Multi-product Exporters and Antidumping: Evidence from China*

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Abstract

I investigate how Chinese exporters respond to market-specific tariff shocks that arise from US antidumping measures. Using Chinese customs data between 2000 and 2006, I find strong evidence that antidumping measures severely distort bilateral trade flows between China and the US. I also provide evidence that the US import restrictions lead to a reduction in Chinese exports to alternative markets. I then investigate the underlying mechanism at the firm level. I document that Chinese firms that were hit with antidumping measures are less likely to export the targeted products not only to the US but also to alternative markets. More importantly, antidumping measures are associated with spillovers across products within firms. That is, multi-product firms tend to switch exports to other unaffected products in alternative markets.

Keywords: Antidumping; Difference-in-Difference; Trade Destruction; Trade Deflection; Product Switching

JEL Classifications: F12; F13;

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1 Introduction

Despite the growing trend of trade liberalization, the use of temporary trade barriers, such as antidumping and countervailing duties, and safeguards, is on the rise (see Blonigen and Prusa, 2016). Antidumping measures are particularly important as they are among the most intensively used forms of trade restrictions.[1] An importing country can levy duties on a trade partner if imported products are *dumped and causing injury to domestic import-competing industries* (WTO Antidumping Agreement, Article 3). Specifically, dumping refers to the practice of exporting a product at a price that is lower than the price usually charged in its home market or less than its production cost. The proliferation of antidumping measures has stimulated the research to evaluate their effects on protected products, firms, and industries.

While the literature has gained significant insights on the effects of antidumping measures on the protected import-competing firms,[2] a much scarcer literature looks at the corresponding effects on the affected foreign counterparts. How do antidumping measures halt trade flows? Do these import restrictions shift exports to alternative markets? In particular, how do the affected firms respond to these market-specific tariff shocks? Do they deflect the targeted products to third countries or switch to other similar or related products? Do these measures have spillover effects that go beyond the affected products? Despite their importance for firm performance, the way these trade restrictions shape the export activities across products within firms remains poorly understood. In this paper, I attempt to fill these gaps by exploring the effects of US antidumping measures on the export behavior of Chinese firms. The analysis of how targeted firms respond to such trade restrictions could give us the story from the flip side of the coin and complete the picture of the effectiveness of antidumping measures.

China serves as a suitable country for this analysis for several reasons. First, China is one of the countries most targeted by antidumping investigations, and the US is the leading initiator. This is possibly due to the fact that the US has an increasing trade deficit with China, and its loss of manufacturing employment (see Pierce and Schott, 2012; David et al., 2013). For example, China made up 20% of the US antidumping caseload between 2000

[1]For example, according to WTO notifications, between 1995 and 2010 a total of 2503 anti-dumping measures were imposed worldwide, while in the same period safeguards and countervailing duties accounted for only 101 and 158 measures, respectively.

[2]This includes Konings and Vandenbussche (2005, 2008, 2013); Pierce (2011).

and 2006.[3] Second, the US is a major trade partner with China, and it is one of the most important markets for Chinese exporters. For firms that have exported to the US during 2000 to 2006, 25% of their total export value was shipped to the US. This means that a substantial amount of trade could potentially be shifted to third markets upon the imposition of US trade restrictions. Third, there is a wealth of available data pertaining to Chinese firms covering a substantial period replete with antidumping practices, which makes China an exceptional case for identifying the impact of antidumping measures on firms.

The objective of this paper is to explore the patterns of export adjustments to antidumping shocks among firms. To do so, I employ a difference-in-difference (DID) approach. Specifically, my identification strategy is based on the comparison of outcome variables (such as participation, the number of exporters, export value, volume, and price) for firms exporting the affected products, compared to firms that do not. That is, my treatment group consists of products that are under investigations and subject to antidumping duties (*targeted* products). The control group includes all uninvestigated products within the 4-digit HS[4] product category to which the affected products belong (*closely-related* products).

I first examine the overall responses at the product level. Using detailed Chinese customs data between 2000 and 2006, I find strong evidence that US antidumping measures severely distort bilateral trade flows between these two countries. Specifically, antidumping-punished products experience a drastic fall by somewhere between 50% and 85% in export flows. Additionally, there is a significant adverse effect on the extensive margin. That is, antidumping measures not only discourage existing exporters from shipping to the US, but also lead to a sharp decrease in the number of exporters. I then estimate the impact of US antidumping measures on Chinese exports to non-US markets. I provide some evidence that the US import restrictions result in a decline in Chinese exports of punished products to alternative markets. One implication derived from this result is that antidumping has negative externalities on trade beyond the offending country. It is associated with collateral damage that spreads to third markets.

Next, I look at export adjustments at the firm level to deepen my analysis of how firms react to these restrictions. We lack empirical evidence of how exporting firms behave when faced with such export restrictions. The existing literature does not inform us whether the

[3]The US initiated a total of 247 antidumping investigations worldwide between 2000 and 2006, in which 48 caseloads were against China.

[4]HS refers to the Harmonized System, which is an internationally standardized system of names and numbers to classify traded products.

affected exporters stop shipping or reduce exports to the policy-imposing country. Also, it does not tell us whether and how exporting firms adjust their exports across destinations.

To this end, I study how firms' specific patterns of trade are affected by this particular form of trade restriction. Specifically, I look at changes in firms' behavior when confronted with regulatory barriers concerning participation in the export markets, values, quantities of exports, and pricing strategy. As antidumping measures in general take form of ad valorem tariffs, they can be thought of as variable export costs for firms. Assuming the existence of a cost of entry in a certain market, recent trade models (e.g. Melitz, 2003) predict that only the most productive firms in the industry will continue to export after an increase in such costs. Therefore, the imposition of import restrictions could affect both the probability of entering a foreign market (extensive margin) and the associated export flows (intensive margin). My results show that antidumping measures not only reduce existing trade flows but also decrease export participation at the firm-product level.

I then turn to the question of whether the imposition of contingency tariffs on products, impact the trade of affected firms to *other* markets. To answer this question, I estimate the export patterns of *targeted* products into *other* markets of firms that were hit by the tariffs, compared to firms that export the same products to the same destination but not punished by the measures. I find that Chinese firms exposed to the disruption of the US market are less likely to export the *targeted* products to alternative markets. There is also a little evidence that firms adjust their export flows to third markets. These findings imply that antidumping measures may have a deterrent effect which spreads to other destinations within firms.

A significant and novel contribution of this paper is that I study the extent to which a tariff shock from the US influences firms' export participation, value, volume, and prices for other untargeted products across markets. I first investigate whether firms switch exports to other products in the US. I find that firms exposed to the US trade shocks reduce their export flows of other uninvestigated products to the US. This finding suggests that an increase in export costs in one market leads firms to cut all exports to that market due to economies of scale. In other words, antidumping creates negative externalities that go beyond the *targeted* products.

I next discuss how the US antidumping measures generate spillovers across products within firms in alternative markets. I find that an export cost increase in the US induce a rise in trade flows in alternative markets, but it hurts export participation. In other words, antidumping causes trade relationship to fail, but multi-product firms tend to switch exports to other

unaffected products in alternative markets. These findings indicate that existing exporters reallocate their products across destinations following trade restrictions. More importantly, the imposition of antidumping duty by the US for one product not only leads firms less likely to export the *targeted* products into *other* markets, but also associated with a decline of entry of other *closely-related* products into *other* markets. That is, an increase in trade policy uncertainty negatively impacts firms' export decision to enter the third country. To this end, I assess how the relative changes in trade costs in one market shape firms' export pattern in *other* markets.

These results are relevant for policy. One implication derived from the current set of results is that antidumping measures have a deterrent effect on the export behavior of affected exporters, improving our understanding of the breadth and extent of such measures. This study also provides new insights into the roles that contingent protection has played in supporting trade liberalization.

This research advances the current literature in three ways. First, my analysis builds on a small but growing literature documenting the effects of antidumping measures on firms from targeted countries. Lu et al. (2013) use monthly data on Chinese exports from 2000 to 2006 and find that there is a substantial negative effect of US antidumping protections on export volumes. Similarly, Chandra and Long (2013) document that the imposition of US antidumping duties decrease both Chinese firms' labor productivity and total factor productivity. My paper differs from prior studies in that I focus on within-firm adjustments. In light of the increasingly heavy use of antidumping measures, my estimates of these microeconomic effects are valuable additions to the current evaluation of such policies.

Secondly, my study sheds light on the literature of how trade policy uncertainty affects firms' export decision (i.e., the extensive margin). My main result is that a tariff hike for one product in the US market is associated with a decline of the export likelihood of the *closely-related* products in *other* market from the same *punished* firm. Debaere and Mostashari (2010), for example, provide evidence that extensive margin responses to US tariff policy changes had an effect on overall US imports from that country. The reallocation effects that I observe also complement the findings in Crowley et al. (2016). They reveal that the use of antidumping measures in one market leads to a decline in entry both for the *targeted* and the *closely-related* products in that market.

Finally, my paper contributes to the literature that seeks to understand how changes in export costs have influenced within-firm adjustments across products and destinations. The

relevance of this issue is highlighted in the work of Goldberg et al. (2010); Berthou and Fontagné (2013); Bernard et al. (2014), all of which show how a permanent reduction in trade costs affect the export margins of firms in relation to export decisions, the number of product exported, and the average sales per product. My paper complements their work by looking at how a temporary increase in trade barriers changes in firm export behavior.

The remainder of the paper is organized as follows. The next section provides a brief summary of the antidumping investigation process in the US. Section 3 describes the data used in the empirical analysis. Section 4 defines the treatment and control groups, as well as a description of the estimation strategy. Section 5 presents the empirical findings. Section 6 concludes.

2 The US Antidumping Procedures

In this section, I provide a brief overview of how an antidumping investigation in the US is carried out and describe the possible outcomes. The flow chart of the US antidumping proceedings is presented in Figure 8 in the Appendix.

To initiate an antidumping investigation, an interested party (e.g. domestic firms and/or labor unions) must file a petition and submit it to the relevant government agencies: the Department of Commerce (DoC) and the International Trade Commission (ITC). The petition contains two pieces of essential information for my study. First, it must specify the exact product that is alleged to have been dumped in the US. The product is defined at the US 8- or 10-digit HS level.[5] Second, the petition has to indicate which country(-ies) is(are) allegedly dumping. Only the countries named in the petition are subject to the investigation.

Within 20 days after the date on which the petition is filed, the DoC determines whether the petition is affirmative. If so, the investigation proceeds on a statutory timeline, with the DoC determining whether the product in question was sold at less than fair value (LTFV) and the ITC determining whether domestic firms suffered a material injury.

