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By
Dmitri Nizovtsev
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Alexandre Skiba*

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Washburn University
School of Business
1700 SW College Ave.
Topeka, KS 66621
785-670-1308
www.washburn.edu/sobu

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* Dmitri Nizovtsev is associate professor of economics at the School of Business at Washburn University. Alexandre Skiba is assistant professor of economics at the University of Wyoming. Comments should be directed to Dmitri Nizovtsev, School of Business, Washburn University, 1700 SW College Ave. Topeka, Kansas 66621, 785-670-1599, dmitri.nizovtsev@washburn.edu.

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Dmitri Nizovtsev
School of Business
Washburn University
1700 SW College Ave.
Topeka, KS 66049
Ph.: (785) 670-1599
Fax: (785) 670-1063
E-mail: dmitri.nizovtsev@washburn.edu

Alexandre Skiba
Department of Economics and Finance
University of Wyoming
1000 E University Ave.
Laramie, WY 82071
Ph: (307) 766-6940
Fax: (307) 766-5090
E-mail: askiba@uwyo.edu

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1. Introduction

Factors affecting prices of imported and exported goods have been extensively studied in the literature and continue to be of great interest to researchers. This is understandable given the steadily growing volume of international trade and the close connection between prices and trade volumes, profits, and welfare. A large portion of work on pricing of internationally traded products focuses on "pass-through", or the extent to which various costs factors and trade barriers are reflected in the final export market price.

The majority of those studies focus on the exchange rate pass-through.[1] Numerous studies have recorded the exchange rate pass-through that is incomplete and occurs with a substantial delay, the estimates of which range from two quarters to two years (Hooper and Mann 1989; Athurokala and Menon 1994; Menon 1996; Campa and Goldberg 2005; Salehizadeh and Rafaat 2012).

Another group of paper studied how prices in the importing country are affected by trade barriers, specifically by quantitative restrictions (Knetter 1994) and tariffs. Feenstra (1989) demonstrated the symmetry of tariff and exchange rate pass-through using the data on US imports from Japan over the period of 1974-1987. Other country-specific studies that followed (Pompelli and Pick 1990; Rezitis and Brown 1999; Mallick and Marques 2008) have also found that, similarly to the effect of exchange rates, pass-through of tariffs is usually less than perfect.

Explanations for incomplete pass-through include the slow price adjustment (Devereux and Yetman 2010) and other market rigidities, as well as the less than perfectly competitive nature of many international markets, which may manifest itself in two forms. One is the "largeness" of the importing country enabling it to affect world prices; the other is the cross-country differences in the degree of market competition, which, along with the imperfect competition among exporting firms enables those firms to price discriminate across those markets (the so called "pricing-to-market" argument, Krugman 1986). Note that the separability of individual markets, an important condition necessary for successful price discrimination, is usually naturally satisfied in the international trade setting due to the presence of transportation costs and – in some cases – trade barriers.[2]

Atkeson and Burstein (2008) demonstrate that pricing-to-market behavior and therefore incomplete pass-through can occur even when prices are set optimally every period, making the "sticky prices" requirement of Devereux and Yetman (2010) unnecessary. Consistently with the pricing-to-market hypothesis, Nicita (2009) and Ural Marchand (2012) find evidence of the tariff pass-through ratio differences across geographical regions and between rural and urban areas.

[1] For an overview of early work on this topic, see Menon (1995) and Goldberg and Knetter (1997).

[2] It is therefore understandable that changes in trade policies also affect exporting firms' pricing-to-market behavior therefore the exchange rate pass-through, see Campa and Goldberg (2005) and Marmolejo (2011).

This paper is also interested in the pricing behavior of exporting firms and their responses to variations in costs and trade barriers. In doing so, we pay particular attention to anti-dumping duties and their special place among other geographical and trade barriers. There are several reasons for such focus. It has been repeatedly noted that anti-dumping duties are being used more frequently, by more countries, and against more products than ever in history (Irwin 2005; Prusa 2005; Zanardi 2006; Bown 2011) and the importance of anti-dumping legislation and practices is not likely to diminish anytime soon. The increase in the importing country prices resulting from the enactment of anti-dumping measures has been recorded in several studies (Prusa 2001; Ganguli 2008; Avsar 2013), resembling the effect of tariffs. However, unlike the case of tariffs or countervailing duties, the implementation of anti-dumping measures is directly contingent on the prices of imports. Therefore the manner in which anti-dumping duties affect decisions of price-setting firms' is different from that of any other trade barriers. That was pointed out by Marston (1990) and Blonigen and Haynes (2002)[3] but so far proper theoretical analysis of this trade policy instrument has been lacking.[4] This forces policymakers to rely on old theories and conjectures, at least some of which are of limited relevance to the new set of trade policy tools.

