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The chilling trade effects of antidumping proliferation

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ABSTRACT

Advocates of antidumping (AD) laws downplay their negative effects by arguing that the trade flows that are subject to AD are small and their distortions negligible. But while the adverse effect of AD on product-level trade has long been established, the question remains whether there are trade effects at the aggregate level. The recent proliferation wave of AD laws and their use provides us with a unique policy change to estimate the true trade effects of adopting and enforcing AD laws. For this purpose, we estimate the effect of AD on bilateral trade flows between the "new adopters" of AD laws and their trade partners. Using a gravity model of annual observations (1980–2000) our estimates show that AD has trade chilling effects on aggregate import volumes but the impacts are heterogeneous across sectors. We find that new tough users experience a chilling of their aggregate imports of 14 billion US$ a year (or 5.9%) as a result of AD measures. For some countries like Mexico and India, the dampening effects of AD laws on trade flows are found to substantially offset the increase in trade volumes derived from trade liberalization.

1. Introduction

Many commentators have expressed the concern that the recent financial crisis may result in rising protectionism. The World Bank (2009) and WTO (2009) already report a substantial increase in trade protection. Especially the use of antidumping measures is on the rise (see Bown, 2009). This is all the more worrying because the capacity to use antidumping (AD) is no longer limited to a subset of developed countries since in the last fifteen years many more (developing) countries have introduced and started using AD laws. Since the early 1980s, the number of countries that adopted an AD law has nearly doubled. While 37 countries had such laws in 1980, this number increased to 93 countries by the end of 2000 (Zanardi, 2004a). The extent of AD proliferation during the period of our analysis (1980–2000) is illustrated in Fig. 1. Most of the "new adopters" are developing countries. The proliferation does not seem to be confined to any particular region but includes developing countries from Asia, Latin America and Eastern Europe. At the same time, the effects of AD on aggregate trade flows are not well understood. This paper tries to fill this gap of the literature by quantifying the trade effects of adopting and enforcing AD laws.

The "adoption wave" illustrated in Fig. 1 provides an interesting policy regime switch which allows us to test for the effects of these laws on trade flows. A similar exercise for countries where these laws have been on the books already for a long time is more complex. Especially for countries like the EU and the US which have established themselves over time as

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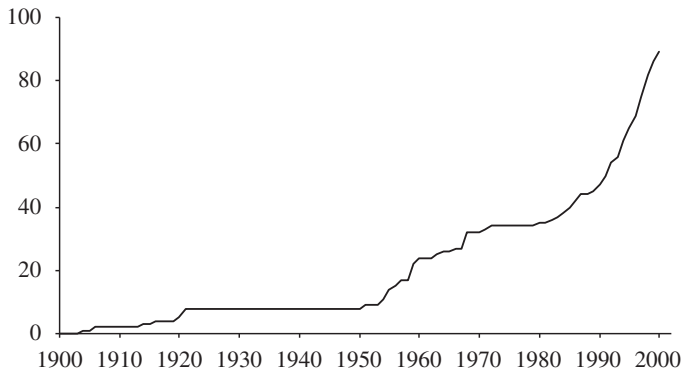

Fig. 1. Number of countries with antidumping laws. *Source*: authors' own calculations.

tough AD users, it is difficult to measure the true impact of AD measures on trade flows since their effects may be present throughout the sample under investigation and well before that since most of these "traditional users" adopted their AD laws around the turn of the 20th century. However, the "new adopters" offer us the possibility to observe trade flows both "before" and "after" the introduction of AD laws.

Our results demonstrate than when countries adopt an AD law into their national legislation, their bilateral imports of commodities from all trade partners and in all goods are seriously chilled (i.e., reduced due to a variety of "spillover" effects) in the years after adoption of the law, *provided* it is used frequently.[2] While other papers have shown that AD measures seriously destroy imports of the products targeted by AD measures (e.g., Prusa, 1997), the question raised in this paper is whether *aggregate* imports can be affected by AD policy. We find this to be the case for those countries that use AD in a systematic way. The effects are not small and are uneven across sectors, with trade in chemicals and agriculture suffering the most. Thus, this paper contributes to a long and distinguished tradition in the literature of identifying economically significant and unintended implications of trade policies, such as AD that go beyond whether the policy itself restricts imports in the products on which it is ultimately imposed. Our findings counter the popular view that the effects of AD are limited to the products they are aimed to protect but instead documents that the impact of AD law proliferation spills over to a more *aggregate* level of bilateral trade flows.

In our analysis based on the gravity equation, we face a number of challenging methodological issues. To control for the potential endogeneity of the decision of a country to adopt an AD law, we use an instrumental variable approach where we first estimate the probability of AD law adoption. To control for the multilateral price (resistance) term of country pairs in the gravity equation, we follow Anderson and Van Wincoop (2003) and Feenstra (2004). Since aggregate exports are likely to be quite persistent over time, we need to account for the dynamics that may be involved. We will also discuss the bias that may arise by excluding zero-trade flows based on recent contributions by Helpman et al. (2008) and Santos-Silva and Tenreyro (2006).

Our dataset consists of annual trade flows from a large set of exporting countries to the partners that adopted an AD law during the sample period (1980–2000). Since not all countries adopt in the same year, we consider the countries that did not adopt the law up to a particular year, as our counterfactual group. To measure AD law enforcement we alternatively use the total number of AD initiations or measures at the country level. Within the group of new adopters, which are mainly developing countries (see Table 1), one can distinguish "tough" and "weak" users, depending on the extent of AD enforcement, measured in terms of the number of AD initiations or measures. It will be an empirical question to investigate whether the intensity of AD usage implies differential aggregate effects. And while our classification of tough and weak users is somewhat ad hoc, we pursue different robustness checks to verify the sensitivity of the results.

In brief, we find that the trade chilling effects of AD are substantial for those countries that systematically use this protectionist tool. In the last section of this paper we engage in a first and tentative attempt to put a dollar value on the impact of AD on trade. Using the elasticities obtained from our analysis for tough new users (i.e., Brazil, India, Mexico, Taiwan and Turkey) we register significant negative impacts of AD on trade, with the largest effects reported in Mexico and India. Annual imports in Mexico are chilled by 6.51 billion US$, or 7.2% of the country's average annual imports, compared to what they would have been in the absence of AD actions.[3] For a country like India that has evolved from a non-user to the most frequent user of AD (Bown and Tovar, 2008), we find that AD actions have resulted in trade losses that seriously offset the increase in trade volumes due to trade liberalization. India started liberalizing in 1991, which led to an annual growth of 17.4% of its imports. Although India has had an AD law in place since 1985, it imposed its first AD measure in 1993 and became a very frequent user ever since. The results of this paper suggest that it suffered from a 6.8% annual loss in imports as a result of AD actions. This confirms the notion that AD actions can substantially hinder the gains in trade

[2] The "chilling" terminology is grounded in the legal literature. In fact, in the 1998 WTO dispute that the EC lodged against the USA for its Antidumping Act of 1916, the EC argued that the AD law had a "chilling effect" on EC exports to the USA since its mere existence led to a lower level of exports than would have otherwise been the case, even though the law was never actually applied. We thank a referee for providing this reference.

[3] All monetary values in the paper are expressed in 1995 real prices.

Table 1
Adoption and use of antidumping laws (1980–2000).