Within 45 days after the date of the filing of the petition, the ITC makes a preliminary determination on whether the domestic industry is suffering (or is threatened by) material injury. A negative preliminary decision would end the proceeding. With the affirmative pre-

[5] At the international level, the HS for classifying goods is a 6-digit code system. A code with a low number of digits defines broad categories of products; additional digits indicate sub-divisions into more detailed definitions. Countries can add more digits for their own coding to subdivide the definitions further according to their own needs.

liminary ITC determination, the DoC makes a preliminary duty determination within the next 115 days, of whether the product named in the petition is sold at LTFV. If the DoC preliminary determination is affirmative, a preliminary duty is imposed from this time onwards. With a negative determination, the DoC nevertheless continues to conduct the investigation, although the preliminary duty is not imposed. The DoC makes a final determination of whether the subject imported merchandise is being sold or is likely to be sold at LTFV within 75 days of its preliminary decision.

If the DoC final determination is negative, the investigation is terminated. Otherwise, the ITC has 45 (or 75) days to conduct the final phase of investigation and make a determination. Once both the DoC and the ITC reach affirmative final determinations, the DoC issues an antidumping order to levy final antidumping duties within seven days. Once imposed, the antidumping duty can be in place for a maximum of five years, except if extended (always by sequences of a maximum of five years) through reviews because of evidence of continuing dumping and injury.

Antidumping measures usually take the form of an ad valorem duty, but could also be a specific duty, a price/quantity undertaking, or a combination of these. In either case, the measures are not only country-industry-wide duty but also firm-specific. That is, relevant US administrative agencies often calculate separate duties for individual companies that are responsible for the largest share of the investigated product. The remaining firms exporting the *targeted* product are subject to an industry-wide antidumping duty. As the US classifies China as a nonmarket economy (NME), Chinese domestic prices are considered unreliable, so a surrogate country is used to calculate the antidumping duty. In practice, firm-specific duties are substantially lower than the industry-wide one (see Figure 9 in the Appendix).

The overall investigation process for antidumping cases can be divided into three stages: (1) the initiation phase, (2) the preliminary duty phase, and (3) the final duty phase. The initiation phase refers to the period from initiation until any preliminary duty is levied. The preliminary duty phase starts from when the US importers have to pay the preliminary antidumping duty until the end of the investigation. During this stage, the investigation can be withdrawn by the petitioner(s) or suspended if an agreement is reached between the affected foreign exporters and the DoC. The final duty phase begins on the date that the final antidumping duty is imposed and continues until the date the antidumping order is revoked. Antidumping investigations usually are concluded within one year (except in special circumstances when the investigation may last up to 18 months).

3 Data

I employ data from the following sources: the Global Antidumping Database (Bown, 2015) and Chinese customs data between 2000 and 2006.[6]

The antidumping data come from the Global Antidumping Database (GAD) of the world bank. They cover all antidumping cases by all user countries in the world, with each investigation mapped to the targeted HS codes from 1980 to 2014. For each antidumping case, the GAD includes detailed product information (classified at the 10-digit HS level), the initiation date, the preliminary and final determination dates and decisions, along with the final remedy. I focus on all the antidumping proceedings carried out by the US against China between 2000 and 2006. I aggregate these products from the 10-digit to the 6-digit HS level.

The Chinese firms' cross-border transaction-level data are obtained from China's General Administration of Customs. It records monthly import and export transactions of all Chinese firms with universal trading partners from 2000 to 2006. Each trade is recorded at the Chinese 8-digit HS level[7] with a quantity, a value, and a unit value as the ratio of the shipment value to quantity. Quantity is measured by one of twelve different units of measurement (such as kilograms, square meters, *et cetera*). Value and unit value are in current US dollar.

I aggregate the monthly customs data to the annual level to avoid the seasonality and lumpiness typical of monthly data. More importantly, most firms do not export a given product to a given market in every month. I also aggregate export products from the 8-digit to the 6-digit HS level.[8] I then match Chinese transaction-level data with US antidumping investigations against China, at the 6-digit HS level. It is the most disaggregated product category that is internationally comparable.

There are a total of 47 US antidumping cases against China between 2000 and 2006, which cover 147 unique products at the 6-digit HS level. Among the investigated products, 77 products ended up with affirmative final determinations and antidumping duties were imposed on them. In addition, 49 products had affirmative preliminary ITC determinations but received negative final ITC determinations; 2 products were withdrawn before the final ITC determination. The rest of the 15 products either withdrew or were given negative

[6]I thank Nankai University for providing the data.

[7]The number of distinct product codes in the Chinese 8-digit HS classification is comparable to that in the 10-digit HS trade data for the US (Manova and Yu, 2016).

[8]The HS codes underwent a major revision in 2002, I adopt the 6-digit HS 1996 codes maintained by the World Customs Organization and use the conversion table from UN Comtrade to convert the HS 2002 codes into the HS 1996 codes, to ensure the consistency of the product categorization over time (2000-2006).

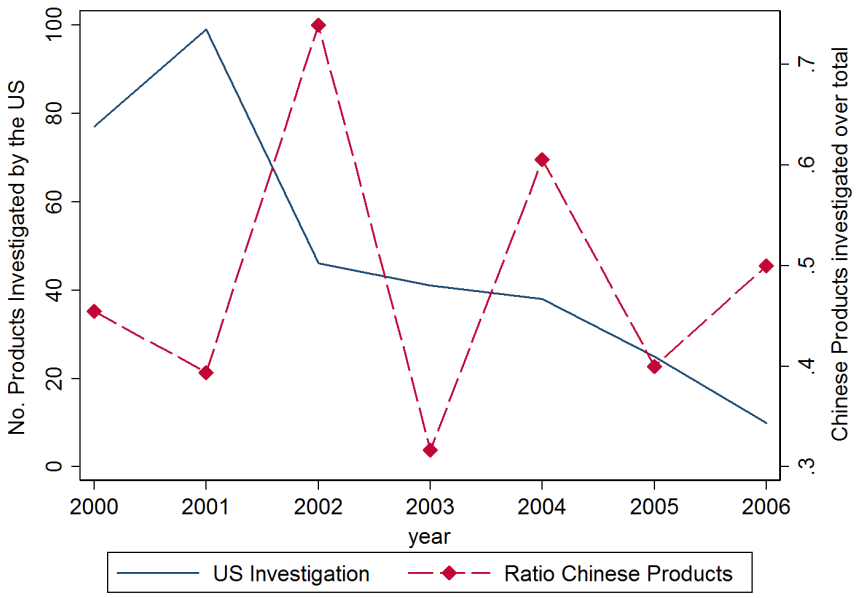

Figure 1: US antidumping investigations against China and the rest of world

Note: Elaboration based on the World Bank Global Antidumping Database from 2000 to 2006. Considering all antidumping investigations launched by the US against third-countries products. The share of Chinese products measured as the ratio between number of US investigations against Chinese products and the total number of US antidumping proceedings against third-countries imports.

decisions at the preliminary ITC stage. Figure 1 shows that the number of products are investigated for dumping by the US has decreased over time. However, the ratio of Chinese products which have been investigated products is consistently high. Table 8, in the Appendix, lists the antidumping cases and related products that are covered in this paper. Figure 10, in the Appendix, illustrates the number of US antidumping initiations against China by year and the ratio of affirmative decisions.

The matched panel data from 2000 to 2006 contain 3,953 product-year-destination level observations and 1,213,138 firm-product-year-destination level observations. This level of disaggregation allows me to study within-firm adjustments at both the extensive and intensive margins of trade. I have 343 products at the 6-digit HS level in the matched data, with 77 of these products are subject to antidumping duties.

4 The Empirical Framework

I proceed with the empirical analysis in two steps. First, I estimate the trade effects of the US antidumping measures at the product level. Second, to gain a better understanding of the mechanisms driving at the product level, I investigate how these import restrictions

shape firms' export patterns.

Following Lu et al. (2013), I define the treatment group as the products that are under investigation and subject to antidumping duties (referred as *targeted* products). Each product in the treatment group is assigned a date of treatment and an ad valorem duty. The control group contains all uninvestigated products within the 4-digit HS product category to which the *targeted* products belong (referred as *closely-related* products). This procedure, therefore, constructs a set of control products that are similar to the treated products.

4.1 Product-level Framework

To evaluate the effects of antidumping measures on Chinese products, I follow Autor (2003) and pursue a difference-in-difference (DID) approach. I compare the export patterns of *targeted* versus *closely-related* products by the following equation:

$$y_{pt} = \gamma_t + \delta_p + \beta_{-4} D_{p,t+\tau(\tau<=-4)} + \sum_{\tau=-3,\tau\neq-1}^{3} \beta_\tau D_{p,t+\tau} + \beta_4 D_{p,t+\tau(\tau>=4)} + \varepsilon_{pt}, \tag{1}$$

where subscripts p and t indicate the 6-digit HS product category and year respectively. I assume that the world consists of the United States (US) and the Rest of the World (RoW). My dependent variables are: (i) a dummy variable taking a value of 1 for a product p that has positive trade flows into a certain destination market in year t (0 otherwise)[9], reflecting export participation; (ii) the number of exporters in each product-year combination in the US and the RoW; These two regressions estimate the effect of antidumping measures at the extensive margin. (iii) the products' export values and quantities (in logs) to the US and the RoW. These regressions are used to capture the intensive margin of trade;[10] and (iv) the log of export prices, proxied by unit export values (the ratio of export value to quantity).

Despite the dichotomous nature of some of my dependent variables, I estimate equation (1) via ordinary least squares (OLS). I also include year fixed effects, γ_t, which control for overall trends and aggregate shocks that may affect all products. The 6-digit HS product fixed effects, δ_p, capture time-invariant product characteristics. The treatment variables $D_{p,t+\tau}$ take value of one for product p in year t if we are exactly τ periods relative to the start of antidumping investigation for product p. The treatment year is defined as the year in which the investigation is initiated. Therefore, instead of a single treatment effect, I have included

[9]If we observe positive trade flows of a product p into a certain destination in year t but no export thereafter, we keep the zero observations in year $t-1$ and $t+1$.

[10]The dependent variables in these regressions include only positive trade values.

3 anticipatory effects (β_{-4}, β_{-3}, β_{-2}) and 5 post-treatment effects (β_0, β_1, β_2, β_3, β_4). Of these 8 indicator variables, the indicator variable $D_{p,t+\tau(\tau<=-4)}$ is equal to one in each year, starting with the 4^{th} year before the investigation, while $D_{p,t+\tau(\tau>=4)}$ is equal to one in each year, starting with the 4^{th} year after the investigation. The remaining indicator variables are equal to one only in the relevant year.