This paper aims to fill this gap by developing a simple pricing-to-market model in a linear demand specification. We show that the pass-through of anti-dumping duties is fundamentally different from that of tariffs, costs, or exchange rates. This theoretical notion is then supported by the empirical evidence. There, we estimate the short-run effect of anti-dumping duties, exchange rates, tariffs, and transportation costs, applying the approach of Blonigen and Haynes (2002) to the detailed monthly data on US imports between April 1990 and September 2002. Depending on the specification, our estimating sample period covers between 58 and 77 anti-dumping cases with affirmative decisions. We control for monthly cost and demand shifters using the US Producer Price Index, Imports Price Index, Exports Price Index, total shipments of the US producers, and exporter-time effects. Our estimates of the extent of the trade barrier pass-through relies on specifications with exporter-product fixed effects. While numerous prior studies have investigated various aspects of the exporting firms' pricing behavior, we are contributing to the literature by systematically comparing the pass-through of a broad set of barriers across a number of different industries.

Our empirical results indicate that the pass-through of anti-dumping duties is more robust than for any other trade barriers, therefore supporting the notion that anti-dumping duties are fundamentally different from any other (trade barriers or cost factors) and tend to invoke a stronger reaction from the exporting

[3] Additionally, Nizovtsev and Skiba (2010) show that even under constant elasticity of demand and constant marginal cost, anti-dumping duties are not passed through completely. This is strikingly different from the case of ad valorem barriers, which under the same specification would be passed through completely (Feenstra 1989).
[4] The only exception know to us is Dinlersoz and Dogan (2010).

firm. Proper understanding of the anti-dumping duty pass-through mechanism helps improve the accuracy of trade policies and the analysis of their welfare implications.[5]

The next section presents the theoretical model. The data sample, empirical procedure, and results are presented in Section 3. The last section provides our conclusions and discusses possible directions for future research.

2. Theoretical Model

Our theoretical model follows the literature on pricing-to-market. Our model is consistent with that of Feenstra (1989) but uses the linear demand specification. Such a modification allows the elasticity of demand to vary along the demand curve and therefore, as pointed in Atkeson and Burstein (2008) and shown in Melitz and Ottaviano (2008), allows for a richer set of scenarios some of which the CES demand specification may not capture. We use that setting to analyze the pass-through of various trade barriers.

There are two countries, Home and Foreign. A firm located in Foreign produces the good at constant marginal cost, C_F.[6] The firm sells the good both in Foreign and in Home. The cost of producing and delivering one unit of the good to the Home consumer is $C_F + s$, where s is the transportation cost. For the purpose of this model, both cost components are (assumed to be) denominated in the Foreign currency.[7] Home demand for the imported good is given by $Q = a - bP_H$, where a and b are linear demand parameters and P_H is the price that Home consumers face.

In the absence of trade barriers the exporting firm profit, measured in the Foreign currency, is

$$\Pi = (\frac{P_H}{E} - C_F - s) \cdot (a - bP_H), \tag{1}$$

where E denotes the bilateral Home-Foreign exchange rate or, more specifically, the price of a unit of Foreign currency expressed in units of Home currency.

The profit function given by (1) is maximized at

[5] As Gallaway et al. (1999) demonstrated, the foreign firm's price adjustment is a major determinant of the welfare effect of anti-dumping duties.

[6] Feenstra (1989) uses a broader set of cost specifications, which is not required for our results. In our model, the imperfect nature of competition in the Home market and the possibility of incomplete pass-through are sufficiently captured by the exporter's ability to adjust its price.

[7] Variations in the invoicing currency may affect the exchange rate pass-through but have minimal effect on the main results of the paper.

$$P_{H0} = \frac{a}{2b} + \frac{E(C_F + s)}{2}\ .^{8} \tag{2}$$

We are interested in the effect of various factors on final prices of goods imported by Home. Following prior literature on import pricing and pricing-to-market, we use the standard measure of pass-through, commonly defined as the percentage change in the final price divided by the percentage change in the underlying factor.

The pass-through of the overall cost (inclusive of both manufacturing and transportation) is

$$\eta_C = \frac{\frac{P_{HN}}{P_{H0}} - 1}{\frac{E(C_F+s)_N}{E(C_F+s)_O} - 1} = \frac{bE(C_F + s)_O}{a + bE(C_F + s)_O} \tag{3}$$

The expression in (3) is consistent with the notion that stronger competition in the Home market (represented by a greater a/b ratio and a flatter demand curve) results in a smaller optimal pass-through. In cases when only one component of the cost increases, its effect on the final price will be proportional to its share in the overall cost.

Similarly, the pass-through of the exchange rate is also incomplete,

$$\eta_E = \frac{\frac{P_{HN}}{P_{H0}} - 1}{\frac{E_N}{E_O} - 1} = \frac{bE_O(C_F + s)}{a + bE_O(C_F + s)} \tag{4}$$

Next, we introduce an import tariff. Trade barriers drive a "wedge" between the price consumers face, P_H, and the price that enters the firm's profit expression. From now on we will refer to the latter price, inclusive of transportation cost but not inclusive of the tariff, as the "border price", P_b. In the presence of a tariff, the relationship between the two prices is trivial, $P_H = P_b(1+t)$, where t is the tariff rate.