Country	Year of AD law adoption (1)	Total AD initiations (2)	Total AD measures (3)	AD initiations per year (4)	AD measures per year (5)
New *tough* users					
Brazil	1987	143	71	10.21	5.07
India	1985	192	138	12.00	8.63
Mexico	1986	180	112	12.00	7.47
Taiwan	1984	73	20	4.29	1.18
Turkey	1989	94	49	7.83	4.08
New *weak* users					
Albania	1999	0	0	0.00	0.00
Bolivia	1992	0	0	0.00	0.00
Bulgaria	1993	0	0	0.00	0.00
Chile	1986	17	7	1.13	0.47
China	1997	22	9	5.50	2.25
Colombia	1990	27	15	2.45	1.36
Costa Rica	1996	6	1	1.20	0.20
Croatia	1999	0	0	0.00	0.00
Czech Republic	1997	3	1	0.75	0.25
Ecuador	1991	1	0	0.10	0.00
Egypt	1998	25	17	8.33	5.67
El Salvador	1995	0	0	0.00	0.00
Fiji	1998	0	0	0.00	0.00
Guatemala	1996	1	1	0.20	0.20
Honduras	1995	0	0	0.00	0.00
Hungary	1994	0	0	0.00	0.00
Iceland	1987	0	0	0.00	0.00
Israel	1991	25	12	2.50	1.20
Latvia	2000	0	0	0.00	0.00
Lithuania	1998	14	0	4.67	0.00
Morocco	1997	0	0	0.00	0.00
Panama	1996	2	0	0.40	0.00
Paraguay	1996	2	1	0.40	0.20
Peru	1991	36	15	3.60	1.50
Philippines	1994	19	12	2.71	1.71
Poland	1997	4	1	1.00	0.25
Romania	1992	0	0	0.00	0.00
Russia	1998	2	0	0.67	0.00
Singapore	1985	2	2	0.13	0.13
Slovak Republic	1997	0	0	0.00	0.00
Slovenia	1993	1	0	0.13	0.00
Spain	1982	1	1	0.05	0.05
Thailand	1994	7	6	1.00	0.86
Trinidad and Tobago	1992	8	4	0.89	0.44
Tunisia	1994	0	0	0.00	0.00
Venezuela	1992	31	20	3.44	2.22
Total		938	515		

Sources: authors' own calculations. *Notes*: (i) Countries listed in alphabetical order in each of the categories "tough" and "weak" users; (ii) In columns (4) and (5) only the actual number of years an AD law has been in place are counted.

volumes from trade liberalization. Overall, our findings point to a chilling in annual imports of around 14 billion US$, or 5.9%, for tough news users of AD. This suggests that AD has a substantial "chilling" effect on the aggregate imports into these countries.

Differently from a recent paper by Egger and Nelson (2006) that investigates the trade effects of AD measures on all countries, we focus on the recent proliferation of AD laws. The adoption of a new trade policy law represents a structural break in a country's trade regime and offers a unique opportunity to truly assess the trade chilling effects of AD. Focusing on countries that adopted an AD law recently permits us to compare trade flows before and after adoption of AD laws. Indeed, this difference can explain the weaker results found by Egger and Nelson (2006) whereby AD leads to modest, albeit negative, effects on aggregate trade.[4]

Our research question is also different from Durling and Prusa (2006) and Bown and Crowley (2007) that identify three distinct trade effects of AD protection but which are all at the product level (i.e., trade destruction, trade diversion and

[4] By including all the countries that ever adopted an AD law, Egger and Nelson (2006) do not systematically control for the pre-AD period.

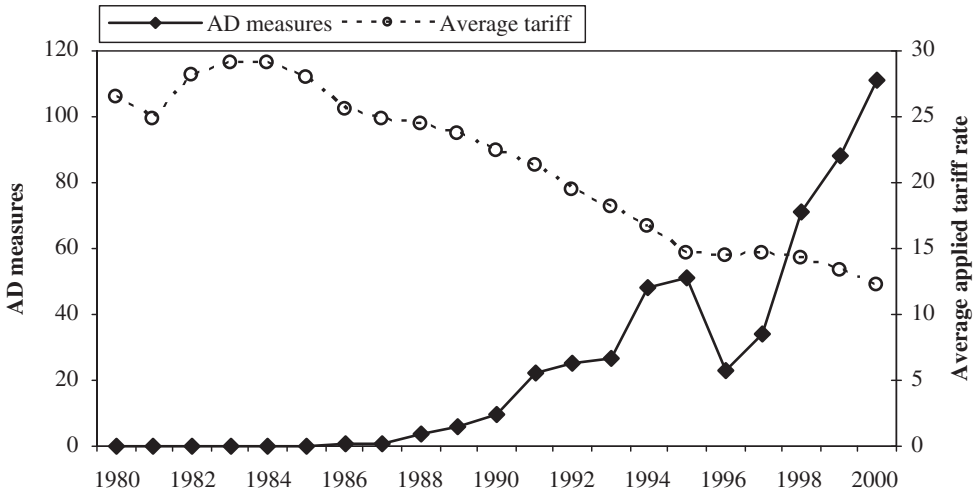

Fig. 2. "New adopters": evolution of tariffs versus antidumping measures. *Source*: authors' own calculations. *Notes*: annual caseload of AD measures by countries that adopted an AD law after 1980; average applied tariff rates of countries that do not have an AD law or adopted one after 1980.

trade deflection).[5] The purpose of our paper is to show that AD can have trade effects beyond the effects at the product level. Our findings show that when properly measured, AD protection chills bilateral aggregate trade. Hence, we identify trade effects of AD protection that go beyond first-order effects which have not been described in the literature thus far. These trade chilling effects may result from "spillovers" effects that will be described in more detail in the next section.

The research question in this paper is also different from recent work evaluating potential linkages between trade liberalization and the subsequent re-imposition of newer forms of import protection, like AD protection.[6] We do not consider the relationship between AD laws and tariff concessions. Rather, we compare trade flows before and after the adoption of AD laws in importing countries, while at the same time controlling for their openness. The empirical analysis shows that while trade liberalization has resulted in significant growth of trade, AD actions seriously dampen this increase in imports in all new tough users.

Our results have important implications. Many especially developing countries joined the World Trade Organization (WTO) in recent years which resulted in lower tariff barriers. But at the same time it can be observed that in the period of our analysis new adopters replaced tariffs with more ad hoc AD protection, as illustrated in Fig. 2. In this paper we show that the adoption and enforcement of AD laws by the new users substantially offset the increase in trade volumes from trade liberalization.[7] Additionally, our paper also suggests that the use of AD policy in response to the global financial crisis could seriously chill aggregate worldwide trade flows, which is likely to aggravate rather than remedy the crisis.

The remainder of the paper is organized as follows. The next section discusses the channels through which AD protection can affect trade. Section 3 illustrates the AD phenomenon. Section 4 discusses the empirical methodology and Section 5 reports the results, the robustness checks and an evaluation of the economic significance of our findings. Finally, Section 6 concludes.

2. Channels through which antidumping can affect trade

This paper takes a general approach by looking at the aggregate effects of AD where a mixture of effects is likely to be at play. Instead of singling out one particular theory, we discuss a number of different channels through which AD policy can affect aggregate trade flows. While some of these channels have already been well documented in the literature, others have received less attention. In line with the partial equilibrium nature of most contributions, the empirical analyses of AD have always focused on the trade flows at the product level directly affected by AD actions. Our more general equilibrium approach implies that various effects can be at play at once, some of which will be discussed below. Based on the typology of theories outlined below, AD policy can have ambiguous effects on trade. While some channels suggest a negative trade

[5] Trade destruction refers to the direct (negative) impact of AD protection on product-level imports subject to the protection. Trade diversion refers to the (positive) impact of AD protection on identical product-level imports originating from countries not subject to AD protection. Trade deflection refers to another indirect impact of AD protection—namely that product-level imports might be shipped to other markets.

