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Global value chains and the removal of trade protection☆

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ABSTRACT

This paper examines how trade protection is affected by changes in the value-added content of production arising through global value chains (GVCs). Exploiting a new set of WTO rules adopted in 1995 that impose an exogenously-timed requirement for countries to re-evaluate their previously-imposed trade protection, we adopt an instrumental variables strategy and identify the causal effect of GVC integration on the likelihood that a trade barrier is removed. Using a newly constructed dataset of protection removal decisions involving 10 countries, 41 trading partners, and 18 industries over 1995–2013, we find that bilateral industry-specific domestic value-added growth in foreign production significantly raises the probability of removing a duty. The results are not limited to imports from China but are only found for the protection decisions of high-income countries. Back-of-the-envelope calculations indicate that rapid GVC growth in the 2000s freed 15% of the trade flows subject to the most common temporary restrictions (i.e. antidumping) applied by high-income countries in 2007.

1. Introduction

The landscape of international trade has evolved considerably in recent decades with the emergence of global value chains (GVCs), which have been well documented by economists (e.g. see, for example, Baldwin and Lopez-Gonzalez (2015) for a descriptive analysis). Yi (2003) was one of the first to demonstrate that it is the combination of vertical specialization and tariff reductions, but not tariff reductions alone, that explains the significant growth in the trade share of output. More recently, Johnson and Noguera (2017) showed that the value-added share of gross manufacturing exports (as a measure of the extent of processing done in a given country) fell by 20 percentage points between 1970 and 2009, due partly to the signing of regional trade agreements. Both contributions reveal the close relationship between trade liberalization and GVC development.

There is a growing literature that examines the interrelationship of GVCs and trade policy. Blanchard (2007, 2010), Ornelas and Turner (2008, 2012), and Antràs and Staiger (2012) make theoretical contributions by examining the effect of offshoring and foreign direct investment (FDI) on optimal trade policy. The empirical literature that links GVCs to trade policy is less abundant

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due to previous data availability. Blanchard et al. (2017) and Mayda et al. (2021) are two papers that reveal how GVC development reduces the incentives to apply trade protection. Similarly, Blanchard and Matschke (2015) and Jensen et al. (2015) empirically show how trade policy has become endogenous to FDI and cross-border intra-firm trade. More recently, the trade war that began in 2018 gave rise to papers by Amiti et al. (2019) and Fajgelbaum et al. (2020), who focus on the welfare implications of trade protection, and Bellora and Fontagné (2019) and Flaaen and Pierce (2019) who also take global vertical linkages into account.

In this paper, we revisit the pre-Trump era and directly examine the effect of GVCs on trade policy. To do so, we exploit new rules introduced with the creation of the World Trade Organization (WTO) in 1995. Taking advantage of this exogenously-timed requirement for countries to re-evaluate their previously imposed trade protection, our setup resembles a quasi-natural experiment as it makes sure that the timing of the removal (or non-removal) decision is exogenous to the strategic decisions of firms and policymakers. Given this setup, we investigate whether growth in the importing country's domestic value-added (DVA) embedded in foreign production influences its trade policy. To take advantage of the granularity of the AD review data, we weight DVA growth by product-specific intra-firm trade shares. Considering that this weighted DVA growth in production might be affected by trade barriers in place, we use an instrumental variables strategy to identify the causal effect.

Our analysis combines a newly constructed dataset on the review of trade barriers with the OECD's Trade in Value Added (TiVA) estimates. It comprises 10 countries, 41 trading partners, and 18 (TiVA) industries over 1995–2013. The 10 policy-imposing countries we consider are four high-income (Australia, Canada, the EU, and the US) and six emerging (Argentina, Brazil, China, Mexico, India, and Turkey) economies that together accounted for 71% of world GDP and 65% of world imports in 2013. Our benchmark empirical result indicates that DVA growth in foreign production significantly raised the probability of removing antidumping duties (i.e. the most common form of non-tariff barriers) by high-income economies, explaining about 15% of these countries' reduction in trade protection in the mid-2000s.

With the availability of more direct measurements of GVCs, there are two papers that are closely related to ours. Blanchard, Bown, and Johnson (2017; BBJ in the following) develop a framework within a terms-of-trade model with political economy considerations to derive empirical predictions on the relevance of home and foreign value-added in foreign and domestic production respectively. Their empirical analysis (based on 14 countries and 16 sectors over 1995–2009) confirms that tariffs and temporary trade restrictions are applied less when GVC linkages are strongest, especially vis-à-vis China.[1] Following the predictions of this model and emphasizing political economy considerations, Mayda, Ludema, Yu, and Yu (2021; MLYY in the following) focus on the trade policies implemented by 28 countries towards China. Exploiting Chinese transaction-level data over 2002–2007, they find that countries curb their trade protection (i.e. both in terms of applied tariffs and antidumping) against China when their imports contain higher shares of DVA. Importantly, they show that this result is contingent upon the industries' political power as well as the customization of inputs.

In common with BBJ and MLYY, we also examine antidumping (AD) as the trade policy of interest. In fact, tariffs are applied to all trade partners (except for preferential tariffs) and change little over this time period. Instead, AD, which is used to address the injurious effects of unfair pricing, is bilateral, targets specific products (i.e. often defined at the 8- or 10-digit level of the Harmonized System (HS) classification), and is frequently used by the world's largest economies. Differently from these two papers, we rely on the exogenous timing of the possible removal of trade protection to identify the causal effect of GVCs on trade policy. Since 1995, the large majority of AD duties are applied for an initial period of five years due to WTO-mandated rules. As a result, AD can only be extended for another five years through an official expiry review. For our setup, this rule implies that the timing of the removal decision of a trade barrier is exogenous, and creates a suitable setting to analyze the effect of GVC development on the removal of trade protection.

There is anecdotal evidence that many countries have removed some AD duties from some of their most important GVC-partners. Table 1 panel (a) provides examples where an importer removed duties from export partners that had relatively higher DVA growth but extended them on others for the same product (e.g. in 2000, the US extended AD duties on Japanese *brass sheet and strip* but removed them from the Netherlands; between 1995 and 1999, US value-added in Japanese and Dutch basic metals production grew by -64% and 3% respectively). Table 1 panel (b) shows examples where an importer extended duties on goods that had relatively lower DVA growth but removed them from others imported from the same country. For example, in 2005, the EU had three duties on India up for expiry; it removed the ones on *non-alloy steel hot rolled flat products* and *cathode-ray color TV picture tubes* but extended the one on *steel wire rope*; the EU's DVA growth for the 'extended' sector was 32% while it reached 71% and 64% for the two 'removed' sectors respectively.

Our benchmark two-stage least squares result indicates that a one standard deviation increase in predicted weighted DVA growth in foreign production increases the probability of removal for high-income countries by 9.3 percentage points, which explains about a quarter of the mean removal probability of 36%. This effect is not at play for the emerging country sample, with some evidence suggesting that these countries' limited engagement in GVCs and inexperience in the AD system may explain the difference. The result for the high-income countries is robust to a battery of sensitivity checks, and is not driven by the most targeted country—i.e. China. In particular, taking the 5-year time exogeneity to the extreme, we uncover the same qualitative result when focusing only on the 109 duties that had to be reviewed by the US in 2000 as a result of the WTO's Anti-Dumping Agreement in 1995. As for the economic effects of our estimates, our back-of-the-envelope calculations indicate that the DVA growth in foreign production

[1] Temporary trade barriers include antidumping (which is the most commonly used), countervailing duties, and safeguards. Antidumping can be used in the presence of unfair pricing; countervailing measures are meant to rectify the effects of illegal subsidies; and safeguards can be introduced when countries face substantial import surges.

Table 1
Examples of AD removals.
Source: Authors' calculations using data from the GAD and TiVA.

(a) Same product-year, different exporters					
Importing country	Product (sector)	Year	Original year	What happened?	DVA statistics
Australia	Linear low-density polyethylene (chemicals)	2008	2003	Extend for Thailand, remove from Korea	90% growth for Thailand ($235M), 118% for Korea ($2.9B)
Turkey	Polyvinyl chloride (chemicals)	2008	2003	Extend for Germany, Italy, Romania, and the US, remove from Belgium, Finland, Greece, Hungary, Israel, and Netherlands	Average DVA growth for removed and extended countries are 95% and 59%, respectively
USA	Brass sheet and strip (basic metals)	2000	1988	Extend for Japan, remove from the Netherlands	−64% growth for Japan ($2.5B), 3% for the Netherlands ($216M)
(b) Same exporter-year, different products					
Importing country	Exporter	Year	Original year	What happened?	DVA statistics
Canada	USA	2000	1986, 1995, 1995	Extend for potatoes (agriculture) and refined sugar (food products), remove from jars (non-metallic products)	Highest DVA growth for non-metallic products of 29% (others had marginal or negative growth)
EU	India	2005	1999, 2000, 2000	Extend for steel wire rope (fabricated metals), remove from non-alloy steel hot rolled flat products (basic metals) and cathode-ray color television picture tubes (electronics)	DVA growth in order are basic metals (71%), electronics (64%), and fabricated metals (32%)
Mexico	USA	2010	2005, 1995, 2005, 2005, 2005, 2000	Extend for carbon steel tubing (basic metals) and four chemical products (chemicals), remove from beef (food products)	Highest DVA growth for food products of 10% (others had marginal or negative growth)

has resulted in about 0.15% of high-income country imports to be freed from trade protection in 2007, equivalent to about 15% of these countries' imports covered by AD.

This paper is related to three strands of the international trade literature. As mentioned above, BBJ and MLYY specifically address the issue of how GVCs affect trade policy decisions. Our paper is largely complementary to theirs but differs in substantial ways. First, we exploit the setup of the AD system by focusing on the removal of trade protection, whose timing is exogenously determined. Second, even though political economy considerations play a role in the introduction of AD duties, we largely close that channel by focusing on protection that is already in place. Third, in comparison to MLYY, we can take into account regional GVC developments in "Factory North America" and "Factory Europe" instead of only focusing on China (at the cost of using more aggregated industry-level data). Relatedly, whereas MLYY proxy for DVA using gross manufacturing trade data, we are also able to account for value-added arising through *indirect* exports. Finally, our analysis applies to the whole range of products subject to AD measures, and not only final goods as analyzed by BBJ, which is crucial since countries increasingly use temporary trade barriers (TTBs; i.e. antidumping measures, countervailing duties, and safeguards) on intermediates instead of final goods.

Second is the literature that examines trade protection along a country's supply chain. Bown (2018) finds evidence of increased use of AD on intermediate goods, threatening GVC linkages. He highlights that many of these TTBs do not expire "on time", ending up being quasi-permanent. This is systematically analyzed by Bown et al. (2021), who find that trade protection on inputs causes employment losses downstream in the US. Similarly, Vandenbussche and Viegelahn (2018) find that Indian firms that have to pay AD duties to import key inputs severely cut back in production. Hoekman and Leidy (1992) provide a simple model to explain how protection on upstream goods can cause downstream users to ask for protection as well. Erbahar and Zi (2017) develop this idea, and find evidence for cascading protection in the US by linking its TTBs through input–output tables. Papers that focus on the political economy channels of trade protection and domestic supply chains include Ludema et al. (2018) who find that verbal opposition by firms influence the outcome of US tariff suspensions proposed by downstream firms, and Gawande et al. (2012) who build on the protection-for-sale model of Grossman and Helpman (1994) and find that trade policy outcomes can be determined by downstream and upstream industries' "lobbying competition".

Third are the contributions on the duration of AD duties and their extensions. The long literature on AD seems to have mostly neglected these aspects, which are nonetheless essential.[2] Moore (2006) studies the US' AD expiry (or "sunset") reviews, and finds that the US generally followed the WTO's 5-year expiry rule, albeit with some (negative) biases against Chinese exporters. Cadot et al. (2007) consider 17 countries for 1979–2005 and using a survival analysis find that the WTO's 5-year expiry rule effectively shortened

[2] See Blonigen and Prusa (2016) for an extensive literature review on antidumping.

the duration of AD duties, thanks largely to the new users of AD. Gourlay and Reynolds (2011) analyze the US' administrative reviews and find that foreign exporters rarely request such reviews to lower the duties they face, potentially due to the high costs of the review process. Nita and Zanardi (2013) provide a comprehensive analysis of the EU's AD reviews, and note that AD duties are reviewed frequently in the EU, not just through expiry reviews but also through interim reviews, where duty *levels* are reviewed. When it comes to the analysis of AD extensions, the paucity of data may explain the few contributions in the literature.

In this paper, we construct a unique AD expiry-review database for four high-income (Australia, Canada, the EU, the US) and six emerging (Argentina, Brazil, China, India, Mexico, Turkey) economies for 1988–2013. We document that (i) once up for review, AD duties are removed half the time on average, (ii) duties on Chinese goods are less likely to be removed relative to duties on other countries' products, and (iii) the average duration of AD is longer than five years (except for Argentina). In this way, we contribute to the AD literature by establishing that part of protectionism might lie under the disguise of prolonging existing duties, which are not counted as "new" trade barriers in the existing literature. Furthermore, the newly collected dataset will help researchers better understand the review process, which turns out to be important as shown by the results in this paper.

In the next section we provide a brief overview of the AD process, with a focus on its review procedures. Section 3 describes the data and provides stylized facts. In Section 4 we explain the mechanism that ties GVCs and trade protection and how that determines our empirical methodology. In Section 5, we provide our results with robustness checks, dig deeper into the diverging results between high-income and emerging country samples, and present a quantification exercise. Finally, Section 6 concludes.

2. Antidumping process

Although countries have some flexibility in their AD administration, the process must follow the general framework set out by the WTO's Anti-Dumping Agreement of 1995. In short, a case is initiated by an industry lodging a petition that presents evidence of alleged sales of a given product from a given country at a price lower than its 'normal value' (i.e. dumping) that cause injury to the domestic industry.[3] Once a case is filed, the relevant authority (or authorities in some countries) pursues an investigation to verify the existence of dumping and injury. If there is evidence that dumping has caused (or threatens to cause) injury to the domestic industry, the administering authority imposes AD duties to rectify the effects of dumping. These duties are applied only to the countries specified in the original petition, with some firms facing substantially higher duties than others due to differences in dumping margins.