The base year is the year before the investigation is initiated. As illustrated in Section 2, an antidumping investigation usually takes 280-420 days. Therefore, $\tau = 0$ is the year of investigation, while $\tau = 1$ is the starting year that final antidumping duty is imposed. The coefficients β_{-4}, β_{-3}, β_{-2} show whether the treatment and control groups have common trends before the antidumping measures. If so, these coefficients should be close to zero and jointly insignificant. On the other hand, the coefficients β_0, $\beta_1, \beta_2, \beta_3$, β_4 show whether the treatment effect fades out, stays constant, or even increases over time.

With this empirical specification at hand, I first assess the trade destruction effect caused by antidumping measures in the US market. That is, I estimate how these measures restrict the trade of the *targeted* products relative to the *closely-related* ones from China to the US. However, the export restrictions to the US can give rise to trade deflection, where a destruction effect at the product level could be offset by an increase in product-level export to other countries. Specifically, I investigate whether the US import restrictions increase the exports of Chinese *targeted* products to the RoW. I assess these dynamic effects by comparing the export patterns of the *targeted* and *closely-related* products in the RoW.

4.2 Firm-level Framework

The aforementioned analysis focuses on the effects of antidumping measures at the product level. But an important and related question is whether these trade restrictions alter individual firms' export behavior. In this section, I analyze how firms' export patterns (whether or not to export, and how much to export) and pricing strategy are changed when faced with such restraints. More importantly, I examine whether these trade shocks lead to the reallocation of activities across products within multi-product firms. By focusing on the responses of exporters to such restrictions, I aim to shed new light on the contribution of firms and product selection in export markets. It is important to understand how the results observed at the product level translate into firm-level exports to gain a better understanding of the underlying microeconomic adjustments.

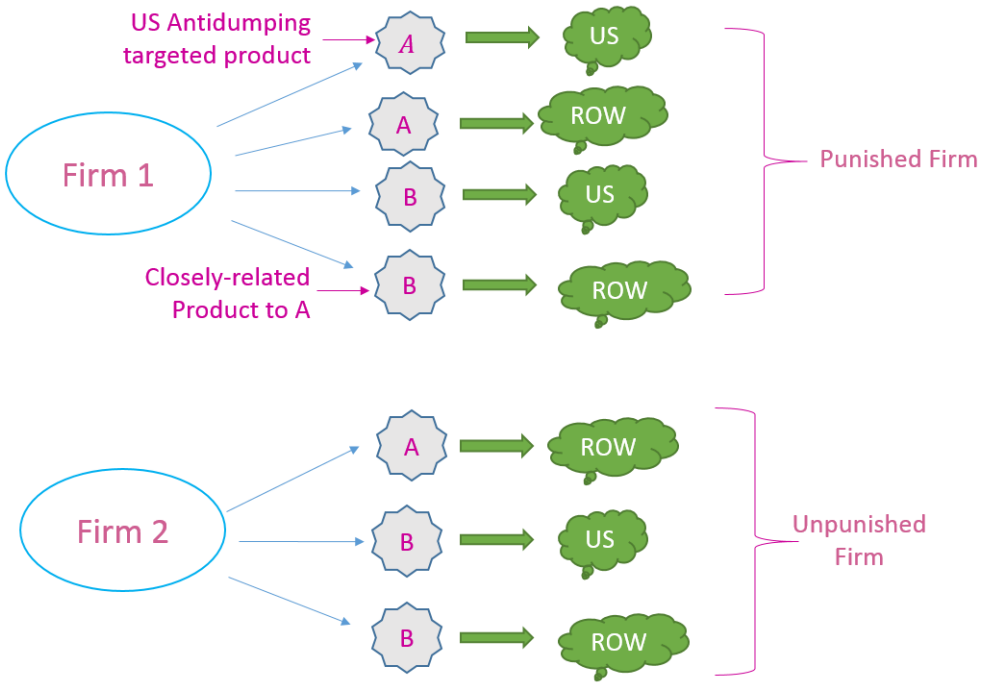

Figure 2: Product and market structure of multi-product firms

Figure 2 provides a graphical explanation of multi-product firms in my analysis. The *punished* firm is defined as an exporter of multiple 6-digit HS products both to the US and the RoW, where at least one of its products is subject to an antidumping duty in the US. In other words, every *punished* firm has direct experience of a tariff hike for a product in the US market. The *unpunished* firm refers to an exporter of a set of 6-digit products that do not face any antidumping duty anywhere in the world. Products A and B are closely-related to each other, as they belong to the same 4-digit HS product category, but product A is subject to an antidumping duty in the US.

4.2.1 Trade Destruction

I first examine whether antidumping measures distort trade for individual Chinese exporters to the US. I again follow Autor (2003) and identify the effect at the firm-product-yearly level using the following equation:

$$y_{fpt} = \gamma_t + \delta_p + \lambda_f + \beta_{-4} D_{p,t+\tau(\tau<=-4)} + \sum_{\tau=-3.\tau\neq-1}^{3} \beta_\tau D_{p,t+\tau} + \beta_4 D_{p,t+\tau(\tau>=4)} + \varepsilon_{fpt}, \quad (2)$$

where the subscripts f, p, and t denote firm, 6-digit HS product line, and year, respectively. The destination here focuses on the US market. My dependent variables are: (i) a dummy variable that equals one if a firm exports a 6-digit HS product to the US in year t (0 other-

wise).[11] This dependent variable explores the extensive margin of trade, i.e., a firm's decision to participate in exporting to the US market (a given product-destination). The other dependent variables are: (ii) a firm's export values and quantities (in logs) to the US, where zero trade flows are dropped from the analysis; and (iii) the price of exported goods (in logs) in the US, proxied by unit export values. I examine the extent to which antidumping measures affect the intensive margins and the export prices of incumbent firms. My hypothesis is that the cost-enhancing antidumping measures have a negative effect on trade flows.

My data set exhibits a substantial fraction of zeros at the firm-product-destination-year level, with over 50% of trade values and quantities found to be zero. There may be two reasons for the zero trade flows: there truly is no bilateral trade, or bilateral trade values are not reported.[12] If I take the logarithm of the value or quantity of trade and use an OLS-based estimation methodology, all observations with zero trade flows would drop out of my estimation sample. This would likely create a bias of my estimated policy impact: if antidumping measures were prohibitive and caused Chinese exporters to completely stop exporting the product under such restrictions, then I would likely underestimate the true effect.

However, this simple truncating method is better than adding a small constant (1 dollar, say) to the value of trade before taking logarithms when employing OLS-based estimation methodology (Head and Mayer, 2014). Because retaining the zero observations without using an estimator that accounts for the limited-dependent nature of the model would lead the results to depend on the unit of measurement. The estimated effect of common currencies switches from negative to positive simply by changing units from dollars to thousands of dollars. For this reason, I simply drop the zero trade flows in my regression.

The explanatory variables are the same as in Equation (1). The coefficients of interest are β_τ, which measure the average difference between the control and treatment groups. Since a year dummy must be omitted, I follow the standard procedure of omitting the first year immediately preceding the investigation. In addition to product and year fixed effects, I include a set of firm fixed effects (λ_f) to control for firm-specific and time-invariant unobserved characteristics which might affect the trade performance of exporters. Standard errors are clustered at the 6-digit HS product level. Figure 3 provides a schematic of the treatment

[11] If we observe positive exports of a product p by a firm to a certain destination in year t but no export after that, we keep the zero observations in year $t-1$ and $t+1$.

[12] Zero trade and missing trade values are typically not satisfactorily distinguishable in trade matrices.

and control groups for this analysis. The treatment group refers to firms exporting to the US a 6-digit HS product that is subject to an antidumping duty in the US (*targeted* products). The control group consists of firm-product-destination triplets that do not face any antidumping duty anywhere in the world. The products in the control group include all uninvestigated products within the 4-digit HS product category to which the *targeted* products belong (*closely-related* products). Notably, the control sample also includes the *punished* firms that export the *closely-related* products.[13]

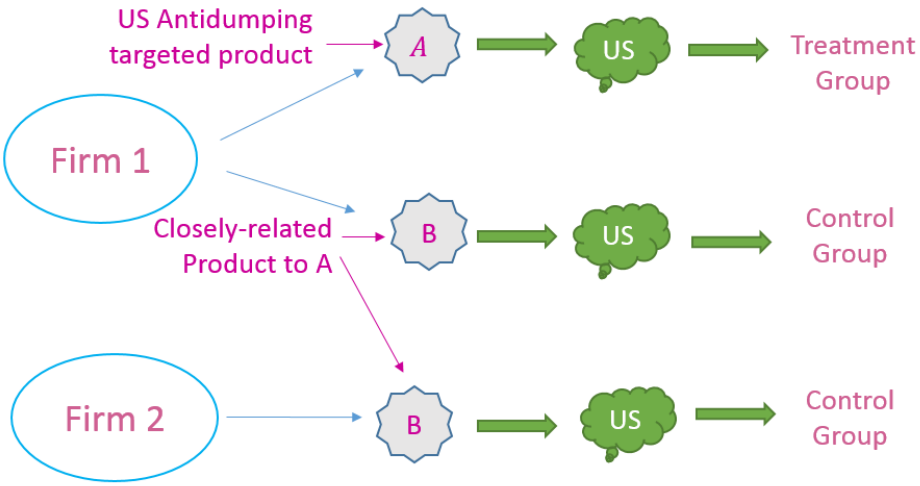

Figure 3: Trade destruction to the US at the firm-product level

4.2.2 Trade Deflection

As exporting to the US becomes tougher, firms may start a new trading relationship to compensate their losses in the US market. That is, I examine whether the US antidumping measures caused Chinese firms to deflect trade, leading to an increase in the exports of *targeted* products to third (non-US) markets. My empirical strategy to evaluate these effects relies again on a difference-in-difference estimation. Here, I compare the export performances in non-US markets of firms that have been directly exposed to the trade restrictions to the non-exposed firms. The estimation specification in this setting is similar to Equation (2), with the only change being the replacement of the outcome variables y_{fpt} for the RoW.

Figure 4 outlines my comparison. Firms 1 and 2 both export product A, which is subject to an antidumping duty in the US. Nevertheless, only Firm 1 is hit by an antidumping duty as

[13]In the unreported table (results are available upon request), I also exclude the *punished* firms that export the *closely-related* products as controls. The results are qualitatively identical.

it exports the *targeted* product A to the US. Firm 2 is not hit by this tariff increase in the US because it only exports the *targeted* product A to the RoW. Therefore, the treatment group consists of *punished* firms exporting to the RoW a 6-digit HS product that is subject to an antidumping duty in the US. The control group refers to *unpunished* firms exporting an US antidumping-*targeted* product but only to the RoW. Therefore, by definition, exporters who trade only to the RoW do not shift exports. I am interested in how existing multi-product firms reallocate the *targeted* products across destinations following export restrictions.