[6] Feinberg and Reynolds (2007) provide evidence that countries that conceded larger tariff reductions at the Uruguay Round initiated relatively more AD cases later on. In their study on India, Bown and Tovar (2008) also find that products with larger tariff cuts due to the trade reforms of the 1990s are associated with an increase in AD protection in the following years. Moore and Zanardi (2008) confirm the existence of a substitution effect from tariffs to AD for some developing countries that are now heavy users of AD.

[7] While we do not engage in a welfare analysis, many studies have investigated the welfare losses due to AD laws. For example, Gallaway et al. (1999) estimate the annual welfare loss of affirmative AD and countervailing actions for the US to be around 4 billion US$ a year. The US International Trade Commission (1995), DeVault (1996) and Anderson (1993) reach the same qualitative conclusions when analyzing specific US AD cases. Although the existing literature focuses on the US, similar qualitative conclusions should hold for other AD users.

chilling effect of AD, others indicate potentially trade enhancing effects. Therefore the question of which effect dominates in practice is ultimately an empirical one.

2.1. Trade destruction effects

Several studies have pointed out the first-order effect of AD where imports are destroyed in the very specific products targeted by AD (Durling and Prusa, 2006; Bown and Crowley, 2007). However, thus far nobody has pointed out that AD can have externalities that spread to other imported products from the same targeted countries and to products from other importing countries. This paper takes a first step in this direction by examining the trade effects of AD on countries' aggregate imports.

2.2. Trade diversion effects

AD protection can give rise to trade diversion whereby some of the first-order negative trade destruction effects of product-level imports are offset by an increase in product-level imports from other partner countries not subject to AD. Several studies (e.g., Prusa, 1997; Konings et al., 2001) have empirically documented the existence of trade diversion that typically results in a net decrease in overall product-level imports. The question, however, is what happens to *aggregate* country level imports. AD protection may have spillover effects on other related products not captured by previous studies. For instance, the import demand of substitute products may also be affected. One way to test for the presence of spillover effects to other product categories is to study more aggregate trade flows. This is exactly what we do in the gravity approach in the next section. While our approach does not allow us to directly measure the extent of trade diversion caused by AD, the result we obtain that AD protection chills aggregate trade flows is an indication that product-level protection has implications for many more products than just the protected ones.

2.3. Downstream effects

In addition to affecting substitute products, AD may also affect more downstream products using the protected one as an input. While AD is likely to result in a trade chilling of the imports of targeted upstream intermediates (Feinberg and Kaplan, 1993; Krupp and Skeath, 2002), little is known about how AD protection on intermediates will affect the imports of more downstream products. Consider the following two instances which suggest that AD may well be trade enhancing. First, when a country uses AD to protect an intermediate input like steel used in the assembly of downstream products like cars, this may negatively impact the competitiveness of domestically assembled cars vis-à-vis foreign ones. In turn, this may result in increased imports of foreign cars increasing the likelihood of an *aggregate* increase in imports. Second, when a country uses AD to protect an unrefined product (e.g., raw shrimps), this will create incentives for partner countries to further process the unrefined product and turn it into a higher value-added product (e.g., processed breaded/frozen shrimps), thus leading the importing country to increase its imports of the high value added product, again increasing the likelihood of an *aggregate* increase in imports.

2.4. Deterrent effects

AD laws and their use can have a deterrent effect on trade partners (Staiger and Wolak, 1994)[8], making them more cautious when shipping their goods to countries that signal to be frequent and tough users of AD. Among others, Reitzes (1993) shows that the threat of AD duties causes significant strategic effects, albeit different depending if firms compete in quantities or prices. These are likely to result in higher prices and lower volumes since trade partners "learn" how to avoid dumping complaints. When exporters ship goods to a country, they will never be quite sure whether they will be facing trade protection. Therefore, due to the deterrent effect of existing of AD laws and previous use of AD measures in the country of destination, shipments are likely to be lower than they would have been in the absence of any AD threat (i.e., in the absence of AD laws). Different types of learning may also come into play. A paper by Blonigen (2006) shows that the probability of filing an AD petition within a particular sector depends largely on how many previous filings there have been in the same sector. This suggests that there is learning behavior on the side of the importing market: the more it has been involved in filing in the past, the more likely it is to use that past knowledge to file again in the future. If signaling and learning are important we would expect the total number of AD measures to have a negative effect on current trade flows.

2.5. Collusive device

Several contributions have shown that AD protection can result in the formation of international cartels and tacit collusion (e.g., Messerlin, 1990; Staiger and Wolak, 1992; Prusa, 1992; Veugelers and Vandenbussche, 1999; Zanardi,

[8] Staiger and Wolak (1994) is one of the earliest studies of this effect, which they call "harassment effect".

2004b). This anticompetitive nature of AD laws is also likely to result in chilled trade. It is important to note that the effect of collusion on imports may depend on whether trade is measured in volumes versus values. In this paper we measure aggregate imports in values, which we deflate with a country-level price deflator. If our aggregate price deflator is affected by price increases in a single product/sector as a result of collusion arising from AD, we cannot exclude the fact that collusion may result in an increase in "measured" imports whenever a positive price effect dominates a negative quantity effect. If empirically, however, we find that AD protection negatively impacts aggregate "measured" imports this would suggest that even in the presence of a positive price effect, the negative effect on imported volumes dominates although we may be underestimating the true fall in imports compared to what would be measured in volumes.

2.6. FDI effects

AD protection can trigger inward foreign direct investment (FDI) which may result in less trade. Exporters may decide to "jump" AD measures by setting up a production plant within the protected market. This can be a profitable strategy, provided that the previously exporting firm has a firm-specific advantage that can be transferred across borders to overcome the fixed cost of setting up an extra plant, as shown theoretically by Belderbos et al. (2004) and Haaland and Wooton (1998). It should therefore hardly be surprising that predominantly Japanese firms have engaged in an AD jumping response, as shown empirically, among others, by Blonigen (2002) for the US and by Girma et al. (2002) for the UK. In this case, trade and FDI are substitutes. Therefore, AD-jumping FDI can have a trade chilling effect.

Alternatively, trade enhancing effects are also possible after foreign firms have engaged in FDI as shown by Blonigen and Ohno (1998). Once foreign firms have located production in the home country, they have an incentive to engage in "protection building trade" where they start to use AD as insiders. In order to *increase* protectionist pressures in the home country against foreign competitors that have not engaged in FDI, they may first increase their own exports to the home country to endogenously trigger protection and to erect larger barriers against other foreign competitors in future periods. Empirically this effect remains to be confirmed but it is clear that protection building trade may initially have a trade enhancing effect on imports.

2.7. Retaliation effects

A number of papers have argued that in many cases, political and strategic considerations (in addition to economic motives) related to retaliation explain the use of AD laws.[9] New users of AD seem to predominantly target traditional users and other new tough users. A priori, it is not clear in which direction the proliferation of AD laws is going to affect trade flows. It depends on the equilibrium that will emerge. If this proliferation results in a Nash equilibrium in which every country is using AD, imports are likely to be reduced. Alternatively, proliferation may result in a politically optimal equilibrium in which imports are expanded because everyone has liberalized and the capacity of everyone to access AD prevents defection from the cooperative equilibrium (Bagwell and Staiger, 1990, 1999). In view of the ambiguous predictions arising from different theoretical models, it is not clear a priori what the trade effects of AD will be as more countries over time adopt AD laws.