The profit of a firm facing a tariff is

$$\Pi_T = (\frac{P_b}{E} - C_F - s)\cdot(a - bP_b(1+t)) = (\frac{P_H}{E(1+t)} - C_F - s)\cdot(a - bP_H)\,. \tag{5}$$

The solution to the profit-maximization problem in this case is

$$P^*_{HT} = \frac{a}{2b} + \frac{E(C_F + s)(1+t)}{2} \tag{6}$$

The optimal tariff pass-through ratio is then,

$$\eta_T = \frac{\frac{P_{HT}}{P_{H0}} - 1}{\frac{1+t}{1} - 1} = \frac{P_{HT} - P_{H0}}{t\cdot P_{H0}} = \frac{CE + s}{\frac{a}{b} + CE + s} \tag{7}$$

[8] Here, the '0' subscript indicates the absence of trade barriers. This price will be used as the point reference in the pass-through analysis that follows.

The equivalence of (3), (4), and (7) suggests the incomplete and symmetric pass-through of tariffs, costs, and exchange rates. While the symmetry result is consistent with the earlier finding by Feenstra (1989) for the CES demand specification, the less-than-complete pass-through is a deviation from that prior work and deserves a brief discussion.

The intuition behind the incomplete pass-through has been pointed out in prior literature on pricing-to-market. First, it requires the presence of imperfect competition in the destination (Home) market and firm's ability to adjust its price. Second, price elasticity of demand has to vary along the demand curve.[9] In our model this requirement is satisfied by adoption of the linear demand specification. Naturally, this simplest version of the non-constant elasticity setup has its limitations. Since the extent of the pass-through depends crucially on how much elasticity changes along the demand curve, in a more general setting the degree of pass-through may depend on the size of a shock (maybe quote someone here).

Next, we consider an anti-dumping duty imposed by Home on the imported product. According to the currently adopted anti-dumping practices, an anti-dumping duty can be imposed only when the price in the importing country ("Home" in our model) is below the reference "fair value", V. Under the most straightforward approach to the fair value determination, V is set equal to the price in the country of origin, P_F, and accounts for transportation costs and the exchange rates as needed, $V=(P_F+s)E$.[10] In the case of an affirmative ruling in an anti-dumping case, the size of the duty is set equal to the "dumping margin", or the ratio of the "fair value", V, to the price of the imported product in Home. It is important to note that the Home price used to make this inference is the border price, P_b. However, in cases when the product in question is also subject to a tariff or a countervailing duty, those duties are also included in the reference price.[11] Using the case of free trade as the reference point, the anti-dumping duty rate is

$$d=\frac{V}{P_{H0}}-1 \tag{8}$$

Since, unlike a tariff, an anti-dumping duty is directly contingent on the price in the destination country, it can in principle be avoided by increasing P_b. This, however, does not happen automatically. For example, the peculiarity of the AD duty setting mechanism in the United States is that, once the dumping margin is determined, the exporter is required to post a cash deposit or a bond for every shipment of the merchandise in an amount equal to the estimated duties owed. This effectively means that

[9] Otherwise, in the constant elasticity specification, the firm's optimal markup over the marginal cost stays the same and the pass-through is always complete. See Feenstra (1989).

[10] Other, more elaborate approaches to calculating the fair value also exist. These include the constructed value approach, an approach based on "best information available" or "facts available" (Moore 2005), and others. The specific procedure used in the calculation of V is not important for our results.

[11] This frequently misunderstood point was carefully explained by Kelly (2010).

the exporting firm's price adjustment does not immediately affect the anti-dumping duty rate; that rate continues to be based on the previously determined dumping margin.

In order for the dumping margin and the duty rate to change, the case has to be reviewed by Home authorities.[12] The review process is lengthy and may take several years. If the revised dumping margin is different from the original one, the past amount paid by the firm is adjusted accordingly. The size of the adjustment equals the difference between the amount previously placed as a deposit and the duty the firm actually owes, as calculated using the newly available information. The size of the refund cannot exceed the initial deposit plus the accrued interest.

A firm faced with an anti-dumping duty sets the new price, taking into account both its operating profit and the projected refund amount. We model this as a one-time decision, assuming the chosen price will apply to all the import flows from that point on.[13] Due to the complexity of the anti-dumping duty setting and collection, we find it more convenient to present the profit optimization problem in terms of the border price.

