significant and less then one for both the pooled and the separate regressions in this case.

should oscillate and converge over time for integrated foreign producers. For non-integrated foreign producers, the negative coefficient on past duty change (i.e. oscillation) can be accommodated by the theory, if demand is sufficiently convex. However, non-integrated oscillation alone cannot confirm or refute the theoretical model.

Both Proposition 3.5 and Proposition 3.3 with convex demand imply that post antidumping duty behavior should differ depending on steady-state prices. Specifically, foreign firms that would not dump in steady-state should cease dumping immediately after duties are imposed. This additional prediction can be used to test the validity of the theory for both the integrated and non-integrated case.

Unfortunately, detecting immediate cessation of dumping in the data is difficult. Revoked orders might seem like a good proxy, but revocation can also be caused by lack of interest by the domestic industry, or by Sunset reviews. As mentioned in Section 2, only after three consecutive reviews with zero duties can an antidumping order be revoked. This last feature of the policy helps differentiate between U.S.-market exit (no administrative reviews) and cessation of dumping (three consecutive reviews without dumping).

In order to examine whether foreign producers that ceased dumping did so immediately, I compare firms whose orders were revoked after a zero-duty review to the group of all other firms. The first group represents firms whose orders were revoked presumably because they ceased dumping: those whose orders were revoked for other reasons did not attempt to cease dumping, nor did those whose orders were not revoked at all. Thus, I define "cessation intent" cases as all revoked antidumping orders whose last duty level (prior to revocation) was *de-minimis*.[28] Fewer than 8% of ongoing orders had zero duties in their latest review, compared to 30% of revoked orders (excluding orders without any reviews, i.e. immediate U.S.-market exit cases). For the cessation-intent group, the average total number of reviews with *de-minimis* duties was 2.7. For all other orders, the average total number of reviews with *de-minimis* duties was 0.4. Thus, as the theory predicts, firms whose last duty prior to revocation was *de-minimis* seem to be consistently trying to reduce their duty level, while this is not the case for orders where the final (or latest) duty level was higher than *de-minimis*.

Figure 8 displays the distribution of non-integrated firms' antidumping duties over time, for both cessation-intent cases and the group of all other cases. Figure 9 does the same for integrated firms' antidumping duties. After the initial antidumping order, duty levels fell drastically, and remained relatively close to zero, in the cessation-intent group. No such pattern is found in the group of all other orders. This distinction holds for both types of foreign producers, further supporting the assertion that foreign producers who ceased dumping did so immediately after the duties were imposed. This empirical result is consistent with the theory for integrated foreign producers, and for non-integrated foreign producers with sufficiently convex demand.

[28]If the dumping margins found by Commerce are 0.5% or less (*de-minimis*), the effective duty is zero.

5.3 Price Paths and Consumer Import-Demand Elasticities

In this section I examine whether and how the slope of the optimal-policy function changes with the elasticity of U.S. consumer demand for the imported good.

As mentioned in section 4, the products in my data can be classified into four groups: steel; chemicals, minerals and metals; finished products; and all other intermediates. Table 8 presents the estimates from the following regression equation:

$$\begin{aligned}\text{Duty change}_{i,t} &= b_0 + b_1\text{Duty change}_{i,t-1} + b_2\text{Duty change}_{i,t-1} * \text{Steel} + b_3\text{Duty change}_{i,t-1} * \text{Chem} \\ &+ b_4\text{Duty change}_{i,t-1} * \text{Finished} + b_5\text{BIA}_{i,t} + b_6\text{BIA}_{i,t-1} + b_7X_i + e_{i,t} \qquad (15)\end{aligned}$$

where $Duty\ Change_{i,t}$ is the change in the duty for firm i between period t and period $t-1$; $Duty\ Change_{i,t} * Commodity\ group$ is the interaction of past duty change with a dummy that equals 1 when the products belongs to the corresponding commodity group (steel, chemicals or finished products); $BIA_{i,t}$ equals 1 whenever best information available was used in period t's review; and X_i are other time-invariant variables, which vary by specification. The table includes four specifications for integrated and non-integrated foreign producers. The first specification has commodity fixed effects (with robust standard errors) and the second has firm fixed effects (with robust standard errors). The third specification replaces the firm-level fixed effects with sector-level fixed effects (3-digit TSUSA codes), since increasing the number of observations within each group of the panel reduces the severity of the Nickell-bias. The last specification utilizes GLS estimation to account for heteroskedasticity and firm-specific autocorrelation. The specifications include all orders with two or more reviews. Since the average number of administrative reviews in the data (excluding zero review orders) is 3.9 and the median is 3, it is plausible that orders with two or more reviews should include many duties that are at or near their steady-state level.

In all four specifications, the coefficient on past duty level is negative, and, except for the first two specifications for non-integrated firms, significant. The coefficient on past duty change for integrated foreign producers of steel is negative and significant. Most interestingly, the coefficient on finished products is negative in all the non-integrated firms' specification (and significant for the second and third specifications) and positive in all the integrated firms' specifications (and significant in all but the second specification).

According to Proposition 3.4, when demand elasticity at or around the steady-state is higher and demand is sufficiently convex, the slope of the non-integrated producer's optimal policy function should be flatter around the steady-state. According to Proposition 3.6, the opposite is true for integrated foreign producers: the optimal policy function should be steeper around steady state the higher the elasticity of demand. A steeper decreasing optimal policy function implies slower convergence over time, while a flatter (decreasing) optimal policy function implies faster convergence over time. This means that for more elastic goods, the coefficient on past duty change should be *more* negative for an integrated producer and *less* negative for a non-integrated producer. To the extent that demand for finished products is less elastic than demand for other intermediates and demand for steel is more elastic, Table 8 provides some support this prediction.

However, the classification of products into the above four categories is very broad and likely to incorporate some products with high demand elasticities with others whose actual demand elasticities are lower. To address this concern, in Table 9 I use a different method to examine the impact of demand elasticities on the pass-through of duties around steady-state. Specifically, I use Broda and Weinstein (2006)'s estimates of (import) demand elasticities. Note that these estimates are drawn under the assumption of CES utility, which is not sufficiently convex to satisfy condition (2) of my Proposition 3.3. However, here I use Broda and Weinstein (2006)'s elasticity estimates to build a binary variable that equals 1 for products with "high" demand elasticity. I use Broda and Weinstein (2006)'s 7-digit TSUSA (The Tariff Schedule of the United States Annotated) elasticities for orders initiated before 1989 and Broda and Weinstein (2006)'s 10-digit HTS (Harmonized Tariff Schedule) elasticities for later orders.[29] I then create a binary variable that is equal to 1 whenever demand elasticity is above the 66^{th} percentile of elasticities in Broda and Weinstein (2006)'s dataset, following their classification. The table presents the estimates from the following regression equation:

$$\begin{aligned}\text{Duty change}_{i,t} &= b_0 + b_1\text{Duty change}_{i,t-1} + b_2\text{Duty change}_{i,t-1} * \text{High elasticity} + b_3\text{BIA}_{i,t} \\ &+ b_4\text{BIA}_{i,t-1} + b_5 X_i + e_{i,t} \qquad (16)\end{aligned}$$

where *Duty Change*$_{i,t}$ is the change in the duty for firm i between period t and period $t-1$; *Duty Change*$_{i,t}$ $*$ *High elasticity* is the interaction of past duty change with the high-elasticity dummy; $BIA_{i,t}$ equals 1 whenever best information available was used in period t's review; and X_i are other time-invariant variables, which vary by specification. The table includes four specifications, which are repeated separately for integrated and non-integrated foreign producers. The first specification includes the time-invariant high-elasticity dummy (with robust standard errors); the second has firm fixed-effects (with robust standard errors); the third replaces the firm-level fixed effects with sector-level fixed effects (3-digit TSUSA codes), since increasing the number of observations within each group of the panel reduces the severity of the Nickell-bias; and the last specification utilizes GLS estimation to account for firm-specific autocorrelation and heteroskedasticity. The specifications include all orders with two or more reviews.

In all four specifications, the coefficient on past duty change is negative and significant (except for the first column), for both non-integrated and integrated foreign producers. Most interestingly, the coefficient on the interaction between high import demand elasticity and past duty change is negative for integrated foreign producers (and significant in the GLS specification) but positive (and significant in the GLS specification) for non-integrated foreign producers.

According to Propositions 3.4 and 3.6 the coefficient on past duty change should be *more* negative

[29] Whenever the investigation covers more than a single TSUSA (or HTS) category, I calculate the average elasticity over all the categories that were included in the antidumping order. I use simple averages since I have no data on the product's actual share of the relevant imports.

in the integrated case and *less* negative in the non-integrated case when the elasticity of demand is higher. To the extent that my measure of high import-demand elasticity is reliable, these findings provide additional support for the theoretical predictions.

6 Concluding Remarks

My model suggests, and my empirical analysis confirms, that trade policies can have very different effects on different foreign producers exporting goods to the U.S. market, depending on these firms' vertical structure: the current U.S. antidumping law creates very different incentives and behavior for vertically-integrated firms than for foreign firms not integrated with their domestic importers. My model accounts for these incentives, while my analysis of data on U.S. antidumping duties verifies the resulting behaviors. Both theoretical and empirical analyses show that optimal dynamic price paths, pass-through of duties to final market prices, and incentives for post-duty exit all differ, depending on the vertical structure of the foreign producer and the domestic importer.

I find that while the duties oscillate over time for both integrated and non-integrated foreign producers, their oscillation patterns differ. Specifically, the pass-through of the duties to U.S. consumer price around steady-state differs for integrated and non-integrated foreign producers. I also find that foreign producers are much more likely than integrated ones to exit the U.S. market after antidumping duties are imposed: since most firms from developing countries (LDCs) are not affiliated with domestic importers, this behavior points up a potential bias against LDCs that is built into U.S. antidumping policy. And this, in turn, illustrates the importance of understanding how the incentives created by trade policy depend on vertical integration: even in the absence of any deliberate discrimination, structural differences between typical firms from different countries can be responsible for firms' differing reactions to trade policy.

The different (and possibly unintended) outcomes of antidumping policy for firms with different vertical structures point up the importance of studying how changes to the policy may affect integrated and non-integrated firms' pricing behavior. For example, a 1998 policy change enabled a non-integrated foreign producer to pay antidumping duties for its importer by declaring itself the "importer of record." Under the assumption that the import sector is fully competitive, the optimization problem of a non-integrated foreign producer that pays its own import duties is identical to the optimization problem of an integrated foreign producer. This allows non-integrated producers to internalize the duties and thus achieve the higher steady-state profits associated with vertical integration (see Proposition 3.7), making them no more likely than integrated foreign producers to exit the U.S. market when new antidumping duties are imposed.

But relaxing the fully-competitive import-section assumption cancels the above result: since both the non-integrated producer and the independent importer can exercise market power, the domestic importer sets its U.S. consumer price "too high." This means that if the non-integrated foreign producer internalizes the duties, it incurs additional costs but cannot lower consumer price as much as it would like, so it will tend to avoid paying the duty even though it can, and the policy change will have no impact in this case. Though a lack of data on duties initiated on or after 1998 puts testing these claims beyond the scope of this paper, they highlight the importance of understanding the impacts of such policies when firms are sophisticated.

Also important is comparative study of firms' behavior under EU and U.S. antidumping policies. The policies differ: the EU does not enable absorption of the duty, whereas the U.S. allows integrated foreign producers to absorb it fully. Specifically, if the consumer price does not rise by the full amount of the initial duty, EU authorities raise the duty until consumer prices there reach the desired level. Future research might comparatively model both policies, to analyze how each policy differentially affects the behavior of integrated and non-integrated foreign producers under these two systems and shed light on the possible welfare implications of each. Such research would not be merely interesting: understanding the effects of firms' structures on their responses to trade policy is crucial to making it more effective.

References

Antràs, P. (2003): "Firms, Contracts and Trade Structure," *Quarterly Journal of Economics*, 118(4), 1375–1418.

Antràs, P., and E. Helpman (2004): "Global Sourcing," *Journal of Political Economy*, 112, 552–580.

——— (2008): "Contractual Frictions and Global Sourcing," in *The Organization of Firms in a Global Economy*, ed. by E. Helpman, D. Marin, and T. Verdier. Harvard University Press.

Antràs, P., and R. W. Staiger (2008): "Offshoring and the Role of Trade Agreements," .

Bernard, A. B., J. B. Jensen, and P. K. Schott (2005): "Importers, Exporters and Multinationals: A Portrait of Firms in the U.S. that Trade Goods," .

Blonigen, B. A., and S. E. Haynes (2002): "Antidumping Investigations and the Pass-Through of Antidumping Duties and Exchange Rates," *The American Economic Review*, 92(4), 1044–1061.

Blonigen, B. A., and J. Park (2001): "Dynamic Pricing in the Presence of Antidumping Policy: Theory and Evidence," Working Paper 8477.