The channels listed above, while not necessarily exhaustive, are indicative of trade effects that may go beyond the products involved in AD cases. Theory suggests that the effects of AD on aggregate trade flows could be positive or negative. Therefore the question must ultimately be resolved by an empirical analysis, which is what we do in the next sections.[10]

3. Antidumping law proliferation

While in the 1980s mainly traditional users with AD laws stemming from the beginning of the century were involved in AD actions, from the late 1980s the proliferation accelerated, nearly doubling the number of countries with an AD law between 1980 and 2000, as shown in Fig. 1.[11] In view of these events, our data consist of annual bilateral trade flows during 1980–2000 between 41 "new adopters" of AD (i.e., countries that adopted their AD law after 1980), which are included as importers in the dataset, and 121 exporting countries.[12] Table 1 lists all the 41 countries and the year in which they adopted the AD law. Even a casual look at this list illustrates the fact that AD has evolved from an instrument of protection

[9] Blonigen and Bown (2003), Feinberg and Reynolds (2007), Moore and Zanardi (2008), Prusa and Skeath (2002, 2005), Vandenbussche and Zanardi (2008).

[10] AD may boost trade if it helps countries to liberalize their trade policies playing the role of a safety valve for protectionist pressures. Moore and Zanardi (2009) empirically show that this is not the case for a sample of 23 developing countries whose majority is also part of our sample.

[11] The list in Zanardi (2004a) shows that the only countries that adopted an AD law between 1970 and 1980 and that would additionally be included by extending the data are Argentina (AD law introduced in 1972) and Uruguay (AD law introduced in 1980). However, AD data for these countries are only available from 1992 so that they would not be included even if the sample were to start in 1970. More generally, systematic AD data for the pre-1980 period are very difficult (if not impossible) to find.

[12] Our analysis only excludes low–income countries (as defined by the World Bank) since they account for very little trade and the data show a lot of missing observations. See Appendix 1 for a list of exporters.

wielded by industrialized countries into a common protectionist tool available to a broad range of countries most of which are developing countries. Among these, we distinguish tough users and weak users. Our benchmark definition of *tough users* refers to those countries that have a caseload of AD actions (i.e., initiations or measures) that is four times as large as the average of our sample.[13] With this rule, Brazil, India, Mexico, Taiwan and Turkey are classified as tough, although in the robustness section we consider alternative definitions.

To quantify the net effect of AD laws on the aggregate trade flows of new users, we constructed a comprehensive and detailed dataset on the adoption and use of AD laws, from which the figures and tables are derived. This dataset is highly disaggregated, since it records with annual frequency the number of AD initiations and measures of each country against each exporter over the period 1980–2000. Moreover, it is not limited to GATT/WTO countries, and has been compiled from a variety of sources in order to overcome the limitations of each given source.[14]

4. Empirical methodology and data

To evaluate the effect of the introduction and subsequent use of AD laws on trade we turn to the gravity model. In its basic form, the gravity equation postulates that trade between two countries is determined by their relative size and the distance between them. While trade flows tend to increase with country size, they decrease with distance. Starting from Anderson (1979) and continuing amongst others with Bergstrand (1985) and Deardorff (1998), it has been shown that various theoretical models deliver a reduced form equation like the gravity equation. Theoretically founded and empirically successful, the gravity equation has been employed extensively to investigate the effects of borders, regional trade agreements, monetary unions, common languages and various other institutional settings on trade flows. We adopt the version of the gravity model by Anderson and Van Wincoop (2003) that includes importers and exporters fixed effects in the regression to control for "multilateral resistance". Indeed Feenstra (2004) has shown that a simple way to account for omitted prices in a cross-section study is to include exporters (α_i) and importers (α_j) fixed effects.

However, prices may vary over time. One way to control for price changes is to introduce, similarly to Rose (2000), the bilateral real exchange rate (RER_{ijt}) that varies over time and tracks price changes. An alternative way to capture the multilateral resistance effect in panel data is to include importer and exporter fixed effects interacted with time dummies (i.e., α_{jt} and α_{it}) as in Baier and Bergstrand (2007) and Subramanian and Wei (2007). Unfortunately, the downside of this last approach is that it requires the explanatory variables of interest to vary over time and across exporters. In our case, the AD variables of interest, such as the role of an AD law and the overall use of AD by importing countries, would drop out. Therefore the gravity specification we use is given in (1) and includes the bilateral real exchange rate

$$\begin{aligned}\ln(X_{ijt}) = {} & \alpha_i + \alpha_j + \beta_1 ADOPTION_{jt} + \beta_2 \ln(overall\ AD\ use_{jt-1}) + \beta_3 \ln(GDP_{jt}) + \beta_4 \ln(GDP_{it}) + \beta_5 \ln(population_{jt}) \\ & + \beta_6 \ln(population_{it}) + \beta_7 \ln(distance_{ij}) + \beta_8 Border_{ij} + \beta_9 Language_{ij} + \beta_{10} Colony_{ij} + \beta_{11} \ln(RER_{ijt}) \\ & + \beta_{12} WTO_{jt} + \beta_{13} RTA_{ijt} + \beta_{14} \ln(Openness\ index_{jt}) + Year\ dummies + \varepsilon_{ijt}. \end{aligned} \quad (1)$$

The dependent variable is the natural log of the real value of exports from country i to country j in period t where zero export flows are dropped from the analysis.[15] Along with the usual set of variables that enter the gravity equation (and that will be discussed below), the focus of this paper is on the AD variables in specification (1).[16] The first AD variable is the adoption dummy, which is equal to 1 from the year when an importer adopts an AD law and 0 before. Here an important caveat applies since the possibility arises that the adoption of AD laws is not an exogenous event. More specifically, a country that is more outward oriented in terms of trade volumes may be more inclined to adopt trade protection laws than countries with a more closed economy. Therefore the extent of bilateral trade flows (i.e., the dependent variable in (1)) may affect the likelihood of a country to adopt an AD law. This simultaneity would imply the endogeneity of the right hand side adoption dummy and would result in inconsistent estimates of the coefficients. To accommodate this possibility, we also use an instrumental variable (IV) specification where the adoption of AD laws is estimated in the first stage.

Second, we include variables capturing the extent of the AD caseload of each importer.[17] The inclusion of "bilateral" initiations or measures as regressors may lead to an endogeneity problem, since AD actions in a given year against each trade partner are likely to be a function of bilateral exports. For this reason, we alternatively use "overall" AD initiations or "overall" AD measures in our main specifications, where endogeneity for each bilateral trade relationship is less likely to

[13] Argentina, South Africa and South Korea have become very frequent users of AD in recent years (Prusa, 2001) but are not included as new users since they adopted their AD law before the start of our sample and we do not observe their trade flows before adoption. In the sensitivity section, we modify our definition of new tough users to include them although AD data for these countries are not available for our entire sample.

[14] See Zanardi (2004a) for the details of the sources for all data and a broad overview of the global use of AD in 1980–2000. In brief, this dataset addresses three problems. First, obvious mistakes and inconsistencies in the GATT and WTO reports have been corrected. Second, missing data for countries members of the GATT/WTO have been obtained using information provided by the national authorities of various countries through direct contact or through their publications. Finally, information on AD petitions initiated by non-WTO countries has been collected. This extensive data work results in a dataset much more comprehensive than those employed in many studies in the literature, with the exception of the AD dataset assembled by Bown (2005), which contains more details but has a narrower coverage in terms of countries and years.

[15] The consequences of dropping zero-trade flows will be discussed in the robustness Section 5.3.

[16] A description of all variables and their sources is provided in Appendix 2.