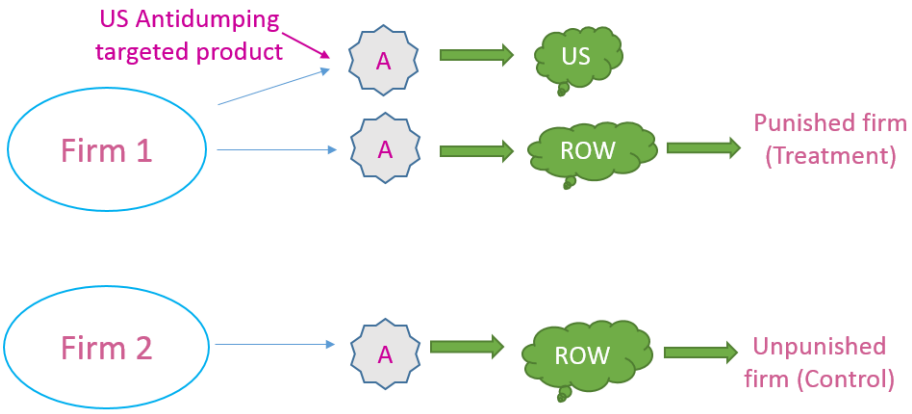

Figure 4: Trade deflection to the RoW at the firm-product level 1

To be consistent with the product-level trade deflection analysis, I also use another control group which is graphically presented in Figure 5. The control group is represented by Firm 2 exporting product B to the RoW, which is not subject to the US antidumping duty but is in the 4-digit HS product category with product A. To put it differently, I focus on the impact of antidumping measures on Chinese firms' export behavior towards alternative markets by using a different control group.

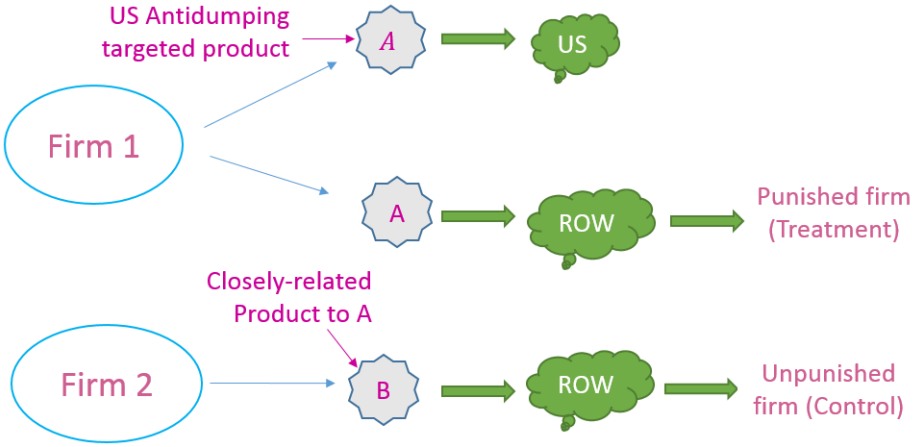

Figure 5: Trade deflection to the RoW at the firm-product level 2

4.2.3 Within-Firm Product Switching

To further enhance our understanding of antidumping measures, and in particular of how US antidumping measures against China spill over across products within firms, I explore whether an antidumping action against one product influences firms' export behavior (participation, value, volume shipped and price strategy) for other products both to the US and the RoW. Specifically, I consider that antidumping measures can have externalities that spread to other products within firms. Figure 6 presents a schematic to illustrate this problem. Firm 1 is an antidumping-*punished* firm because it exports product A to the US, which is subject to an antidumping duty. I investigate the export pattern of Firm A's *closely-related* product B both to the US and RoW, to see whether a tariff hike for one product within a firm has an effect on its export performance for other products.

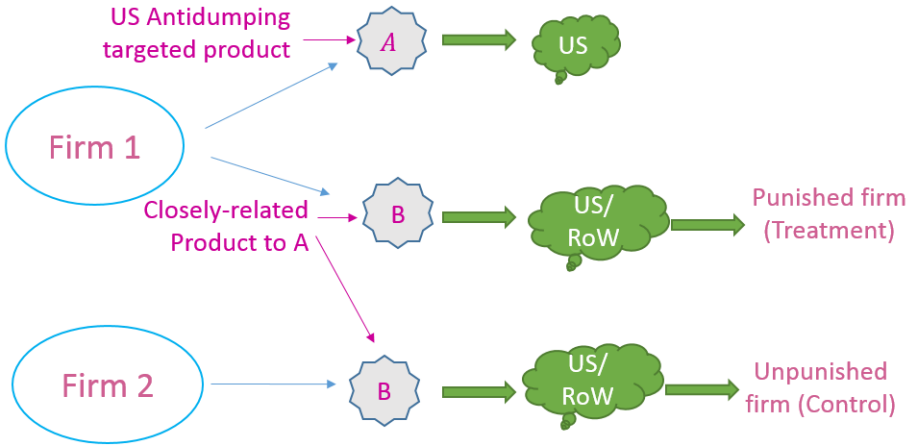

Figure 6: Within-firm product switching behavior to the US/RoW

In other words, I study the extent to which a cost shock in one market impacts firm choice of export participation, value, quantity and price across markets. It is important to understand this because it has important implications for the welfare effect of trade policy changes. I focus on the role of product spillovers in the dynamics of firm-product-level exports.

5 Empirical Results

5.1 Product-level Trade Destruction

Before turning to the estimates of Equation (1), I provide a visual summary of the time trend of export values for treatment and control at quarterly intervals spanning from four years prior to four years after the antidumping investigations. The vertical line marks the date of initiation of the investigations. This figure provides initial evidence that antidumping measures do affect the export values. First, there is an upward trend in the export values for both groups before the investigation. Second, it seems that before the investigation, the treatment and control groups do not exhibit differential time trend, indicating that the pre-existing trends are similar for both groups. Third, antidumping measures have a clearly dampening effect on the export values of the treatment group.

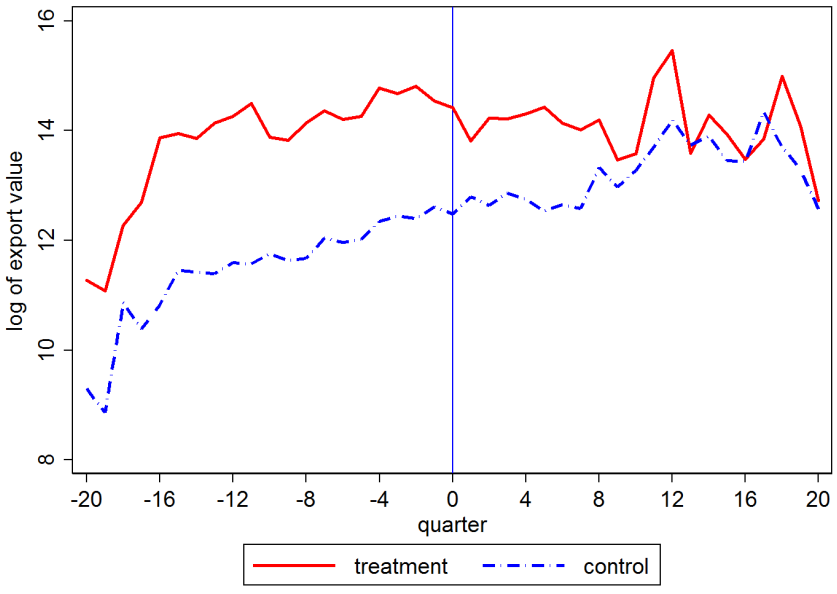

Figure 7: Time trend of product-level export values to the US

The regression results for the trade destruction effects of antidumping measures at the product level are shown in Table 1. In column (1), the dependent variable is the export participation dummy for exporting to the US. Before the investigation, the coefficients (β_{-4},

β_{-3},β_{-2}) are close to zero and jointly insignificant, which indicate that the DID common trends assumption seems satisfied in this context. Moreover, it clearly emerges that antidumping measures are associated with a modest but meaningful reduction in the probability of a product being exported to the US. Specifically, I find that antidumping-*targeted* products are 15 percentage points less likely to be exported compare to the *closely-related* products in the second year after the investigation. Their export probability is further reduced by approximately 28 percentage points in the third years after the measures. However, the negative effects are short-lived, only lasting for two years. From the 4^{th} year after the initiation, there is a small reduction in export participation, but it is not significant. Antidumping measures hence act as an additional cost of exporting to the US market and increase the threshold for export participation for a short period.

In a further extensive-margin estimation, I test their effects on the number of exporters in every product-destination-year cell. The results are shown in column (2). The number of exporters exporting the *targeted* products in the first three years following the investigation is between 20% to 30% less than the number of firms exporting the *closely-related* products.[14] Notably, the presence of antidumping measures reduces the total number of firms active in the US market by 50% from year four onwards. In other words, the presence of antidumping measures is not only associated with negative estimated impact on export participation, but also with a drastic decrease in the number of exporters.

Column (3) of Table 1 shows the OLS estimates of Equation (1), when the dependent variable is the log of export values in the US. The estimated coefficients of the treatment leads in this column are close to zero, showing little evidence of an anticipatory response for the products about to be subject to antidumping duties. Nevertheless, a strong pattern emerges year one after the investigation (the starting point of imposition of the antidumping duties). Export values decline is sizable, by around 50% to 80% in years 1 to 3 following initiation of the investigations. They further go down by about 85% in year 4 forward. The point estimates are significant at conventional levels. There is strong evidence of a significant decline in export values of the *targeted* products relative to the *closely-related* ones, following the initiation of antidumping measures. The subsequent column repeats these estimates when using the log of export quantities as the dependent variable. The pattern of coefficients, in this case, is very similar to column (3), providing robust evidence that antidumping measures

[14]The exact percentage difference in the predicted y when $D_{p,t} = 1$ versus when $D_{p,t} = 0$ is $\%\triangle y = 100 \times (e^{\beta} - 1)$.

severely distort bilateral trade flows between China and the US.

Column (5) documents how antidumping measures affect export prices, proxied by the unit values at the 6-digit HS level. However, this estimation may suffer from measurement error, as the unit values I calculate may be polluted by aggregation across firms. The results reveal that the price changes do not contribute a lot to variations in the export flows to the US. That is, export prices are remarkably stable over time, despite the antidumping measures that the products are subject to.