——— (2004): "Dynamic Pricing in the Presence of Antidumping Policy: Theory and Evidence," *American Economic Review*, 94(1), 134–154.

Broda, C. M., and D. E. Weinstein (2006): "Globalization and the Gains from Variety," *Quarterly Journal of Economics*, 121(2), 541–585.

Bruno, G. S. F. (2005): "Approximating the bias of the LSDV estimator for dynamic unbalanced panel data models," *Economic Letters*, 87, 361–366.

Díez, F. L. (2008): "The Disparate Effects of Tariffs on Offshoring Industries," .

Finger, J. M. (1981): "The Industry-Country Incidence of 'Less than Fair Value' Cases in US Import Trade," *Quarterly Review of Economics and Business*, 21(2), 260–279.

Gallaway, M. P., B. A. Blonigen, and J. E. Flynn (1999): "Welfare Costs of the U.S. Antidumping and Countervailing Duty Laws," *Journal of International Economics*, 49, 211–244.

Grossman, G. M., and E. Helpman (2002): "Integration versus outsourcing in Industry Equilibrium," *Quarterly Journal of Economics*, 117, 85–120.

Harrison, A. (1991): "The New Trade Protection: Price Effects of Antidumping and Countervailing Measures in the United States," *World Bank Working Paper*.

Helpman, E., M. J. Melitz, and S. R. Yeaple (2004): "Export Versus FDI," *American Economic Review*, 94, 300–316.

Herander, M. G., and J. B. Schwartz (1984): "An Empirical Test of the Impact of the Threat of U.S. Trade Policy: The Case of Antidumping Duties," *Southern Economic Journal*, pp. 59–79.

Lindsey, B., and D. Ikenson (2002): "Antidumping 101: The Devilish Details of Unfair Trade Law," Discussion paper, Center for Trade Policy studies.

Milgrom, P., and C. Shannon (1994): "Monotone Comparative Statics," *Econometrica*, 62(1), 157–180.

Nickell, S. (1981): "Biases in Dynamic Models with Fixed Effects," *Econometrica*, 49(6), 1417–1426.

Nunn, N., and D. Trefler (2008): *The Organization of Firms in a Global Economy*chap. Incomplete Contracts and the Boundaries of the Multinational Firm. Harvard University Press.

Ornelas, E., and J. L. Turner (2008a): "Protection and International Sourcing," .

——— (2008b): "Trade liberalization, outsourcing, and the hold-up problem," *The Journal of International Economics*, 74, 225–241.

Prusa, T. J. (1997): "The Trade Effects of U.S. Antidumping Actions," in *The Effects of U.S. Trade Protection and Promotion Policies*, ed. by R. C. Feenstra, pp. 191–213. University of Chicago Press.

——— (2005): "Antidumping: A Growing Problem in International Trade," *The World Economy*, 28(5), 683–700.

Salvatore, D. (1987): "Import Penetration, Exchange Rates and Protection in the United States," *Journal of Policy Modeling*, 9(1), 125–141.

Staiger, R. W., and F. A. Wolak (1994): "Measuring Industry-Specific Protection: Antidumping in the United States," *Brookings Papers on Economic Activity: Microeconomics*, pp. 51–118.

Stokey, N. L., R. E. Lucas, and E. C. Prescott (1989): *Recursive Methods in Economic Dynamics*. Harvard University Press, Cambridge, Massachusetts, and London, England.

Zanardi, M. (2004): "Anti-dumping: What are the Numbers to Discuss at Doha?," *The World Economy*, 27(3), 403–433.

A Proofs

Proof of Proposition 3.2 Since the integrated foreign producer is a monopoly by assumption, its profit maximization problem in the absence of antidumping policy is

$$\max_p D(p)(p-c) \tag{17}$$

Denote by $\hat{p_I}$ the solution to this problem. Then $\hat{p_I}$ solves the F.O.C., that is:

$$D'(\hat{p_I})(\hat{p_I}-c)+D(\hat{p_I})=0. \tag{18}$$

The integrated optimization problem with antidumping policy is

$$\max_p D(p)(p(1-\tau(p)-c). \tag{19}$$

Where, as we saw above, $\tau(p)=\frac{FV}{p}-1$. Plugging the expression for $\tau(p)$ into (19) and rearranging, we get:

$$\max_p D(p)(2p-FV-c) \tag{20}$$

Which yields the following F.O.C.:

$$D'(p)(2p-FV-c)+2D(p)=0. \tag{21}$$

Plugging $\hat{p_I}$ into (21) and using (18), we get

$$D'(\hat{p_I})(\hat{p_I}-FV)+D(\hat{p_I})>0. \tag{22}$$

That is, the F.O.C. with antidumping duties is positive at $\hat{p_I}$, implying that the optimal static price with antidumping duties, $\overline{p_I}$ is higher than the optimal static price in the absence of antidumping policy.

For the optimal static price with antidumping duties to be lower than FV, (21) must be negative at the fair-value price FV, that is

$$D'(FV)(FV-c)+2D(FV)<0, \tag{23}$$

which can be rewritten as

$$\begin{aligned} -D(FV)[\frac{-D'(FV)}{D(FV)}FV-2] &< cD'(FV) \\ -D(FV)[\eta(FV)-2] &< cD'(FV)<0, \end{aligned} \tag{24}$$

where $\eta(FV)$ denotes demand elasticity at the fair-value price. Clearly, $\overline{p_I}<FV$ only if $\eta(FV)$ is high enough. ∎

Proof of Proposition 3.3 The proof for the first part of Proposition 3.3 can be found in Blonigen and Park (2001). In order to prove the second part, I use the following Lemmas:

Lemma A.1 *Given the non-integrated foreign producer's problem,*

$$\Pi(\{p_t^*\}_{t=1}^{\infty}, \{\tau_t\}_{t=1}^{\infty}) = \sup_{\{p_t^*\}_{t=1}^{\infty}} \sum_{t=1}^{\infty} \delta^t (p_t^* - c) D([1 + \tau(p_{t-1}^*)]p_t^*) \tag{25}$$

, the corresponding dynamic programming problem is:

$$V(p_{-1}^*) = \sup_{p^* \in [c,\infty)} \{(p^* - c)D([1 + \tau(p_{t-1}^*)]p_t^*) + \delta V(p^*)\} \tag{26}$$

Then the non-integrated foreign producer's problems (25) and (26) have unique solutions which are bounded, continuous and equivalent to each other. The optimal policy function,

$$G(p_{-1}^*) = \{p^* \in [0, \infty) | V(p_{-1}^*) = \sup_{p^* \in [c,\infty)} \{(p^* - c))D([1 + \tau(p_{t-1}^*)]p_t^*) + \delta V(p^*)\} \tag{27}$$

is a non-empty, compact-valued and upper-hemi continuous correspondence.

Proof Apply theorem 4.6 from Stokey, Lucas, and Prescott (1989). Then, for the integrated firm:

1. WLOG, define the set of prices the foreign firm can choose from $P = [c, \overline{p}]$, where $D(\overline{p}) = 0$ by assumption (A1). Since the firm will never choose a price lower than marginal cost, we can confine out attention to prices above c.[30] Thus, the impact of setting export prices higher than $\overline{p}$ on future payoffs is identical to the impact of setting price equal to $\overline{p}$. Then P is a closed subset of R and hence convex.

2. $\forall p^* \in P$, the set of next period's feasible state variables (prices) if today's state is p^* is $\Gamma(p^*) = [c, \overline{p}] \equiv P$, making it nonempty, compact-valued (closed and bounded subset of R) and continuous.

3. The per-period payoff function, $[p^* - c]D([1 + \tau(p_{t-1}^*)]p_t^*)$ is continuous (multiplication of continuous functions) and bounded (multiplication of bounded function D and bounded sum, since $p^* \leq \overline{p} < \infty$. ∎

Lemma A.2 *$V(p^*)$ is a strictly increasing function in $p^* \in [c, \overline{p})$. Denote the per-period profits of the non-integrated foreign producer by $\pi(p^*; \tau) = (p^* - c)q[(1 + \tau)p^*]$. If the foreign producer chooses its initial price in the absence of antidumping duties, then if $\frac{\partial^2 \pi(p^*;\tau)}{\partial p^* \partial \tau} > 0$, the non-integrated foreign producer's optimal pricing path will have $p_t^* \in (c, \overline{p}]$ $\forall t \geq 0$.*

Proof We can apply Theorem 4.7 in Stokey, Lucas, and Prescott (1989), as long as we show the following hold (in addition to the conditions of Lemma 1):

1. $$\pi(p^*; \tau) = (p^* - c)D([1 + \tau(p_{t-1}^*)]p_t^*)$$

   is strictly increasing in $p_{-1}^* \in [c, FV)$. Indeed, taking the derivative of the per-period profit function by p_{-1}^* (recall that $1 + \tau(p_{-1}^*) = \frac{FV}{p_{-1}^*}$) we get: $\frac{FV}{(p_{-1}^*)^2}(-D')(p^* - c) > 0$ $\forall p^* \in (c, FV]$.

2. Γ is monotone in p^* since for $p^{*\prime} \leq p^*$, $\Gamma(p^{*\prime}) = [c, \overline{p}] \subseteq \Gamma(p^*) = [c, \overline{p}]$

[30] Blonigen and Park (2001) have a detailed proof showing the firm will never choose a price below marginal costs. Intuitively, not only static optimization precludes setting price at less than marginal costs, but also the lower the price, the higher future duties, the lower future demand and so future profits cannot be higher.

Next I narrow down the domain and image of $G(p^*)$. If $\frac{\partial^2 \pi(p^*;\tau)}{\partial p^* \partial \tau} > 0$, we can still show that $p_0^* > FV$ is not optimal: (A2) implies that $(p_0^* - c)D(p_0^*) < (FV - c)D(FV)$. In addition, $V(p_0^*) = V(FV)$ since the next period duty is zero in both cases. Thus, choosing FV strictly raises the payoff hence $p_0^* \leq FV$.

We cannot show the same claim holds for p_1^* since if the non-integrated foreign producer chooses $p_1^* > FV$, with $\tau_1 > 0$ the F.O.C. at $p_1^* > FV$ is not necessarily negative. This is because the derivative of profits w.r.t price is increasing in the duty in this case. Still, the non-integrated foreign producer would never choose $p^* > \overline{p}$, since demand is zero for all prices above this level by assumption (A1). ∎

Lemma A.3 *Let $h(p^*) = \max G(p^*)$, $l(p^*) = \min G(p^*)$. If $\frac{\partial^2 \pi(p^*,\tau)}{\partial p^* \partial \tau} > 0$, the optimal correspondence for the non-integrated firm, $G(p^*)$, is decreasing in p^* in the sense that $h(p^{*\prime\prime}) < l(p^{*\prime})$ $\forall \{(p^{*\prime}, p^{*\prime\prime}) | p^{*\prime\prime} > p^{*\prime}; p^{*\prime\prime}, p^{*\prime} \in (c, \overline{p}]\}$. The optimal policy function is constant for $p^* \geq FV$.*

Proof Assume $\frac{\partial^2 \pi(p^*;\tau)}{\partial p^* \partial \tau} > 0$, where $\pi(p^*;\tau) = (p^* - c)D([1+\tau]p^*)$.

Let $p^{*\prime} < FV$. Then $p^{*\prime}$ in $G(p^{*\prime})$ uniquely defines the current antidumping duty by $\tau(p^{*\prime}) = \frac{FV - p^{*\prime}}{p^{*\prime}}$. By definition:

$$\begin{aligned} &(l(p^{*\prime}) - c)D(l(p^{*\prime})[1+\tau(p^{*\prime})]) + \delta V(l(p^{*\prime})) \geq \\ &(p^* - c)D([1+\tau(p^{*\prime})]p^*) + \delta V(l(p^*)), \text{ for all } p^* \in [c, FV] \end{aligned} \tag{28}$$

Take $p^{*\prime\prime} > p^{*\prime}$. Then $\tau(p^{*\prime\prime}) < \tau(p^{*\prime})$. Thus, $\exists \alpha \geq 0$ such that:

$$\begin{aligned} &(l(p^{*\prime}) - c)D(l(p^{*\prime})[1+\tau(p^{*\prime\prime})]) + \delta V(l(p^{*\prime})) = \\ &(l(p^{*\prime}) - c)D(l(p^{*\prime})[1+\tau(p^{*\prime})]) + \delta V(l(p^{*\prime})) + \alpha \end{aligned} \tag{29}$$

because $\frac{\partial D}{\partial \tau} < 0$ since price is increasing in costs, while demand is decreasing in price.
Claim:

$$\begin{aligned} &(p^* - c)D([1+\tau(p^{*\prime})]p^*) + \delta V(p^*) + \alpha > \\ &(p^* - c)D([1+\tau(p^{*\prime\prime})]p^*) + \delta V(p^*)), \text{ for all } p^* \in (l(p^{*\prime}), FV] \end{aligned} \tag{30}$$

Proof: Define $A(p^*) = [(p^* - c)D([1+\tau(p^{*\prime})]p^*)] + \delta V(p^*) + \alpha] - [(p^* - c)D([1+\tau(p^{*\prime\prime})]p^*) + \delta V(p^*)] \equiv [\pi(p^*;\tau(p^{*\prime})) + \delta V(p^*) + \alpha] - [\pi(p^*;\tau(p^{*\prime\prime})) + \delta V(p^*)]$ Then by definition of α, $A(l(p^{*\prime})) = 0$. Our claim will hold if we can show that $\frac{\partial A(p^*)}{\partial p^*} > 0$:

$$\frac{\partial A(p^*)}{\partial x} = \frac{\partial \pi(p^*;\tau(p^{*\prime}))}{\partial x} - \frac{\partial \pi(p^*;\tau(p^{*\prime\prime}))}{\partial p^*} > 0 \tag{31}$$

since $\tau(p^{*\prime\prime}) < \tau(p^{*\prime})$ and by our assumption above, marginal profits are increasing in τ.