Until the introduction of the WTO's Anti-Dumping Agreement, there was no general rule about the length of an AD duty, which could have remained in place without any specific limit (except if the AD legislation of a country already included a time limit). Instead, Article 11.3 of the WTO's Anti-Dumping Agreement specifies that *"any definitive anti-dumping duty shall be terminated on a date not later than five years from its imposition ..., unless the authorities determine, in a review ..., that the expiry of the duty would be likely to lead to continuation or recurrence of dumping and injury"*.[4] Thus, duties are generally introduced for a 5-year period and can be extended beyond this initial time only upon completion of an expiry review. Similarly, measures cannot be removed at will (even by governments) without reviewing a case.[5] We exploit this WTO rule to make sure that the timing of the possible renewal of a duty is not strategically chosen by the domestic industry or policymakers. Thus, observations in our econometric analysis are duties that, legislatively, are supposed to expire in a given year during 1995–2013 (irrespective of whether or not an expiry review is conducted, as further discussed below). Therefore, a duty on a given country for a specified product may appear more than once in our analysis if that duty is extended at least once.

As an example, consider the case of the US duties on *brass sheet and strip* (part of the basic metals sector) imported from Japan and the Netherlands, as reported in Table 1 panel (a). The original petitions were filed by the US domestic industry in July 1987 and the investigation was concluded with the introduction of AD duties in December 1988. As a result of the newly introduced WTO rules, expiry reviews (separately for each country) were initiated in early 1999. Although continued evidence of dumping was found for both countries, material injury caused by imports from the Netherlands was not found. As a result, the AD duties against the Netherlands expired in April 2000, while those on Japan were extended for an additional five years. Absent the new regulations, it is likely that the AD duties against the Netherlands would not have been removed in 2000. The duties against Japan were further reviewed in 2005 and 2011 and extended in both cases.[6] In terms of our econometric analysis, this case provides us with four observations: one review for the Netherlands and three reviews for Japan. Notice that all observations pertain to the period after the WTO's Anti-Dumping Agreement, as we use this regulation to eliminate the endogeneity of a review's timing, not to define a difference-in-differences setup.

While countries have slightly different review procedures (as detailed in Appendix Section B), duties are generally subject to an expiry review if an interested party, or the authority in charge of AD policy, requests that such a review takes place. If there is no review initiated, then the duties expire at the end of their previously-set (e.g. 5-year) limit. Note that when an expiry review is not initiated, we still have an observation in our dataset for the year in which the duty does expire. Interestingly, the new WTO

3 See Blonigen and Prusa (2016) for a thorough description of the history and implementation of AD laws.

4 See https://www.wto.org/english/docs_e/legal_e/19-adp_01_e.htm for the description of Article 11.

5 Institutional framework of the AD makes it difficult for governments to remove duties prematurely. In fact, less than 5% of AD duties were removed before the 5-year mark in our sample, due largely to some emerging economies' imposition of 4-year measures. Excluding these investigations does not change our results.

6 The effective date of extension of the second review was April 2006 leading to an extension until 2011. Although outside of our sample period, these duties were extended also in 2017.

requirement applied to all AD duties in place in 1995, and not only to the ones implemented since the introduction of the agreement. As a result, a large number of duties, mostly imposed by high-income countries, were suddenly up for expiry in 2000 (see Figure B.1 in Appendix Section B). In a robustness check, we exploit this characteristic by focusing solely on US AD duties up for removal in the early 2000s.

3. Data

In the next two subsections, we present the data used in our analysis. In describing our dependent variable, we also provide more details in general about the removal of AD duties (e.g. by country and sector), as this aspect has not received much attention in the literature due to previous data unavailability.

3.1. Dependent variable: AD removals

In order to exploit the institutional setting of AD removals, we collected expiry-review data for all major AD users via official government sources.[7] These consist of four high-income (Australia, Canada, the EU, and the US) and six emerging countries (Argentina, Brazil, China, India, Mexico, and Turkey). Together, these countries' AD petitions made up 72% of the world AD caseload in 1995–2013, and they accounted for about 71% of world GDP in 2013. This unique dataset enables us to see the initiation, preliminary, and final decision dates, as well as whether the administering authority has decided to remove the duty. Note that not all AD duties are reviewed unless an interested party asks for a review to be carried out. As shown in Appendix Table B.2, out of the 1,844 unique duties in our dataset, 69% were subject to an expiry review (with significant heterogeneity across countries). This means that 567 duties[8] never had expiry reviews and thus they were let to expire in their due course (mostly in 5 years). The likelihood of an expiry review investigation and its cost depend on that country's institutional setting as explained in Appendix B.

We combine our database on AD expiry reviews with the original Global Antidumping Database (GAD) (Bown, 2015) to add duties that expired without an expiry review. This allows us to track each duty from its original imposition date to its expiry/removal regardless of whether the duties were officially reviewed before expiry (we also have investigations that were still in force as of end-2013, the end of our sample period). We create our dependent variable, which is whether the duties are removed or not, by proxying the year that the duties are "supposed to expire". This is simple for cases without an expiry review—for those we take the expiry year as the supposed-to-expire year. For measures with an expiry review, we take the final-decision year of the expiry review investigation as the year when measures are supposed to expire. Thus, for each investigation, we have a supposed-to-expire year variable and a dummy that indicates whether the duties are removed.

As a result, the dataset used in our econometric analysis includes each AD duty that was up for removal sometime in 1995–2013. Some duties appear only once, as they were not extended when up for renewal the first time, but some others reappear in different years if they were extended at least once during our sample period. For example, the US duties on Japanese *brass sheet and strip* described in Section 2 were subject to three expiry reviews in 1995–2013. In our benchmark regression with 1,184 observations, we have 814 unique AD duties. This means that the same duty appears, on average, 1.45 times in our sample. This is in line with the 37% average removal rate reported in the last row of Table 2, which indicates that, on average, almost two-thirds of duties are extended at a given time, resulting in many of the duties appearing more than once in our dataset.

Table 2 provides summary statistics on trade barrier removals for the sample used for our benchmark regression. The corresponding Table A.3 that uses the entire sample is in Appendix A.[9] Note that our regression sample is only about half of the entire sample due to three main reasons. First, our analysis starts from 2000, which corresponds to five years after the WTO's Anti-Dumping Agreement in 1995 that mandated expiry reviews, and thus we exclude reviews that occurred pre-2000. Second, we lose observations where the exporter is not one of the 63 countries that are in the TiVA dataset, which we rely on to compute our main independent variable as explained in the next subsection. Third, some observations lack the required controls that we include in our benchmark specification.[10] Still, the correlation for the removal rates between the two samples is 0.82. Before delving into statistics, it is important to mention that the US has the largest share (38%) of observations, followed by India (18%).

The first fact to notice from Table 2 is the 37% removal rate shown in the last row of column 3 (this share is 50% for the entire sample as shown in the last row of Table A.3 column 3). Nevertheless, this figure varies from a low of 14% for Turkey, to a high of 55% for Argentina. As shown in column 6, AD duties on the most frequently targeted country China are less likely to be taken off (25%).[11] In the following columns we examine the metals and chemicals sectors, the top AD-using industries making up 37% and 38% of observations.[12] Splitting the sample reveals that around half of high-income country observations are in the metals sector, whereas around 60% of emerging economy observations are in the chemicals sector. The removal rate for the metals sector is about the same as the average at 36% (column 9), while for the chemicals sector it is slightly larger than the average at 41% (column 12). Appendix B.1 provides more details on the data, with a focus on the duration and extension of duties. Among other statistics, the data reveals that AD duties, on average, last more than five years for all our countries except Argentina (who often imposes AD for two years instead of the usual five), and the ones imposed by the US last longest (12 years on average).

[7] See Appendix Table A.1 for each country's official online government source.

[8] This figure is 145 in the subset of observations that we use in our benchmark regression sample.

[9] We refer to the set of all observations that are in 1996–2013 as the "entire sample", even though we have collected data dating back to 1988. The reason why we exclude them is that AD duties did not have to abide by the maximum 5-year expiry-review rule before the WTO's Anti-Dumping Agreement in 1995.

[10] The regression sample also does not include the 385 observations that are collinear with the set of fixed effects in our benchmark specification.

[11] Running a simple regression of a removal dummy on a Chinese-exporter dummy (with importer-industry and year fixed effects) gives a coefficient of −0.24, significant at the 1% level.

[12] We include both basic and fabricated metals in the metals sector for our descriptive statistics.

Table 2
Summary statistics on AD reviews.

Importing country	(1) Number of duties due to expire	(2) Number of removals	(3) Removal share	(4) Number of duties due to expire on China	(5) Number of removals on China	(6) Removal share for China	(7) Number of duties due to expire (metals)	(8) Number of removals (metals)	(9) Removal share (metals)	(10) Number of duties due to expire (chem.)	(11) Number of removals (chem.)	(12) Removal share (chem.)
Australia	23	11	48%	2	1	50%	0	0	–	13	4	31%
Canada	81	38	47%	21	6	29%	51	27	53%	0	0	–
EU	128	61	48%	59	22	37%	32	18	56%	60	24	40%
USA	446	133	30%	120	18	15%	268	78	29%	72	18	25%
High-income	678	243	36%	202	47	23%	351	123	35%	145	46	32%
Argentina	22	12	55%	10	5	50%	14	9	64%	0	0	–
Brazil	84	27	32%	27	5	19%	22	9	41%	28	11	39%
China	69	28	41%	–	–	–	6	5	83%	54	18	33%
India	214	108	50%	76	30	39%	4	3	75%	192	98	51%
Mexico	36	12	33%	12	2	17%	23	9	39%	9	3	33%
Turkey	81	11	14%	46	4	9%	19	2	11%	21	7	33%
Emerging	506	198	39%	171	46	27%	88	37	42%	304	137	45%
Total	1,184	441	37%	373	93	25%	439	160	36%	449	183	41%

Notes: The sample covers the 2000–2013 period used in our benchmark regressions.

3.2. Independent variables

Our main independent variable, bilateral-industry-level growth in DVA, as well as our instruments are from TiVA. For the 1995–2011 period, TiVA computes country-industry-specific value-added content (in millions of $) for each country's exports of a particular industry in the following way:[13]

$$\mathrm{VA}_{isjx} = (\hat{\mathbf{V}}\mathbf{B}\ \mathrm{exports}_{jx})_{is}, \tag{1}$$

where VA_{isjx} is the value-added supplied directly and indirectly by country i's sector s to country j's gross exports of industry x. Here, $\hat{\mathbf{V}}$ is the diagonalized matrix of value-added to output ratios, $\mathbf{B} = (\mathbf{I} - \mathbf{A})^{-1}$ is the Leontief inverse matrix, where $\mathbf{A}$ is the matrix of input coefficients derived from the OECD's Inter-Country Input–Output tables, and $\mathrm{exports}_{jx}$ is country j's gross exports of x.

We use these value-added figures to first compute the total (i.e. $\sum_s$) share of country i's value-added in country j's exports of industry x. Then, using the proportionality assumption, we multiply this share with exporter j's total production of x, which is also provided by TiVA, to attain value-added figures for each country in another country's industry-level production (this can be done by simply replacing exports with production in Eq. (1)). We use the resulting domestic valued-added measures, DVA_{ijxt}, which vary by year t, to create our main regressor lagged 4-year log change in DVA_{ijxt} (cumulative growth rate).

Note that there is still debate among practitioners regarding the most appropriate way to estimate value-added figures at the bilateral (and sectoral) level. These concerns are largely focused on how thinly to divide the "pie" of value-added, and how to deal with its double-counted components. TiVA largely follows the methodology of Wang et al. (2013) who extend the framework of Koopman et al. (2014) to compute bilateral sector-specific value-added figures. Borin and Mancini (2019), for example, argue that this approach systematically underestimates foreign value-added in exports and propose an alternative method. Despite this potential mismeasurement, TiVA's reported value-added figures are very similar to the ones obtained using the procedure by Borin and Mancini (2019): in our sample the correlation of DVA growth using the two methodologies is 0.99.[14]

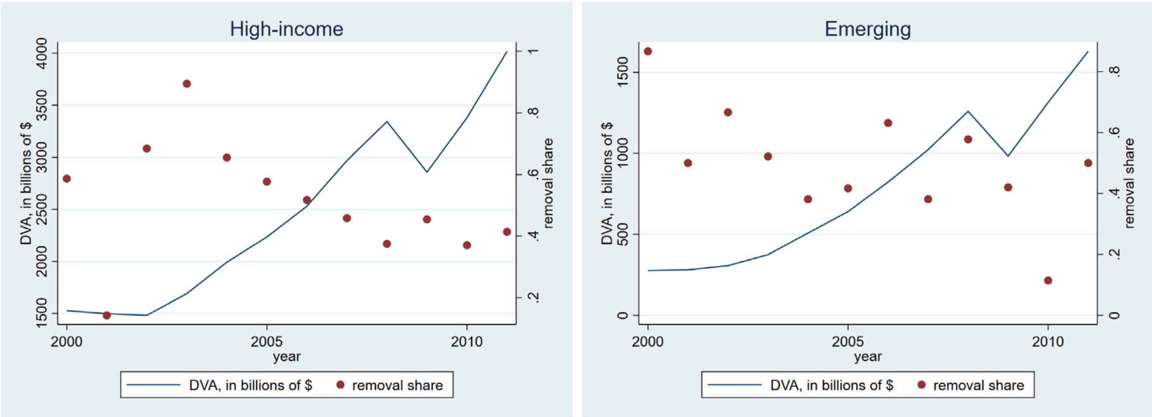
Fig. 1 plots DVA in foreign manufacturing in billions of $ (on the left axis) and removal shares (on the right axis), separately for high-income and emerging countries in our sample. Notice that the removal share is the number of removed country-product duties divided by the total number of country-product duties that are due to expire in a given year. Focusing first on panel (a), both graphs show that the DVA in foreign production has consistently increased since the early-2000s, except during the Great Trade Collapse in 2009, when the DVA in foreign production dropped sharply. Note, however, that the DVA levels of high-income countries are substantially larger than that of emerging countries—at its peak in 2011, the DVA of emerging countries stood at around $1.6 trillion, less than half of the $4 trillion of value-added provided by high-income countries for foreign production. Both graphs seem to indicate that there is a slight downward trend in removal shares alongside a growth of DVA levels in foreign production.

The graphs in panel (b) focus on the chemicals and metals sectors, the two industries with the most number of AD duties up for expiry. For high-income countries, there is a positive relationship between removal shares and DVA in metals that is not apparent for chemicals. The reverse is true for the emerging country sample: a slightly positive relationship between removal shares and DVA for the chemicals sector, but not for the metals sector.