Table 1: Trade destruction effect on the US at the product level

Time relative to invetigation	(1) **Participation dummy**	(2) **log of # of exporters**	(3) **log of export value**	(4) **log of export volume**	(5) **log of export price**
4 or More Years Before	-0.097	-0.100	-0.321	-0.335	0.013
	(0.078)	(0.200)	(0.489)	(0.506)	(0.106)
3 Years Before	-0.124*	0.027	-0.253	-0.182	-0.072
	(0.071)	(0.134)	(0.277)	(0.274)	(0.069)
2 Years Before	0.017	0.084	0.039	0.136	-0.097
	(0.032)	(0.062)	(0.138)	(0.182)	(0.073)
Investigation Starts	0.020	0.031	0.006	0.140	-0.134
	(0.040)	(0.077)	(0.211)	(0.241)	(0.131)
1 Years After	-0.051	-0.223**	-0.640**	-0.533	-0.110
	(0.037)	(0.102)	(0.270)	(0.326)	(0.135)
2 Years After	-0.156***	-0.440***	-1.617***	-1.525***	-0.093
	(0.041)	(0.114)	(0.369)	(0.371)	(0.120)
3 Years After	-0.286***	-0.355**	-1.594***	-1.689***	0.094
	(0.058)	(0.150)	(0.376)	(0.386)	(0.126)
4 or More Years After	-0.011	-0.706***	-1.862***	-2.007***	0.142
	(0.062)	(0.160)	(0.474)	(0.521)	(0.160)
Year FE	Yes	Yes	Yes	Yes	Yes
Product FE	Yes	Yes	Yes	Yes	Yes
Observations	2059	1786	1786	1785	1785
Adjusted R^2	0.243	0.931	0.802	0.767	0.847

Standard errors clustered at the product level in parentheses.* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

It looks odd that I do not find any price adjustments, since firms should have the incentive to manipulate their duty margin by lowering their domestic price.[15] However, for nonmarket economies such as China, the domestic price is irrelevant to the calculation of the dumping margin. Instead, the costs from a surrogate country are used. Consequently, there is no

[15]By lowering the price in the home market, the product's "normal value" is then lower and firms can set a low price for their exports.

incentive for Chinese firms to alter their domestic prices in response to such trade shocks. Therefore, it is not surprising that I do not find much price of a response.

Taken together, these estimates strongly support the inference that US antidumping measures considerably reduce the export flows of the *targeted* products from China, by 50%-85% on average. Furthermore, they also cause the *targeted* products less likely to be exported and decrease the number of exporters. More specifically, I find that antidumping measures drive 50% of exporters out of the US markets. Given that it could take over a year for an antidumping investigation to result in the imposition of a definitive import restriction, the finding of no contemporaneous responses is understandable.

I also use quarterly product-level export data as robustness check. This allows me to avoid some of the partial year bias present in annual data and gives me more precise estimates. Table 9 in the Appendix presents the estimation results. The estimates confirm that the imposition of US import restrictions negatively affect both the extensive and intensive margins of trade.

5.2 Product-level Trade Deflection

The US use of antidumping measures against China may impose an externality on alternative markets. Table 2 presents the results in which I examine how the imposition of US import restraints affect Chinese exports of the *targeted* products to third country markets. In column (1) the dependent variable is the export participation dummy to the RoW. The estimated coefficients for treatment leads are consistently negative and significant at the conventional levels, suggesting that the treatment and control groups do not have parallel trends before antidumping measures. Therefore, one might worry that they might differ in unobservable ways that invalidate the estimates. In column (2), I estimate their effects on the number of Chinese firms exporting to the RoW. I find that antidumping measures are negatively correlated with the number of exporters. Specifically, in the year immediately following initiation, the drop in the number of exporters appears to be small (albeit not significantly), followed in years 1 to 3 by a considerable reduction in the number of exporters. That is, the number of firms in the first three years following the investigation decreases by between 15% and 22%, and these point estimates are consistently significant. Combined with the findings in column (2) of Table 1, the results reveal that the US antidumping measures have led to a considerable decline in the number of exporters both serving the US and the RoW.

The next two columns of Table 2 repeat the estimates for the products' export values and quantities in the RoW. First, we see relatively stable coefficients for the leads centered around

0, which yield no evidence of anticipatory effects. Second, there are significant short-term (3 years) negative effects of US antidumping measures on export flows of Chinese products to third markets. That is, rather than an increase in exports to the RoW, US import constraints are associated with a chilling effect on Chinese *targeted* products to alternative markets.

Specifically, in years 1 through 3 following the US antidumping measures, there is strong evidence of an acceleration of export reductions. The US antidumping-*targeted* products experience a sizable decline of 24% to 48% in export flows to the RoW during 1 to 3 years following the measures. These estimates lend support to the fact that US trade measures reduce Chinese trade flows to alternative markets. However, these effects appear to be short-term, lasting for 3 years, while the longer-run effects appear to be also negative but insignificant. These findings are in line with Bown and Crowley (2010), who also document that the US import restrictions against China have a chilling effect on Chinese exports to third markets.

Table 2: Trade deflection effect on the RoW at the product level

Time relative to invetigation	(1) **Participation dummy**	(2) **log of # of exporters**	(3) **log of export value**	(4) **log of export volume**	(5) **log of export price**
4 or More Years Before	-0.058	0.062	0.065	-0.038	0.102*
	(0.047)	(0.114)	(0.227)	(0.220)	(0.061)
3 Years Before	-0.109*	0.080	0.167	0.091	0.075*
	(0.062)	(0.066)	(0.107)	(0.110)	(0.044)
2 Years Before	0.025**	0.025	0.018	-0.015	0.033
	(0.010)	(0.044)	(0.080)	(0.086)	(0.024)
Investigation Starts	-0.021***	-0.070	-0.274**	-0.235**	-0.039
	(0.008)	(0.050)	(0.110)	(0.114)	(0.026)
1 Years After	-0.007	-0.153**	-0.514***	-0.415***	-0.099***
	(0.008)	(0.071)	(0.126)	(0.129)	(0.035)
2 Years After	-0.018*	-0.246***	-0.636***	-0.592***	-0.043
	(0.010)	(0.079)	(0.129)	(0.137)	(0.043)
3 Years After	-0.053***	-0.239**	-0.647***	-0.671***	0.023
	(0.010)	(0.109)	(0.166)	(0.173)	(0.057)
4 or More Years After	-0.058***	-0.004	-0.238	-0.422	0.184**
	(0.013)	(0.137)	(0.269)	(0.275)	(0.087)
Year FE	Yes	Yes	Yes	Yes	Yes
Product FE	Yes	Yes	Yes	Yes	Yes
Observations	2138	2069	2069	2069	2069
Adjusted R^2	0.113	0.947	0.874	0.882	0.957

Standard errors clustered at the product level in parentheses.* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

The estimated coefficients for the price in column (5) are consistently negative and sig-

nificant, which imply a failure of the DID approach as both groups do not have the parallel trends before the antidumping shocks. To summarize the results of Table 2, I find that the products exposed to the trade disruption do not shift exports to other markets. On the contrary, I provide some evidence that US trade restrictions lead to a decline in Chinese exports of the same products to alternative markets.

These findings are relevant to policy-making. One implication derived from the current results is that *targeted* products may face an additional cost of antidumping, as they are not able to deflect trade and recoup some of the losses. This suggests that antidumping measures incur collateral damage and are even more detrimental to developing countries like China than has previously been considered.

In a robustness check I use quarterly product-level export data. Table 10 in the Appendix presents the estimation results. The results are similar to the ones in Table 2 which confirms that antidumping measures have negative externalities that distort trade in other markets.

5.3 Firm-level Trade Destruction

I have shown that antidumping measures significantly distort trade both to the US and the RoW at the product level. I now look at export adjustments within firms. Table 3 presents the results of how antidumping measures shape Chinese firms' export behavior in the US. The control group is represented by the firms exporting *closely-related* products. Column (1) reports the estimated responses of the effect on export participation at the firm-product-destination level. Specifically, the estimates show no effects in the years before the investigations. This implies that the pre-trend identification assumption is satisfied. However, two years after the investigation, firms are 2.2 percentage points less likely to export antidumping-*targeted* products to the US relative to firms exporting *closely-related* products.

The following two columns of Table 3 present the results on firms' intensive margins of trade: how firm-level export flows to the US are affected by the US import restraints. Both of them show that pretreatment trends do not differ between treatment and control groups. Specifically, column (2) indicates that the presence of an antidumping measure has a negative but only marginally significant effect on the export values of incumbents to the US. Similarly, column (3) reveals that incumbents which export the *targeted* products to the US experience a modest decline in export volumes, approximately ranging from 5% to 20% three years after the investigation. Notably, the export flows of survivors do not seem to be significantly affected by the US imposition of antidumping measures. Therefore, I suspect that the substantial

drop of export flows found at the product level is mainly driven by the extensive margins: sharp reductions both in export participation and the number of exporters. That is, some firms may have had to stop shipping the products targeted by the measures entirely, while the remaining ones are much less negatively affected. In column (5), I estimate Equation (2) with the log of export prices. It seems that the pre-trend identification assumption is violated. Therefore, estimations based on this model do not identify the causal effect.

Combining the findings in Table 1 and 3, we see that an increase export costs (i.e., the imposition of antidumping duties) translates into lower exports through a decrease in export probability, and a decline in the number of exporters. It is also associated with reductions in export flows of *targeted* products from survivors.

Table 3: Trade destruction effect on the US at the firm level

Time relative to investigation	(1) **Participation dummy**	(2) **log of export value**	(3) **log of export volume**	(4) **log of export price**
4 or More Years Before	0.014	0.028	-0.038	0.073**
	(0.012)	(0.094)	(0.096)	(0.034)
3 Years Before	-0.008	0.035	-0.014	0.057**
	(0.014)	(0.093)	(0.091)	(0.022)
2 Years Before	0.006	-0.020	-0.027	0.010
	(0.007)	(0.049)	(0.044)	(0.018)
Investigation Starts	0.012	-0.042	-0.046*	0.006
	(0.013)	(0.026)	(0.027)	(0.014)
1 Years After	-0.002	-0.080*	-0.096**	0.016
	(0.008)	(0.047)	(0.044)	(0.022)
2 Years After	-0.022**	-0.099	-0.118*	0.019
	(0.011)	(0.068)	(0.066)	(0.030)
3 Years After	0.009	-0.105	-0.207*	0.108**
	(0.012)	(0.093)	(0.106)	(0.045)
4 or More Years After	-0.010	-0.088	-0.174	0.083*
	(0.015)	(0.127)	(0.118)	(0.047)
Year FE	Yes	Yes	Yes	Yes
Product FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Observations	476373	240517	239775	239775
Adjusted R^2	0.010	0.414	0.436	0.714

Standard errors clustered at the product level in parentheses.* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

5.4 Firm-level Trade Deflection

Do US antidumping measures lead to *punished* Chinese firms deflecting *targeted* products to non-US markets, relative to *unpunished* firms exporting the same products? Table 4 presents the estimation results where the control group is the *unpunished* firms that export US antidumping-*targeted* products, but only to the RoW. Overall, we may conclude that Chinese firms which are exposed to the disruption of the US market do not deflect trade flows to other markets. However, antidumping measures hamper firms' extensive margin of trade, which make them less likely to export the *targeted* products even to alternative markets.