Thus, combining equations (28), (30) and using the definition of α, we get:

$$\begin{aligned} (l(p^{*\prime}) - c)D([1+\tau(p^{*\prime\prime})]p^*) + \delta V(l(p^{*\prime})) \quad &> \\ (p^* - c)D([1+\tau(p^{*\prime\prime})]p^*) + \delta V(l(p^*)) + \alpha, \text{ for all } p^* \in (l(p^{*\prime}), FV] \end{aligned} \tag{32}$$

Consequently, $p^* \notin G(p^{*\prime\prime})$ for all $p^* \in (l(p^{*\prime}), FV]$, implying $h(p^{*\prime\prime}) \leq l(p^{*\prime})$ $\forall p^{*\prime\prime} > p^{*\prime}$.

Let $p^{*\prime} > FV$. Then $\forall p^{*\prime\prime} \in (p^{*\prime}, \overline{p}]$, $\tau(p^{*\prime}) = \tau(p^{*\prime\prime}) = 0$. Thus, $G(p^{*\prime}) = \{p^*\} \in \arg\max[(p^* - c)D([1+\tau(p^{*\prime})]p^*) + \delta V(p^*)] =$
$\{p^*\} \in \arg\max[(p^* - c)D([1+\tau(p^{*\prime\prime})]p^*) + \delta V(p^*)] = G(p^{*\prime\prime})$. In other words, the optimal policy function is constant for export prices above the fair-value price in this case. ∎

Since initial enforcement of antidumping duties is uncertain, firms that assign low enough probability to being caught will set $p_0^* < p_N^{*,s}$ (Otherwise, $p_0^* = p_N^{*,s}$ and there is no price dynamics). If an antidumping duty order is published in period 1 with initial duty $\tau = \frac{FV - p_0^*}{p_0^*} > \frac{FV - p_N^{*,s}}{p_N^{*,s}}$, the price path $p_1^*, p_2^*, p_3^*, \ldots$ is determined by the optimal policy function $G(p^*)$ characterized in Lemma 3, since antidumping duties are enforced with certainty and by Lemma 1 the non-integrated optimization problem is equivalent to the dynamic programming problem which is solved by G. By assumption, $\frac{\partial^2 \pi(p^*, \tau)}{\partial p^* \partial \tau} > 0$.

1. Suppose $p_N^{*,s} = FV$. Since G is decreasing, dumping will cease immediately in this case. Specifically, $p_0^* < p_1^*$, $p_1^* \geq FV$ (since for $p^* \geq FV$, $G(p^*) = G(FV)$ by lemma 3) and $p_2^* = FV$. Consequently, $tau_0 > \tau_1 = \tau_2 = 0$.
2. Otherwise, $p_N^{*,s} < FV$ and $p_0^* < p_N^{*,s}$. Decreasing G implies export price will first increase, then decrease and keep oscillating between high and low levels until it reaches the unique steady-state level of duties $\frac{FV - p_N^{*,s}}{p_N^{*,s}} > 0$. That is, $p_0^* \leq p_1^*$, $p_1^* \geq p_2^*$ and $\tau_0 \geq \tau_1$, $\tau_1 \leq \tau_2$. Consequently, consumer prices will oscillate as well. Specifically, since $p_1^* \frac{FV}{p_0^*} > 1 > p_2^* \frac{FV}{p_1^*}$ and so on, the importer entails higher costs and sets higher consumer prices when p^* is higher (and vice versa). ∎

Proof of Proposition 3.4 To characterize the relation between the elasticity of market demand at steady-state consumer price and the optimal policy function, check how the slope of the optimal policy function changes with demand elasticity η_p at steady-state consumer price, i.e. the fair-value price. The non-integrated foreign producer's per-period profits when duty level is $\tau = \frac{FV}{p_{t-1}^*} - 1$ are:

$$\pi(p_t^*; p^* t - 1) = D(\frac{p_t^*}{p_{t-1}^*} FV)[p_t^* - c] \tag{33}$$

The sign of the derivative of optimal export price by last period's export price equals the derivative of marginal profits w.r.t p_{t-1}^* (by Milgrom and Shannon (1994). Thus

$$\begin{aligned} \frac{\partial^2 \pi}{\partial p_t^* \partial p_{t-1}^*} = & -D''(\frac{p_t^*}{p_{t-1}^*} FV)\{\frac{p_t^* FV}{{p_{t-1}^*}^2} + (p_t^* - c)\frac{p_t^* FV^2}{{p_{t-1}^*}^2}\} \\ & -\frac{FV}{{p_{t-1}^*}^2}(p_t^* - c)D'(\frac{p_t^*}{p_{t-1}^*} FV) \end{aligned} \tag{34}$$

At steady-state, $p_t^* = p_{t-1}^* = p_N^{*,s}$. Plugging back into (34) and rearranging, we get:

$$\begin{aligned} \frac{\partial^2 \pi^{NVI}}{\partial p_t^* \partial p_{t-1}^*}|_{(p_t^* = p_{t-1}^* = p_N^{*,s})} = & -\frac{FV}{p_N^{*,s}} D''(FV)[1 + (p_N^{*,s} - c)\frac{FV}{p_N^{*,s}}] - (p_N^{*,s} - c)D'(FV)\frac{FV}{p_N^{*,s2}} = \\ & -\frac{FV}{p_N^{*,s}} D''(FV)[1 + (p_N^{*,s} - c)\frac{FV}{p_N^{*,s}}] + \frac{(p_N^{*,s} - c)D(FV)}{p_N^{*,s2}}\eta_p(FV), \end{aligned} \tag{35}$$

Where $\eta_p(FV)$ is price elasticity of demand at the fair-value price FV (which is steady-state consumer price in the non-integrated case). It is easy to see that $\frac{\partial^2 \pi^{NVI}}{\partial p_t \partial p_{t-1}}$ is increasing in the elasticity of demand at steady-state $\eta_p(FV)$ since $(p_N^{*,s} - c) > 0$ (holding FV and $D(FV)$ fixed). As noted above, the sign of this derivative equals the sign of the slope of the optimal policy function.

When the optimal policy function is increasing (i.e. when the derivative of optimal export price w.r.t. antidumping duties is negative), this means that the derivative in (35) is positive. The higher $\eta_p(FV)$ is, the more positive this derivative is and the steeper the slope of the optimal policy function around steady-state. As a result, the higher $\eta_p(FV)$, the less prices respond to antidumping duty changes around FV and the slower the convergence to steady-state.

When the optimal policy function is decreasing (i.e. when the derivative of optimal export price w.r.t. antidumping duties is positive), this means that the derivative in (35) is negative. The higher

$\eta_p(FV)$ is, the less negative this derivative is and the flatter the slope of the optimal policy function around steady-state. As a result, the higher $\eta_p(FV)$, the less prices respond to antidumping duty changes around FV and the faster the convergence to steady-state. ∎

Proof of Proposition 3.5 In order to prove the Proposition, I use the following Lemmas:

Lemma A.4 *Given the integrated foreign producer's problem,*

$$\Pi(\{p_t\}_{t=1}^{\infty}, \{\tau_t\}_{t=1}^{\infty}) = \sup_{\{p_t\}_{t=1}^{\infty}} \sum_{t=1}^{\infty} \delta^t (p_t(1-\tau_t) - c)D(p) \tag{36}$$

, the corresponding dynamic programming problem is:

$$V_{VI}(p_{-1}) = \sup_{p\in[c,\infty)} \{(p[1-\tau(p_{-1})] - c)D(p) + \delta V(p)\} \tag{37}$$

Then the integrated foreign producer's problems (36) and (37) have unique solutions which are bounded, continuous and equivalent to each other. The optimal policy function,

$$G^{VI}(p_{-1}) = \{p \in [c,\infty) | V(p_{-1}) = \sup_{p\in[c,\infty)} \{(p[1-\tau(p_{-1})] - c)D(p) + \delta V(p)\} \tag{38}$$

is a non-empty, compact-valued and upper-hemi continuous correspondence.

Proof Apply theorem 4.6 from Stokey, Lucas, and Prescott (1989). Let P^r denote the set of prices the foreign firm can choose from. $\forall p \in P^r$, let $\Gamma(p)$ denote the set of next period's feasible state variables (retail prices) if today's state is p. Then, for the integrated foreign firm:

1. WLOG, define $P = [c, \overline{p}]$: by (A2) $D(p) = 0\ \forall p \geq \overline{p}$ and $\tau(p) = 0$ as long as $\overline{p} \geq FV$. Thus, the impact of setting prices higher than $\overline{p}$ on future payoffs is identical. Then P is a closed subset of R and hence convex. Furthermore, $\forall p \in P$,

2. $\Gamma(p) = [c, \overline{p}] \equiv P$, making it nonempty, compact-valued (closed and bounded subset of R) and continuous.

3. The per-period payoff function, $[p(1-\tau(p_{-1}))-c]D(p)$ is continuous (multiplication of continuous functions) and bounded (multiplication of bounded function D and bounded sum, since $p \leq \overline{p} < \infty$. ∎

Lemma A.5 $V_{VI}(p)$ *is a strictly increasing function in* $p \in [c, FV)$*. If the foreign firm chooses its initial price in the absence of antidumping duties, then we can focus on the optimal price path where* $p_t \in (c, \overline{p}]\ \forall t \geq 0$ *for the integrated foreign firm.*

Proof For the integrated foreign producer, we can apply Theorem 4.7 in Stokey, Lucas, and Prescott (1989), as long as we show the following hold (in addition to the conditions of Lemma 1):

1. $[p - c - \frac{FV - p_{-1}}{p_{-1}} p]D(p)$ is strictly increasing in $p_{-1} \in [c, FV)$. Indeed, taking the derivative of the per-period profit function by p_{-1} we get: $\frac{FV}{(p_{-1})^2} pD(p) > 0\ \forall p \in (0, FV]$.

2. Γ is monotone in p since for $p' \leq p$, $\Gamma(p') = [c, \overline{p}] \subseteq \Gamma(p) = [c, \overline{p}]$

Next, we can show that $p_0 \leq FV$. Suppose $p_0 > FV$. The S.O.C. of the per-period profit of the integrated firm is positive and by (A2), the static optimum is lower than FV, so that $(p_0 - c)D(p_0) < (FV - c)D(FV)$ for $p_0 > FV$. In addition, $V_{VI}(p_0) = V_{VI}(FV)$ since next period's duty is zero in both cases. Thus, choosing FV strictly raises the payoff so $p_0 \leq FV$.