[13] See https://www.oecd.org/sti/ind/tiva/TiVA2018_Indicators_Guide.pdf for a detailed explanation.

[14] We use the `icio` command in Stata developed by Belotti et al. (2020) to compute value-added figures.

(a) High-income versus emerging countries



(b) By sector

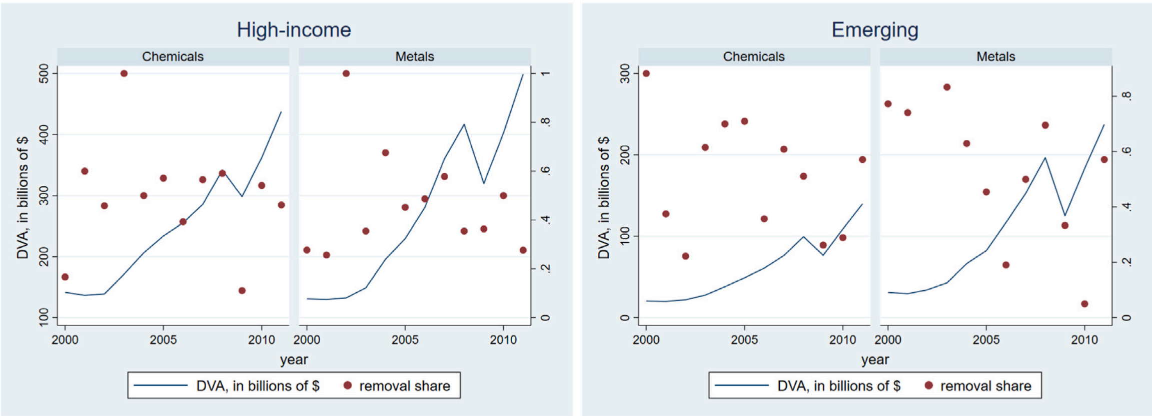


Fig. 1. DVA in foreign production and the share of removals.
Source: Authors' depictions using data from the GAD and TiVA.

Data limitations constrain our regression analysis in some ways. TiVA provides data for 63 countries only, and lumps the remaining countries into the “rest of the world" category. The list of 63 countries includes all our policy-imposing economies but not all the exporting countries in our sample. Thus, out of the 82 exporters in our data, we are able to include only 41 countries. Nevertheless, this set of countries includes the most frequently targeted countries: China, South Korea, Japan, the US, and the EU (including its individual countries).[15] The same database provides us with gross exports by exporter at the industry level which we use to construct our instrument (details are in Section 4). Note that the TiVA database ends in 2011 and since we use lags of DVA growth, we impute 2012 figures using 2011 data to take advantage of our full AD reviews data that ends in 2013 (in a robustness check we exclude 2013).[16]

Notice that our dependent variable, the removal decision, is at the investigation level, which varies at the country-pair and 6-digit Harmonized System (HS6) product level (most duties are applied at an even more disaggregate level than HS6, but we aggregate up to the internationally standardized HS6 level for cross-country comparison). To be able to match these investigations to TiVA industries, we first concord all HS6 to the HS1992 nomenclature to have a consistent set of products throughout our sample period.

[15] To make sure that the composition of the European Union does not change within our sample period, we use the EU15 definition (Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, and the UK).

[16] In 2018, the OECD released a newer version of TiVA for 2005–2016, but we prefer to use the 1995–2011 version to be able to include the rapid GVC expansion that occurred in 1995–2007. Unfortunately, the two versions cannot be easily aggregated due to methodological differences in calculating value-added. See https://www.oecd.org/industry/ind/tiva-2018-differences-tiva-2016.pdf for details. Also, our choice of TiVA as opposed to using the World Input Output Database (WIOD) is due to TiVA's broader coverage of countries (63 versus 40) for the required 1995–2011 period. Similarly, even though another frequently used dataset, the Eora Global Supply Chain Database, includes a large set of countries, it features only eight manufacturing sectors—too aggregated for our purpose of analyzing trade barriers at the product level.

Table 3
Summary statistics of regression variables.

	All (1,184 obs.)		High-income (678 obs.)		Emerging (506 obs.)		
Variable	(1) Mean	(2) Sd.	(3) Mean	(4) Sd.	(5) Mean	(6) Sd.	(7) t-test
$removal_{mijnht}$	0.372	0.484	0.358	0.480	0.391	0.489	−1.158
$\Delta \ln DVA_{injt-1} \times \omega_{mj}$	0.134	0.211	0.087	0.157	0.196	0.253	−9.103***
$\Delta \ln exch.\ rate_{ijt-1}$	0.004	12.857	−0.260	9.577	0.356	16.250	−0.816
$\Delta \ln TiVA\ output_{int-1}$	0.074	0.153	0.063	0.150	0.089	0.157	−2.898***
$\Delta \ln TiVA\ output_{jnt-1}$	0.094	0.178	0.103	0.182	0.082	0.173	2.003**
$\Delta imports_{ijmt-1}$	0.146	1.042	0.145	0.915	0.147	1.192	−0.039
$\ln employment_{iht-1}$	13.183	1.240	13.192	1.098	13.171	1.410	0.290
RTA_{ijt-1}	0.062	0.241	0.040	0.196	0.091	0.288	−3.632***
ω_{mj}	0.304	0.251	0.334	0.255	0.265	0.239	4.748***
$\Delta \ln exports_{jnt-1,-i} \times \omega_{mj}$	0.128	0.236	0.141	0.273	0.110	0.173	2.270**
$\Delta \ln DVA_{injt-1}$	0.529	0.496	0.343	0.414	0.779	0.488	−16.619***
$\Delta \ln exports_{jnt-1,-i}$	0.481	0.634	0.499	0.748	0.456	0.437	1.168
$\ln DVA_{injt}$	7.315	1.813	7.866	1.560	6.576	1.865	12.944***

Notes: The t-statistic in column 7 tests for the difference in the means between the high-income and the emerging country samples for each variable.

The US used a different coding system prior to 1988, and for those we use the Tariff Schedule of the United States Annotated (TSUSA) to HS concordance tables provided by Feenstra (1996). Then, we assign each investigation to one of the 18 tradable IO industries of the OECD's Trade in Value Added (TiVA) database using the HS6-ISIC Rev.3 and ISIC Rev.3-IO industry concordance tables provided by the UN Comtrade and OECD, respectively.[17] These industries are listed in Appendix Table A.2. Also, by using the HS6-ISIC Rev.3 correspondence tables, we link each investigation to a unique 4-digit ISIC Rev. 3 industry, which enables us to use importer–exporter-ISIC fixed effects.[18]

To make our main independent variable specific to the products under investigation, we multiply DVA growth rates by intra-firm trade shares of the targeted HS6-country since it is plausible that GVC participation is related to the extent of intra-firm trade observed in a given industry. We obtain these shares, classified according to the North American Industry Classification System (NAICS), from the US Census Bureau's NAICS Related Party Database.[19] The dataset provides the share of US imports transacted between related parties for each 6-digit NAICS and exporting country for 2005–2019. We use the earliest year available (i.e. 2005),[20] and concord NAICS to HS6 (using the conversion tables from Pierce and Schott, 2012) to map average bilateral intra-firm trade shares for each investigation (using weighted instead of average shares does not change the results as the correlation between these shares is 0.98). Thus, the share for, say, USA–Brazil in HS 870110 is also used for Canada–Brazil in HS 870110. We use the mirror intra-firm trade shares for observations when the US is the exporter (i.e. we assume that the share for USA–Brazil is the same as the share for Brazil–USA). These shares, which vary from 0% to 97% with a mean of 30% for the investigations in our sample (see Table 3), proxy for the GVC intensity of products under investigation. In robustness checks, we also experiment with product-based shares (i.e. not bilateral) to capture the fact that some goods are more prone to be involved in GVCs than others.

Throughout our analysis, we also include several other control variables. Industry output growth variables (for both importing and exporting countries) are from TiVA. Bilateral exchange rate growth rates are computed using data from the US Department of Agriculture (USDA). For import growth at the HS6 level, we use import data from UN Comtrade.[21] To control for time-varying political influence we include importer-industry employment data from UNIDO at the 2-digit ISIC Rev.3 level, and define a dummy variable for country pairs that are part of regional trade agreements (RTAs) using data from de Sousa (2012).

4. Methodology

The examples in Table 1 suggest that there is a relationship between DVA growth and trade protection, which we formally test in this paper. But why would we expect such a relationship to exist?

BBJ build a multi-sector multi-country model of trade policy with GVCs and show that final-good tariffs decrease in the DVA in those goods because of terms-of-trade motives. In this setup, higher tariffs would lower the world price of the good in question, which

[17] Note that in some cases with multiple HS6, an investigation can be mapped to multiple TiVA industries. In these instances, we select the industry that is mapped to the largest number of HS6 within that investigation, and in instances with ties (less than 2% of cases) we assign industries manually using the product description.

[18] Our benchmark sample has 47 unique 4-digit ISIC industries.

[19] This dataset is available at https://relatedparty.ftd.census.gov.

[20] Note that using another year would not change our results, as the correlation of these shares over time is very high (e.g. the correlation between 2005 and 2010 shares is 0.83).

[21] Note that an investigation might include multiple HS6; in those cases we aggregate imports to the investigation level by summing up import values for all targeted HS6.

in turn would hurt (i.e. reduce profits) domestic upstream producers. This is the case regardless of political economy considerations. They show that the optimal bilateral tariff imposed by country i on product x from country j in year t is given by:

$$tariff_{ijxt} = \beta_{ijxt} \times DVA_{ijxt} + \frac{1}{\varepsilon_{ixj}} + R_{ijxt}. \tag{2}$$

Here DVA_{ijxt} is value-added supplied directly and indirectly by i for j's production of x, $\beta_{ijxt} < 0$ captures non-time-varying importer-industry political economy weights, bilateral import-demand and export-supply elasticities, as well as time-varying bilateral product-specific imports, and $\frac{1}{\varepsilon_{ixj}}$ is the bilateral export-supply elasticity that is ubiquitous in terms-of-trade models. The last component R_{ijxt} is a collection of terms that captures non-time-varying political economy weights for upstream and downstream industries, bilateral import-demand and export-supply elasticities, time-varying bilateral product-specific imports, and foreign value-added FVA_{ixt}, which is value-added supplied directly and indirectly for i's production of x by all countries j except i.[22]

BBJ estimate a reduced-form of Eq. (2) and find that TTBs, especially against China, are applied less when GVC linkages, as proxied by high levels of DVA, are strong.[23] Our analysis is complementary to BBJ's, but differs in four significant ways. First, instead of examining the stock of imposed AD measures, we are focusing on AD removals. Second, instead of analyzing the relationship between DVA levels and trade policy in levels, we examine the effect of DVA *growth* on trade protection removals—since we have *changes* on the right-hand side, this enables us to difference out non-time-varying factors at the importer–exporter-TiVA industry level such as aggregate political economy weights.[24] Third, whereas BBJ analyze TTB coverage ratios at the importer–exporter-industry-year level, our observations are at the more disaggregate importer–exporter-investigation-year level, where an investigation refers to a set of HS6 products. Fourth, we include all types of goods in our analysis while they restrict their sample to final goods.

It is important to elaborate on BBJ's focus on final goods. Theoretically, they argue that the choice of input tariffs might influence the government's optimal final good tariffs via its effect on DVA_{ijxt} and FVA_{ixt}. Mainly due to this reason, the authors defer the simultaneous determination of input and final good tariffs and its empirical analysis to future research.[25] Note, however, that countries also provide value-added to other nations' production of intermediates through the supply of raw materials and services.[26] This means that intermediates can also be viewed as final goods from the perspective of suppliers further upstream. Thus, with this caveat in mind, our methodology based on BBJ's theoretical prediction is valid as long as potential additional motives that determine input tariffs are orthogonal (or at least not opposed) to the terms-of-trade incentive to remove AD duties on goods that contain large DVA, regardless of whether they are destined for final consumers or downstream producers. Note that an additional motive for removing tariffs could be to help downstream firms that import the targeted products. However, downstream firms do not have legal standing in AD investigations, and thus their interests cannot officially influence the removal decision. Still, in one of our robustness checks, we split the sample to final goods versus intermediates to verify that the mechanism is at play for both set of goods.

Based on Eq. (2), our estimating specification is given by:

$$removal_{mijnht} = \beta(\Delta \ln DVA_{ijnt-1} \times \omega_{mj}) + \alpha\omega_{mj} + \gamma \mathbf{X}_{mijht} + \theta_{ijh} + \delta_t + \epsilon_{mijnht}, \tag{3}$$

where our dependent variable is a binary indicator equal to 1 if the AD duty is removed. Notice that our analysis is framed at the investigation (m: set of targeted HS6 products) and year (t) level, with a bilateral importer–exporter (ij), TiVA industry (n), and ISIC sector (h) dimension. As explained in the data section, we assign investigations to industries using the targeted HS code information. Each investigation m, based on the targeted HS6, is matched to a unique ISIC industry h (one of the 79 ISIC Rev. 3 industries), and a unique TiVA IO industry n (one of the 18). Note that this aggregation from the product level to the industry level creates some random measurement error which is likely to attenuate our estimated coefficients.

Our main independent variable $\Delta \ln DVA_{ijnt-1} \times \omega_{mj}$ is the log growth of DVA of an importer i in the exporter j's production of targeted industry n in the last 4-years before the duty is supposed to expire (lagged 4-years generally corresponds to growth since last renewal/imposition)[27] weighted by intra-firm trade shares ω_{mj}, which we also control for separately. We use these shares to exploit the variation that comes from the granularity of the AD data. As shown by Alfaro and Charlton (2009) and Blanchard and Matschke (2015), products that tend to be traded within firm-boundaries plausibly drive DVA growth rates at a higher degree than ones that are traded at arm's length. Thus, one can assume that GVC participation is proportional to the share of intra-firm trade within an industry. As a result of this more disaggregate dimension for our key regressor, we are able to include importer–exporter-ISIC industry and year fixed effects to control for potential omitted variables. Applying intra-firm trade shares based on US data to all the importers in our dataset poses some limitations, and we explore alternative strategies for the construction of these shares in Section 4.1.

[22] See BBJ (2017) page 19 for equation (1) written in more detail as well as its derivation on page 12.

[23] BBJ also find empirical support for their prediction that high levels of FVA dampen incentives to raise tariffs.