The firm's profit from selling each unit of the product in Home is similar to the expression previously obtained for the case of a tariff,

$$\pi = \frac{P_{bAD}}{E} - C_F - s. \tag{9}$$

Every unit sold at the new price qualifies the firm for a refund denominated in Home currency, in the amount of

$$r = P_{bAD}d - (V - P_{bAD}) = P_{bAD}(1+d) - V, \text{ if } P_{bAD} \leq V, \text{ or} \tag{10}$$

$$r = V \cdot d, \text{ if } P_{bAD} \geq V. \tag{11}$$

Whenever the firm's short-term profit-maximizing price in the absence of trade barriers, P_{b0}, is below the fair value V, both the operating profit and the total refund amount are clearly decreasing in P_b in the $P_b > V$ range. Therefore, setting $P_{bAD} > V$ is never optimal and the formula in (10) applies. Therefore the total profit is

$$\Pi_{AD} = \left(\frac{(2+d)P_{bAD}}{E} - (\frac{V}{E} + C_F + s) \right) \cdot (a - bP_{bAD}(1+d)) \tag{12}$$

The optimal price solving the profit-maximization problem in the presence of an anti-dumping duty is

[12] In our sample period, reviews could occur by request of the exporting firm or domestic firms.

[13] In principle, price adjustment can occur multiple times but, empirically, such occasions are rare. This is explained by the fact that the review process is costly, lengthy, and its outcome is uncertain. Therefore we believe our two-period model is sufficiently accurate to capture the most important aspects of the anti-dumping process.

$$P^*_{bAD} = \frac{a}{2b(1+d)} + \frac{(V + C_F E + sE)}{2(2+d)} \tag{13}$$

Taking (8) into account, (13) corresponds to the Home consumer price

$$P_{HAD} = \frac{a}{2b} + \frac{(P_{H0}(1+d) + C_F E + sE)(1+d)}{2(2+d)} \tag{14}$$

The optimal ADD pass-through ratio is then,

$$\eta_{AD} = \frac{\frac{P_{HAD}}{P_{H0}} - 1}{\frac{1+d}{1} - 1} = \frac{P_{HAD} - P_{H0}}{d \cdot P_{H0}} = \frac{V(1+d) - (CE + sE)}{d(2+d)\left(\frac{a}{b} + CE + sE\right)} = \frac{P_{H0}(1+d)^2 - (CE + sE)}{d(2+d)\left(\frac{a}{b} + CE + sE\right)} \tag{15}$$

Several facts about this expression are worth pointing out. First, (15) is notably different from (7) obtained for the case of a tariff. Second, for the same duty rate, the pass-through of an anti-dumping duty will always be greater than that of a tariff:

$$\eta_{AD} - \eta_T = \frac{P_{H0}(1+d)^2 - E(C_F + s)}{d(2+d)\left(\frac{a}{b} + E(C_F + s)\right)} - \frac{E(C_F + s)}{\frac{a}{b} + E(C_F + s)} = \frac{(P_{H0} - E(C_F + s))(1+d)^2}{d(2+d)\left(\frac{a}{b} + E(C_F + s)\right)} \tag{16}$$

The above expression is always positive due to the exporting firm's participation – in order for the firm to be interested in entering the Home market), P_{H0} has to be greater than the cost of delivering the good to Home, $E(C_F + s)$.

The third important difference between the pass-through of an anti-dumping duty and that of a tariff is that for the adopted demand specification tariff pass-through is independent of the size of the tariff whereas the anti-dumping pass-through is strictly decreasing in d. [14]

$$\frac{d\eta_{AD}}{dd} = -\frac{(2+2d)(P_{H0} - E(C_F + s))}{d^2(2+d)^2\left(\frac{a}{b} + E(C_F + s)\right)^2} < 0 \tag{17}$$

To summarize the last two points can be summarized by stating that the pass-through of an anti-dumping duty is greater than the pass-through of the same-size tariff but that difference gets smaller as the rate of respective duties increases.

$$\frac{d(\eta_{AD} - \eta_T)}{dd} = -\frac{(1+d)(P_{H0} - E(C_F + s))}{(2+d)\left(\frac{a}{b} + E(C_F + s)\right)} < 0 \tag{18}$$

[14] This is consistent with the insight from Nizovtsev and Skiba (2010), who find that the pass-through of AD duties is smaller when the demand is more elastic. While that result is obtained for the constant-elasticity setting, it can be generalized to the present linear demand specification where elasticity increases as one moves up along a demand curve.

3. Data and empirics

In this section we test our theoretical results empirically. The main purpose of the estimation is to compare the pass-through of the anti-dumping duties into the prices of imports to the pass-through of other trade barriers.

3.1. Data.

The primary source of our data is the dataset contains monthly data on the US imports available from US census. These data are available at 10-digit level of product disaggregation (the finest publically available from the US Census) for all exporters worldwide. The dataset includes information on total value of imported goods, total quantity of imported goods and the name of the units, the amount of import duties paid[15], and the "import charge" which we use to measure shipping cost. For this study, we use the data from April 1990 to September 2002.

We also use the information on bilateral exchange rates from the COMPUSTAT data base. We use average monthly exchange rates.[16] In the cases where multiple currencies existed during the sample period we kept the one with the longest coverage. This applies to Romania, Turkey, Brazil, Ghana and the countries that joined the European Monetary Union during our sample period and had their exchange rates to the US dollar quoted in euro.