Specifically, in column (1) the dependent variable is a dummy variable that equals 1 if a firm exports a 6-digit HS product to the RoW, which is subject to the US antidumping duty. We observe that the US-imposed antidumping duty on product p hurts the export probability to non-US markets by a *punished* firm. The estimated leads show that there are no pre-trends before the investigation. In the years after the investigation, an antidumping-*punished* firm is between 4.4 to 8.8 percentage points less likely to export the *targeted* products to the RoW, relative to a firm that does not face such a tariff hike. The implication is that antidumping measures may have a deterrent effect which spreads to other destinations from the same *punished* firms.

Columns (2) and (3) repeat these estimates where the dependent variables are the firms' export values and quantities of the *targeted* products to the RoW. There is little evidence that firms adjust their export flows to the RoW following the restrictions. My point estimates in these two columns are always positive, but I cannot reject the hypothesis that they are equal to zero. Ultimately, antidumping shocks create negative spillovers and have harmful effects on the ability of affected firms to export the *targeted* product to other destinations.

Table 4: Trade deflection effect on the RoW at the firm level

Time relative to investigation	(1) **Participation dummy**	(2) **log of export value**	(3) **log of export volume**	(4) **log of export price**
4 or More Years Before	-0.001	0.069	-0.092	0.161**
	(0.017)	(0.159)	(0.188)	(0.072)
3 Years Before	0.001	0.041	-0.065	0.107**
	(0.013)	(0.145)	(0.166)	(0.048)
2 Years Before	-0.004	0.050	0.002	0.047
	(0.011)	(0.081)	(0.092)	(0.029)
Investigation Starts	-0.009	-0.026	0.004	-0.030**
	(0.013)	(0.042)	(0.049)	(0.013)
1 Years After	-0.012	0.001	0.042	-0.036
	(0.011)	(0.068)	(0.089)	(0.027)
2 Years After	-0.044***	0.002	0.052	-0.049
	(0.013)	(0.085)	(0.110)	(0.032)
3 Years After	-0.041**	0.038	0.050	-0.007
	(0.018)	(0.097)	(0.122)	(0.039)
4 or More Years After	-0.088***	0.116	0.138	-0.019
	(0.016)	(0.110)	(0.149)	(0.051)
Year FE	Yes	Yes	Yes	Yes
Product FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Observations	726763	378752	378752	378752
Adjusted R^2	0.038	0.401	0.448	0.722

Standard errors clustered at the product level in parentheses.* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

To check the consistency of these estimates with the product-level trade deflection analysis, in Table 5 I examine whether US trade protections result in *punished* firms shifting *targeted* products to other destinations, relative to *unpunished* firms exporting *closely-related* products. Column (1) reveals that antidumping measures reduce the export probability of the *targeted* products to the RoW from a *punished* firm. Specifically, there is a decline of between 6.2 and 11.8 percentage points in the export probability to the RoW at the firm-product-destination level. Columns (2) and (3) repeat these estimates for export values and quantities. In years 1 through 3 following the investigation, there is some evidence of rising export flows. The final estimate indicates a sizable of 16.5 percentage points increase in export values from the 4^{th} year onwards following the measures.

Table 5: Trade deflection effect on the RoW at the firm level

Time relative to investigation	(1) **Participation dummy**	(2) **log of export value**	(3) **log of export volume**	(4) **log of export price**
4 or More Years Before	0.021	0.081	-0.051	0.136***
	(0.018)	(0.102)	(0.113)	(0.046)
3 Years Before	0.013	0.029	-0.062	0.095***
	(0.013)	(0.107)	(0.115)	(0.030)
2 Years Before	0.001	0.039	-0.002	0.042**
	(0.010)	(0.057)	(0.060)	(0.019)
Investigation Starts	-0.014	-0.017	0.006	-0.024**
	(0.013)	(0.028)	(0.032)	(0.010)
1 Years After	-0.020	0.014	0.039	-0.023
	(0.013)	(0.036)	(0.049)	(0.020)
2 Years After	-0.062***	0.018	0.044	-0.029
	(0.014)	(0.048)	(0.060)	(0.021)
3 Years After	-0.060***	0.053	0.025	0.029
	(0.018)	(0.058)	(0.076)	(0.031)
4 or More Years After	-0.118***	0.165**	0.137*	0.027
	(0.021)	(0.068)	(0.076)	(0.028)
Year FE	Yes	Yes	Yes	Yes
Product FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Observations	933655	477918	476357	476357
Adjusted R^2	0.040	0.436	0.478	0.740

Standard errors clustered at the product level in parentheses.* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Summing up Table 5, there is some evidence of trade deflection. The US antidumping measures are associated with the *punished* firms increasing the trade flows of the *targeted* products to third markets. At first blush, this may seem odd, as I find that the imposition of US import restraints reduces Chinese export flows to third-country markets at the product level (see Table 2). One explanation for the chilling effect detected at the product level is attributed to the substantial decline in the number of exporters. Firms hit by US import restraints but that stay in the market are capable of circumventing the constraints by selling more to non-US markets. Therefore, we observe from columns (2) and (3) that the *punished* firms that continue exporting increase their export flows to alternative markets. That is, existing exporters reallocate the *targeted* products across destinations to offset their loss in

the US market.

5.5 Within-firm Product Switching

It is perfectly plausible that a trade restriction against one line of goods from a given exporter, f, could have effects on exports of other goods from f. That is, the breadth or extent of antidumping measures may go beyond the *targeted* products within firms. Consequently, I examine whether an antidumping measure against one product influences firms' export decisions for other products both to the US and the RoW. First, I focus on how firms reshuffle export activities across products in the US. The dependent variables in columns (2) and (3) of Table 6 are firms' export values and quantities of the *closely-related* products to the US. The estimates show that the limitations on trade with the US negatively affect the trade flows of the *closely-related* products. Firms that were hit by these trade restraints reduce their exports of unaffected products to the US.

The use of antidumping measures on one set of products against a firm reduces the trade flows of other unaffected products from the same firm to the initiation country. That is, antidumping measures have a deterrent effect on firms, leading them to reduce shipments of the *closely-related* products to the US. The antidumping-*punished* firms may "learn" how to avoid dumping complaints by lowering the value or volume, and raising the price. In other words, antidumping measures have a chilling effect on trade beyond the *targeted* products within firms. Moreover, combining the findings in Table 3, we conclude that an increase in the marginal cost of serving one market leads firms to downsize all their exports in that market. These results demonstrate how the country-product specific nature of antidumping measures imposes externalities on non-targeted country-product pairs, widening our understanding of the breadth of such measures.

My results can also be interpreted in light of the literature on heterogeneous firms and fixed costs of trade (Melitz, 2003). Chinese exporters who may not recover the fixed export costs required to service the US market reduce the exports both on the *targeted* and *closely-related* products. Consequently, antidumping measures generate greater welfare losses in the named country than generally recognized.

Table 6: Within-firm product switching to the US

Time relative to investigation	(1) **Participation dummy**	(2) **log of export value**	(3) **log of export volume**	(4) **log of export price**
4 or More Years Before	0.082***	0.205	0.057	0.158***
	(0.017)	(0.157)	(0.173)	(0.042)
3 Years Before	0.052***	0.130	0.110	0.025
	(0.013)	(0.113)	(0.116)	(0.031)
2 Years Before	0.041***	0.054	0.054	0.003
	(0.009)	(0.061)	(0.062)	(0.018)
Investigation Starts	-0.021***	-0.050	-0.051	-0.004
	(0.007)	(0.035)	(0.032)	(0.022)
1 Years After	-0.045***	-0.034	-0.067	0.026
	(0.010)	(0.050)	(0.046)	(0.028)
2 Years After	-0.088***	-0.106*	-0.173***	0.051*
	(0.017)	(0.063)	(0.061)	(0.028)
3 Years After	-0.085***	-0.073	-0.177*	0.089***
	(0.015)	(0.104)	(0.094)	(0.028)
4 or More Years After	-0.160***	-0.089	-0.180	0.061*
	(0.027)	(0.153)	(0.145)	(0.034)
Year FE	Yes	Yes	Yes	Yes
Product FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Observations	275343	136468	135959	135959
Adjusted R^2	-0.018	0.444	0.446	0.720

Standard errors clustered at the product level in parentheses.* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

To complete the analysis of the effects of US antidumping measures on Chinese firms, I analyze whether trade shifts to other products within a firm to other destinations. In column (1) of Table 7, my dependent variable is a dummy variable that equals 1 if a firm exports an unaffected 6-digit HS product to the RoW in year t. I find that antidumping measures have a large negative impact on export participation. The *punished* firms are less likely to export the *closely-related* products to the RoW, relative to their *unpunished* counterparts. For instance, the export probability of an uninvestigated product in an affected firm decreases by almost 6 percentage points two years after the investigation.

Proceeding across specifications, in column (2) I redefine the dependent variable to be a firm's export value of unaffected products to the RoW. The estimates show that there is a 12

Table 7: Within-firm product switching to the RoW

Time relative to investigation	(1) **Participation dummy**	(2) **log of export value**	(3) **log of export volume**	(4) **log of export price**
4 or More Years Before	0.003	0.202**	0.115	0.089**
	(0.013)	(0.091)	(0.093)	(0.044)
3 Years Before	-0.005	0.031	0.001	0.030
	(0.013)	(0.076)	(0.079)	(0.025)
2 Years Before	-0.001	0.051	0.052	-0.002
	(0.010)	(0.042)	(0.046)	(0.015)
Investigation Starts	-0.002	0.022	0.029	-0.006
	(0.007)	(0.021)	(0.022)	(0.012)
1 Years After	-0.014	0.029	0.025	0.005
	(0.010)	(0.035)	(0.034)	(0.021)
2 Years After	-0.059***	0.034	0.014	0.016
	(0.013)	(0.051)	(0.049)	(0.026)
3 Years After	-0.035**	0.116**	0.074	0.046*
	(0.015)	(0.057)	(0.057)	(0.025)
4 or More Years After	-0.097***	0.182***	0.160**	0.022
	(0.016)	(0.069)	(0.079)	(0.040)
Year FE	Yes	Yes	Yes	Yes
Product FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Observations	1187834	593817	591812	591812
Adjusted R^2	0.036	0.410	0.433	0.729

Standard errors clustered at product level in parentheses.* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

percentage increase in the value of exporting the *closely-related* products for a firm which was hit with a tariff hike, compared to a firm that does not face the policy change. On the one hand, antidumping measures have led Chinese firms to reduce the probability of exporting other unaffected products to the RoW. On the other hand, the decline in trade probability toward other unaffected products reduces market competition, and hence make the markets more accessible to survivors. Therefore, firms remaining in the market increase their export flows. To put it differently, multi-product firms appear to shift exports towards products that are not affected by the tariff hikes to third markets. More importantly, combining the findings in Table 5, we could conclude that the imposition of antidumping duty on one product within a firm, as a measure of rising trade policy uncertainty, negatively impacts a firm's export

decision across products in *other* markets.