However, we cannot show the same for p_1. Specifically, consider choosing $p_1 > FV$, with $\tau_1 > 0 = \tau_0$. The F.O.C. is a decreasing function , and from (A2) we know that with zero duties the F.O.C. at $p_1 > FV$ is negative (since the static optimum is lower than FV). Yet because the derivative of profits w.r.t. price is increasing in the duty level, we do not know whether the F.O.C. is negative at $p_1 > FV$ with $\tau_1 > 0$. Nonetheless, the integrated foreign producer will never set a price above $\overline{p}$, since by assumption (A1) demand is zero for all prices above it. ∎

Lemma A.6 *Let $h(p) = \max G_{VI}(p)$, $l(p) = \min G_{VI}(p)$. Then the optimal correspondence for the integrated firm, $G_{VI}(p)$, is decreasing in p in the sense that $h_{VI}(p') < l_{VI}(p'')\ \forall\{(p', p'')|p'' < p'; p'', p' \in [c, \overline{p}]\}$. G_{VI} is constant for $p \geq FV$.*

Proof Let $p' \in [c, FV]$. Then p' in $G_{VI}(p')$ uniquely defines the current antidumping duty by $\tau(p') = \frac{FV-p'}{p'}$. By definition:

$$\begin{aligned}\{l(p')[1-\tau(p')]-c\}D(l(p'))+\delta V(l(p')) \geq \\ \{p[1-\tau(p')]-c\}D(p)+\delta V(p), \text{ for all } p \in [c,\overline{p}]\end{aligned} \tag{39}$$

Take $p'' > p'$. Then $\tau(p'') < \tau(p')$. Thus, $\exists \alpha > 0$ such that:

$$\begin{aligned}\{l(p')[1-\tau(p')]-c\}D(l(p'))+\delta V(l(p'))+\alpha = \\ \{l(p')[1-\tau(p'')]-c\}D(l(p'))+\delta V(l(p'))\end{aligned} \tag{40}$$

because $[l(p') - c - \tau(p')l(p')] < [l(p') - c - \tau(p'')l(p')]$ since $\tau(p'') < \tau(p')$

Claim:

$$\begin{aligned}\{p[1-\tau(p')]-c\}D(p)+\delta V(p)+\alpha > \\ \{p[1-\tau(p'')]-c\}D(p)+ \\ \delta V(p), \text{ for all } p \in (l(p'),\overline{p}]\end{aligned} \tag{41}$$

Proof: Define $A(p) = (\{p[1-\tau(p')]-c\}D(p)+\delta V(p)+\alpha) - (\{p[1-\tau(p'')]-c\}D(p)+\delta V(p))$. Then by definition of α, $A(l(p')) = 0$. Our claim will hold if we can show that $\frac{\partial A(p)}{\partial p} > 0$:

$$\frac{\partial A(p)}{\partial p} = [\tau(p'') - \tau(p')][D(p) + D'(p)p]$$

The first expression in parentheses in negative since $\tau(p'') < \tau(p')$. The second expression is negative iff the elasticity of demand $\eta_p = D'(p)\frac{p}{D(p)} < -1$, which holds when importer is a monopoly.

Thus, combining equations (39), (41) and using the definition of α, we get:

$$\begin{aligned}\{l(p')[1+\delta(1+r)-(1-\delta(1+r))\tau(p'')]-c-\delta(1+r)FV\}D(l(p'))+\delta V(l(p'))+\alpha > \\ \{p[1+\delta(1+r)-(1-\delta(1+r))\tau(p'')]-c-\delta(1+r)FV\}D(p)+ \\ \delta V(p), \text{ for all } p \in (l(p''),\overline{p}]\end{aligned} \tag{42}$$

Consequently, $p \notin G_{VI}(p'')$ for all $p \in (l(p'), FV]$, implying $h(p'') \leq l(p')\ \forall p'' > p'$.

Note that if $p' \geq FV$, then $\forall p'' > p'$, $\tau(p'') = \tau(p') = 0$. Consequently, $G_{VI}(p') = \{p\} \in \arg\max[\{p[1-\tau(p')]-c\}D(p)+\delta V(p)] =$
$\{p\} \in \arg\max[\{p[1-\tau(p'')]-c\}D(p)+\delta V(p)] = G_{VI}(p'')$. Consequently, the integrated foreign producer's optimal policy function is constant for prices above the fair-value price FV. ∎

Since initial enforcement of antidumping duties is uncertain, firms that assign low enough probability to being caught will set $p_0 < p_I^s$, where p_I^s is the stationary U.S. consumer price for the integrated producer (Otherwise, $p_0 = p_I^s$ and there is no price dynamics). If an antidumping duty order is published in period 1 with initial duty $\tau = \frac{FV-p_0}{p_0} > \frac{FV-p_I^s}{p_I^s}$, the price path $p_1, p_2, p_3, ...$ is determined by the optimal policy function $G_{VI}(p)$ characterized in Lemma 6, since antidumping duties are enforced with certainty and by Lemma 1 the integrated optimization problem is equivalent to the dynamic programming problem which is solved by G_{VI}.

1. Suppose $p_I^s = FV$. Since G is decreasing, dumping will cease immediately in this case. Specifically, $p_0 < p_1$, $p_1 \geq FV$ (since for $p \geq FV$, $G_{VI}(p) = G_{VI}(FV)$ by lemma 6) and $p_2 = FV$. Consequently, $tau_0 > \tau_1 = \tau_2 = 0$.

2. Otherwise, $p_I^s < FV$ and $p_0 < p_I^s$. Decreasing G implies consumer price will first increase, then decrease and keep oscillating between high and low levels until it reaches the unique steady-state level of duties $\frac{FV - p_I^s}{p_I^s} > 0$. That is, $p_0 < p_1$, $p_1 \geq p_2$ and $\tau_0 < \tau_1$, $\tau_1 \leq \tau_2$ etc. ∎

Proof of Proposition 3.6 To characterize the relation between the elasticity of market demand at steady-state consumer price and the optimal policy function, check how the slope of the optimal policy function changes with demand elasticity η_p at steady-state consumer price p_I^s. The integrated foreign producer's per-period profits when duty level is $\tau = \frac{FV}{p_{t-1}} - 1$ are:

$$\pi^{VI}(p_t; p_{t-1}) = D(p_t)[2p_t - \frac{p_t}{p_{t-1}} FV - c] \tag{43}$$

The sign of the derivative of optimal consumer price by last period's consumer price equals the derivative of marginal profits w.r.t p_{t-1}^* (by Milgrom and Shannon (1994). The second derivative of profits w.r.t price and duties is

$$\frac{\partial^2 \pi^{VI}}{\partial p_t \partial p_{t-1}} = \frac{FV}{{p_{t-1}}^2}[D(p_t) + p_t D'(p_t)] =$$

At steady-state, $p_t = p_{t-1} = p_I^s$. Plugging back into (44) and rearranging, we get:

$$\begin{aligned} \frac{\partial^2 \pi^{VI}}{\partial p_t \partial p_{t-1}}|_{p_t = p_{t-1} = p_I^s} &= \frac{FV}{{p_I^s}^2}[D(p_I^s) + p_I^s D'(p_I^s)] = \\ & -\frac{FV}{{p_I^s}^2 D(p_I^s)}[\eta_p(p_I^s) - 1] \end{aligned} \tag{44}$$

Where $\eta_p(p_I^s)$ is price elasticity of the demand at the integrated steady-state consumer price p_I^s (and it is bigger than 1 for monopoly). It is easy to see that $\frac{\partial^2 \pi^{VI}}{\partial p \partial p_{t-1}}$ is decreasing in the elasticity of demand at steady-state $\eta_p(p_I^s)$ since $D(p) > 0$. Recall that the sign of this derivative equals the sign of the slope of the optimal policy function. Since the optimal policy function is decreasing, this means that the derivative in (35) is negative. The higher $\eta_p(p_I^s)$ is, the more negative this derivative is and the steeper the slope of the optimal policy function around steady-state. As a result, the higher $\eta_p(p_I^s)$, the more prices respond to antidumping duty changes around steady-state and the slower the convergence to steady-state. ∎

Proof of Proposition 3.7 From Proposition 3.1 we know that in the non-integrated case, steady-state consumer price is $p_N^s = FV$ regardless of the non-integrated foreign producer's price choice $p_N^{*,s}$. Thus, non-integrated steady-state profits are: $D(FV)(p_N^{*,s} - c) \leq D(FV)(FV - c)$. By contrast, the integrated foreign producer fully controls p. Thus, we can use a revealed-preference type of argument. specifically, *ceteris paribus*, had the integrated foreign producer chosen to set its steady-state U.S. consumer price, p_I^s, so that $p_I^s = FV$ then its steady-state (static) profits would equal $D(FV)(FV - c)$, no less than non-integrated profits in this case. However, the integrated foreign producer is free to choose consumer price according to profit maximization. Hence, if it sets $p_I^s = \frac{FV}{1+\tau} < FV$ it must be that its profits with this price are higher than its profits with $p_I^s = FV$. Consequently, whenever the integrated foreign producer's steady-state profits are strictly higher than those of the non-integrated foreign producer. Only when the both integrated and non-integrated foreign producer's steady-state price equals the fair-value ($p_N^{*,s} = p_N^s = FV$) will they make the same steady-state profits. ∎

Proof of Corollary of Proposition 3.7 Let f_x denote fixed export costs, π_I^s and π_N^s denote steady-state profits of the integrated and non-integrated foreign producer, accordingly. From Proposition 3.7 we know that $\pi_I^s \geq \pi_N^s$ (equality holds only when $p_N^{*,s} = p_N^s = FV$).

If $\pi_I^s > f_x > \pi_N^s$, non-integrated foreign producer steady-state profits with antidumping duties are negative whereas integrated steady-state profits with antidumping duties are positive. Thus, non-integrated foreign producer's steady-state continuation value is negative.

In period 1, when antidumping duties are imposed, then

1. If $\frac{\partial^2 \pi(p^*,\tau)}{\partial p^* \partial \tau} < 0$, the non-integrated foreign producer will immediately exit the U.S. market. According to Proposition 2, in this case prices increase monotonically to steady-state. This implies that on the equilibrium path, $p_t = \frac{p_t^*}{p_{t-1}^*} FV > FV$, so that $D(p_t) < D(FV)$. On the other hand, we know that $p_{t-1}^* < p_t^* < ... < p_N^{*,s} \leq FV$. Thus, once antidumping duties are imposed per-period profits are lower than steady-state profits (since both quantity and price are lower than steady-state's). Since we assumed steady-state profits are lower than f_x, the per-period export cost, per-period profits are also lower than f_x. Hence, the non-integrated foreign producer will exit immediately once duties are imposed since profits net of export costs are negative from then on. Obviously, integrated continuation value when antidumping duties are imposed is higher: first, steady-state profits are higher than f_x. Second, per-period profits oscillate between higher and lower levels. Specifically, when duty is lower than steady-state level (following a high price period), costs are lower and profits are higher than at steady-state. Thus, integrated continuation value cannot be lower than non-integrated continuation value once duties are imposed.

2. If $\frac{\partial^2 \pi(p^*,\tau)}{\partial p^* \partial \tau} > 0$ then by Proposition 3, either dumping ceases immediately or non-integrated prices and duties oscillate and converge to steady-state dumping.

   - If steady-state is no dumping, we know it is reached in period 2 (where period 1 is the first time duties are imposed). Furthermore, the profits in the first period are lower than steady-state profits, which are lower than f_x by assumption. To see why, note that non-integrated profits at $p_1^*(> FV > p_0^*)$ with duties are lower than profits at p_1^* without antidumping policy:

   $$D(p_1^*)(p_1^* - c) > D(\frac{p_1^*}{p_0^*} FV)(p_1^* - c), \tag{45}$$

   since $D(p_1^*) > D(p_1^* \frac{FV}{p_0^*}$ when $FV > p_0^*)$. But from assumption (A2) we know that

   $$D(p_1^*)(p_1^* - c) < D(FV)(FV - c), \tag{46}$$

   where $D(FV)(FV - c)$ are steady-state profits of the non-integrated foreign producer in this case. The inequality holds since for prices at or above fair-value price, duties are zero so per-period profits there equal static profits in the absence of antidumping policy. Because the optimal static price is lower than fair-value by assumption (A2) we know that profits are decreasing in price for prices at or above the fair-value price. As a result, once antidumping duties are imposed, non-integrated continuation value is negative so the non-integrated foreign producer immediately exits the US market. By contrast, if integrated steady-state is no dumping, its continuation value from period 1 on is positive since we assumed steady-state profits are higher than f_x and steady-state is reached in period 2. Since period 1 costs are $\tau_1 > 0$, profits in period 1 are lower than steady-state profits (with zero duties). However, as long as profits in period 1 (net of f_x) are not too-low, integrated continuation value once duties are imposed will be positive and the integrated foreign producer will stay in the US market.
   - Otherwise, duties oscillate and converge to steady-state dumping. Suppose steady state is reached in period T. Then $\exists 1 \leq t^{NVI} \leq T$ such that non-integrated per-period profits net export costs from period t^{NVI} on are negative (since profits are a continuous function of price).
   Using the same reasoning, $\exists 1 \leq t^{VI} \leq T$ such that integrated per-period profits net export costs from period t^{VI} on are positive.
   Let $\hat{t} = \max\{t^{VI}, t^{NVI}\}$. Then $\forall t > \hat{t}$, integrated continuation value is positive and non-integrated continuation value is negative. As long as the foreign producer's discount factor is not too low, and $\hat{t}$ is not too far from 1, we can conclude that at period 1, non-integrated continuation value will be negative, while integrated continuation value will be positive. Thus, *ceteris paribus*, non-integrated foreign producer will exit the U.S. market immediately after antidumping duties are imposed while the integrated foreign producer will stay.

Thus, the integrated foreign producer is more likely than the non-integrated foreign producer to have a higher continuation value once antidumping duties are imposed. As a result, the non-integrated foreign producer is more likely to exit the U.S. market post antidumping duty imposition. ∎

B Dynamic Pricing Model with Retroactive Duty Adjustments

In reality, once current duty is calculated based on prices during the period of review, the importers are reimbursed or charged for the difference between actual payments they made during that period and the "correct" payments according to the updated duty level, with interest. Below I claim that, under reasonable assumptions, the dynamic optimization problems of foreign producers with and without adjustment payments are qualitatively similar.