[17] Although the count of initiations and measures is a relatively rough indicator of AD use, it is difficult to have other comparable variables. For example, AD duties may be defined per unit or ad valorem with specific rates for different exporters. In many cases this information is also missing.

arise since these variables are based on all AD initiations or measures imposed in a particular year against all other trade partners. Any individual exporting trade partner is unlikely to exert influence over the overall number of AD actions taken by the importing country in any particular year. To reduce the endogeneity even further, we lag the overall AD initiations and AD measures in (1) by one year.[18] From an economic point of view, the number of AD cases against all other trade partners can be regarded as an indication of the overall AD stance of a country and is in line with the objective of uncovering the aggregate trade effects of AD.

The other regressors in Eq. (1) are standard for a gravity equation. The importing country's GDP_j controls for demand aspects, while the exporter's GDP_i controls for supply effects.[19] Populations are expected to enter with positive signs (since larger countries generally trade more), while the distance between the trading pair impairs the flow of goods and should have a negative coefficient. The dummy variable for countries sharing a border is expected to have a positive coefficient (since neighboring countries trade more). Similarly, common language and colonial ties should positively affect trade. Given the long span of the sample and the large set of countries, we control for price changes by introducing the bilateral real exchange rate (RER_{ijt}). Year dummies control for any time variation common to all trade relationships (e.g., business cycle effects, globalization trends, etc.).

Another set of regressors is used to control for trade policy aspects since AD laws and their use may be correlated with other trade instruments. The WTO dummy variable takes a value of 1 if an importing country is a member of the WTO (formerly GATT). Regional trade agreements should have a positive impact on trade if both trading partners are members (and the dummy variable RTA should provide evidence in this regard).[20] In order to isolate the effects of AD from the other trade policy instruments, we use the 'Freedom to Trade with Foreigners' index ($Openness\ index_{jt}$) published by the Fraser Institute (Canada). It varies between zero and ten, with higher values indicating more open countries (see Gwartney and Lawson, 2003, for details). As a sensitivity check, we also used the KOF index of economic globalization (Dreher, 2006), which is based on trade, FDI flows, and trade restrictions. Even if this index has a more limited coverage in terms of countries, our conclusions on the effects of AD are unchanged although the KOF index itself exhibits lower significance levels.[21]

A different approach to the inclusion of importer and exporter fixed effects is the use of country-pair fixed effects. Country-pair fixed effects more generally account for all time invariant variables specific to the bilateral trade relationship between any two sets of countries since the estimates are based on the time variation within each cross section. Although our main approach is to follow Anderson and Van Wincoop (2003) and Feenstra (2004) by including separate importers and exporters fixed effects to take into account the multilateral price (resistance) terms, we turn to the country-pair fixed effects approach as a robustness check.

Following Eichengreen and Irwin (1998) and Bun and Klaassen (2002) we acknowledge that bilateral exports tend to be persistent series and control for dynamics by including either a lagged dependent variable or assuming an autoregressive process (AR(1)) for the error term. With a dynamic specification, the estimated coefficients can be interpreted as short run elasticities and the values of the coefficients are in general smaller than in static gravity models (Disdier and Head, 2008).

5. Discussion of results

5.1. An IV model for the adoption of antidumping laws

To overcome the potential endogeneity of the AD adoption variable we use IV. Unfortunately, the literature does not provide much guidance in terms of what may explain adoption of AD laws (i.e., which regressors to use as instruments in the first stage). Empirically, Vandenbussche and Zanardi (2008) use a duration model in search of the determinants that can explain cross-country differences in terms of the timing of AD law adoption.[22] Their results suggest that a country's adoption decision is mainly driven by retaliation motives, WTO entry, change in overall trade openness, and adoption decisions by surrounding countries. Indeed even a casual look at Table 1 suggests that many countries seem to adopt AD

[18] Note that the possibility of reverse causality would lead to an upward bias of the coefficient estimates on AD cases since exports flows and AD activity are positively correlated. Thus, in case of reverse causality any negative estimate would represent a lower bound of the true effect.

[19] In some studies, GDPs are treated as endogenous variables since exports/imports constitute part of GDP. However, for most countries the contribution of bilateral exports/imports in total GDP is a relatively small share and GDP is a function of net multilateral exports. Moreover, Frankel (1997), among others, has documented that the coefficient estimates of standard gravity models are largely unaffected by treating GDPs as endogenous.

[20] Various regional trade agreements may have quantitatively different effects on trade among members. Also, the formation of an RTA may be endogenous. Baier and Bergstrand (2004) have shown that there are economic and other factors such as the similarity between countries in terms of size and GDP and their proximity that positively affect the probability of RTA formation. They show that the coefficient on the RTA variable is likely to be underestimated when not controlling for endogeneity of the RTAs. Here we merely include RTA as a control variable and are not interested in the magnitude of the coefficient.

[21] Both indices of trade liberalization include trade volumes as one of their dimensions, which may render the indices endogenous. However, the low correlation that we find in the data between the trade liberalization indices on the one hand and bilateral trade volumes on the other (i.e., −0.007 and 0.008 for the openness index and the KOF index, respectively) suggests that the indices consist of sufficient other dimensions. Also, these indices reflect a country's overall openness whereas the dependent variable is limited to bilateral trade.

[22] A duration methodology is very different from a linear analysis hence, estimates cannot be compared.

Table 2
What explains the adoption of antidumping laws by new adopters?

Regressors	First stage IV model			
	(1)	(2)	(3)	(4)
Years from joining WTO_{jt}	0.020*** (0.001)	–	–	–
Years from joining WTO_{jt} pre UR	–	0.021*** (0.001)	0.022*** (0.001)	0.025*** (0.001)
Years from joining WTO_{jt} post UR	–	0.058*** (0.004)	0.070*** (0.004)	0.067*** (0.004)
%Δ Openness index$_{jt}$	–	–	0.165*** (0.016)	–
AD measures received in past two years$_{jt}$	–	–	–	0.007*** (0.001)
F	1100.68***	1190.54***	1942.89***	1173.20***
R^2	0.73	0.73	0.73	0.73
Observations	33,222	33,222	32,213	33,222
Under-identification test (p-value)	0.00	0.00	0.00	0.00
Weak-identification test (F-statistic)	518.22	258.79	224.51	197.34
Over-identification test (p-value)	–	0.37	0.37	0.66

Notes: (i) The dependent variable is the AD adoption dummy; (ii) the pre and post UR variables together add up to the "years from joining the WTO" but now refer to the number of years of WTO membership separately for the countries that joined before or after the UR, respectively; (iii) robust standard errors in parenthesis. ***denotes significance at the 1% level; (iv) all regressors from specification (2) in Table 3 included but not reported to save on space.

laws after their entry into the WTO. However, it is worth noting that the adoption of an AD law is not part of the obligatory WTO package, meaning that countries are free to choose whether or not to adopt an AD law.

Searching for possible instruments to identify a country's decision to adopt an AD law, Table 2 reports the estimated coefficients for specifications that include a number of institutional factors that may affect AD law adoption. We include the time of WTO membership (i.e., years from WTO membership), retaliation motives (i.e., cumulative AD measures received by the importer in the last two years) and the evolution of trade policy stance (i.e., percentage change in openness index). For the years from WTO membership, we distinguish whether a country joined the WTO before or after the Uruguay Round. The WTO has been less insistent on the trade liberalization efforts of developing countries under the principle of special and differential treatment. However, after the Uruguay Round the WTO hardened its position and the conditions for WTO membership have become stricter. This implies that developing countries had to make more concessions in terms of lowering their tariffs (Subramanian and Wei, 2007), which may increase their willingness to adopt contingent protection laws like AD. To test for this possibility, we split the "years from joining the WTO" depending on whether a country joined before or after the completion of the Uruguay Round.