Summarizing the results, antidumping measures do have measurable effects on firms, and the behavior of the *punished* firms is clearly more affected than the *unpunished* firms. Antidumping measures cause firms not only to alter export destinations but also to adjust the products they exports. Multi-product firms could cushion the detrimental effects of increasing trade costs in one destination through adjustments across products and destinations. I document that within-firm changes in export product constitute a significant channel of firms' adjustment in response to trade shocks.

6 Conclusion

Using rich firm-level Chinese customs data over the period 2000-2006, I empirically examine how antidumping measures contribute to product- and firm-level export dynamics. I find strong evidence that US trade restrictions reduce Chinese export flows both to the US and to alternative markets. Moreover, the imposition of antidumping measures negatively affects the extensive margin of trade. That is, antidumping-*targeted* products are less likely to be exported, and there is a reduction in the number of exporting firms across destinations. Antidumping measures therefore incur collateral damage and distort trade in third markets.

However, the overwhelming distortion impact on trade at the product level hides a very rich set of within-firm adjustments. To uncover the channel through which aggregate exports are affected, I further look at their impact at the firm-product level. I document that Chinese firms that were hit by US antidumping measures are less likely to export the *targeted* products across destinations. The implication is that antidumping creates negative externalities that go beyond the policy-imposing country. More importantly, antidumping measures are associated with spillovers across products within firms. That is, the export flows of uninvestigated products to the US from the *punished* firms also experience a modest decline. However, to compensate their loss in the US market, affected firms tend to switch exports to other unaffected products in alternative markets. These findings indicate that existing exporters reallocate their products across destinations following the trade restrictions. They also suggest that firms facing increasing export costs in one market will deviate their exports to another market. Existing heterogeneous firm models only have constant marginal cost, which ignore an important constraint on firm choices.

This paper adds to the literature on trade policy and how it affects multi-product firms'

export behavior. Given that the existing literature has focused on evaluating the effects of antidumping measures by emphasizing on the product level, my finding of significant effects on the within-firm adjustments implies that the current estimates of the trade distortions associated with antidumping measures are underestimated.