B.1 The Non-Integrated Foreign Producer's Optimization Problem With Adjustment Payments

I start by considering the problem of the non-integrated foreign producer with retroactive duty adjustments. The non-integrated domestic importer pays the duties and hence receives or pays any adjustment payments. To the extent that adjustment payments affect the independent importer's prices, they may (indirectly) affect the equilibrium behavior of the non-integrated foreign producer.

With full competition in the import sector, the U.S. consumer price must equal the importers' marginal cost. With adjustment payments, this means that

$$p_t = p_t^*(1+\tau_t) + \delta_m(1+r_t)a(p_t^*), \tag{47}$$

where r_t is the interest rate, δ_m is the importer's discount factor and $a(p_t^*)$ is the adjustment payment for period t, that is

$$a(p_t^*) = \begin{cases} p_t^*\tau_t - p_t^*\tau_{t+1} = FV\frac{p_t^*}{p_{t-1}^*} - FV, & \text{if } p_t^* \leq FV; \\ p_t^*\tau_t - 0 = FV\frac{p_t^*}{p_{t-1}^*} - p_t^*, & \text{Otherwise;} \end{cases}$$

By plugging in the explicit expression for $a(p_t^*)$ in (47), we get:

$$p_t = \begin{cases} FV\frac{p_t^*}{p_{t-1}^*}[1+\delta_m(1+r_t)] - \delta_m(1+r_t)FV, & \text{if } p_t^* \leq FV; \\ FV\frac{p_t^*}{p_{t-1}^*}[1+\delta_m(1+r_t)] - \delta_m(1+r_t)p_t^*, & \text{Otherwise} \end{cases} \tag{48}$$

Note first that in steady-state, $p_t^* = p_{t-1}^*$ so the U.S. consumer price p_N^s equals the fair-value price (because of (A2) $p^* > FV$ is not optimal). When $p_t^* \neq p_{t-1}^*$, this restores the dynamics for the non-integrated foreign producer: current- and past-export price choices affect the current consumer price. Consequently, the non-integrated dynamic model with adjustment payments is qualitatively similar to the dynamic model above and the main results are unaltered.

B.2 The Integrated Foreign Producer's Optimization Problem With Adjustment Payments

The integrated foreign producer is liable for all duty payments and hence its per-period profit function also includes the adjustment payments. An important feature of these payments is that they are received only after the relevant administrative review was conducted. That is, the foreign producer is reimbursed (or charged) retroactively for over (or under) payments of duty made in the previous period. Thus, the integrated foreign producer's optimization problem, given FV and p_0, is to find the sequence of retail prices, $\{p_t\}_{t=0}^{\infty}$ that solves

$$\sup_{\{p_t\}_{t=0}^{\infty}} \sum_{t=0}^{\infty} \delta^t [p_t(1-\tau_t(p_{t-1})) - c + \delta(1+r_t)a(p_t)]D(p_t), \tag{49}$$

where r_t is the interest rate, and $a(p_t)$ is the adjustment payment for period t, namely

$$a(p_t) = \begin{cases} p_t\tau_t - p_t\tau_{t+1} = (1+\tau_t)p_t - FV, & \text{if } p_t \leq FV; \\ p_t\tau_t - 0, & \text{Otherwise;} \end{cases}$$

To understand the important role of adjustment payments, consider what would happen if the foreign producer were exactly reimbursed for any over or under payment it made over the review period ($\delta(1+r) = 1$). In this case, the dynamic problem of the foreign producer collapses to a static optimization problem since

$$\begin{aligned} \sup_{\{p_t\}_{t=0}^{\infty}} \sum_{t=0}^{\infty} \delta^t [p_t(1 - \tau_t(p_{t-1}^r)) - c + a_t] D(p_t) &= \\ \sup_{\{p_t\}_{t=0}^{\infty}} \sum_{t=0}^{\infty} \delta^t \{2p_t - c - FV\} D(p_t) & \end{aligned} \tag{50}$$

so that the foreign producer would choose the same optimal price in each period and there will be no price dynamics.[31] However, if the foreign producer has strong enough preference for the present, future reimbursement will not make up for duty payments today, thus restoring the dynamics in the foreign producer's optimization problem. This means the foreign producer's costs today will still be affected by its past price choice. Specifically, the inverse of the foreign producer's discount factor needs to be higher than Commerce's interest ($\delta < \frac{1}{1+r_t}$). Since it is reasonable to treat the interest rate paid by the government as the "risk-free" rate, the assumption that the foreign producer is impatient (or that it has higher risk than the "risk-free" level) is not restrictive.

Since the optimization problem above is qualitatively similar to the integrated optimization problem of the former section, its solution and the characteristics of the integrated foreign producer's optimal price path are similar to those presented in Propositions 3.3 and 3.4. Thus, the proofs for the optimization problem with adjustment payments are not repeated here.

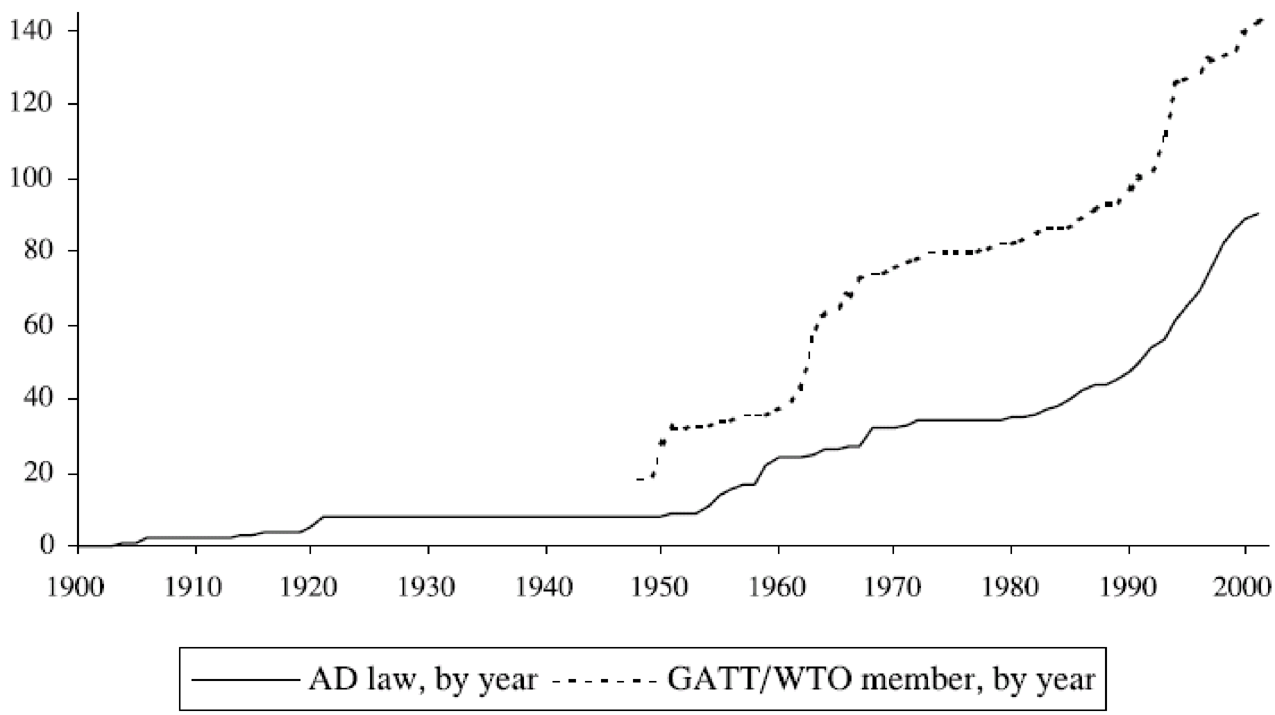
[31] The foreign producer's optimal price in (50)is still higher than the static optimum $\hat{p_I}$ in the absence of antidumping policy. To see why, note that the foreign producer's profits without antidumping policy are $(p - c)D(p)$, whereas in (50) they can be rewritten as $[p - c - (FV - p)]D(p)$. Since $FV \geq p$, the costs in (50) are higher than the costs in the no antidumping-policy case, leading to a higher static U.S. consumer price $\overline{p_I}$ in the former case, namely $\overline{p_I} > \hat{p_I}$

C Detailed Data Description

Name	Source[a]	Description
International Trade Commission case	Original dataset	International Trade Commission case identification number, which identifies the antidumping investigation
Commerce case	Addition	Commerce case identification number, which appears in the Federal Registrar documents
Country	Original dataset	Home country of the foreign producer.
Product	Original, with additions	Name of product under investigation. Description Harmonized Tariff Schedule codes were added.
Decision	Original dataset	Investigation outcome (antidumping duties imposed; negative determination; terminated)
Firmname	Original dataset	Name of foreign producer.
Integrated	Addition	1 if the foreign producer was integrated with U.S. importing according to Commerce records.
Change	Addition	1 if non-integrated foreign producer became integrated past antidumping duties, by Commerce records.
dateinitiated	Addition	Initiation date of the investigation by Commerce
orderdate	Addition	Date of antidumping duty order (where applicable).
daterevoked	Addition	Revocation date of the duty (where applicable).
sunsetrevoc	Addition	1 if order revoked through Sunset review.
length	Addition	length of order in days, as of May 1, 2008.
c cv	Original dataset	1 if constructed value was used to calculate fair-value price, rather than home market price. (only for original investigations which ended in duties).
c 3c	Original dataset	1 if third country sales were used to determine fair-value price, rather than home market price (only for original investigations which ended in duties).
Number	Addition	Count of ARs (0 for original investigation)
firmradd	Investigation and first AR - Original dataset All subsequent reviews - addition	Level of antidumping duty
Change in antidumping duty	Addition	Difference between present (t) and previous $(t-1)$ duty
Last Change in antidumping duty	Addition	The difference between $t-1$ and $t-2$ duty levels
Last Change in duty X integrated	Addition	Interaction between the two variables
ar date	First AR - original dataset	administrative review's date of publication
	All subsequent reviews - addition	
poi start date	Investigation & first AR - original dataset All subsequent reviews - addition	First day of the investigation period
poi end date	Investigation & first AR - original dataset All subsequent reviews - addition	Last day of the investigation period
ar bia	First AR - original dataset All subsequent reviews - addition	1 if best information available was used by Commerce instead of foreign firm information
ar fpet	First AR - original dataset All subsequent reviews - addition	1 if the specific foreign firm asked to be reviewed
ar fpet x integrated	Addition	Interaction between the two variables
ar dpet	First AR - original dataset All subsequent reviews - addition	1 if a domestic firm asked for the specific foreign firm to be reviewed
ar dpet x integrated	Addition	Interaction between the two variables
both	Addition	1 if both domestic and the foreign firm asked for review
both x integrated	Addition	Interaction between the two variables
first	Addition	When both asked for review, this variable is 0 if domestic firm asked first, 1 if foreign firm asked first and 2 if both applied on the same day