All the instruments used in Table 2 are highly significant and the tests reported at the bottom of the table suggests that the instruments are econometrically valid (i.e., the model is identified, the instruments are not weak[23], and the over-identifying restrictions are satisfied). Overall, countries are much more likely to adopt an AD law the longer they have been a member of the WTO, and the effect is stronger for those countries that joined after the Uruguay Round. The probability of adoption is also higher the more the countries have been targeted with AD measures by other countries in previous years and the more they have liberalized in the recent past, which corresponds to anecdotal evidence and is in line with the results found by Vandenbussche and Zanardi (2008).[24] Our preferred specification and the one we will be using to control for the endogeneity of AD law adoption is the one in column (4) where we split the number of years since joining the WTO into a pre or post Uruguay period and we do not loose observations due to the inclusion of the change in the openness index.[25]

5.2. Does the adoption of antidumping laws chill trade?

Results of various specifications of the gravity equation as in (1) are shown in Table 3. Column (1) reports OLS results without accounting for the endogeneity of AD adoption but controlling for dynamics by including a lagged dependent variable. The OLS specification shows that the number of AD measures that an importing country introduces in a given year has a negative and significant effect on aggregate trade flows. The AD adoption dummy itself is not significant, which seems to suggest that the enforcement rather than the adoption of the law chills aggregate imports. In column (2), we control for the potential endogeneity of the AD adoption dummy by instrumenting it by column (4) of Table 2. Similar to the OLS case, we find that the number of AD measures a country imposes significantly chills trade but find no significant

[23] Although critical values for the weak identification test have not been tabulated for non i.i.d. errors, the rule of thumb of Staiger and Stock (1997) is that the F-statistic should be at least 10 for weak identification not to be considered a problem.

[24] Differently from Vandenbussche and Zanardi (2008), we do not use as an instrument the number of countries in the same continent with an AD law because it appears to influence trade flows.

[25] Results in the following section would be similar if we had chosen other specifications from Table 2.

Table 3
Global trade effects of *adopting* and *using* antidumping laws.

Regressors	OLS (1)	IV (2)	AR(1) (3)	AR(1) (4)
Real *exports*$_{ijt-1}$	0.750*** (0.007)	0.750*** (0.007)	–	–
***Overall AD measures*$_{jt-1}$**	−0.030*** (0.011)	−0.026** (0.012)	−0.028*** (0.011)	–
Overall AD measures$_{jt-1}$ *tough*	–	–	–	−0.034** (0.016)
Overall AD measures$_{jt-1}$ *weak*	–	–	–	−0.021 (0.015)
***AD adoption*$_{jt}$**	0.020 (0.020)	−0.101 (0.140)	0.013 (0.024)	–
AD *adoption*$_{jt}$ *tough*	–	–	–	−0.001 (0.053)
AD *adoption*$_{jt}$ *weak*	–	–	–	0.015 (0.027)
***Openness index*$_{jt}$**	0.278*** (0.043)	0.284*** (0.044)	0.403*** (0.101)	0.409*** (0.102)
Real *GDP*$_{jt}$	0.103*** (0.023)	0.109*** (0.023)	0.247*** (0.030)	0.248*** (0.030)
Real *GDP*$_{it}$	0.119*** (0.031)	0.118*** (0.031)	0.220*** (0.041)	0.219*** (0.041)
***Population*$_{jt}$**	0.418*** (0.121)	0.377*** (0.127)	0.970*** (0.299)	0.967*** (0.299)
***Population*$_{it}$**	0.185 (0.114)	0.184 (0.114)	0.010 (0.319)	0.013 (0.319)
***Distance*$_{ij}$**	−0.342*** (0.014)	−0.342*** (0.014)	−1.454*** (0.032)	−1.455*** (0.032)
***Border*$_{ij}$**	0.150*** (0.025)	0.150*** (0.025)	0.680*** (0.096)	0.679*** (0.096)
***Language*$_{ij}$**	0.125*** (0.022)	0.124*** (0.022)	0.518*** (0.073)	0.519*** (0.073)
***Colony*$_{ij}$**	0.179*** (0.029)	0.180*** (0.029)	0.809*** (0.117)	0.809*** (0.117)
***RER*$_{ijt}$**	−0.019*** (0.007)	−0.021*** (0.008)	−0.027*** (0.009)	−0.027*** (0.009)
***RTA*$_{ijt}$**	0.157*** (0.018)	0.158*** (0.018)	0.218*** (0.033)	0.217*** (0.034)
***WTO*$_{jt}$**	0.068*** (0.023)	0.087*** (0.030)	0.040 (0.038)	0.040 (0.038)
Endogeneity test (p-value)	–	0.42	–	–
AR(1): ρ	–	–	0.77	0.77
R^2	0.89	0.89	0.43	0.43
F	1,903.11***	1,895.54***	813.78***	805.82***
Observations	33,222	33,222	33,222	33,222

Notes: (i) The dependent variable is the log of real exports from country i to country j; (ii) all variables, except dummies, are in logs; (iii) year dummies, importer and exporter fixed effects included in all specifications; (iv) robust standard errors in parenthesis. **denotes significance at the 5% level and ***1% level; (v) the IV regression in column (2) is based on the instruments reported in column (4) of Table 2; (vi) in columns (3) and (4) the errors are assumed to follow an AR(1) process and the Prais–Winsten estimator is used, which implies estimating $y_t-\rho y_{t-1}=\beta x_t-\beta\rho x_{t-1}+\mu_t$. The estimated autocorrelation parameter ρ is reported at the bottom of the table. Thus, for time invariant regressors, the point estimate should be corrected by $(1-\rho)$; for example, the effect of distance in column (3) is given by $-1.454(1-0.77)\cong-0.334$.

additional effect of the adoption dummy. The test reported at the bottom of column (2) rejects the endogeneity of AD adoption. Thus, in the following we will treat the AD adoption decision as exogenous.

In column (3) of Table 3 we account for the dynamic nature of the exports series by including an autoregressive process of the first order (i.e., AR(1) process).[26] From the results we note that the coefficient on "overall" AD measures is stable in terms of size and significance across specifications with a short run elasticity of trade chilling of −0.028 for AD measures.

In the last column (4) of Table 3 we allow for differential effects of *tough* and *weak* new users as classified in Table 1. It appears that the results are mainly driven by the *tough* users of AD. For weak AD users the significance of "overall" measures disappears while for tough users we now find a larger and significant short run elasticity of −0.034. As with previous results, the decision to adopt an AD law is not significant.

It is interesting to note that when we use overall AD *initiations* instead of overall AD measures for the specifications of Table 3, the significance of the coefficient disappears, although still negative. This suggests that it is not the number of cases that are initiated that matters but only the number of cases that actually results in import restrictions. Instead of "overall" AD measures we also experimented with "bilateral" AD measures instrumented by their lagged values, but they were never significant.[27] This suggests that the trade chilling effects are due to the overall use a country makes of its AD instrument and not its bilateral use. Put differently, even when an exporting country does not face any AD measures itself in its export market, its exports will still be affected by the overall number of AD measures that the receiving country takes against other exporting countries, which act as a deterrent in all bilateral trade relationships.

The results of Table 3 can be summarized as follows. Once we properly account for the structural break in a country's trade policy regime by including the time of AD adoption, we find that aggregate imports are chilled for those new users of

[26] Time series such as exports are likely to be persistent over time and to display correlated disturbances. The empirical literature is overwhelmingly dominated by the AR(1) model to control for this and is considered a reasonable model (Green, 2000, page 531). Instrumenting the lagged dependent variable with a two period lag yields the same results.

[27] Results not reported to save on space but available upon request.