[24] The optimal tariff depends on additional time-varying factors such as import penetration and FVA. To proxy for a change in import penetration, we control for import growth in all our regressions (product-level import penetration data is not publically available), and control for FVA as a robustness check. Controlling for these variables and focusing on log changes also help us address the heterogeneity in the β coefficient. The reason we do not include FVA growth in all our regressions is because it does not have a bilateral dimension and thus is highly collinear with our importer–exporter-industry fixed effects.

[25] BBJ also note that input tariffs in their sample were in general very low with little variation over time due to WTO commitments.

[26] For example, based on data from TiVA, we find that the share of services DVA in total DVA in China's exports of manufactures in 2011 was 56% for the EU, 48% for the US, 41% for Canada, and 38% for Australia.

[27] The correlation between the 4-years DVA growth rate and the DVA growth rate since last renewal/imposition is 0.87. We use the 4-years DVA growth rate since it enables us to retain the 133 observations where last renewal/imposition is before 1995.

Note that differently from BBJ, we use growth rates instead of DVA in levels because our dependent variable captures a *change* in trade protection instead of its level. As for the timing, we use a lagged 4-year DVA growth rate to be able to identify the DVA growth over a reference period, whose robustness to alternative definitions is verified.

An example should make the setup of our specification clearer. Table 1 panel (a) shows that Australia (i) removed duties on *linear-low density polyethylene* (m) imported from Korea (j) in 2008 (t). During 2003–2007, Australia's value-added in Korea's production of chemicals (n) grew by 118% ($\Delta \ln DVA_{ijnt-1}$), reaching \$2.9 billion. The average intra-firm trade share (ω_{mj}) for this product exported by Korea was 30%, making our key regressor, weighted DVA growth ($\Delta \ln DVA_{ijnt-1} \times \omega_{mj}$), 36%. For this observation, $removal_{mijnt}$ would be 1.

Following papers by Knetter and Prusa (2003) and Bown and Crowley (2013, 2014) who show the importance of macro variables in influencing trade policy, we include bilateral exchange rate growth in $\mathbf{X}$. We further control for importer-industry and exporter-industry output growth rates based on TiVA (n) classification,[28] and investigation m-specific bilateral lagged 4-year import growth rate that proxies for a change in import penetration ratios to be in line with the theory.[29] To proxy for time-varying political influence, we include lagged importer-industry log employment levels at the 2-digit ISIC Rev. 3 level.[30] We also control for RTAs since Johnson and Noguera (2017) have pointed out their significant influence in the development of GVCs.

We include importer–exporter-ISIC fixed effects, θ_{ijh}, to control for variables such as institutional differences across countries, lobbying power of certain industries (e.g. the US steel industry), differential treatment of certain exporters (e.g. China), and bilateral import-demand and export-supply elasticities. We add year fixed effects, δ_t, to capture global shocks such as the Great Recession. Having this restrictive set of fixed effects in our differenced model means that the variation in our main regressor weighted DVA growth comes from its demeaned fluctuations that are not captured by global conditions. We prefer to use the linear probability model instead of a probit specification as we have many fixed effects and thus can run into the incidental parameters problem. Still, we report the probit results in the robustness section.

Theory suggests that β is positive: DVA growth rate raises the probability that a trade barrier is removed. However, there are two challenges associated with interpreting the estimated β in Eq. (3) as a causal effect. First, ideally, we would want the possibility of removal to be randomly drawn for any duty in place. This is not the case, but the rule imposed by the WTO to review any existing AD duty every five years provides an exogenous timing for each measure, known in advance to firms but not adjustable. Second, our main independent variable is potentially endogenous to the fact that AD duties are in place—firms would be less likely to expand their GVCs if they face higher duties back home. Since all our observations consist of importer–exporter-product combinations that are already sitting under trade protection, simple OLS regressions would suffer from a selection bias. Thus, in order to identify the strictly exogenous portion of DVA growth in production, we use an instrumental variables strategy.

Our instrument, $\Delta \ln exports_{jnt-1,-i,-m} \times \omega_{mj}$, is the exporter j's industry n-specific 4-year log growth rate in exports to the rest of the world weighted by intra-firm trade shares ω_{mj}. The intuition behind this instrument is that an exogenous export supply shock would require more DVA from any country participating in that good's production. Note that the instrument does not include exports to the importing country i with the trade barrier in place so that it does not violate the exclusion restriction. Also, following Dauth et al. (2014), we exclude the importer's neighboring countries from $\Delta \ln exports_{jnt-1,-i,-m}$ to make sure that the export growth is not due to GVC-related demand shocks (e.g. excluding China's exports to Canada and Mexico in the instrument when considering an AD measure imposed by the US on China).[31] Moreover, the instrument excludes the HS6 product(s) that are sitting under AD to make sure that the export growth is not due to trade deflection. We use this instrument and estimate specification (3) using two-stage least squares (2SLS), clustering the standard errors at the country-pair level to account for correlated shocks (our results are robust to clustering at the importer–exporter-industry level).

An alternative and intuitive way to think about the relationship between GVCs and trade protection is based on an FDI/offshoring argument, whereby a country would not want to restrict imports that contain substantial DVA. This mechanism is proposed by Jensen et al. (2015), who show that increased vertical FDI and intrafirm trade has led to lower demands for AD protection by US companies.[32] Similarly, Blanchard and Matschke (2015) find that the US has given preferential market access through its Generalized System of Preferences scheme to countries that host US multinational affiliates that export back to the US. Applied to our framework of duty reviews, this would mean that increased GVC participation would increase the likelihood of removing trade barriers thanks to FDI and offshoring.

It is simple to change the main regressor in specification (3) to measure DVA in imports to reflect this alternative channel, as we do in one of our robustness checks (and the results are qualitatively the same). However, it is not possible to test one channel against the other since DVA in imports and DVA in foreign production are, by construction, very similar to each other since bilateral imports is included in foreign production. Since we use DVA growth as our regressor, these two variables might differ not because of GVC linkages, but if bilateral imports grow at a substantially different rate than foreign production.

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[28] We exclude exports from exporter-industry output growth rates.

[29] This variable, which is bound between −2 and 2, is calculated using the formula proposed by Davis et al. (1996) so that we retain periods with zero imports.

[30] The intuition behind this control variable is that industries with large employment are more likely to have some political influence in trade policy (Baldwin, 1989). Note that the time invariant portion of potential lobbying activity is captured by importer–exporter-ISIC fixed effects.

[31] Neighbor-country data are taken from CEPII's Gravity Database (Head et al., 2010).

[32] Note that certain downstream firms within an industry might support AD protection if it can lead to hurting their direct competitors. Since our study is at the industry-level, and not at the firm-level, we are not able to address this concern regarding within-industry competition for protection.

Table 3 shows the summary statistics for the variables in our benchmark specification. Columns 1 and 2 show the mean and standard deviation of the variables for the sample with all countries. Note that the total number of observations is 1,184, which excludes the 385 singletons that are collinear with the importer–exporter-ISIC fixed effects. The following columns focus on the split high-income and emerging country samples. Column 7 tests the difference in means for each variable between the two samples and reports the corresponding t-statistic. Note that removal rates are similar between the two samples (36% and 39%). However, DVA growth rates are significantly higher for emerging economies (78% versus 34%). Also, these countries are more likely to be in RTAs when compared to high-income importers (9% versus 4%). However, high-income economies have significantly larger log DVA levels (7.9 versus 6.6), and their AD duties target products that have higher intra-firm trade shares (33% versus 27%). The data reveal substantial heterogeneity in these shares, which we discuss in the next subsection.

4.1. Intra-firm trade shares

In our analysis, we use US intra-firm trade shares for all importing countries in our sample. Even though this is likely to alleviate endogeneity concerns, it assumes that intra-firm trade shares are similar across importing countries, which may be less plausible in some circumstances. For example, multinational corporations located in countries other than the US might have very different strategies to engage in related-party trade across products and trading partners, and this would make the US intra-firm trade shares significantly different from the ones of other countries. One concern is that this might cause a systematic bias in our results, even if the instrument continues to be strong. In this regard, the robustness checks carried out on various different samples (e.g. excluding Mexico) prove useful to dispel such a concern.

An alternative way to address this issue is to calculate intra-firm trade shares at the product level (i.e. ignoring the bilateral dimension), exploiting the fact that some products are more prone to participation in GVCs than others. Although this observation is correct on average, there is still significant variation within products across countries in the data and for the observations in our sample. For example, HS code 721250 (*certain flat rolled products of iron or steel*) is involved in almost 100 reviews in our sample with an average (non-bilateral) share of intra-firm trade of 25%. However, the actual shares for the 89 US reviews for HS 721250 included in our analysis (for which the intra-firm bilateral share is “correct") vary between 0% and 90%, with an average of 47%. Importantly, switching to intra-firm trade shares at the product level substantially reduces the variation in our main regressor. The standard deviation of bilateral product shares that we use in our benchmark analysis is 0.25 (with an average share of 0.30), whereas this figure falls to 0.15 (with an average share of 0.43) when we compute shares at the product level (on the sample of exporters included in the empirical analysis). To reconcile the product dimension and variation among exporters, we calculate these shares for the top 5 (China, Japan, Korea, Russia, and Taiwan) and top 10 (adding Brazil, Germany, India, Italy, and Thailand) targeted exporters in our sample.

A yet alternative possibility is to regress the bilateral US HS6 intra-firm trade shares on a set of country and HS6 fixed effects:

$$\omega_{js} = \theta_j + \theta_s + \epsilon_{js}, \tag{4}$$

where j indicates the trade partner and s the HS6 product. We can then use these estimated product fixed effects to construct $\hat{\omega}_m$ by averaging $\hat{\theta}_s$ for each investigation m that may include multiple HS6 lines. The econometric challenge of this approach is that the use of an estimated regressor would require a correction for the standard errors obtained from our IV regressions. As in, for example, Redding and Venables (2004), this correction is often done by using a bootstrapping procedure. In our setting, this is not trivial since the dataset used to generate the product fixed effects is different from the one used for the IV regressions, and the number of products is significantly higher (i.e. 1,964 HS6 products) than the number of exporters, which may give rise to a bias in the estimated product fixed effects in the bootstrap procedure. Notwithstanding these caveats, we show results with and without bootstrapped standard errors, to see whether these results are consistent with the benchmark analysis based on ω_{mj}.

Note that we can also ignore the intra-firm trade shares altogether and do not interact DVA growth. This comes at the cost of a less granular definition of our key regressor, as DVA is defined at the more aggregate TiVA sector level. Consistent with this choice, to have enough variation in our independent variable, we use exporter and importer-TiVA industry fixed effects and replace year fixed effects with year trends. We use this specification as another robustness check. Among the various options, we use the bilateral intra-firm trade shares in our benchmark analysis and report results based on the three possibilities discussed above right after the discussion of our main results and before engaging in a battery of robustness checks.

5. Results

Table 4 reports our main results. We start with the full sample before splitting it between high-income and emerging economies.[33] The first three columns report our benchmark results with year fixed effects while the last three columns use year trends instead to gain more variation.

Column 1 shows that the DVA growth coefficient is positive and significant at the 5% level when we use the entire sample. When we split the set of countries into two, results are qualitatively different. The DVA growth coefficient is positive and highly significant for high-income countries (in column 2), which indicates that a one standard deviation increase of the *predicted* 4-year

[33] The qualitative results would be unchanged if we used an interaction term for our main regressor to allow different effects for high-income and emerging countries but we prefer to split samples to allow flexible responses for all regressors.

Table 4
Main results.

Dep. var.: $removal_{mijnht}$	Benchmark with year FE			Year trends		
	(1) All	(2) High-income	(3) Emerging	(4) All	(5) High-income	(6) Emerging
$\Delta \ln DVA_{injt-1} \times \omega_{mj}$	0.620**	0.696***	−0.042	0.398**	0.638***	−0.554
	(0.239)	(0.263)	(0.531)	(0.190)	(0.205)	(0.458)
$\Delta \ln exch.\ rate_{ijt-1}$	0.000	0.002	0.001	0.001	0.002	0.002
	(0.001)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)
$\Delta \ln TiVA\ output_{int-1}$	−0.354**	−0.332	−0.075	−0.158	−0.156	0.128
	(0.177)	(0.222)	(0.210)	(0.131)	(0.147)	(0.285)
$\Delta \ln TiVA\ output_{jnt-1}$	0.018	−0.048	0.415**	0.038	−0.084	0.415**
	(0.141)	(0.157)	(0.204)	(0.139)	(0.151)	(0.202)
$\Delta imports_{ijmt-1}$	0.006	0.013	0.014	0.000	0.006	0.009
	(0.015)	(0.020)	(0.021)	(0.015)	(0.020)	(0.022)
$\ln employment_{iht-1}$	−0.195	−0.099*	−0.544***	−0.188	−0.106	−0.617**
	(0.119)	(0.057)	(0.145)	(0.117)	(0.067)	(0.252)
RTA_{ijt-1}	0.306**	0.542***	0.058	0.364***	0.617***	0.170
	(0.134)	(0.193)	(0.176)	(0.120)	(0.180)	(0.194)
ω_{mj}	−0.187	−0.442*	0.660	−0.103	−0.486*	1.058**
	(0.225)	(0.246)	(0.549)	(0.197)	(0.249)	(0.446)
$year_t$				0.011*	0.011	0.037**
				(0.007)	(0.008)	(0.018)
Importer–Exporter-ISIC FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	No	No	No
KP	59.2	52.9	13.4	64.3	55.2	15.8
Observations	1,184	678	506	1,184	678	506

Notes: Standard errors clustered by country-pair are in parentheses. Significance levels: * p<0.10, ** p<0.05, *** p<0.01.

Table 5
IV sensitivity.