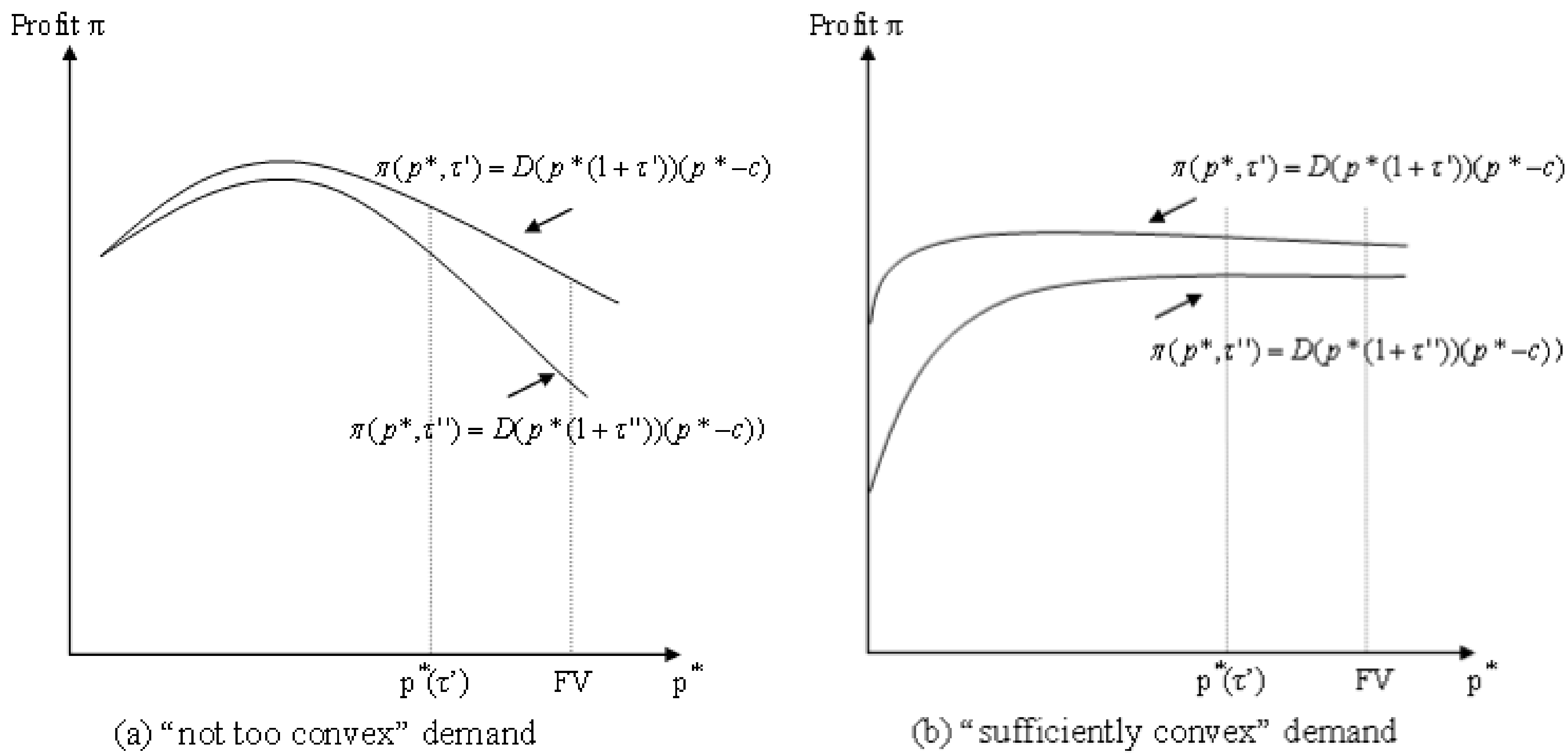
[a] The data for this paper are based on the dataset of Blonigen and Park (2004). This column indicates whether the variable was part of their original dataset or added by me. The source of all variables added to the original database is the Federal Registrar, through the Lexis-Nexis legal research database.

Figure 1: More WTO members mean more antidumping laws[a]



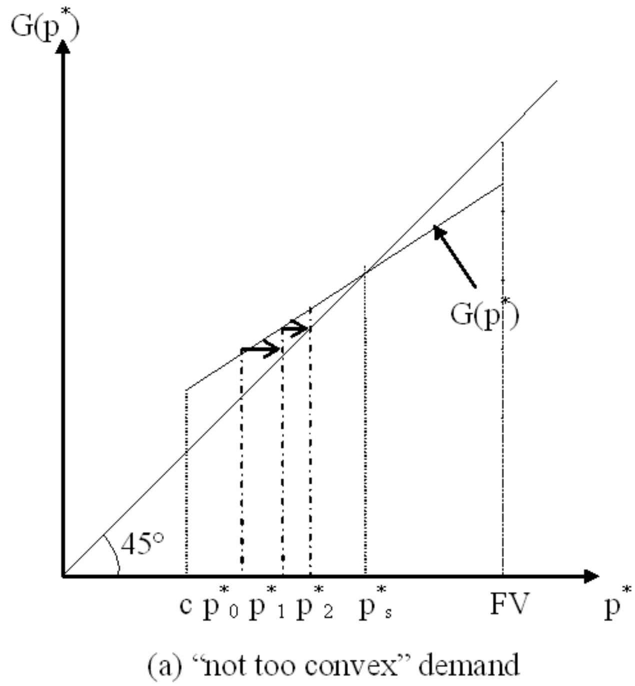
[a]This figure is taken from Zanardi (2004), p. 409. Note the strong correlation between membership at the WTO (World Trade Organization) and its predecessor, the General Agreement on Tariffs and Trade, and the use of antidumping laws. WTO membership limits the use of import/export tariffs, so that countries resort to antidumping duties in order to protect specific domestic industries against "low priced" imports.

Figure 2: The impact of higher duty $\tau'' > \tau'$ on non-integrated price when marginal profits are decreasing (a) or increasing (b) in duty[a]



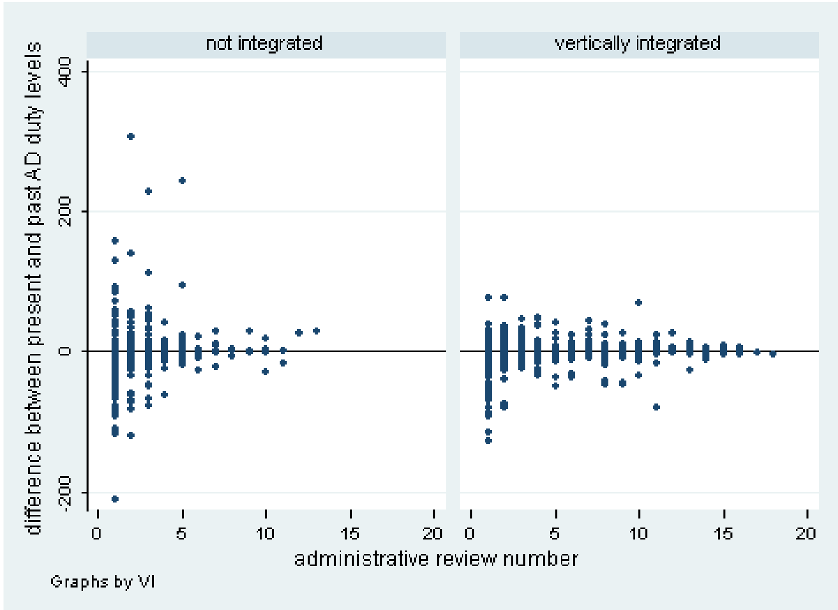
[a] Note that when the derivative of marginal profits w.r.t. the duty is negative (a), the slope of the per-period profit function decreases more in export prices the higher duty level. When marginal profits are increasing in the duty (b), the slope of the per-period profit function decreases less in export price the higher the duty level.
Let $p^*(\tau')$ denote the optimal price for the firm when antidumping duty level is τ' (note that it is higher than the per-period optimal price due to the impact of current price on future duties). if marginal profits are decreasing w.r.t. the duty (a), the firm will never choose a price higher than $p^*(\tau')$ in response to higher duties $\tau'' > \tau'$, since the cost of doing so (in terms of profit loss) is higher when the duty is higher. The converse is true when the derivative of marginal profits w.r.t. the duty is positive (b), since in this case the cost of choosing a price above $p*(\tau')$ is lower when the duty is higher.

Figure 3: Non-integrated optimal policy, marginal profits decreasing (a) or increasing (b) in duty[a]



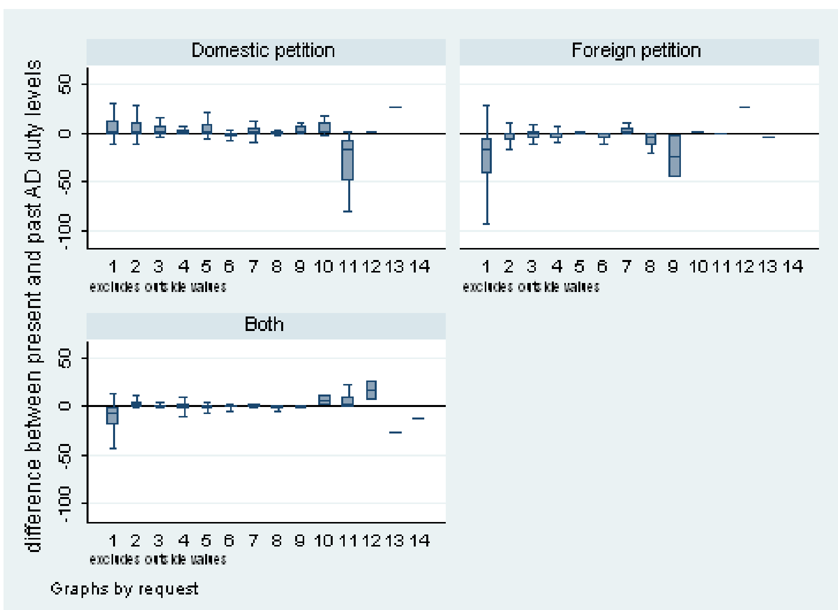
[a]Note that when the slope of the optimal policy function is positive (a), the convergence to steady-state is monotone, while a negative slope (b) means that prices oscillate around steady-state and steady-state is stable only if the slope is less than one in absolute value. Point A indicates the case of a steady-state with positive dumping, while point B fits the case of a non-dumping steady-state.

Figure 4: Duty changes over time for non-integrated (left) and integrated (right) firms[a]



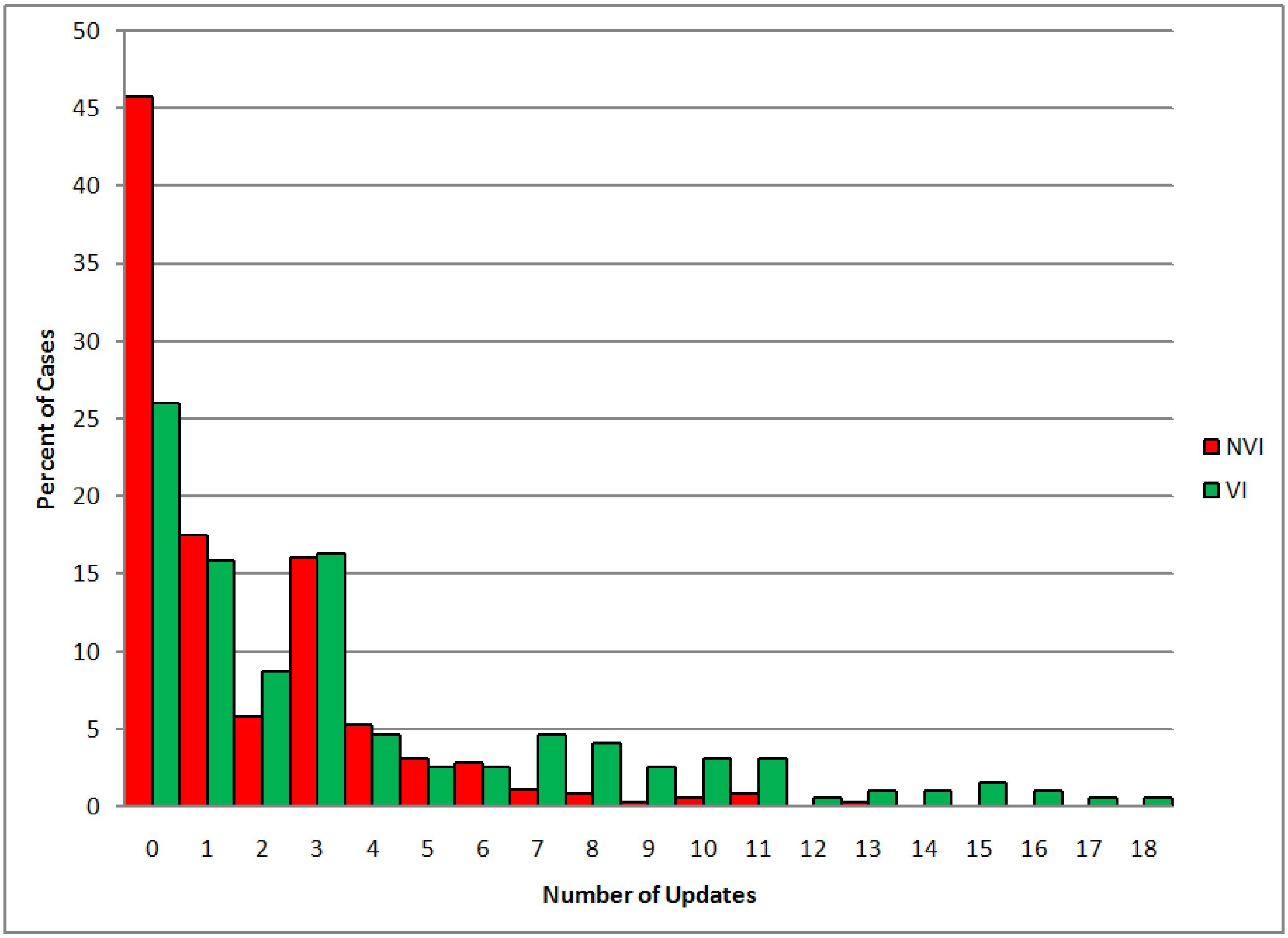
[a]The graph shows the distribution of antidumping duty changes by administrative review for non-integrated (left) and integrated (right) foreign producers. Note that for non-integrated foreign producers duties are more dispersed initially but converge faster. integrated duty changes are less dispersed but take longer to converge.