AD that have established themselves as frequent users of AD measures. The extent of the actual enforcement of the law after its adoption appears to be crucial.

All the other regressors show the expected signs, and their significance is in line with the results obtained in other studies. However, it is important to note that the dynamic specification that we use results in smaller point estimates for all coefficients compared to static gravity models. As for the dynamics, lagged exports are always highly significant—confirming that the exports series are quite persistent over time.[28] Distance always has a negative and significant coefficient—confirming the well-known result that the further away the importing country is from the exporting country, the smaller the trade that flows between them. The openness index is always positive and significant, meaning that the more open the importing country is, the higher the worldwide exports that flow towards that country. The GDP of the importing and exporting countries are positive and have a significant effect on trade. In terms of population, only the coefficient for the importing country is significant and positive. Common border, common language and colonial ties are important explanatory variables, as has already been established in the literature. The real exchange rate shows the expected negative sign as a depreciation of the importer country's currency against that of the exporting country leads to lower exports, and is highly significant in almost all specifications. Belonging to the same regional trade agreement has a positive effect and its significance is robust across specifications. The evidence is more mixed on GATT/WTO membership whose significance varies across specifications.[29] One caveat to note is that in the AR(1) specifications in the last two columns of Table 3, the coefficients seem substantially larger especially on the time invariant variables such as distance, border, colony and language. However, this is due to the nature of the AR (1) correction whereby the effect of time invariant regressors is now given by the estimated coefficient times $(1-\rho)$ where ρ is the estimated autocorrelation parameter reported at the bottom of Table 3. Once this is taken into account, the estimates in columns (3) and (4) are very similar to their counterparts in the previous two columns.

5.3. Robustness and sensitivity checks

Table 4 presents the results of various other specifications. In the first two columns, we verify that our results are robust to different methodologies while the remaining columns check the sensitivity of our conclusions to alternative definitions of tough new users.

5.3.1. Country pair fixed effects and zero trade flows

In the first column of Table 4 we show the results of a country-pair fixed effects regression analogous to column (4) in Table 3. These country-pair fixed effects account for a bias that may arise from time-invariant omitted variables in (1). The results are very much in line with the earlier results in Table 3. Again, the overall number of AD measures has a highly significant and negative effect on aggregate trade with a coefficient equal to -0.040 on tough new users, which can usefully be compared to the coefficient -0.034 in column (4) of Table 3 where instead of country-pair fixed effects we used importers and exporters fixed effects. As for the other time varying gravity equation variables they are all highly significant with the expected sign, apart from RER_{ijt} that loses its significance possibly because there is not much within variation in the sample.

Some recent studies on the gravity equation have pointed out that zero trade flows may bias the OLS estimates. Santos-Silva and Tenreyro (2006) propose a Poisson estimator that can accommodate zero values for the dependent variable. Alternatively, Helpman et al. (2008) suggest using a two-stage Heckman selection model. Interestingly both papers conclude that correcting for zero-trade flows does not make much difference. If anything, Santos-Silva and Tenreyro (2006) show that simply applying a Poisson estimator on the non-zero trade flows can improve on standard OLS results because of the way that this estimator deals with heteroskedasticity. In column (2) of Table 4 we therefore show the results of a Poisson estimation. The results on the trade chilling effects of AD measures for tough new users remain qualitatively the same. In this specification the adoption dummy for tough users becomes significant but only at the 10% level, which is not enough to draw strong inferences. The main purpose for its inclusion is to account for the structural break in the trade policy regime.

5.3.2. Alternative definitions of tough new users

We also verify the sensitivity of our results to different definitions of tough users. In column (3) of Table 4 we define tough users on the basis of the number of AD cases per year (of existence of the AD law). In contrast to our benchmark definition, this allows us to take into account the number of years the AD legislation has been in place. How this alternative definition affects countries' ranking can be verified from the last two columns of Table 1 where we report for each country the number of AD initiations and measures per year, respectively. Ranking countries in terms of initiations or measures per year, we observe the same clear break between the top five users of AD and the rest of the sample. The five toughest users

[28] When controlling for an AR(1) process, the estimated autocorrelation coefficient ρ reported at the bottom of the tables is large and similar to the coefficient on the lagged dependent variable (i.e., 0.77).

[29] Our methodology of importer and exporter fixed effects and exports (instead of total trade) as the dependent variable is very close to Subramanian and Wei (2007) who find a positive effect of GATT/WTO membership. Using a different approach, Rose (2004) does not find a robust significant effect.

Table 4
Robustness checks: country-pair fixed effects and definition of tough users.

Regressors	Fixed effects	Poisson	Definitions of tough users		
	(1)	(2)	(3)[a]	(4)[b]	(5)[c]
Real $exports_{ijt-1}$	–	0.887*** (0.005)	–	–	–
$Overall\ AD\ measures_{jt-1}$ *tough*	−0.040*** (0.016)	−0.023** (0.010)	−0.029* (0.016)	−0.033*** (0.013)	−0.026** (0.013)
$Overall\ AD\ measures_{jt-1}$ *weak*	−0.020 (0.016)	−0.006 (0.008)	−0.025* (0.015)	−0.012 (0.023)	−0.022 (0.015)
$AD\ adoption_{jt}$ *tough*	−0.089 (0.062)	−0.051** (0.024)	−0.032 (0.054)	0.047 (0.036)	−0.008 (0.053)
$AD\ adoption_{jt}$ *weak*	0.034 (0.028)	−0.019 (0.012)	0.023 (0.026)	−0.011 (0.030)	0.008 (0.027)
Openness $index_{jt}$	0.354*** (0.113)	0.268*** (0.036)	0.422*** (0.103)	0.390*** (0.102)	0.379*** (0.100)
Real GDP_{jt}	0.211*** (0.028)	0.112*** (0.021)	0.250*** (0.030)	0.245*** (0.030)	0.264*** (0.030)
Real GDP_{it}	0.168*** (0.032)	0.054** (0.024)	0.219*** (0.041)	0.220*** (0.041)	0.210*** (0.040)
$Population_{jt}$	0.151* (0.084)	0.138* (0.083)	0.990*** (0.300)	0.921*** (0.303)	0.820*** (0.295)
$Population_{it}$	0.612*** (0.078)	−0.0003 (0.068)	0.015 (0.319)	0.008 (0.320)	0.047 (0.301)
$Distance_{ij}$	–	−0.084*** (0.007)	−1.455*** (0.032)	−1.454*** (0.032)	−1.453*** (0.031)
$Border_{ij}$	–	0.121*** (0.013)	0.679*** (0.096)	0.680*** (0.096)	0.700*** (0.095)
$Language_{ij}$	–	0.025** (0.010)	0.518*** (0.073)	0.519*** (0.073)	0.497*** (0.069)
$Colony_{ij}$	–	0.075*** (0.014)	0.810*** (0.117)	0.809*** (0.117)	0.843*** (0.114)
RER_{ijt}	−0.012 (0.012)	−0.022*** (0.003)	−0.027*** (0.009)	−0.028*** (0.009)	−0.025*** (0.009)
RTA_{ijt}	0.169*** (0.062)	0.072*** (0.017)	0.217*** (0.034)	0.217*** (0.034)	0.193*** (0.032)
WTO_{jt}	0.032 (0.037)	0.082*** (0.022)	0.042 (0.039)	0.042 (0.038)	0.036 (0.038)
AR(1): ρ	0.77	–	0.77	0.77	0.77
R^2	0.40	0.98	0.43	0.43	0.44
F (χ^2 in column 2)	28.08***	700,811.60***	806.04***	804.85***	884,20***
Observations	29,835	33,222	33,222	33,222	35,452