Dep. var.: $removal_{mijnht}$	Alternative IV (HS2)			Instrument import growth		
	(1) All	(2) High-income	(3) Emerging	(4) All	(5) High-income	(6) Emerging
$\Delta \ln DVA_{injt-1} \times \omega_{mj}$	0.448**	0.674***	−0.354	0.822**	0.789**	0.712
	(0.222)	(0.231)	(0.423)	(0.387)	(0.374)	(0.787)
$\Delta \ln exch.\ rate_{ijt-1}$	0.001	0.003	0.001	−0.001	0.002	−0.000
	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.004)
$\Delta \ln TiVA\ output_{int-1}$	−0.205	−0.261	0.099	−0.547**	−0.517**	−0.115
	(0.198)	(0.265)	(0.288)	(0.238)	(0.250)	(0.396)
$\Delta \ln TiVA\ output_{jnt-1}$	0.057	0.074	0.208	−0.021	−0.060	0.403
	(0.135)	(0.192)	(0.168)	(0.154)	(0.147)	(0.318)
$\Delta imports_{ijmt-1}$	0.001	0.013	0.004	0.407***	0.290**	0.486
	(0.015)	(0.022)	(0.020)	(0.142)	(0.138)	(0.335)
$\ln employment_{iht-1}$	−0.233	−0.118	−0.532***	−0.348*	−0.097	−0.797**
	(0.150)	(0.073)	(0.144)	(0.180)	(0.078)	(0.324)
RTA_{ijt-1}	0.288**	0.507**	0.048	0.048	0.606**	−0.353
	(0.138)	(0.199)	(0.203)	(0.203)	(0.282)	(0.331)
ω_{mj}	−0.079	−0.363	0.940*	−0.181	−0.419	0.273
	(0.256)	(0.254)	(0.532)	(0.325)	(0.322)	(0.674)
Importer–Exporter-ISIC FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
KP	144.8	113.3	43.1	5.49	6.04	1.18
Observations	1,074	610	464	1,184	678	506

Notes: Standard errors clustered by country-pair are in parentheses. Significance levels: * p<0.10, ** p<0.05, *** p<0.01.

weighted DVA growth in foreign production increases the probability of removing an AD duty by 9.3 percentage points,[34] which is 26% of the mean removal rate of 36%. However, this result does not hold for emerging economies in column 3. The first-stage results in Appendix Table A.4 indicate that the instrument is positive and significant at the 1% level in all specifications of Table 4, with Kleibergen-Paap (KP) Wald-F statistics above the critical value of 16.4 (9.0) for 10% (15%) maximal IV size in columns 1–2 and 4–5 (3 and 6).

The last three columns of Table 4 replace year fixed effects with year trends, as a less demanding specification. The results are qualitatively the same, with column 5 showing that a one standard deviation increase in *predicted* weighted DVA growth increasing

[34] This is calculated as $0.696 \times 0.133 = 0.093$.

Table 6
Alternative strategies for intra-firm trade shares.

(a) High-income	(1) Product shares (top 5)	(2) Product shares (top 5), trends	(3) Product shares (top 10)	(4) Product shares (top 10), trends	(5) Estimated product shares (top 5)	(6) Estimated product shares (top 5), trends	(7) Estimated product shares (top 10)	(8) Estimated product shares (top 10), trends	(9) Without shares
$\Delta \ln DVA_{injt-1} \times \omega_m$	0.870*	0.721**	0.761	0.622*	1.277**	1.388**	0.986*	1.218**	
	(0.507)	(0.341)	(0.484)	(0.317)	(0.578)	(0.524)	(0.521)	(0.498)	
					[0.689]*	[0.632]**	[0.552]*	[0.504]**	
$\Delta \ln DVA_{injt-1}$									0.253**
									(0.116)
KP	26.5	50.4	26.1	49.0	47.4	56.5	54.9	63.0	25.6
Observations	682	682	682	682	682	682	682	682	873
(b) Emerging	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$\Delta \ln DVA_{injt-1} \times \omega_m$	−2.952	−1.679	−191.05	−1.731	−0.060	−0.930	−1.164	−1.985	
	(4.944)	(1.123)	(12,874)	(1.064)	(1.269)	(1.597)	(1.591)	(1.652)	
					[0.970]	[1.037]	[1.087]	[1.017]	
$\Delta \ln DVA_{injt-1}$									−0.317
									(0.217)
KP	0.92	9.24	0.00	8.64	10.1	8.96	7.54	8.88	19.6
Observations	507	507	507	507	507	507	507	507	688
Imp-Exp-ISIC FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Exporter FE	No	No	No	No	No	No	No	No	Yes
Importer-TiVA FE	No	No	No	No	No	No	No	No	Yes
Year trend	No	Yes	No	Yes	No	Yes	No	Yes	Yes
Year FE	Yes	No	Yes	No	Yes	No	Yes	No	No

Notes: All regressions include the controls used in Table 4; they are omitted in the table for clarity. Columns 5–8 use $\hat{\omega}_m$ as the interaction. Standard errors clustered by country-pair are in parentheses. Bootstrapped standard errors resampled by HS4 are in brackets. Significance levels: * p<0.10, ** p<0.05, *** p<0.01.

the probability of removal for high-income countries by 8.4 percentage points. Notice that using year trends increases the strength of the instrument for all three samples potentially due to increased variation in the instrument.

An interesting result that comes out from Table 4 is the non-significant coefficients of the macro variables (exchange rate growth, importer industry growth, exporter industry growth) that were found to be important determinants of AD petitions by high-income countries in the existing literature. For emerging economies, exporter industry growth positively affects the probability of AD removals. This is in line with the findings of Bown and Crowley (2014) who show that the number of AD initiations by emerging economies decrease with foreign GDP growth.[35] This reveals that emerging country AD authorities anticipate "continued likelihood of dumping" by exporters who face negative demand shocks in their own countries.[36] Surprisingly, import growth at the HS6 level (covering the products that are investigated) does not have a significant effect on the probability of removal. Note that this might be due to these imports being endogenous to AD protection, which we tackle in one of our robustness checks. The level of employment at the importer-industry level has a negative effect on the probability of removal, especially for emerging economies, hinting that large industries can put pressure on the administering authorities to keep duties in place. We also find that high-income countries are more likely to remove duties on their RTA partners. Finally, the intra-firm trade shares themselves tend to decrease the probability of removals by high-income countries. This result is intriguing, as it is consistent with the fact that downstream firms do not have legal standing in AD expiry reviews.

Comparing the results in Table 4 with the analogous OLS results reported in Appendix Table A.5 reveals that OLS coefficients have the expected positive sign in all specifications, but are statistically significant only in columns 1 and 4, with lower magnitudes. This negative bias of the OLS coefficient is possibly due to the measurement error in the DVA growth variable or an omitted variable that is related to removals and DVA growth in opposite ways. In either case, the bias suggests that having AD protection in place affects DVA growth, and that an instrument is needed to identify the exogenous variation in DVA growth.

Before engaging in a long list of robustness checks, Table 5 reports the results of two exercises related to the IV approach while Table 6 is dedicated to the issue of the trade shares discussed in Section 4.1. In the first three columns of Table 5, the instrument is calculated using exports at the 2-digit HS level, which allows for a more disaggregate definition of industry (i.e. 73 HS2 industries instead of 18 TiVA sectors). We do this exercise since the HS2 definition is closer to the HS6 products being investigated when compared to the more aggregate TiVA definition. Thus, the portion of DVA identified by HS2 exports in the first stage is plausibly

[35] Bown and Crowley (2013) find this result also for high-income countries for the pre-crisis (pre-2009) period.

[36] This "venting-out" via exports with "dumped" prices is formalized by Crowley (2010) who builds on the reciprocal dumping model of Brander and Krugman (1983).

more relevant to the removal decisions which are at the HS6 level. This causes us to lose 110 observations due to removing the exports of the investigated HS6 from the HS2 flows and thus having zero HS2 exports for cases that cover entire HS2 sectors. However, our instrument is stronger as indicated by the KP statistics. The magnitude of the effect is similar to the benchmark effect of 9.3 percentage points found in Table 4: a one standard deviation increase in predicted weighted DVA growth in foreign production raises the probability of removal by 8.7 percentage points for high-income countries.

In the last three columns of Table 5, taking into consideration that import growth might also be endogenous to AD in place, we instrument import growth with the importer's import growth of the same HS6 from the rest of the world ($\Delta imports_{imt-1,-j}$), which proxies for a demand shock. The positive and significant effect of DVA growth on AD removals by high-income countries is preserved. Note that the KP statistics with two endogenous regressors are still higher than the critical value (4.6) based on a 15% maximal IV size, but lower than the critical value (7.0) based on a 10% maximal IV size. Appendix Table A.6 shows the first-stage results of Table 5. Overall, the results in Tables 4 and 5 point to a clear conclusion: the decisions of high-income countries to remove trade barriers are (statistically and economically) affected by the extent of value chain integration.

Table 6 panels (a) and (b) report specifications based on the alternative strategies to construct intra-firm trade shares as discussed in Section 4.1, for high-income and emerging country samples respectively. We report only the coefficient of interest and omit the estimated coefficients of control variables for clarity. In the first four columns, we use product-specific intra-firm trade shares based on the top 5 and top 10 exporters defined in terms of involvement in AD reviews. Given the more limited variation in these shares compared to the bilateral ones used so far, we show results using year fixed effects and year trends, which are less demanding. The results are qualitatively similar to our benchmark findings with a significant effect of DVA growth on removals for high-income countries and no effect for emerging economies. The level of significance is generally higher when including the year trend. In unreported results, we verify that with year trends the key coefficient for high-income countries remains significant at the 10% level even when we use the group of top 15 or all exporters in the benchmark sample (i.e. 29 in total) to construct ω_m, while the coefficient for the emerging country sample is never statistically significant. As for the instrument, it performs well for the high-income countries, while the KP statistics are below the critical value for emerging economies.

Columns 5–8 of Table 6 report instead the results using product fixed effects estimated according to Eq. (4). Since $\hat{\omega}_m$ is generated in these specifications, we report conventional clustered standard errors as well as bootstrapped ones based on 200 repetitions for the estimation of the fixed effects, resampled within a given HS4. The results confirm our earlier findings. Explicitly controlling for country-wide effects seems to help in that the significance levels in columns 5–8 are higher than in columns 1–4 where the observed averages were used. As expected, the bootstrapped standard errors are generally larger than the conventional ones but the significance levels of our key regressor are virtually unchanged. As before, the coefficients are more precisely estimated when using year trends instead of year fixed effects. In unreported results, we find that our coefficient of interest remains significant at the 10% level even when we enlarge the sample for the estimation of the product fixed effects to the top 15 or all 29 exporters in the benchmark sample. Like in all previous results, we do not find a significant effect of DVA growth for the sample of emerging economies. Again, as indicated by the KP statistics, our instrument is strong for high-income countries but does not perform as well for emerging economies.

Finally, the last column of Table 6 sidesteps the concerns about these intra-firm trade shares by not using an interaction, at the cost of a more aggregate definition of our key regressor.[37] The results lead to the same conclusion: positive and significant effect of DVA growth on removals for high-income countries but no effect for emerging economies.[38] Overall, Tables 5 and 6 confirm that our benchmark results are not systematically affected by the IV strategy we follow, and the way in which we utilize US intra-firm trade data to exploit the granularity of AD reviews with sufficiently high KP statistics for both sample of countries.

5.1. Robustness checks

Table 7 panels (a) and (b) provide robustness checks for our high-income and emerging economy benchmark results respectively (columns 2 and 3 in Table 4). We report only the main coefficient and omit the control variables for clarity. In column 1, we separate importer-industry and exporter fixed effects to gain more variation, and find a slightly larger coefficient. In column 2, we employ a probit estimator since our dependent variable is a binary indicator, while in column 3 we cluster standard errors at the importer–exporter-TiVA industry level, and find similar results.[39] In column 4, we change our regressor to be DVA growth in imports instead of foreign production to test for the alternative FDI/offshoring channel. The results are qualitatively similar to our benchmark case, consistent with the fact that DVA in imports is constructed similarly to DVA in foreign production. In column 5, we use a 3-year (instead of 4) DVA growth rate, and obtain similar results.

In column 6 of Table 7, we control for lagged 4-year FVA growth to be more closely in line with the theory but it turns out not to be statistically significant, while our coefficient of interest is significant at the 5% level. In column 7, we add the log level of ad-valorem duties imposed in the original investigation as policymakers might be reluctant to remove large duties. This turns out

[37] Notice that in this case we are using year trends instead of year fixed effects. Otherwise, the instrument loses its strength since the year dummies absorb a lot of the variation in the first stage, even though none of them are statistically significant in the second stage.

[38] In terms of magnitude, the point estimates in columns 1–8 indicate that a one standard deviation increase in predicted DVA growth explains between 17% and 25% (and an overall average of 21%) of the reduction in duties, similar to the 26% effect found for our main specification. The effect from column 9 is slightly lower (i.e. 15%).

[39] Note that the number of clusters in that case increases from 56 to 136, leaving only five observations on average per cluster (for the high-income sample).

Table 7
Robustness checks on specification.

(a) High-income	(1) Importer-ISIC FE	(2) Probit	(3) Alt. cluster	(4) DVA in imports	(5) 3-yr DVA growth	(6) FVA growth	(7) Duty levels	(8) Product type	(9) Final goods	(10) Inputs	(11) Other barriers
$\Delta \ln DVA_{injt-1} \times \omega_{mj}$	0.761**	2.285**	0.696**	0.856***	0.546*	0.762**	0.706***	0.697**	1.386***	0.462*	0.660**
	(0.315)	(0.914)	(0.333)	(0.278)	(0.314)	(0.324)	(0.254)	(0.264)	(0.442)	(0.272)	(0.312)
$\Delta \ln FVA_{int-1}$						−0.113					
						(0.214)					
$\ln duty_m$							−0.056*				
							(0.029)				
$input_m$								0.057			
								(0.119)			
$\Delta \ln tariffs_{imjt-1}$											−0.049
											(0.074)
$TTBpetition_{imjt}$											−0.010
											(0.152)
KP	36.3	47.1	49.4	19.5	31.6	38.0	61.3	52.4	216.0	36.8	52.0
Observations	829	555	678	675	677	678	648	678	98	565	655
(b) Emerging	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
$\Delta \ln DVA_{injt-1} \times \omega_{mj}$	0.197	−0.739	−0.042	−0.023	0.153	−0.062	−0.274	−0.040	−2.040	−0.052	−0.051
	(0.272)	(2.390)	(0.619)	(0.320)	(0.613)	(0.520)	(0.761)	(0.539)	(8.640)	(0.588)	(0.529)
$\Delta \ln FVA_{int-1}$						0.113					
						(0.124)					
$\ln duty_m$							−0.043				
							(0.059)				
$input_m$								−0.296**			
								(0.128)			
$\Delta \ln tariffs_{imjt-1}$											0.060
											(0.062)
$TTBpetition_{imjt}$											0.052
											(0.100)
KP	30.2	8.96	9.00	32.6	16.9	17.1	9.16	13.4	0.57	12.3	13.8
Observations	653	372	506	495	506	506	419	506	34	461	492
Importer-ISIC FE	Yes	No	No	No	No	No	No	No	No	No	No
Exporter FE	Yes	No	No	No	No	No	No	No	No	No	No
Imp-Exp-ISIC FE	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: All regressions include the controls used in Table 4; they are omitted in the table for clarity. Panel (a) and (b) have robustness checks for the results in Table 4 columns 2 and 3 respectively. Column 2 reports slope estimates. Standard errors clustered by country-pair are in parentheses. In column 3, standard errors are clustered at the importer–exporter-TiVA industry level. Significance levels: * p<0.10, ** p<0.05, *** p<0.01.

to be the case, as shown by the negative and significant coefficient we find for $\ln duty_m$ for high-income economies.[40] Note that this specification results in a smaller sample size due to some observations missing duty levels and dumping margins.