Finally, the information about the anti-dumping duties comes from the Temporary Trade Barrier Database (Bown, 2010). We use dates of the final duty determination to determine the month in which the anti-dumping duty was applied. We also referenced the product file that lists HS product codes at 8 or 10-digit level of disaggregation. The cases that report only 6 digit products were omitted from our analysis.

In order to control for the industry cost and demand shocks we use monthly time series on shipment values by the US manufacturers, monthly producer price index (PPI), imports price index (IPI), and exports price index (EPI). Domestic shipments and the PPI are available at 3-digit level of NAICS. EPI and IPI are available at 2- or 4-digit level of the harmonized system. We used concordance between harmonized system US import product codes and NAICS used in Feenstra's trade database.

[15] The import duties are based on the tariff schedule and do not include AD duties or countervailing duties.
[16] Our results are robust to using the end of month rates.

3.2. Construction of the data set.

We start by selecting anti-dumping investigations with affirmative decisions. The anti-dumping cases are identified by the product and by the exporting country. We adopt this use of the word "case."[17]

For each country-case combination we perform the following steps. First, we match the country-case information (i.e. duty, initiation and determination dates, number of foreign petitioners) to the US imports in all goods that belong to the same HS 6-digit categories as the goods listed in the anti-dumping case, from all exporters. This way we have the broadest comparison group, even though not all of these observations are used in estimation. Second, we identify[18] case-related observations as those that refer to import in a category that is subject of an anti-dumping investigation and from a country that is listed in the country-case. Third, identify the window of analysis. In this step we decide how many months before and after the investigation are included in the regression.

In order to focus on the immediate impact of the trade barriers, we further condition the sample in the following way. First, cases that were initiated before the beginning of our sample period and those where the final determinations took place after the end of our sample period are excluded from consideration. Second, we keep a minimum of a two-year (24 month) window on each side of the case[19]. In other words, we keep only those cases that were initiated at least two years after the first month available in our trade data and completed at least two years prior to the last month of our trade data. For comparison, Blonigen and Haynes (2002) use 1989-1995 monthly data, which amounts to 7x12=84 observations. We restrict the observation window to reduce the overlapping effect of duties and to even out the "before" and "after" time periods across the anti-dumping cases.

3.3. Comparison group

In order to identify the effect of anti-dumping duty we need to compare imports of case-related categories to some comparison group. This comparison group is important for tracing out changes in prices that can be attributed to the demand and supply shocks. The comparison group can consist of the US imports of other products within the same HS 6-digit category from the same country as well as from the imports of the same HS 8-digit category from all countries worldwide. We refer to the comparison group that contains only HS 6-digit categories from the same country as the "narrow" comparison group and to the one that also includes imports from all other countries as the "broad" comparison group.

[17] This is an important clarification because there is also a way to identify cases that were initiated at the same time but we do not use this information.

[18] Identifying is listed as a separate step because this is where we perform the robustness check. The window can be identified in different ways.

[19] We verify robustness of our findings to various window length as well as to removing window restriction.

3.4. Construction of variables

Our main dependent variable is the unit price of imports. It is calculated as the value of imports of good g from the exporting country e during month m (including corresponding import duty and import charge) divided by the corresponding quantity:

$$p_{egm} = \frac{VAL_{egm} + DUTY_{egm} + CHA_{egm}}{Q_{egm}}. \tag{19}$$

In the US imports data, the units of trade volume measurement vary. We use kilograms and count of items, where available, as our measure of units. The quantity of the original data is classified according to several different units. If the same product is measured in different units we do not concord those units and treat product-unit combinations as unique products.

In Bown (2010), the final anti-dumping duty is reported in percentages, e.g., 25.3. In the cases when there are qualifications and explanations in brackets after the reported anti-dumping duty, we applied the duty to the entire category. We use the reported duty as if there were no explanations but also mark those cases for robustness check. The anti-dumping duty variable is defined as

$$\tau^{AD}_{cegm} = \begin{cases} 1 + AD_{cegm}/100, & \text{if } m > m^F \\ 0, & \text{otherwise} \end{cases}, \tag{20}$$

where m^F is the month of final duty determination.

The other bilateral costs shifters are tariff, exchange rate, and freight charge. To calculate tariff we divided the calculated the amount of import duty and by the import value and expressed it in ad valorem terms similar to the anti-dumping duty:

$$\tau^{TAR}_{egm} = 1 + \frac{DUTY_{egm}}{VAL_{egm}}. \tag{21}$$

To calculate the per-unit shipping cost we divided the total amount of import charge by the imported quantity,

$$f_{egm} = \frac{CHA_{egm}}{Q_{egm}}. \tag{22}$$

The shipping cost variable differs from the other trade barrier because it is not expressed in the ad valorem terms. This is because the shipping cost is not necessarily proportional to the value of the shipped goods. Prior literature provides evidence that the shipping cost is not iceberg. Therefore, if expressed relative to the value, i.e. as a percentage of price, the shipping cost is would increase when the price decreases. Such negative relation between the shipping cost and the price would not reflect pass-through but rather the nature of the shipping costs.