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7 Appendix

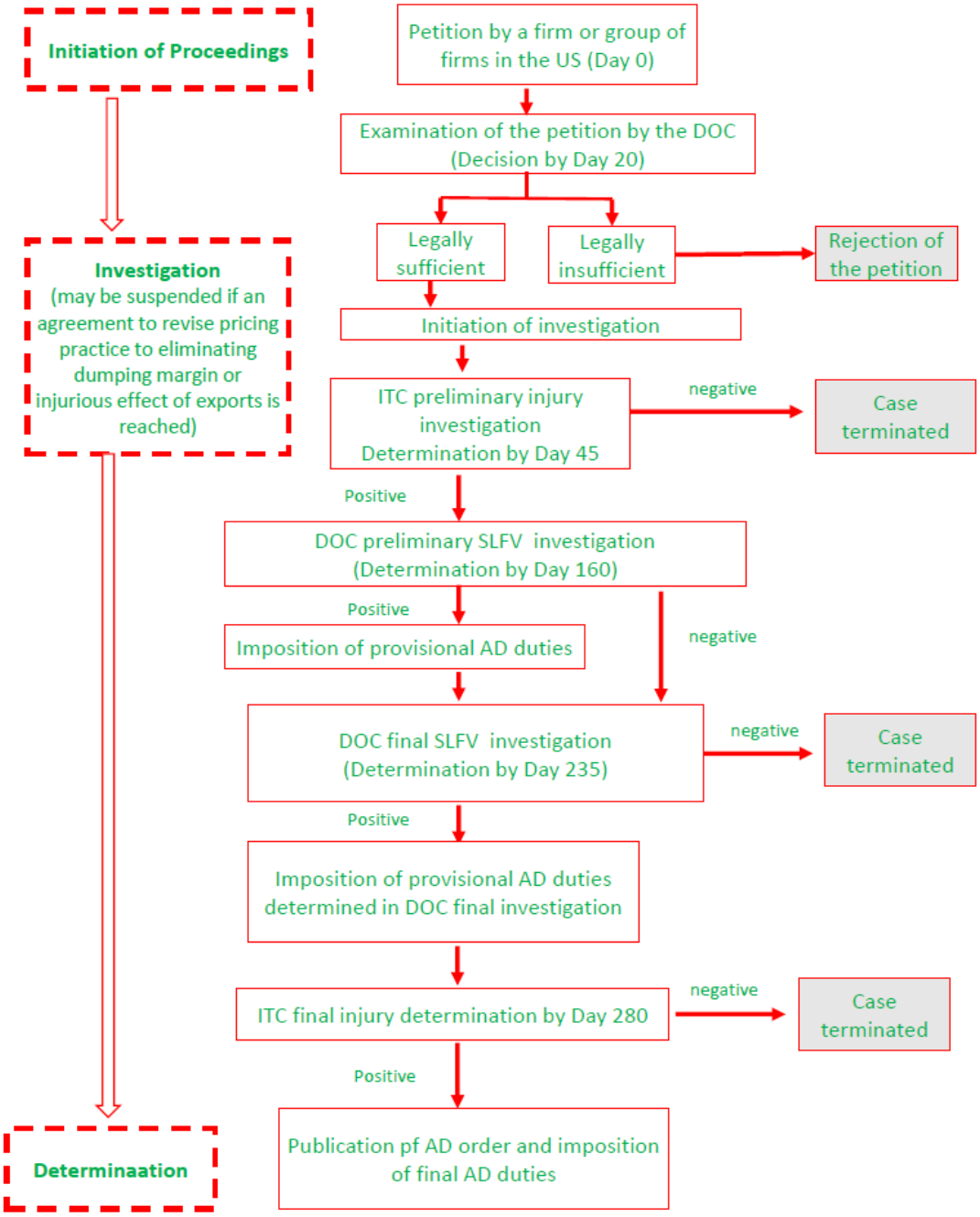

Figure 8: Flow Chart of US' Antidumping Proceedings

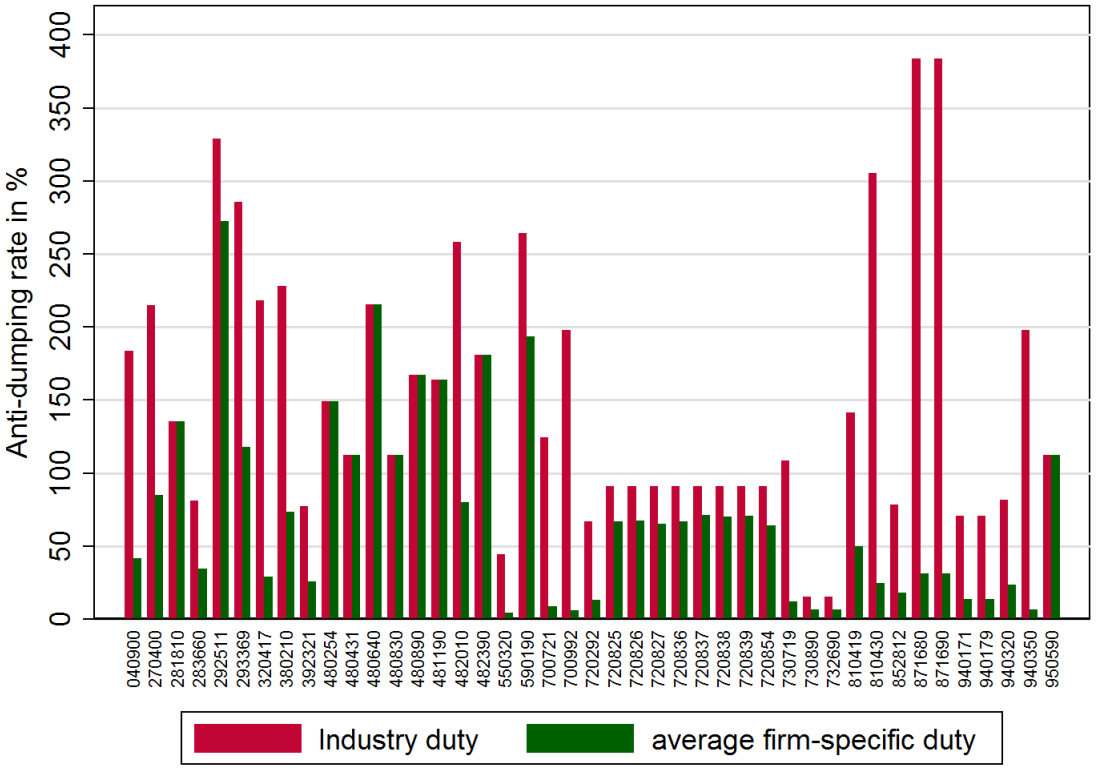

Figure 9: US antidumping measures against China: average duty per product

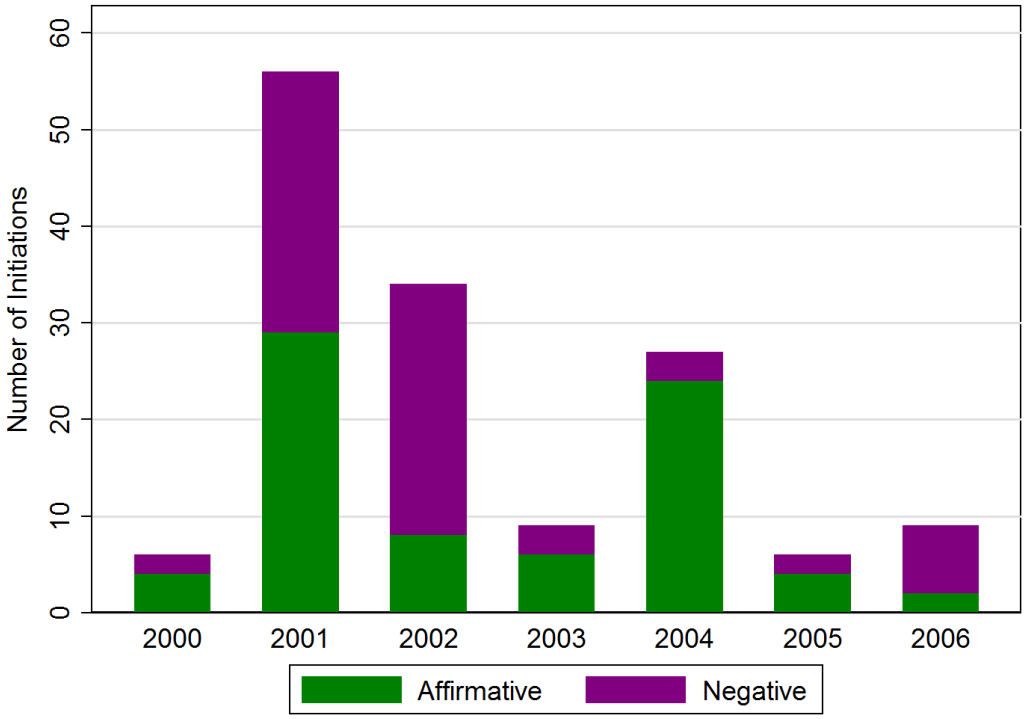

Figure 10: Antidumping initiations by year

Table 8: List of antidumping cases and treatment products

Case ID	Investigation Date	Treatment products	Preliminary Duty	Final Duty
USA-AD-874	07-Jul-2000	721420	59.98	133
USA-AD-893	06-Oct-2000	210690, 040900, 170290	183.8	183.8
USA-AD-899	22-Nov-2000	721119, 722511, 720827 721114, 720837, 720826 722540, 721250, 722519 721240, 722530, 720840 721090, 720854, 720853 722691, 720839, 720825 720838, 720890, 722619 720836, 720810, 722611	67.44	90.83
USA-AD-921	01-Mar-2001	481950, 481920	164.75	164.75
USA-AD-932	04-May-2001	940179, 940171	134.77	70.71
USA-AD-986	30-Nov-2001	720292	78.52	66.71
USA-AD-990	27-Feb-2002	730711	55.13	75.5
USA-AD-1010	08-May-2002	730890, 732690	32.73	15.61
USA-AD-1013	18-Jul-2002	292511	363.22	329.04
USA-AD-1014	13-Sep-2002	390530	97.86	7.86
USA-AD-1020	04-Oct-2002	283660	81.3	81.3
USA-AD-1021	06-Nov-2002	730719	146.41	111.36
USA-AD-1022	29-Nov-2002	281810	218.93	135.18
USA-AD-1034	13-May-2003	852812	78.45	78.45
USA-AD-1043	27-Jun-2003	392321	80.52	77.57
USA-AD-1046	30-Jun-2003	293213	31.33	136.86
USA-AD-1047	08-Jul-2003	940320, 940390	153.76	153.76
USA-AD-1058	10-Nov-2003	940350, 700992	198.08	198.08
USA-AD-1059	21-Nov-2003	871680, 871690	346.94	383.6
USA-AD-1060	28-Nov-2003	320417	370.06	217.94
USA-AD-1070a	23-Feb-2004	480439, 481890, 950590 480261, 482390	266.83	266.83
USA-AD-1070b	23-Feb-2004	480254, 480262, 480591 480890, 482050, 480431 480830, 480269, 480640 480230, 482090,	163.36	112.64
USA-AD-1071	09-Mar-2004	810419, 810430	177.62	141.49
USA-AD-1082	21-May-2004	293369	179.48	285.63
USA-AD-1091	06-Apr-2005	590190	264.09	264.09
USA-AD-1095	19-Sep-2005	482010, 481022, 481190	258.21	258.21
USA-AD-1103	29-Jun-2006	380210	228.11	228.11
USA-AD-1104	29-Jun-2006	550320	44.3	44.3

Table 9: Trade destruction effect on the US at the product level

Time relative to invetigation	(1) **Participation dummy**	(2) **log of # of exporters**	(3) **log of export value**	(4) **log of export volume**	(5) **log of export price**
9 or More Quarters Before	-0.036	-0.132	-0.300	-0.147	-0.151
	(0.058)	(0.101)	(0.249)	(0.246)	(0.111)
8 Quarters Prior	0.084*	-0.105	-0.208	-0.034	-0.174*
	(0.048)	(0.081)	(0.210)	(0.194)	(0.101)
7 Quarters Prior	0.071	-0.086	-0.153	-0.023	-0.129
	(0.049)	(0.071)	(0.186)	(0.203)	(0.139)
6 Quarters Prior	0.075	0.010	0.051	0.158	-0.106
	(0.048)	(0.070)	(0.183)	(0.187)	(0.113)
5 Quarters Prior	0.084*	-0.080	-0.006	0.098	-0.104
	(0.049)	(0.064)	(0.172)	(0.177)	(0.113)
4 Quarters Prior	0.068	-0.192***	-0.129	-0.242	0.114
	(0.050)	(0.067)	(0.168)	(0.195)	(0.128)
3 Quarters Prior	0.017	-0.101*	0.021	0.107	-0.087
	(0.043)	(0.055)	(0.147)	(0.166)	(0.076)
2 Quarters Prior	0.045	0.018	0.136	0.112	0.024
	(0.041)	(0.048)	(0.151)	(0.163)	(0.071)
Investigation Starts	0.026	-0.129**	-0.170	-0.166	-0.003
	(0.038)	(0.063)	(0.147)	(0.176)	(0.088)
1 Quarter After	0.031	-0.195***	-0.268	-0.135	-0.133
	(0.048)	(0.070)	(0.202)	(0.218)	(0.126)
2 Quarters After	-0.037	-0.279***	-0.756***	-0.735**	-0.020
	(0.058)	(0.102)	(0.277)	(0.326)	(0.118)
3 Quarters After	-0.104**	-0.344***	-0.842***	-0.587***	-0.255*
	(0.052)	(0.092)	(0.237)	(0.223)	(0.137)
4 Quarters After	-0.129**	-0.411***	-1.069***	-0.986***	-0.087
	(0.052)	(0.113)	(0.293)	(0.315)	(0.135)
5 Quarters After	-0.124**	-0.412***	-0.797***	-0.546**	-0.252*
	(0.058)	(0.104)	(0.242)	(0.251)	(0.151)
6 Quarters After	-0.166***	-0.401***	-0.806***	-0.544*	-0.265**
	(0.061)	(0.135)	(0.274)	(0.310)	(0.133)
7 Quarters After	-0.176***	-0.567***	-1.725***	-1.525***	-0.205
	(0.054)	(0.123)	(0.407)	(0.388)	(0.197)
8 Quarters After	-0.183***	-0.536***	-1.439***	-1.436***	-0.005
	(0.055)	(0.137)	(0.378)	(0.403)	(0.177)
9 or More Quarters After	-0.151***	-0.600***	-1.529***	-1.494***	-0.036
	(0.053)	(0.131)	(0.319)	(0.321)	(0.148)
Product FE	Yes	Yes	Yes	Yes	Yes
Quarter FE	Yes	Yes	Yes	Yes	Yes
Observations	8236	6012	6012	6009	6009
Adjusted R^2	0.491	0.938	0.810	0.763	0.708

Standard errors clustered at the product level in parentheses.* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 10: Trade deflection effect on the RoW at the product level

Time relative to invetigation	(1) **Participation dummy**	(2) **log of # of exporters**	(3) **log of export value**	(4) **log of export volume**	(5) **log of export price**
9 or More Quarters Before	-0.035	0.115*	0.191	-0.001	0.192***
	(0.039)	(0.069)	(0.140)	(0.150)	(0.059)
8 Quarters Prior	0.059***	0.107	0.144	-0.027	0.172***
	(0.013)	(0.070)	(0.124)	(0.135)	(0.051)
7 Quarters Prior	0.056***	0.095	0.132	-0.004	0.136***
	(0.012)	(0.059)	(0.124)	(0.131)	(0.043)
6 Quarters Prior	0.050***	0.083	0.125	0.025	0.100**
	(0.011)	(0.053)	(0.126)	(0.133)	(0.045)
5 Quarters Prior	0.047***	0.045	0.098	0.017	0.082*
	(0.011)	(0.054)	(0.114)	(0.125)	(0.045)
4 Quarters Prior	0.026***	0.046	0.050	-0.037	0.087*
	(0.008)	(0.057)	(0.107)	(0.118)	(0.045)
3 Quarters Prior	0.004	0.073	0.083	-0.028	0.111
	(0.014)	(0.047)	(0.114)	(0.176)	(0.094)
2 Quarters Prior	-0.002	0.006	0.057	0.035	0.023
	(0.005)	(0.037)	(0.082)	(0.091)	(0.043)
Investigation Starts	-0.000	0.011	-0.268*	-0.278**	0.010
	(0.005)	(0.040)	(0.137)	(0.140)	(0.028)
1 Quarter After	0.030***	-0.099*	-0.497***	-0.488**	-0.009
	(0.009)	(0.051)	(0.192)	(0.206)	(0.045)
2 Quarters After	0.020**	-0.065	-0.349**	-0.353**	0.004
	(0.009)	(0.048)	(0.175)	(0.175)	(0.038)
3 Quarters After	0.018*	-0.066	-0.420***	-0.459***	0.039
	(0.010)	(0.052)	(0.149)	(0.154)	(0.041)
4 Quarters After	0.007	-0.120**	-0.531***	-0.568***	0.037
	(0.016)	(0.051)	(0.165)	(0.163)	(0.044)
5 Quarters After	-0.012	-0.105**	-0.539***	-0.579***	0.040
	(0.021)	(0.052)	(0.172)	(0.171)	(0.043)
6 Quarters After	-0.012	-0.203***	-0.552***	-0.556***	0.004
	(0.018)	(0.071)	(0.190)	(0.199)	(0.048)
7 Quarters After	-0.029	-0.222***	-0.517***	-0.606***	0.090*
	(0.023)	(0.070)	(0.172)	(0.178)	(0.051)
8 Quarters After	-0.019	-0.235***	-0.572***	-0.665***	0.093*
	(0.019)	(0.070)	(0.179)	(0.185)	(0.049)
9 or More Quarters After	-0.054***	0.014	-0.122	-0.332**	0.210***
	(0.012)	(0.077)	(0.160)	(0.165)	(0.059)
Product FE	Yes	Yes	Yes	Yes	Yes
Quarter FE	Yes	Yes	Yes	Yes	Yes
Observations	8804	8315	8315	8315	8315
Adjusted R^2	0.249	0.949	0.849	0.861	0.932

Standard errors clustered at the product level in parentheses.* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$