In column 8, we control for whether the investigation targets an input rather than a final good. In fact, DVA might inherently be lower in the production of inputs, and thus excluding the input dummy might bias our main estimated coefficient.[41] The results show that type of good does matter (i.e. lower probability of removing AD on inputs) for emerging economies but not for high-income countries. As explained in Section 4, BBJ theoretically show that higher levels of DVA should dampen tariffs on final goods, but they are silent on tariffs on intermediates. Thus, in column 9, we restrict the sample to final goods, and in column 10, we focus on intermediates only.[42] In both columns, we find a positive and significant coefficient, but a larger one for final goods.

Finally, in column 11, we control for changes in other trade barriers since papers by Feinberg and Reynolds (2007) and Moore and Zanardi (2009) indicate that there might be substitution between the use of different trade barriers. We include lagged 4-year applied tariff growth and also a dummy indicating whether there was a new TTB petition during the "supposed-to-expire" year covering the

40 We obtain these duties from GAD and use dumping margins when the duties are not in ad-valorem form (e.g. specific duties in terms of quantities).

41 We assign each investigation to a type of product (i.e. final goods (including capital goods) and intermediates) using the Broad Economic Categories (BEC)-HS6 concordance table provided by the UN.

42 The majority of AD duties target intermediates, as shown by the much smaller sample size of final goods for both set of countries. Moreover, 97% of observations in our benchmark sample involve "processed goods" (as opposed to "primary goods"), indicating that almost all products in our sample are prone to global value chains.

Table 8
Robustness checks on sample.

(a) High-income	(1) No CHN exporter	(2) No MEX exporter	(3) No EU/ARG importer	(4) Exclude 2013	(5) No metals	(6) No chem.	(7) Imposed pre-2002	(8) Imposed pre-2002, trends	(9) Initiated reviews	(10) Initiated reviews, trends	(11) Include ROW
$\Delta \ln DVA_{injt-1} \times \omega_{mj}$	0.588*	0.707***	0.557*	0.596**	1.351*	0.701**	0.452	0.546**	0.335	0.407*	0.726***
	(0.293)	(0.260)	(0.307)	(0.263)	(0.725)	(0.323)	(0.320)	(0.244)	(0.232)	(0.222)	(0.259)
KP	50.6	52.2	39.3	55.7	45.8	40.2	76.2	60.4	34.9	38.9	54.6
Observations	476	676	550	627	315	531	565	565	541	541	689
(b) Emerging	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
$\Delta \ln DVA_{injt-1} \times \omega_{mj}$	0.380	−0.058	−0.071	−0.365	0.264	0.584	0.105	−0.375	0.021	−0.179	−0.005
	(0.571)	(0.532)	(0.518)	(0.653)	(0.551)	(0.491)	(1.548)	(0.993)	(0.450)	(0.482)	(0.516)
KP	9.88	13.6	14.4	9.61	6.94	21.0	1.70	3.02	22.5	16.8	13.5
Observations	335	500	484	460	418	201	234	234	342	342	518
Imp-Exp-ISIC FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	Yes

Notes: All regressions include the controls used in Table 4; they are omitted in the table for clarity. Panel (a) and (b) have robustness checks for the results in Table 4 columns 2 and 3 respectively. Column 2 of panels (a) and (b) exclude the EU and Argentina as an importer respectively. Columns 8 and 10 use year trends instead of year fixed effects. Standard errors clustered by country-pair are in parentheses. Significance levels: * p<0.10, ** p<0.05, *** p<0.01.

same HS6-exporter combination.[43] Column 11 shows that other trade barriers do not have a significant effect on removal decisions. In short, none of these methodological alternatives affect the previous qualitative result for either set of countries.

The next set of robustness checks, in Table 8, employs different samples with panels (a) and (b) dedicated to high-income and emerging countries, respectively. We start in column 1 by excluding China as an exporter since it is the most frequently targeted country by AD duties.[44] In column 2, we exclude Mexico as an exporter due to its large share of processing trade and special trading relationship with the US. In column 3 of panel (a), we exclude the EU from the sample of high-income countries as the EU also alters the duration of certain measures through interim reviews, which are not included in our dataset. In column 3 of panel (b), we drop Argentina from the sample since it has a distinct AD review procedure and often imposes AD duties for a shorter (2-year) duration. In column 4, we exclude 2013 since we had imputed 2012 DVA values using 2011 data (since the TiVA dataset stops in 2011). None of these modifications change our qualitative results.

In columns 5 and 6 of Table 8, we exclude the two most frequently targeted sectors, metals and chemicals respectively, and the coefficients remain positive, albeit at a lower level of significance. In column 7, we exclude trade barriers that were enacted after 2001 when China joined the WTO and the GVCs expanded at a faster rate. We engage in this check because DVA growth might have had an effect on the duties that were originally imposed after 2001. Even though our IV strategy should address this problem as our instrument is not related to the period when the duty was initially imposed, column 7 acts as a further robustness check on the selection issue. We find that in this case, the coefficient remains positive but not significant at the conventional levels. As this may be due to limited variation in these observations, we relax the specification and replace year fixed effects with year trends in column 8, and the coefficient becomes significant at the 5% level.

Note that by treating initiated and non-initiated reviews equally, we are assuming that the non-initiated reviews would not have led to extensions of AD measures if a review had been initiated. Considering that an interested party would not request a (costly) review if it knows that the duties are likely to be removed, this choice is reasonable. As a further check, in column 9, we focus on the initiated reviews (i.e. we exclude duties that expired without a review) and find a positive but insignificant coefficient. As we did in column 8, we use year trends in column 10 to recover some variation and find a significant coefficient for the subsample of initiated reviews. Finally, column 11 recovers some observations by imputing “rest of the world" DVA figures for exporters that are not in the TiVA dataset. Results are robust to these modifications. Importantly, in all columns for panel (a) and in columns 6, 9, and 10 of panel (b), the KP statistics are above the critical value.

Finally, as a further robustness check, we take the exogeneity of the timing of reviews to the extreme and consider AD duties imposed before 1995 and up for renewal in the US in 2000–2001.[45] Here, since our sample size is limited, we exclude industry fixed effects and use robust (instead of clustered) standard errors (and continue to include intra-firm trade shares as before). The first two columns of Table 9 show the results if we focus on the 109 duties (excluding eight singletons) up for expiry in 2000, at

[43] We thank John Romalis for sharing a sample of the tariff data used in Feenstra and Romalis (2014). This data is at the importer–exporter-SITC Rev.2-year level, and takes into account tariffs in trade agreements with their phase-in schedules, as well as other preference schemes provided to developing countries. We match this dataset with our investigations using the UN’s HS combined-SITC Rev.2 concordance table, and take the simple average tariff for each investigation which can include multiple HS6 codes. We take the log growth rate by first adding 1 to tariffs to include zeros.

[44] Kee and Tang (2016) use transaction-level data and show that their Chinese value-added estimate is higher than what is reported by IO-based estimates due to aggregation biases. Even though the importer–exporter-industry fixed effects should address this concern, our exclusion of China in this column is a further check on this issue.

[45] For this exercise, we only include the US since other countries already had some form of mandated review procedures for AD duties.

Table 9
The US AD reviews in 2000–2001.

Dep. var.: $removal_{mijnht}$	2000		2000–2001	
	(1)	(2)	(3)	(4)
$\Delta \ln DVA_{injt-1} \times \omega_{mj}$	1.453***	1.542**	1.405***	1.535**
	(0.484)	(0.622)	(0.476)	(0.605)
$\Delta imports_{ijmt-1}$		0.121**		0.112**
		(0.051)		(0.049)
$\ln employment_{iht-1}$		0.133		0.118
		(0.131)		(0.116)
ω_{mj}	0.024	0.231	0.049	0.216
	(0.332)	(0.341)	(0.318)	(0.336)
Exporter FE	Yes	Yes	Yes	Yes
Year FE	No	No	No	Yes
KP	14.0	12.4	17.1	13.9
Observations	109	109	118	118

Notes: Robust standard errors are in parentheses. Significance levels: * p<0.10, ** p<0.05, *** p<0.01.

the cost of being able to add (in column 2) only the import growth and employment controls because of the cross-section setup and the inclusion of exporter fixed effects. In the following two columns, we include duties up for renewal also in 2001, which enables us to include a year dummy in column 4. The estimated coefficient of interest is positive and highly significant in all four columns. The most conservative specification in column 4 indicates that a one standard deviation increase in predicted weighted DVA growth in foreign production increases the probability of removal by 15 percentage points—explaining 41% of the mean removal rate of 36.4% for this sample.

In conclusion, our results hold to a battery of robustness checks, dealing with methodological and conceptual sensitivities. Thus, there is strong evidence of the role of GVCs in the removal of AD duties for high-income economies but not for emerging economies. In the next section, we dig deeper into this diverging result before quantifying the effect for high-income countries.

5.2. Emerging economies

The robustness checks confirm that the effect of DVA growth on AD renewals is systematically different between high-income and emerging economies. This result is intriguing and deserves further investigation. First, we check whether this divergence is due to outliers. To this end, we re-estimated the specification in column 3 of Table 4 excluding one country at a time, one sector (as defined in TiVA) at a time, and chemicals and metals sectors for one country at a time. From the resulting 32 specifications (not reported here but available on request), we obtain only one significant estimate for our coefficient of interest (i.e. positive at the 10% level when excluding the chemicals sector in Mexico although the significance disappears if year fixed effects are replaced by year trends). Thus, it seems that the result for emerging countries is not due to outliers or data issues but must be explained by a different economic rationale.

In search for such a channel, a possible explanation may be that these emerging countries are not so much integrated in GVCs for them to play a role in determining the renewal of AD measures. To shed more light on this aspect, we calculated a country (or country-sector) involvement in GVCs. The literature uses various definitions, distinguishing between forward and backward linkages. To be internally consistent with the TiVA dataset that we use throughout the analysis, we use the same dataset for this exercise. For each country pair, sector, and year, TiVA provides the total DVA contribution of a country in the foreign production of a sector. For example, in 2000, China provided $3.6 billion worth of DVA in US production of motor vehicles worth $443 billion. Summing up over trade partners, China provided a total of $9.3 billion worth of DVA for the world production of motor vehicles (excluding production in China), which was worth $1.6 trillion in 2000 (i.e. a share of 0.57%; as a comparison, Mexico's corresponding share was 0.74%).

Using this data, we calculate two series on an annual basis: (i) the share of DVA/production for each of our importers (without an industry dimension) and (ii) the share of DVA/production for each of our importers in each TiVA sector (as in the numerical example above). Notice that these calculations are carried out on the whole of agricultural, mining, and manufacturing sectors (even though AD reviews for some countries do not necessarily span all of them). With these shares, we then calculate which importing country or which country-sector has a share above the median (i.e. in the top 5 of our 10 importers). At the country level, these statistics confirm that the importers in the high-income sample are always above the median with the exception of Australia in two years. China is the fifth country that is always above the median. If we were to add China to our high-income sample, our baseline specification would produce a point estimate for our regressor of interest that would be slightly larger and more precisely estimated than what is reported in column 2 of Table 4.

We observe more variation when we exploit the country-sector dimension. All sectors for the US and the EU are above the median DVA share and this is mostly the case for Canada as well. Instead, only 60% of the Australian observations are in the above category. As for the emerging countries, most Chinese sectors are above the median while Argentina and Turkey do not have any sector in any year with a share of DVA above the median. We exploit this variation and split the sample of emerging economies

Table 10
Emerging economies.

Dep. var.: $removal_{mijnht}$	Level of DVA		More recent samples			
	(1) Below	(2) Above	(3) From 2002	(4) From 2005	(5) From 2008	(6) From 2011
$\Delta \ln DVA_{injt-1} \times \omega_{mj}$	−0.190	1.081	−0.013	−0.169	0.389	6.890**
	(0.656)	(1.384)	(0.570)	(0.684)	(0.328)	(2.892)
$\Delta \ln exch.\ rate_{ijt-1}$	−0.000	0.007	0.001	−0.003	−0.003	−0.029
	(0.004)	(0.005)	(0.003)	(0.002)	(0.002)	(0.053)
$\Delta \ln TiVA\ output_{int-1}$	0.078	−8.851	0.214	−0.265	−0.469	−1.900
	(0.334)	(7.553)	(0.303)	(0.291)	(0.417)	(5.254)
$\Delta \ln TiVA\ output_{jnt-1}$	0.464**	−1.868**	0.368	0.311	0.759*	−2.902
	(0.214)	(0.849)	(0.230)	(0.336)	(0.385)	(3.210)
$\Delta imports_{ijmt-1}$	0.009	0.118**	0.014	0.014	0.001	−0.067
	(0.025)	(0.047)	(0.023)	(0.025)	(0.035)	(0.073)
$\ln employment_{iht-1}$	−0.569***	0.748	−0.301	−0.056	−0.115	−2.895
	(0.146)	(1.024)	(0.253)	(0.325)	(0.259)	(2.275)
RTA_{ijt-1}	0.029		0.046	0.071	0.134	−0.282
	(0.178)		(0.178)	(0.182)	(0.303)	(0.896)
ω_{mj}	0.789	−1.322	0.682	0.707	0.347	−2.513
	(0.677)	(1.969)	(0.595)	(0.668)	(0.517)	(2.154)
Importer–Exporter-ISIC FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
KP	9.74	21.3	11.8	10.9	108.3	9.12
Observations	418	81	453	377	258	72

Notes: Standard errors clustered by country-pair are in parentheses. Significance levels: * p<0.10, ** p<0.05, *** p<0.01.

based on whether the sector to which an AD review belongs to is below or above the median DVA level of that sector. The results of this exercise are reported in the first two columns of Table 10. The point estimates indicate a different economic behavior for our regressor of interest. The negative sign persists for the AD reviews in sectors with DVA levels below the median. Instead, the sign is positive for reviews pertaining to sectors with high levels of DVA involvement, although the effect is imprecisely estimated possibly because of the small sample size.[46] For the sample of high-income countries, only 10 observations fall into the category of below median DVA. Excluding these observations from our benchmark regression does not change the qualitative results but, as expected, leads to a higher estimated coefficient for our main regressor. Thus, it does seem that the level of GVC involvement may be key in explaining the determinants of AD renewals.