Estimation of path-through requires that we control for other price determinants. Such controls need to vary by month and match to match the extensive industry coverage of our dataset. To this end we use monthly non-seasonally adjusted Producer Price Index (PPI) to control for the changes in the prices of US substitutes. These are taken from the PPI program of census. Some of the output is exported and therefore we control for the Exports Price Index (EPI). The Imports Price Index (IPI) is used to capture overall changes in the prices of the US imports. IPI could vary due to changes in the costs and composition of the foreign producers. Exporter-specific costs are harder to measure because to do so we would need monthly costs measures or industry-level producer price indices for multiple countries. We also use shipments by the US producers to control for shifts in the availability of domestic alternatives.

3.5. Pass-through specification

We estimate the following equation using fixed-effects estimator, where the fixed effects are defined by as a unique case-exporter-product combination.

$$\begin{aligned}\ln p_{cegm} = {} & \beta_1^1 \ln \tau_{cegm}^{AD} + \beta_2^1 I_{cegm} \ln \tau_{cegm}^{AD} + \beta_3^1 \tau_{egm}^{TAR} + \beta_4^1 \ln E_{em} + \beta_5^1 \ln f_{cegm} \\ & + \beta_6^1 PPI_{gm} + \beta_7^1 \ln IPI_{gm} + \beta_8^1 \ln EPI_{gm} + \beta_9^1 \ln DS_{gm} + \beta_{ceg}^1 + \varepsilon_{cegm}^1 \end{aligned}, \tag{23}$$

where τ_{cegm}^{AD} is the ad valorem equivalent of the anti-dumping duty, τ_{cegm}^{TAR} is the actual ad valorem tariff rate, E_{em} is the exchange rate, f_{cegm} is the unit shipping cost, PPI_{gm} is the monthly producer price index, EPI_{gm} is the monthly exports price index, IPI_{gm} is the monthly imports price index[20], DS_{gm} is the domestic supply measured as the value of monthly shipments by the US producers and by NAICS industry, β_{ceg}^1 is the case-exporter-good fixed effect, I_{cegt} is the indicator that a given case-exporter-product-month observation is not explicitly listed in the case. Index c on I_{cegt} indicates that the exporter-product-month observation is related to case c. Interaction between this dummy and the size of the anti-dumping duty captures the effect the duty on the prices of imports other than the product category under consideration. Indexing variables by the case is important because imports of the same product in a given month are potentially be related to several anti-dumping cases.

The freight rate is assumed to satisfy the exclusion restriction as in Khandelwal (2010). This assumption is justified because all of our specifications include case-exporter-product fixed effects. Standard errors are calculated allowing for clustering of the error terms by the exporter. This makes our standard errors robust to heteroskedasticity and the possible correlation of the error terms within exporter

[20] The detailed information about the calculation of the imports and exports price indices can be found in Chapter 15 of the BLS Handbook of Methods available at http://www.bls.gov/opub/hom/pdf/homch15.pdf.

across products, as well as the possible correlation of the error terms across periods within exporter across, within and across goods.

The results of the estimation are presented in Table 1. The anti-dumping pass-through is about 0.2 indicating that a 10% increase in the ad valorem equivalent of an anti-dumping duty increases the price of imports by about 2% in the short run. The effect of tariff varies but is not statistically significant. The cost of shipping has a robust effect on the delivered price. A 10% increase in the unit shipping cost increases the price of imports by about 2.5%. Not surprisingly the short-run pass-through of the exchange rates is weak. The coefficients on the price indices are difficult to interpret because the indices are strongly correlated. When included into regression separately,[21] each of the price indices is statistically significant and positive. The effect of the monthly shipments on the prices is negative indicating that an increase in shipments suppresses the prices of imports even after controlling for the price indices.

Proper control for the changes in the market conditions is crucial for the estimation of the pass-through. In order to make sure that the insignificance of the price indices can be attributed to the correlation among them, we construct the first principal component of the three indices.

$$\begin{aligned}\ln p_{cegt} &= \beta_1^2 \ln \tau_{cegm}^{AD} + \beta_2^2 I_{cegm} \ln \tau_{cegm}^{AD} + \beta_3^2 \tau_{egm}^{TAR} + \beta_4^2 \ln f_{cegm} + \beta_5^2 \ln E_{em} \\ &+ \beta_6^2 PI_{gm}^{PCA} + \beta_7^2 \ln DS_{gm} + \beta_{ceg}^2 + \varepsilon_{cegm}^2\end{aligned} \quad . \tag{24}$$

The results of the estimation are presented in Table 2. The effect of the combined price index is positive, statistically significant, and robust. The magnitude of the coefficient is not meaningful because the combined price index combines logarithms of the three price indices.