Figure 5: Changes in the duties over time by the identity of the petitioner for review[a]



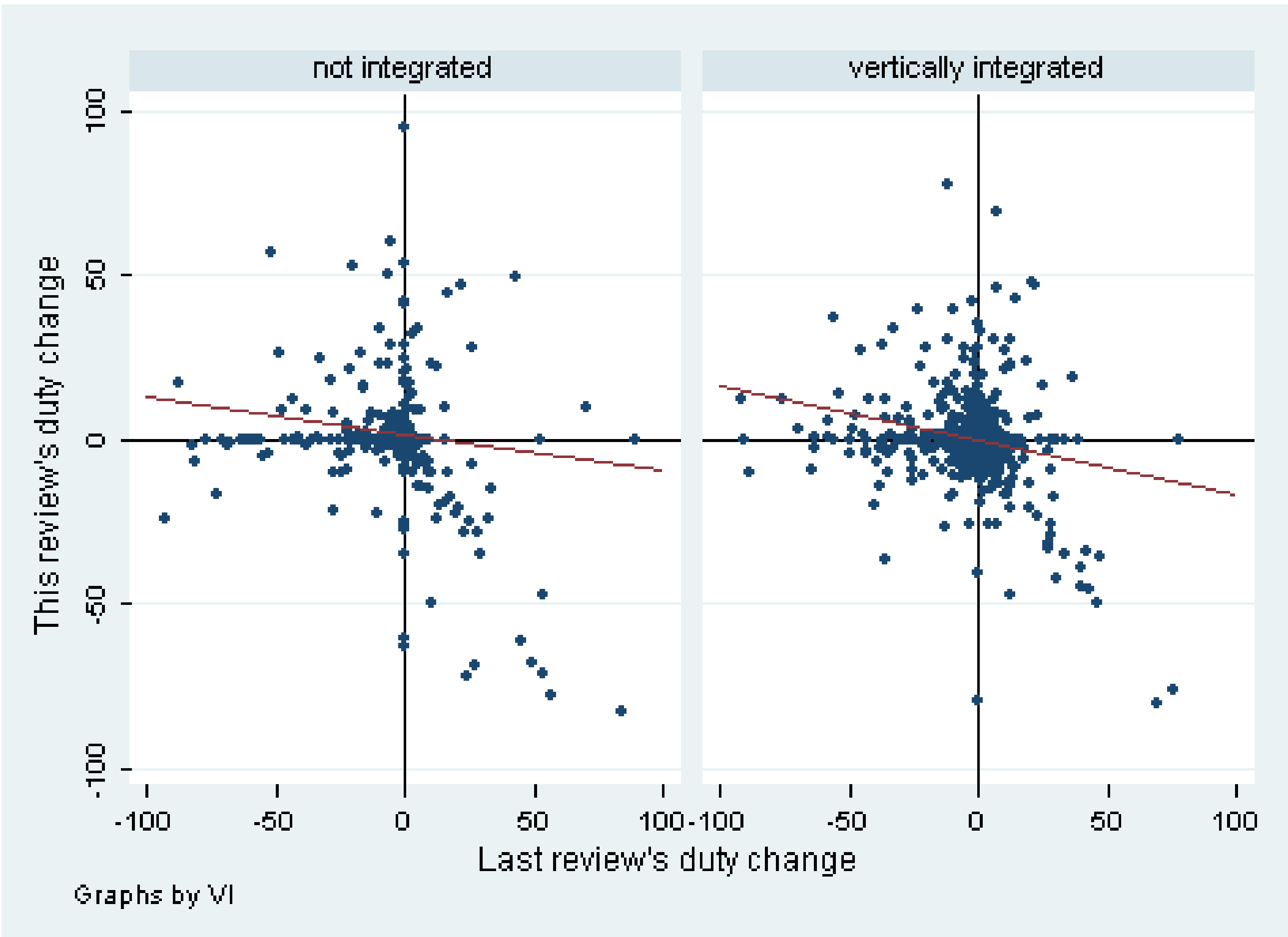
[a]The graph displays box plots of duty changes by administrative review number. The box represents the interquartile range and the mean is represented by a line inside the box. The difference in the duties tends to be positive following a domestic review petition (at least for the first 10 reviews); negative following a foreign petition; and pretty symmetric around zero when both ask for the review, with the exception of the first review (tendency towards negative duty change) and 10th and above reviews (tendency towards positive duty change).

Figure 6: Distribution of antidumping orders by number of administrative reviews[a]



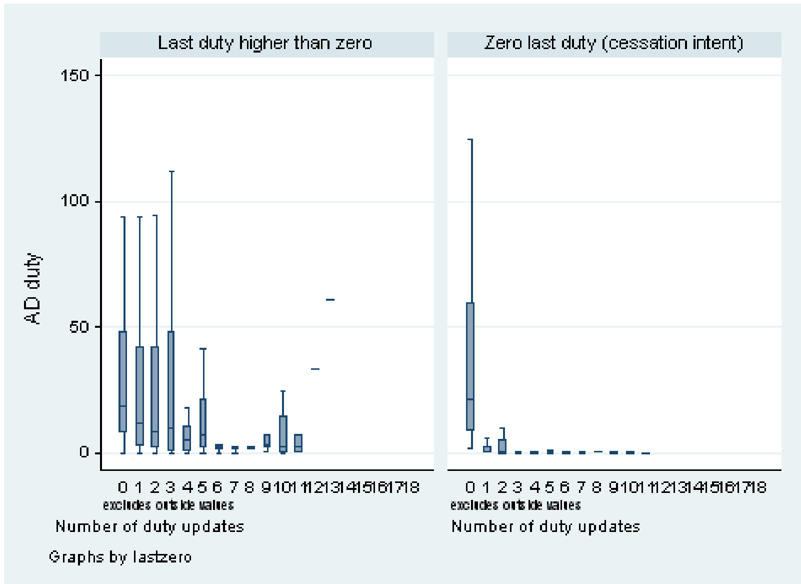
[a]The graph shows the distribution of antidumping duty orders (initiated between 1980 and 1995) by number of administrative reviews for integrated and non-integrated foreign producers. Note that 46% of non-integrated foreign producers had no administrative reviews of their antidumping order. This is significantly higher than the proportion of integrated foreign producers without any administrative reviews (26%). To the extent that zero reviews indicate exit of the foreign producer from the U.S. market, this means non-integrated foreign producers are more likely to exit the domestic market once duties are imposed.

Figure 7: Scatter plots of current and past duty changes, by integration status[a]



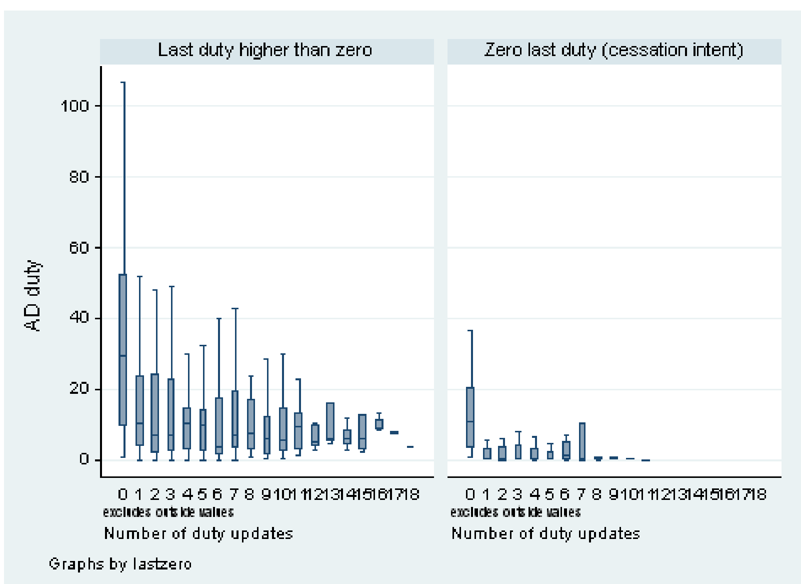
[a]The figure includes scatter plots of last period's duty change on current duty change for non-integrated (left) and integrated (right) foreign producers. Observations with duty changes above 100% were omitted for clarity (17 observations or about 1% of the data). The graphs also include the corresponding regression lines. Both seem to suggest a negative relation between current and past duty changes.

Figure 8: Distribution of non-integrated duties over time, cessation-intent orders and all others[a]



[a]The graph displays box plots of non-integrated firms' antidumping duties by number of review for cessation-intent cases (right) and all other cases (left). The box represents the interquartile range and the mean is represented by a line inside the box. Cessation-intent cases are defined as revoked cases where the last duty level was zero. Note that for cessation-intent cases (right), duty levels fell drastically after the first review and stays very close to zero. For all other reviews (left), there is no such distinct pattern.

Figure 9: Distribution of integrated duties over time, cessation-intent orders & all others[a]



[a]The graph displays box plots of integrated firms' antidumping duties by number of review for cessation-intent cases (right) and all other cases (left). The box represents the interquartile range and the mean is represented by a line inside the box. Cessation-intent cases are defined as revoked cases where the last duty level was zero. Note that for cessation-intent cases (right), duty levels fell drastically after the first review and stays very close to zero. For all other reviews (left), there is no such distinct trend in duty levels.

Table 1: Distribution of firms by vertical structure for each investigation outcome[a]

Decision	% integrated firms
Positive	35%
Negative	30%
Terminated	30%

[a]Positive indicates investigations that ended with an affirmative determination and an antidumping order; Negative indicates investigations that ended in negative determination; Terminated are investigation that ended in agreement between the foreign producer and Commerce to increase prices (without duties being imposed).

Table 2: Characteristics of antidumping duties in the data[a,b]

	All antidumping orders	Non-integrated	Integrated	Difference
Avg. initial duty	32.71%	34.40%	29.62%	4.78%
	(1.52)	(2.00)	(2.23)	
Avg. duties	20.78%	24.80%	16.52%	8.28%***
	(0.76)	(1.28)	(0.76)	
Avg. duties	19.18%	22.40%	16.14%	6.26%***
(exc. no-review orders)	(0.77)	(1.36)	(0.75)	
Avg. Initial change in duty	-12.56	-9.79	-16.38	6.60*
	(1.86)	(2.69)	(2.37)	
Avg. changes in duties	-2.43	-1.64	-3.11	1.47
	(0.71)	(1.32)	(0.69)	
Percent of duties calculated using BIA[c]	21%	24%	18%	7%***
Percent of firms that ever had BIA in duty calculation	47%	45%	51%	-6%***
Avg. length of order (years)	11.8	11.7	12	-0.3**
	(0.06)	(0.08)	(0.09)	
Percent of reviews initiated by domestic party	66%	62%	72%	-10%***
Percent of reviews initiated by foreign party	59%	55%	67%	-11%***

[a]Std. deviations are given in parentheses. The first column displays the means for all orders. The second and third display means for integrated and non-integrated foreign producers, separately. The fourth displays the results of a t-test for equality of integrated and non-integrated means. The data include all antidumping duties initiated between 1980 and 1995.

[b]* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

[c]Best information available is used when the foreign firm's information is deemed inadequate and results in high duties.

Table 3: Distribution of initial duty change[a]

Initial duty change	All	Excluding best information available[b]
Negative	218 (61%)	159 (75%)
None	65 (18%)	30 (14%)
Positive	76 (21%)	23 (11%)
Total	359	212

[a]According to the theory, when the enforcement of duties is uncertain foreign producers should dump more initially and raise their price once antidumping duties are imposed. Foreign producers that place high enough probability on being caught, however, will set their price at the steady-state dumping level even before actual duties are imposed. Thus, duties should either decrease or remain unchanged following their imposition. In the first column of the table, 79% of cases conform with the theoretical prediction, but for 21% of the cases duties increased further after the initial antidumping order. After I exclude cases where use of best information available could have affected the direction of duty change, the percentage of cases where duties increased or remained unchanged at the first review increases to 89%.

[b]Since the use of best information available (BIA) tends to increase the calculated duty regardless of the firm's price, I exclude cases where best-information available was used in the first review and the duty increased above its initial level and cases where it was used in the initial order and the duty decreased in the first review.

Table 4: Distribution of duty changes over time[a]

Firm duty path	Non-integrated	integrated
Ever twice decreasing	27 (14%)	24 (17%)
Ever twice increasing	21 (11%)	13 (9%)
Always decreasing	4 (2%)	5 (3%)
Always increasing	3 (2%)	1 (1%)
Always decreasing, excluding BIA[b]	4 (2%)	4 (3%)
Always increasing, excluding BIA	0 (0%)	0 (0%)

[a]When the enforcement of antidumping duties is uncertain, the theory predicts that once such duties are imposed duty levels should oscillate over time for integrated foreign producers and either oscillate or converge monotonically for non-integrated foreign producers. The first two rows of the table present the proportion of firm-specific cases with at least two consecutive decreasing or increasing duty changes, by vertical structure. The following two rows display the proportion of cases where duties increased or decreased monotonically, by vertical structure. The last two rows present the proportion of cases where duties increased or decreased monotonically, excluding cases where use of best information available could have affected the direction of duty change. About 25% of integrated and non-integrated foreign producers' duties increased or decreased twice in a row. Less than 3% of integrated and non-integrated foreign producers' duties decreased monotonically, and none had monotonically increasing duties (once best-information-available cases are excluded).