An alternative explanation for the conclusion reached for emerging economies could be due to their inexperience in the use of the AD system. Since these countries started using AD much later than the set of high-income countries, it may be the case that they are still learning how to implement it and the earlier years in the sample may be part of this movement towards a steady state. To consider this channel, we re-estimate the specification for emerging economies postponing the first year included in the sample. The last four columns of Table 10 report the results when the sample begins in 2002, 2005, 2008, and 2011, respectively. There is a consistent pattern: the point estimate of the coefficient of interest is positive for all the estimates on samples starting in 2008 or later, while it is always negative when earlier years are included. Furthermore, the estimate is significant when only the last three years of the sample are used. These results lend support to the hypothesis of some learning of the AD system taking place for emerging economies.

In conclusion, these results suggest that involvement in GVCs and learning are two possible explanations for our finding. It is also the case that these hypotheses are not mutually exclusive and possibly reinforce each other. In fact, 80% of emerging-country observations related to sectors with DVAs above median levels are in the years after 2007.

5.3. Quantification exercise

How important are our findings in terms of their economic magnitude for high-income countries? One way to answer this question is to use our estimates to calculate the change in the probability of AD removals if there had not been any DVA growth. With this piece of information, we can also calculate the share of trade freed from trade protection because of DVA growth. In other words, how different would the trade policy of high-income countries look like in the absence of GVCs?

Based on the specification of Table 4 column 2, Table 11 provides different ways to look at the economic effects of DVA growth on trade protection in high-income countries. In each case, we show the results for 2001 and 2007, which are chosen so as to compare periods with different DVA experiences and exclude the financial crisis. All these figures are based on a comparison between the actual 4-year DVA growth rates and a hypothetical scenario where these rates are zero (i.e. no change in GVC interrelationships).

[46] Replacing the year fixed effects with a trend does not change these results qualitatively. Estimating just one model with an interaction of the regressor of interest and an above dummy (and likewise for the instrument) would deliver similar conclusions (i.e. negative estimate for the main effect and positive coefficient for the interaction) but with a low KP statistic.

Table 11
Quantification exercise.

(a) 2001	(1) Number of duties up for expiry	(2) Avg. 4-year $\Delta \ln DVA_{injt-1}$	(3) Avg. (4-year $\Delta \ln DVA_{injt-1} \times \omega_{mj}$)	(4) % increase in removal probability	(5) % of imports freed	(6) % of AD protection freed
All high-income	32	9.48%	−0.11%	−0.29%	−0.00%	−0.02%
EU	4	11.39%	−0.30%	−0.39%	−0.00%	−0.01%
USA	25	13.31%	1.69%	7.37%	0.01%	0.16%
Chemicals	7	27.30%	10.16%	21.56%	0.05%	5.69%
Metals	20	0.89%	−4.00%	−9.74%	−0.07%	−1.02%
(b) 2007	(1)	(2)	(3)	(4)	(5)	(6)
All high-income	59	67.82%	26.33%	34.87%	0.15%	14.72%
EU	18	65.47%	20.04%	23.45%	0.06%	3.22%
USA	38	69.68%	30.79%	41.76%	0.11%	5.35%
Chemicals	8	71.74%	15.84%	20.29%	0.03%	4.37%
Metals	30	77.12%	36.61%	41.38%	0.97%	23.98%

Notes: All results are based on estimated coefficients from column 2 of Table 4. Column 2 reports the average 4-year DVA growth ($\Delta \ln DVA_{injt-1}$). Column 3 reports the average of intra-firm trade share weighted 4-year DVA growth ($\Delta \ln DVA_{injt-1} \times \omega_{mj}$). Figures in column 4 are the percentage increase in the removal probability when we compare predicted probabilities with observed $\Delta \ln DVA_{injt-1} \times \omega_{mj}$ and when $\Delta \ln DVA_{injt-1} \times \omega_{mj} = 0$. Figures in columns 5 and 6 are computed using average import coverage shares of AD duties, which we obtained from Bown (2011).

Column 2 reports the average observed increase in DVA for the AD duties up for renewal in a given year while column 3 shows the value for our regressor of interest, which is given by multiplying DVA growth rates with intra-firm trade shares. Since these shares are always below 1 (i.e. on average equal to 33%, as reported in Table 3), the values in column 3 are (substantially) lower than the actual DVA growth rates.[47] Column 4 shows that the average removal rate of AD duties for high-income countries is 35% higher in 2007 because of DVA growth while there is only a negligible effect (i.e. −0.29%) in 2001. Notice, first, the significant jump between the two years, which is due to the much higher DVA growth rates that countries experienced over the more recent period, as shown in columns 2 and 3.

We can translate the number of duties removed due to DVA growth into trade coverage ratios using figures from Bown (2011). We find that, on average, 0.15% of high-income manufacturing imports were freed from AD duties in 2007 because of the increase in DVA. To put these figures in context, column 6 translates the effects in terms of reduced AD protection: around 15% of AD protection were removed due to DVA growth in 2007 while, again, the effect in 2001 is essentially zero. Considering that in 2007 the stock of AD duties covered 1% of these high-income countries' total imports, this quantification exercise highlights the role of GVCs in shaping trade policy, and how these effects can be hidden in the "details" of the AD system (i.e. never reaching headline news).

Table 11 also shows that the aggregate results hide significant country and sector heterogeneity. The US seems to experience more freer trade than the EU in 2007, possibly due to the smaller number of duties up for expiry in the EU. At the sector level, the metals sector records the largest effect in 2007, which is consistent with the prime role of this sector in the use of AD and the substantial growth of its GVCs in the second part of the sample (while it experienced a GVC contraction in the years up to 2001). Furthermore, it is important to notice that similar DVA growth rates across sectors result in changes of different magnitudes depending on the intra-firm trade shares, which vary significantly across products.

While these results allow us to put the estimates in perspective and point out the significant role of GVCs in shaping trade policy, it is important to keep in mind the caveats that go with such an exercise. First, note that our main quantification result corresponds to the growth in DVA during 2003–2007, when international trade grew exceptionally. Thus, the counterfactual figures would be smaller in periods with slower growth in trade. Second, the calculations regarding trade ratios do not take into account how duties of different levels may have different coverage in terms of goods in differently sized markets. Here, we assume that the duties are identical (in a given market or sector), which is correct only "on average", but also note that the number of duties up for renewal in a given year is often not large (32 in 2001, and 59 in 2007).

6. Conclusion

The interaction of global value chains and trade policy has turned out to be an important avenue of research, especially with the 2018–2020 US–China trade tensions that threatened to disrupt established cross-border linkages. To contribute to this research, we exploited the exogenously imposed timing of AD reviews and tested the effect of DVA growth on the removal of trade protection. Our analysis is based on the motivation that domestic firms will favor the removal of trade barriers on goods that contain their own value-added, and Blanchard et al.'s (2017) theoretical prediction that countries have an incentive to remove trade barriers on products that have large domestic content due to terms-of-trade considerations.

[47] Figures in column 3 can be negative even when the averages in column 2 are positive (e.g. when DVA growth is negative for products with relatively high intra-firm shares).

To this end, we assembled a unique AD expiry-review database for four high-income (Australia, Canada, the EU, the US) and six emerging (Argentina, Brazil, China, India, Mexico, Turkey) economies for 1988–2013 to construct our dependent variable capturing whether an AD duty up for renewal is removed or not. The TiVA dataset from the OECD provided us with data on DVA growth, which we interacted with product-specific intra-firm trade shares to make it vary at the same level of AD reviews. By exploiting WTO rules introduced in 1995 and instrumenting DVA growth in foreign production with exogenous export supply shocks, our benchmark result for high-income countries showed that a one standard deviation increase in weighted DVA growth increased the likelihood of removing a trade barrier by 9.3 percentage points. This result is highly robust to alternative specifications and samples, including the set of US AD duties that suddenly came up for review in 2000. Instead, this conclusion does not hold for the sample of emerging economies. This different outcome is not due to a specific country or sector but can be explained by the low level of GVC engagement of these countries and some learning on their part in the use of the AD system, which they all introduced more recently than the high-income countries. In fact, taking these considerations into account led to results in line with the conclusions reached for high-income countries, albeit not statistically significant because of the few observations when restricting the sample accordingly.

Our back-of-the-envelope calculations showed that DVA growth in foreign production has resulted in an increase in the probability of AD removals of around 35%, equivalent to a reduction of 15% in AD trade coverage. Thus, our results reveal that trade policy is not only becoming endogenous to GVC linkages in the world but that the effects are economically large. Thus, our results can potentially shed light on another channel through which GVC expansion contributed to the reduction of trade barriers, benefiting consumers and improving economic efficiency, but also creating additional adjustment pressure impacting workers especially in import-competing sectors.

Appendix A. Appendix tables

See Tables A.1–A.6.

Table A.1
Data sources.

Policy-imposing country	Data source
Argentina	https://www.argentina.gob.ar
Australia	https://www.industry.gov.au/regulations-and-standards/anti-dumping-and-countervailing-system
Brazil	http://www.mdic.gov.br
Canada	http://cbsa-asfc.gc.ca/sima-lmsi/menu-eng.html
China	http://english.mofcom.gov.cn
EU	http://trade.ec.europa.eu/doclib/cfm/doclib_search.cfm
India	http://www.dgtr.gov.in
Mexico	https://www.gob.mx/se/acciones-y-programas/industria-y-comercio-unidad-de-practicas-comerciales-internacionales-upci
Turkey	https://www.ticaret.gov.tr/ithalat/ticaret-politikasi-savunma-araclari
USA	https://www.usitc.gov

Table A.2
TiVA industries.

TiVA industry	TiVA industry code	Share of observations
Chemicals and chemical products	C24	31.37%
Basic metals	C27	29.25%
Fabricated metal products except machinery and equipment	C28	5.96%
Textiles, textile products, leather and footwear	C17T19	4.49%
Food products, beverages and tobacco	C15T16	4.18%
Rubber and plastics products	C25	4.06%
Machinery and equipment n.e.c	C29	4.02%
Pulp, paper, paper products, printing and publishing	C21T22	3.02%
Other non-metallic mineral products	C26	2.94%
Manufacturing n.e.c; recycling	C36T37	2.59%
Computer, electronic and optical products	C30T33X	2.36%
Electrical machinery and apparatus n.e.c	C31	1.78%
Other transport equipment	C35	1.24%
Wood and products of wood and cork	C20	0.85%
Agriculture, hunting, forestry and fishing	C01T05	0.62%
Coke, refined petroleum products and nuclear fuel	C23	0.50%
Mining and quarrying	C10T14	0.50%
Motor vehicles, trailers and semi-trailers	C34	0.27%

Notes: Based on the 2,585 observations in our sample.

Table A.3
Summary statistics on AD reviews for the entire sample.

Importing country	(1) Number of duties due to expire	(2) Number of removals	(3) Removal share	(4) Number of duties due to expire on China	(5) Number of removals on China	(6) Removal share for China	(7) Number of duties due to expire (metals)	(8) Number of removals (metals)	(9) Removal share (metals)	(10) Number of duties due to expire (chem.)	(11) Number of removals (chem.)	(12) Removal share (chem.)
Australia	164	118	72%	21	15	71%	15	13	87%	78	50	64%
Canada	252	143	57%	36	14	39%	157	86	55%	2	2	100%
EU	348	232	67%	97	46	47%	87	61	70%	137	82	60%
USA	686	224	33%	137	22	16%	403	114	28%	102	33	32%
High-income	1,450	717	49%	291	97	33%	662	274	41%	319	167	52%
Argentina	192	128	67%	48	23	48%	74	46	62%	19	12	63%
Brazil	150	68	45%	38	8	21%	39	22	56%	50	26	52%
China	120	45	38%	–	–	–	10	8	80%	87	29	33%
India	329	203	62%	87	37	43%	18	17	94%	242	138	57%
Mexico	171	71	42%	57	19	33%	71	29	41%	41	16	39%
Turkey	173	63	36%	61	10	16%	36	10	28%	53	32	60%
Emerging	1,135	578	51%	291	97	33%	248	132	53%	492	253	51%
Total	2,585	1,295	50%	582	194	33%	910	406	45%	811	420	52%

Notes: The sample covers the entire 1996–2013 period.

Table A.4
First-stage for Table 4.

	Benchmark with year FE			Year trends		
Dep. var.: $\Delta \ln DVA_{injt-1} \times \omega_{mj}$	(1) All	(2) High-income	(3) Emerging	(4) All	(5) High-income	(6) Emerging
$\Delta \ln exports_{jnt-1,-i} \times \omega_{mj}$	0.347***	0.328***	0.561***	0.386***	0.368***	0.604***
	(0.045)	(0.045)	(0.153)	(0.048)	(0.050)	(0.152)
$\Delta \ln exch.\ rate_{ijt-1}$	0.001**	0.001	0.001***	0.001**	0.001	0.001**
	(0.000)	(0.001)	(0.001)	(0.000)	(0.001)	(0.000)
$\Delta \ln TiVA\ output_{int-1}$	0.022	0.076	0.122*	0.054	0.015	0.146*
	(0.044)	(0.075)	(0.063)	(0.043)	(0.046)	(0.083)
$\Delta \ln TiVA\ output_{jnt-1}$	0.014	−0.001	0.075	0.023	0.012	0.059
	(0.035)	(0.042)	(0.067)	(0.036)	(0.045)	(0.058)
$\Delta imports_{ijmt-1}$	0.002	−0.003	0.010**	0.009**	0.004	0.012**
	(0.004)	(0.004)	(0.005)	(0.004)	(0.005)	(0.005)
$\ln employment_{iht-1}$	−0.032	−0.023	−0.037	−0.025	−0.023	−0.017
	(0.024)	(0.030)	(0.081)	(0.024)	(0.034)	(0.075)
RTA_{ijt-1}	−0.071*	−0.039	−0.121**	−0.100***	−0.048	−0.113**
	(0.039)	(0.070)	(0.048)	(0.038)	(0.060)	(0.055)
ω_{mj}	0.384***	0.179**	0.549***	0.371***	0.183**	0.528***
	(0.074)	(0.073)	(0.111)	(0.074)	(0.078)	(0.108)
$year_t$				0.002	0.003*	0.002
				(0.002)	(0.002)	(0.006)
Importer–Exporter-ISIC FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	No	No	No
Adj-R^2	0.74	0.60	0.82	0.73	0.56	0.81
Observations	1,184	678	506	1,184	678	506

Notes: Standard errors clustered by country-pair are in parentheses. Significance levels: * p<0.10, ** p<0.05, *** p<0.01.