The exporter-product-case fixed effects capture the effect of persistent differences in cost factors specific to countries and goods. They do not however capture time-varying but exporter-specific cost shifters such as changes in wages, cost of capital. In order to capture those we estimate set of specifications with the exporter-month fixed effects.

$$\begin{aligned}\ln p_{cegt} &= \beta_1^3 \ln \tau_{cegm}^{AD} + \beta_2^3 I_{cegm} \ln \tau_{cegm}^{AD} + \beta_3^3 \tau_{egm}^{TAR} + \beta_4^3 \ln f_{cegm} \\ &+ \beta_5^3 PI_{gm}^{PCA} + \beta_6^3 \ln DS_{gm} + \beta_{ceg}^3 + \beta_{em}^3 + \varepsilon_{cegm}^3\end{aligned} \tag{25}$$

The results of the estimation are presented in Table 3. Introducing exporter-month fixed effects does not alter our main results. The pattern of difference between AD duty and the other trade barriers is robust to the inclusion of these fixed effects. This suggests that the exporter-product factors captured by the fixed effects along with the time-varying indices capture the effect of the changes in the exporter prices on the prices of the US imports.

[21] Those results are not reported here for brevity and are available upon request.

4. Conclusion

Anti-dumping duties have been singled out as an effective and therefore extremely harmful trade barrier. An important channel for the negative welfare effect works through the change in the prices of imports. See for example Blonigen et al. (1999). This paper contributes to the literature by directly evaluating the pass-through of various trade barriers on import prices. We find that anti-dumping duties affect import prices more than tariffs or exchange rates. This implies that anti-dumping measures are much more effective in raising price of the imported goods in a country and profits of domestic companies (if that is the goal of a domestic protectionist policy). This may explain their prominence among trade policies used presently.

Our pass-through coefficients are different from Blonigen and Hayes (2002) most likely due to the fact that we use a sample that includes multiple goods and countries. The difference does however suggest that the pass-through is possibly heterogeneous across products or exporters. We leave evaluation of the pass-through heterogeneity to future research.

Our theoretical and empirical findings confirm the well-established result that the pass-through of tariffs and costs (including the exchange rates) is incomplete. In fact, in our case it is not significantly different from zero.

Our theoretical model suggests that the analysis of import tariffs cannot be automatically applied to anti-dumping duties. This calls for a new, detailed set of models that carefully examine the effects of that policy and the incentives it creates for various parties involved.

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Table 1. Pass-through of AD duties and other trade barriers

Comparison group Min case obs	Narrow NA	Narrow 18	Narrow NA	Narrow 18	Broad NA	Broad 18	Broad NA	Broad 18
AD duty	0.179	0.205	0.222	0.242	0.200	0.190	0.208	0.203
	(0.068)*	(0.088)*	(0.080)*	(0.092)*	(0.084)*	(0.089)*	(0.088)*	(0.094)*
Related AD duty			0.008	-0.076			0.012	0.027
			(0.174)	(0.135)			(0.040)	(0.049)
Tariff	-0.827	-0.680	0.741	1.071	-0.246	-0.283	-0.036	0.045
	(0.943)	(1.093)	(0.437)	(0.578)	(0.505)	(0.457)	(0.471)	(0.386)
Shipping cost	0.319	0.267	0.308	0.250	0.255	0.216	0.257	0.215
	(0.036)**	(0.037)**	(0.033)**	(0.035)**	(0.037)**	(0.044)**	(0.037)**	(0.044)**
Exchange rate	0.010	0.016	0.010	0.014	0.012	0.019	0.009	0.016
	(0.004)*	(0.007)*	(0.004)*	(0.005)*	(0.004)**	(0.007)**	(0.004)	(0.008)
Producer PI	-0.010	-0.005	-0.378	-0.537	0.145	0.124	0.050	-0.064
	(0.442)	(0.509)	(0.321)	(0.251)*	(0.174)	(0.207)	(0.166)	(0.200)
Exports PI	0.312	0.531	0.132	0.293	0.171	0.192	0.177	0.205
	(0.224)	(0.234)*	(0.136)	(0.159)	(0.133)	(0.155)	(0.144)	(0.166)
Imports PI	0.684	0.467	1.034	0.945	0.858	0.839	0.898	0.923
	(0.425)	(0.516)	(0.399)*	(0.455)	(0.209)**	(0.269)**	(0.218)**	(0.283)**
Domestic supply	-0.116	-0.152	-0.096	-0.127	-0.089	-0.090	-0.092	-0.095
	(0.038)**	(0.050)**	(0.044)*	(0.042)**	(0.049)	(0.055)	(0.051)	(0.058)
R^2	0.26	0.20	0.26	0.20	0.22	0.18	0.22	0.18
N.obs	20,082	14,849	19,871	14,652	166,340	96,539	163,587	93,702
N.case	24	21	24	20	24	21	24	20
N.exporter-case	77	63	77	61	78	64	78	61
N.exporter-case-good	1245	477	1233	469	17415	3166	17259	3059

Notes: All variables in logs. All specifications include case-exporter-product fixed effects. Standard errors in brackets are clustered by exporter.