[b]Since use of best information available (BIA) tends to increase the calculated duty regardless of the firm's price, I exclude cases where best information available was used in the current review and the current duty increased, and cases where it was used in the previous review and the duty subsequently decreased.

Table 5: Regression of past duty change on current duty change, integrated and non-integrated foreign producers[a,b,c]

Dependent variable: Present change in antidumping duties

	I		II		III		GLS	
Variable	Non-integrated	Integrated	Non-integrated	Integrated	Non-integrated	Integrated	Non-integrated	Integrated
Last change in	-0.105	-0.149**	-0.321**	-0.181***	-0.279*	-0.177***	-0.104***	-0.151***
Antidumping duties	(0.062)	(0.046)	(0.112)	(0.044)	(0.107)	(0.039)	(0.003)	(0.000)
Best information	25.577***	7.563***	16.561**	4.854*	21.400***	6.332*	25.179***	7.395***
available used curently[d]	(6.269)	(2.051)	(5.225)	(2.139)	(4.636)	(2.610)	(0.093)	(0.079)
Best information	-11.974***	-5.074**	-7.433	-6.181**	-6.895	-5.483*	-10.972***	-5.094***
available used last period[d]	(4.058)	(1.696)	(5.853)	(2.134)	(4.662)	(2.181)	(0.667)	(0.072)
Constant	-0.907	-0.751	-0.746	-0.254	-1.844	-0.646**	-0.829***	-0.528***
	(1.117)	(0.588)	(1.271)	(0.395)	(1.225)	(0.531)	(0.040)	(0.050)
Fixed Effects	No	No	firm	firm	TSUSA (3-digit)	TSUSA (3-digit)		
No. groups			137	114	56	40		
No obs	420	583	420	583	393	576	399	566
R^2	0.13	0.10	0.08	0.08	0.10	0.10		

[a] Standard errors in parentheses

[b] * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

[c] The first specification pools over all observations for non-integrated and integrated firms, separately (with robust standard errors). The second includes firm fixed effects with robust standard errors, the third replaces firm fixed effects with sector fixed effects (there are 34 observations with missing sector data), and the last performs GLS estimation to control for heteroskedasticity and firm-specific autocorrelation. Note that the coefficient on past duty change is negative, less than one and significant both for integrated and non-integrated foreign producers. This is consistent with oscillation and convergence of duties over time.

[d] "Best information available" is used when the foreign firm's information is deemed inadequate. It tends to result in high duties.

Table 6: Regression of normalized past duty change on current normalized duty change, integrated and non-integrated firms[a,b,c]

Dependent variable: normalized present change in antidumping duties

	I		II		III		GLS	
Variable	Non-integrated	Integrated	Non-integrated	Integrated	Non-integrated	Integrated	Non-integrated	Integrated
Normalized last	-0.027	-0.025	-0.244**	-0.106*	-0.132*	-0.046	-0.032***	-0.008***
change in duties	(0.042)	(0.047)	(0.083)	(0.044)	(0.057)	(0.023)	(0.001)	(0.003)
Best information	19.371*	10.279*	13.068*	11.887*	13.554**	11.887*	20.707***	7.563***
available used currently[d]	(7.967)	(3.648)	(6.113)	(4.709)	(4.459)	(5.077)	(0.019)	(0.850)
Best information	-4.289	-16.178*	1.909	-15.078*	-2.049	-15.465	-3.940***	-11.853***
available used last period[d]	(6.432)	(7.132)	(9.780)	(7.123)	(7.412)	(7.634)	(0.669)	(1.147)
Constant	-0.967	-0.120	-1.243	-0.802	-0.283	-0.663	-1.208***	-0.007***
	(1.087)	(1.598)	(2.529)	(1.041)	(1.546)	(0.571)	(0.022)	(0.001)
Fixed Effects	No	No	firm	firm	TSUSA (3-digit)	TSUSA (3-digit)		
No. groups			129	111	56	38		
No. obs	365	550	365	550	345	544	336	530
R^2	0.04	0.03	0.02	0.03	0.03	0.03		

[a] Robust standard errors in parentheses

[b] * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

[c] To account for the fact that duty updates do not always occur at fixed intervals, I normalize duty changes by the length of the interval between the reviews (in years). This normalization results in the loss of observations where the results of several consecutive review periods were published at the same time.
The first specification pools over all observations for non-integrated and integrated firms, separately (with robust standard errors). The second includes firm fixed effects with robust standard errors, , the third replaces firm fixed effects with sector fixed effects (there are 26 observations with missing sector data), and the last performs GLS estimation to control for heteroskedasticity and firm-specific autocorrelation.
Note that the coefficient on past duty change is negative, less than one and (mostly) significant for both integrated and non-integrated foreign producers. This is consistent with oscillation of duties over time.

[d] "Best information available" is used when the foreign firm's information is deemed inadequate. It tends to result in high duties.

Table 7: Regression of past duty change on current duty change, integrated and non-integrated firms[a,b,c]
Dependent variable: present change in antidumping duties

	I		II	
Variable	Non-integrated	Integrated	Non-integrated	Integrated
Last change	-0.315***	-0.182***	-0.274***	-0.179***
in duties	0.049	0.030	0.042	0.030
Best information	14.753**	4.711**	19.816***	6.207***
available used currently[d]	4.907	1.771	3.737	1.581
Best information	-7.114*	-6.209***	-6.809	-5.427***
available used last period[d]	4.910	1.774	3.759	1.619
Constant	1.457	-0.309	-0.209	-0.624
	2.801	0.719	2.240	0.679
FE	firm, review year		3-digit TSUSA, review year	
	3-digit TSUSA trend		3-digit TSUSA trend	
No. groups	128	111	56	40
No. obs	393	576	393	576
R^2	0.07	0.09	0.09	0.10

[a]Standard errors in parentheses

[b]* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

[c]To account for specific industry trends, the specifications in the table include not only firm (or sector) fixed effects, but also sector trends. These trends are created by interacting the 3-digit TSUSA of each product that is subject to antidumping duties with the year of the original order or the administrative review. The first specification includes firm and review-year fixed effects and industry trends. The second includes sector and review-year fixed effects and their interactions. Note that the coefficient on past duty change is negative, less than one and significant for both integrated and non-integrated foreign producers. This is consistent with oscillation of duties over time.

[d]"Best information available" is used when the foreign firm's information is deemed inadequate. It tends to result in high duties.

Table 8: Impact of last duty change on current duty change by commodity group, integrated and non-integrated foreign producers[a,b,c]

	I		II		III		GLS	
	Non-integrated	Integrated	Non-integrated	Integrated	Non-integrated	Integrated	Non-integrated	Integrated
Last change in antidumping duties	-0.047	-0.122**	-0.139	-0.140***	-0.159***	-0.138***	-0.028***	-0.066***
	(0.102)	(0.045)	(0.101)	(0.039)	(0.038)	(0.016)	(0.005)	(0.011)
Last change*steel	-0.032	-0.407*	0.139	-0.391***	0.034	-0.413***	-0.001	-0.399***
	(0.125)	(0.169)	(0.220)	(0.068)	(0.110)	(0.054)	(0.005)	(0.032)
Last change*chemicals	-0.089	0.042	-0.156	0.018	-0.042	0.003	-0.094***	-0.031**
	(0.119)	(0.108)	(0.136)	(0.121)	(0.092)	(0.093)	(0.011)	(0.011)
Last change*finished	-0.099	0.220***	-0.498***	0.163	-0.428***	0.198**	-0.041	0.142***
	(0.227)	(0.066)	(0.135)	(0.080)	(0.121)	(0.067)	(0.051)	(0.011)
Best information available used currently[d]	26.262***	7.955***	13.977**	5.417*	19.489***	6.633*	24.959***	7.572***
	(6.197)	(1.949)	(4.612)	(2.209)	(3.834)	(2.715)	(0.065)	(0.226)
Best information available used last period[d]	-11.748**	4.831**	-8.950	-5.798**	-7.364	-5.238*	-12.559***	-5.328***
	(4.106)	(1.658)	(5.855)	(2.097)	(4.449)	(2.194)	(0.929)	(0.228)
Constant	-0.503	-0.886	1.027	-0.247	-0.866	-0.536*	-0.512***	-0.364***
	(2.345)	(0.672)	(1.851)	(0.402)	(1.216)	(0.262)	(0.038)	(0.050)
Fixed Effects	commodity	commodity	firm	firm	TSUSA (3-digit)	TSUSA (3-digit)		
No. groups			137	114	56	40		
No. obs	420	583	420	583	393	576	399	566
R^2	0.14	0.16	0.06	0.14	0.08	0.14		

[a]Standard errors in parentheses

[b]† $p < 0.1$ * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

[c]Steel includes all steel and carbon-steel sheets, plates, bearings, nails, pipes etc, excluding finished products e.g. cookware; Chemicals, minerals and metals include all chemical compounds, metals (e.g. magnesium) and minerals (e.g. cement) but not intermediate or consumer products produced from them; Finished products are all products which are not inputs into further production, e.g. microwaves, bicycles, pencils, towels and agricultural and food/agricultural products (flowers, salmon, mushrooms, shrimp etc.); The remainder are all products which do not fit another category, e.g. acrylic yarn, iron castings, DRAMs.
The first specification includes commodity fixed effects, the second has firm fixed effects (both with robust standard errors), the third replaces firm fixed effects with sector fixed effects (there are 34 observations with missing sector data), and the fourth utilizes GLS to account for heteroskedasticity and firm-specific autocorrelation. Note that the coefficient on past duty change is negative, less than one both for integrated and non-integrated foreign producers. This is consistent with oscillation of duties over time. The coefficient on last duty change for finished products is less negative for integrated foreign producers and more negative for non-integrated foreign producers. The coefficient on last duty change for steel (relative to other intermediates) is more negative for integrated foreign producers. To the extent that demand for finished products is less elastic than demand for other intermediates in the data (and demand for steel is more elastic), this is consistent with the prediction of the theoretical model.

[d]"Best information available" is used when the foreign firm's information is deemed inadequate. It tends to result in high duties.

Table 9: Impact of last duty change & import demand elasticities on current duty change, integrated and non-integrated producers[a,b,c]

	I		II		III		GLS	
	Non-integrated	Integrated	Non-integrated	Integrated	Non-integrated	Integrated	Non-integrated	Integrated
Last change in antidumping duties	-0.134	-0.123**	-0.409*	-0.143***	-0.387*	-0.139***	-0.156***	-0.050***
	(0.109)	(0.043)	(0.160)	(0.038)	(0.148)	(0.015)	(0.010)	(0.011)
Last change*High demand elasticity[d]	0.060	-0.074	0.204	-0.113	0.233	-0.114	0.100***	-0.148***
	(0.111)	(0.111)	(0.171)	(0.105)	(0.151)	(0.086)	(0.013)	(0.011)
High elasticity	-5.875	1.332						
	(3.376)	(1.332)						
Best information available used	25.883***	7.564***	15.423***	4.892*	19.869***	6.378*	25.048***	6.218***
Currently[e]	(6.148)	(2.041)	(4.452)	(2.143)	(3.845)	(2.629)	(0.134)	(0.578)
Best information available used	-11.807**	-4.995**	-7.657	-5.901**	-6.863	-5.303*	-12.333***	-4.429***
last period[e]	(4.012)	(1.670)	(5.751)	(2.115)	(4.514)	(2.200)	(0.918)	(0.518)
Constant	2.821	-0.753	-0.283	-0.267	-1.377	-0.635*	-0.824***	-0.432***
	(1.927)	(0.630)	(1.328)	(0.409)	(1.120)	(0.540)	(0.141)	(0.014)
Fixed Effects			firm	firm	TSUSA (3-digit)	TSUSA (3-digit)		
No. groups			137	114	56	40		
No. obs	420	583	420	583	393	576	399	566
R^2	0.14	0.11	0.08	0.10	0.10	0.10		

[a] Standard errors in parentheses

[b] * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

[c] I use Broda and Weinstein (2006)'s import demand elasticities, which are drawn under the assumption of CES utility. Using Broda and Weinstein (2006)'s data on elasticities at the 7-digit TSUSA and 10-digit HTS level, I classify the elasticities as "high" if they are above the 66^{th} percentile of estimated elasticities in the data. I then define the binary variable "high elasticity" accordingly. I exclude from the sample cases that had no reviews (immediate U.S. market exit).
Note that the coefficient on the interaction of high-elasticity with substitution elasticity is positive for the non-integrated case and negative for the integrated case, and significant in the last specification. This is consistent with the predictions of the theoretical model.

[d] High demand elasticity is defined as elasticity above the 66^{th} percentile in the original Broda and Weinstein (2006) data.

[e] "Best information available" is used when the foreign firm's information is deemed inadequate. It tends to result in high duties.