Table A.5
OLS results.

	Benchmark with year FE			Year trends		
Dep. var.: $removal_{mijnht}$	(1) All	(2) High-income	(3) Emerging	(4) All	(5) High-income	(6) Emerging
$\Delta \ln DVA_{injt-1} \times \omega_{mj}$	0.297**	0.186	0.174	0.238*	0.257*	0.052
	(0.138)	(0.179)	(0.176)	(0.128)	(0.145)	(0.208)
$\Delta \ln exch.\ rate_{ijt-1}$	0.000	0.002	0.001	0.001	0.002	0.001
	(0.001)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)
$\Delta \ln TiVA\ output_{int-1}$	−0.321*	−0.223	−0.094	−0.133	−0.108	−0.026
	(0.175)	(0.224)	(0.200)	(0.133)	(0.145)	(0.243)
$\Delta \ln TiVA\ output_{jnt-1}$	0.015	−0.065	0.403*	0.045	−0.072	0.362*
	(0.141)	(0.156)	(0.205)	(0.139)	(0.152)	(0.213)
$\Delta imports_{ijmt-1}$	0.007	0.010	0.013	0.002	0.010	−0.001
	(0.015)	(0.020)	(0.021)	(0.015)	(0.020)	(0.021)
$\ln employment_{iht-1}$	−0.211*	−0.122**	−0.524***	−0.204*	−0.142*	−0.557**
	(0.119)	(0.053)	(0.131)	(0.117)	(0.075)	(0.240)
RTA_{ijt-1}	0.294**	0.520***	0.076	0.349***	0.602***	0.236
	(0.139)	(0.170)	(0.176)	(0.119)	(0.170)	(0.171)
ω_{mj}	−0.007	−0.266	0.486**	−0.011	−0.337	0.560**
	(0.195)	(0.279)	(0.239)	(0.189)	(0.277)	(0.228)
$year_t$				0.012*	0.014*	0.033**
				(0.006)	(0.008)	(0.016)
Importer–Exporter-ISIC FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	No	No	No
Adj-R^2	0.10	0.12	0.12	0.09	0.10	0.08
Observations	1,184	678	506	1,184	678	506

Notes: Standard errors clustered by country-pair are in parentheses. Significance levels: * p<0.10, ** p<0.05, *** p<0.01.

Table A.6
First-stage for Table 5.

	Alternative IV (HS2)			Instrument import growth		
	(1) All	(2) High-income	(3) Emerging	(4) All	(5) High-income	(6) Emerging
	Dep. var.: $\Delta \ln DVA_{injt-1} \times \omega_{mj}$			Dep. var.: $\Delta \ln DVA_{injt-1} \times \omega_{mj}$		
$\Delta \ln exports_{jnt-1,-i} \times \omega_{mj}$	0.598***	0.583***	0.828***	0.346***	0.326***	0.551***
	(0.050)	(0.055)	(0.126)	(0.045)	(0.044)	(0.156)
$\Delta imports_{imt-1,-j}$				0.006	0.015*	−0.002
				(0.006)	(0.009)	(0.009)
				Dep. var.: $\Delta imports_{ijmt-1}$		
$\Delta \ln exports_{jnt-1,-i} \times \omega_{mj}$				−0.207	−0.171	−0.785
				(0.201)	(0.221)	(0.601)
$\Delta imports_{imt-1,-j}$				0.259***	0.328***	0.186
				(0.079)	(0.096)	(0.116)
Importer–Exporter-ISIC FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,074	610	464	1,184	678	506

Notes: Table reports the instruments only and omits the control variables for brevity. Standard errors clustered by country-pair are in parentheses. Significance levels: * p<0.10, ** p<0.05, *** p<0.01.

Appendix B. Institutional setting

Countries differ in how they administer antidumping protection. Some countries such as the US and Canada have a dual-track system where dumping and injury determinations are made separately by two different bodies. The EU and most other countries have a single-track system, where the same government body examines dumping, injury, and their causality. Countries also differ in how they administer reviews for existing AD duties. These differences influence how frequently AD duties go through expiry reviews, and when they do, how likely they are to be extended. Since these differences might influence the probability of a trade barrier being removed, we briefly explain each country's AD review mechanism in this section. For readers interested in the details, Table B.1 shows the official online sources for each country's AD review mechanism.

Among the high-income economies in our sample, the US and Canada follow a similar approach. In the US, the International Trade Administration (ITA) of the Department of Commerce publishes in the Federal Register a notice of initiation of a review of AD duties (also called "sunset" reviews), and if no interested party responds, then the duties expire in their scheduled date. If interested parties do respond adequately to the notice of initiation, the ITA (for dumping) and the International Trade Commission (ITC; for injury) conduct full reviews jointly, as in original AD investigations. Note that the ITA also conducts annual administrative reviews

Table B.1
Government sources for AD review procedures.

Policy-imposing country	AD review administering authority	Source
Argentina	The National Commission for Foreign Trade	http://www.sice.oas.org/antidumping/legislation/arg/766_e.asp
Australia	The Anti-Dumping Commission	https://www.adcommission.gov.au/accessadsystem/continuationinquiries/Pages/default.aspx
Brazil	The Department of Commercial Defense	http://www.mdic.gov.br/index.php/comercio-exterior/defesa-comercial/145-o-que-e-defesa-comercial
Canada	The Canadian International Trade Tribunal (CITT) & The Canada Border Services Agency (CBSA)	http://cbsa-asfc.gc.ca/sima-lmsi/expg-ldexp-eng.html
China	Ministry of Commerce (MOFCOM)	https://enforcement.trade.gov/trcs/downloads/documents/china/index.html
EU	The European Commission	http://trade.ec.europa.eu/doclib/docs/2013/april/tradoc_151019.pdf
India	Directorate General of Trade Remedies	https://www.dgtr.gov.in/sites/default/files/NCV%20MT%20SSR%20ENGLISH.pdf
Mexico	The Secretariat of the Economy	see Bowman, Covelli, Gantz, and Uhm (2010)
Turkey	The Ministry of Trade	http://www.tariff-tr.com/AntiDumping.aspx
USA	The International Trade Administration (ITA) & The International Trade Commission (ITC)	https://www.usitc.gov/trade_remedy/documents/handbook.pdf

that can result in changes of duty levels. In Canada, the Canadian International Trade Tribunal (CITT) determines whether there is a need for a review. If yes, then the Canada Border Services Agency (CBSA) conducts a review on the likelihood of "continued or resumed dumping" if duties were to be revoked. Finally, if the CBSA concludes affirmatively, the CITT examines the link between dumping and the likelihood of injury to decide whether to extend the duties. Note that akin to the US' administrative reviews, Canada undertakes interim reviews which can change the level of duties. The only major difference between the two countries is that in the US the review investigations officially start once there is adequate demand from the domestic industry, whereas in Canada, the administering authority decides whether to conduct a review.

In the EU, the European Commission (the Commission) publishes a Notice of Impending Expiry. If the domestic industry responds adequately to the notice, the Commission begins an official expiry review to decide whether to extend the duties. These reviews can also be initiated by the Commission *ex-officio*. Note that the Commission also conducts interim reviews where the level of duties can change, and in some cases the duties can be prolonged (Nita and Zanardi, 2013). The expiry reviews in Australia follow a similar procedure, except that the domestic industry must actively respond to the Anti-Dumping Commission's expiry notice. Like the EU, interested parties can also request periodic reviews that can result in the modification of duty levels. Note that this type of (non-expiry) reviews are not included in our database and are outside the scope of our research.

The emerging economies in our sample have more flexible approaches to conducting expiry reviews. In fact, the official government sources of some countries do not specify the exact requirements for a review to be valid. Nevertheless, all of the six countries' AD administering authorities publish a notice of expiry before a duty is supposed to expire. It seems that in all of them, the administering authority can initiate a review *ex-officio* like in the EU, or the domestic industry can respond to the notice of expiry to officially start an expiry review investigation. While all six countries' systems look similar to each other, Mexico's system (even though having a single-track investigation system) is very close to the US and Canada system, and Turkey's review procedures are very similar to the EU's. Like the high-income countries, the emerging economies have interim reviews, and some of these can result in the prolongation of duties. For all countries, once an expiry review is initiated, the administering authority must find that the removal of duties will lead to injury or threat of injury caused by continued dumping—an obscure task that requires coming up with a counterfactual.

B.1. Duration and extension of duties

In Table B.2, we examine the duration and extension of duties. In column 1, we present the mean duration of an AD duty for each country, including duties that were still in effect as of end-2013 (censored). The AD duties imposed by the US last longest, with an average of 12 years. This is three years longer than the country with the second-highest duration of duties, Mexico. Note that Argentina, who often imposes duties for two years, is the country with the minimum average duration of 4.8 years. Restricting the sample to expired duties (uncensored) in column 2 gives similar conclusions.[48] Column 3 shows the average number of extensions

[48] About a third of the duties in our data were still in effect by the end of 2013, making the uncensored sample size two-thirds of the censored sample size.

Table B.2
Duration and extension of AD duties.

Importing country	(1) Mean duration of duties (censored)	(2) Mean duration of duties (uncensored)	(3) Mean number of extensions (censored)	(4) Mean number of extensions (uncensored)	(5) Number of expiry reviews	(6) Share of duties with an initiated review
Australia	6.51	6.25	0.37	0.21	103	64%
Canada	7.74	7.66	0.63	0.38	214	86%
EU	7.48	7.18	0.42	0.24	180	51%
USA	11.99	11.54	1.14	0.49	604	89%
High-income	9.26	8.48	0.75	0.34	1,101	74%
Argentina	4.82	4.37	0.44	0.25	71	39%
Brazil	7.95	6.78	0.85	0.38	101	74%
China	6.08	6.20	0.69	0.24	76	70%
India	5.96	5.67	0.44	0.13	211	64%
Mexico	9.05	9.02	1.00	0.59	141	78%
Turkey	6.51	6.68	0.71	0.11	120	68%
Emerging	6.43	6.04	0.62	0.25	720	64%
Total	7.90	7.38	0.69	0.30	1,821	69%

Notes: Data is based on the entire sample (1996–2013). Duration is in number of years. Censored includes the duties that are still in effect as of end-2013 (total of 1,844 duties), whereas uncensored has the removed duties only (1,248 duties).

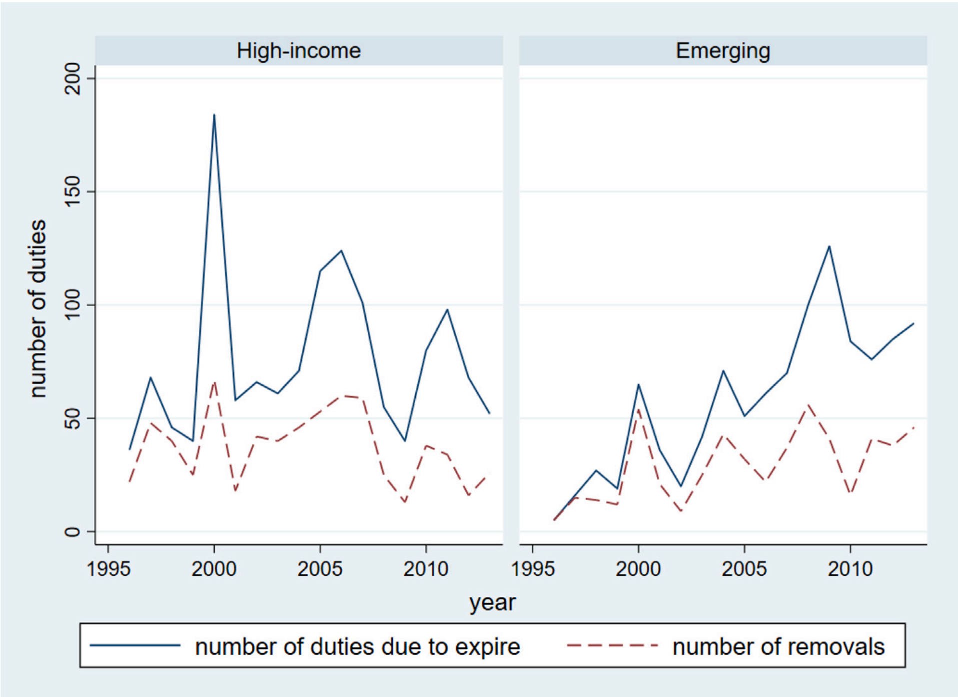

Fig. B.1. Number of duties to expire and removals. *Notes*: Sample covers 1996–2013 with 2,585 observations. The high-income countries are Australia, Canada, the EU, and the US; the emerging countries are Argentina, Brazil, China, India, Mexico, and Turkey.

by each country—again, the US stands out by extending a duty 1.1 times on average, followed by Mexico. Finally, columns 5 and 6 show the number of expiry reviews conducted by each importing country and the share of duties that went through expiry reviews. On average, a duty is reviewed 69% of the time. This high figure is largely driven by the US (89%), Canada (86%), and Mexico (78%), and it is lowest for Argentina, who reviews cases only 39% of the time. This heterogeneity in the share of duties that are reviewed is largely due to the different AD institutional settings of the countries.

Next, we analyze the evolution of removals over time. Fig. B.1 shows the number of duties to expire and the number of removals for the high-income (Australia, Canada, the EU, the US) and emerging-country (Argentina, Brazil, China, India, Mexico, Turkey) samples separately. Note how, for high-income countries, the number of duties due to expire peaks in 2000, due to the new WTO mandate on reviewing existing duties by 2000. The removal share after 2000 had a mean of 47% with a standard deviation of 14%. For emerging countries, the number of duties due to expire has a rising trend as these countries become frequent users of temporary trade barriers. For them, the removal share after 2000 had a mean of 49% with a standard deviation of 13%. The low standard deviations for the removal shares reveal that these shares do not change much over the years. Moreover, a simple *t*-test that compares the two samples' removal shares shows that they are not significantly different from each other.

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