Table 2. Pass-through of AD duties and other trade barriers (combined price index).

Comparison group Min case obs	Narrow NA	Narrow 18	Narrow NA	Narrow 18	Broad NA	Broad 18	Broad NA	Broad 18
AD duty	0.176	0.184	0.226	0.237	0.204	0.195	0.213	0.207
	(0.075)*	(0.089)	(0.081)*	(0.087)*	(0.088)*	(0.091)*	(0.092)*	(0.095)*
Related AD duty			0.006	-0.085			0.021	0.034
			(0.177)	(0.132)			(0.040)	(0.046)
Tariff	-0.736	-0.332	0.552	1.099	-0.495	-0.493	-0.249	-0.145
	(0.840)	(0.985)	(0.466)	(0.578)	(0.537)	(0.479)	(0.489)	(0.428)
Shipping cost	0.319	0.267	0.308	0.250	0.255	0.216	0.257	0.215
	(0.036)**	(0.037)**	(0.033)**	(0.035)**	(0.037)**	(0.043)**	(0.037)**	(0.044)**
Exchange rate	0.010	0.016	0.009	0.013	0.011	0.018	0.008	0.014
	(0.004)*	(0.007)*	(0.004)*	(0.005)*	(0.004)**	(0.007)*	(0.005)	(0.008)
Combined price index	0.043	0.044	0.038	0.038	0.049	0.049	0.048	0.048
	(0.010)**	(0.013)**	(0.010)**	(0.013)**	(0.009)**	(0.010)**	(0.009)**	(0.011)**
Domestic supply	-0.121	-0.133	-0.128	-0.145	-0.107	-0.107	-0.109	-0.113
	(0.033)**	(0.044)**	(0.034)**	(0.043)**	(0.052)*	(0.058)	(0.054)*	(0.062)
R^2	0.26	0.20	0.26	0.20	0.22	0.18	0.22	0.18
N. obs	20,082	14,849	19,871	14,652	166,340	96,539	163,587	93,702
N.case	24	21	24	20	24	21	24	20
N.exporter-case	77	63	77	61	78	64	78	61
N.exporter-case-good	1245	477	1233	469	17415	3166	17259	3059

Notes: All variables in logs. All specifications include case-exporter-product fixed effects. Standard errors in brackets are clustered by exporter.

Table 3. Pass-through of AD duties and other trade barriers (exporter-month FE).

Comparison group Min case obs	Narrow NA	Narrow 18	Narrow NA	Narrow 18	Broad NA	Broad 18	Broad NA	Broad 18
AD duty	0.176	0.184	0.226	0.237	0.204	0.195	0.213	0.207
	(0.075)*	(0.089)	(0.081)*	(0.087)*	(0.088)*	(0.091)*	(0.092)*	(0.095)*
Related AD duty			0.006	-0.085			0.021	0.034
			(0.177)	(0.132)			(0.040)	(0.046)
Tariff	-0.736	-0.332	0.552	1.099	-0.495	-0.493	-0.249	-0.145
	(0.840)	(0.985)	(0.466)	(0.578)	(0.537)	(0.479)	(0.489)	(0.428)
Shipping cost	0.319	0.267	0.308	0.250	0.255	0.216	0.257	0.215
	(0.036)**	(0.037)**	(0.033)**	(0.035)**	(0.037)**	(0.043)**	(0.037)**	(0.044)**
Exchange rate	0.010	0.016	0.009	0.013	0.011	0.018	0.008	0.014
	(0.004)*	(0.007)*	(0.004)*	(0.005)*	(0.004)**	(0.007)*	(0.005)	(0.008)
Combined price index	0.043	0.044	0.038	0.038	0.049	0.049	0.048	0.048
	(0.010)**	(0.013)**	(0.010)**	(0.013)**	(0.009)**	(0.010)**	(0.009)**	(0.011)**
Domestic supply	-0.121	-0.133	-0.128	-0.145	-0.107	-0.107	-0.109	-0.113
	(0.033)**	(0.044)**	(0.034)**	(0.043)**	(0.052)*	(0.058)	(0.054)*	(0.062)
R^2	0.26	0.20	0.26	0.20	0.22	0.18	0.22	0.18
N. obs	20,082	14,849	19,871	14,652	166,340	96,539	163,587	93,702
N.case	24	21	24	20	24	21	24	20
N.exporter-case	77	63	77	61	78	64	78	61
N.exporter-case-good	1245	477	1233	469	17415	3166	17259	3059

Notes: All variables in logs. All specifications include case-exporter-product fixed effects. Standard errors in brackets are clustered by exporter. All specification include exporter-month fixed effects.