Notes: (a) Tough new users defined as top five ranked countries in terms of initiations and measures per year (see Table 1); (b) tough new users defined as countries with more than 1.18 measures per year; (c) tough new users defined as for previous table plus Argentina, South Africa and South Korea; (i) the dependent variable is the log of real exports from country i to country j; (ii) all variables, except dummies, are in logs; (iii) year dummies, importer and exporter fixed effects included in specifications (2) to (5); (iv) robust standard errors in parenthesis. *denotes significance at the 10% level, **5% level and ***1% level; (v) in columns (1) and (3)–(5) the errors are assumed to follow an AR(1) process and the Prais–Winsten estimator is used, which implies estimating $y_t-\rho y_{t-1}=\beta x_t-\beta\rho x_{t-1}+\mu_t$. The estimated autocorrelation parameter ρ is reported at the bottom of the table.

now include all but Taiwan from our benchmark definition plus Egypt, previously not included. The reason for this reversal is that Taiwan has been a consistent user of AD over time ever since its adoption of the law in 1984 but with a relatively low number of cases per year. On the other hand, Egypt only adopted an AD law in 1998 but introduced a very large number of AD petitions resulting in a high number of AD cases per year. Hence, Egypt can be considered as a much "newer" user than Taiwan.

The results using this alternative definition of tough users are presented in column (3) of Table 4 and show that the chilling effect of AD measures on imports is still present but with a smaller coefficient and a lower level of significance. Interestingly, there is evidence of chilling effects of AD also among the weak users of AD. Clearly, this significance of the weak users is driven by the inclusion of Taiwan. These results seem to imply that a country like Taiwan that has been using AD consistently for a long time has more of a trade chilling effect on trade than a country that started using it only recently (e.g., Egypt).

Because Taiwan appears to be a critical country, we also try another definition of tough users now based on the number of AD measures per year but where we include all countries that have a score that is at least as high as the one of Taiwan (i.e., 1.18). This definition implies adding China, Columbia, Egypt, Peru, the Philippines and Venezuela to the group of original tough users. Applying this definition confirms our previous results in the sense that the AD measures imposed by these new tough users clearly reduce trade flows by a coefficient of −0.033, significant at 1% level, while imports of the remaining new weak users do not exhibit any effect for the AD measures they impose. And finally, in column (5) of Table 4 we identify new tough users as the countries in our benchmark definition plus three additional countries (i.e., Argentina, South Africa and South Korea) that adopted an AD law before 1980 but that only became active in the use of AD during our sample period. Again, the estimates are qualitatively identical (i.e., AD measures by tough new users chill all imports from trade partners).

Thus far we have focused on the proliferation of AD laws which started after 1980. Before 1980, the main users of AD laws consisted of a handful of countries (US, EU, Canada, Australia and New Zealand). The main reason for not including them in our analysis is that most of these traditional users adopted their AD laws around the turn of the 20th century. This makes it difficult to assess the effect of AD adoption and use on their trade flows especially due to a lack of consistent trade

data before adoption. Without controlling for the year of AD law adoption and without observations on trade flows before adoption, it is impossible to asses the true trade effects of AD laws. Indeed, when we include the traditional AD users as importing countries[30], the effect of overall AD measures on trade flows in the period that we study becomes largely insignificant, although still negative. This result is in line with the findings of Egger and Nelson (2006). However, in our view, including all AD users cannot capture the true trade chilling effects of AD. One cannot exclude the possibility that the trade flows of "traditional users" are chilled compared to what they would have been in the absence of AD laws. This is why in this paper we focus uniquely on those countries that recently adopted AD laws, which is arguably the only set of countries that offers a unique opportunity to truly assess the trade chilling effects of AD.

In conclusion, the robustness and sensitivity checks confirm the results presented earlier, suggesting that AD measures have a significant trade chilling effect on aggregate imports. Although alternative definitions of new tough users serve to illustrate differences across groups of users, they do not change the conclusion that the use of AD measures hinders trade flows directed to the tough users of AD.

5.4. Sectors and exporters effects

The purpose of this section is to carry out two additional experiments that may qualify our main result. First, we examine whether aggregate trade chilling effects are driven by few broadly defined sectors. Second, we single out some of the most targeted exporters, such as China, to see if their exports to tough users are chilled more than the average effect estimated so far.

5.4.1. Sector level analysis

Thus far we have shown that product-level AD measures affect aggregate trade flows. However, their impact may be uneven across sectors. Similar to Subramanian and Wei (2007), we aim to verify to what extent the trade effects are driven by certain sectors. Indeed, the majority of AD cases by the new users are from the iron and steel, chemicals, and textile sectors. Also the agricultural sector, which is still quite protected in various countries, is involved in relatively many AD cases, especially among new users of AD, as shown by Reynolds (2007) and Moore and Zanardi (2009).[31]

To examine the sectoral impact of AD, we turn to COMTRADE data that provide a sectoral breakdown of bilateral trade flows although with a smaller number of observations than the IMF data used previously. The results of our preferred specification of column (4) in Table 3 are confirmed when using COMTRADE data, as shown in column (1) of Table 5. The only major difference is the evidence of a trade chilling effect of AD measures for the weak users, which suggests that if anything the IMF data provides a conservative estimate of the true trade chilling effects of AD measures.

From column (2) to column (5) in Table 5, we then re-estimate our preferred specification subtracting, one at a time, the bilateral trade flows in the sectors iron and steel, chemicals, textiles, and agriculture from the aggregate bilateral flows.[32] Finally, in column (6), we exclude all four sectors. The results show that subtracting trade in iron and steel or textile sectors does not drive the chilling results since the estimated coefficients in columns (2) and (4) are basically unchanged. However, when subtracting chemicals or agriculture, the trade impact of AD measures becomes weaker, but it remains significant. But when all four sectors are excluded at once, as done in column (6), the significance of the AD measures by tough new users on bilateral trade flows disappears. This suggests that while product-level trade protection presents trade chilling effects that spill over to a more aggregate level, the spillovers are predominantly occurring in the broad sectors to which the products belong to. These broad sectors together represent over 25% of total aggregate trade. The overall trade chilling effects of AD measures on aggregate bilateral trade are thus driven by a few large sectors, consistent with Subramanian and Wei's (2007) findings of differential effects of trade liberalization across sectors.

5.4.2. Export targets

To further enhance our understanding of the results, and in particular to try to understand which exporters may bear a larger burden, we allow for the possibility that the trade effects of AD differ across trading partners. The top five most targeted exporters by the new tough users during the period of our analysis are China (12.65%), USA (11.45%), Russia (6.63%), Brazil (6.02%) and South Korea (5.42%).

To investigate whether China, the number one targeted country, suffered relatively more from AD measures against its exports than other countries, we interact AD measures imposed by the tough users with a dummy for bilateral imports from China. Although the interaction term is negative, its insignificance (with a p-value of 0.12) suggests that the chilling effect on China's exports is similar to that of other trade partners. Considering only the recent years (i.e., 1995–2000) when Chinese exports have surged the most does not change this conclusion: the interaction term for China for these years is still insignificant. The results are similar (i.e., insignificance of interaction terms) when the top five users are lumped together

[30] Seventeen extra importers are included in this exercise, including the traditional users (i.e., Australia, Canada, EU, New Zealand and US).

[31] Reynolds (2007) argues that agricultural cases accounts for 6% of worldwide AD investigations between 1987 and 1997, but over 10% of total investigations among new users such as Brazil and Columbia. She also shows that a 10.8% AD duty by Mexico on the imports of US rice in 2000 resulted in a 10% decrease in the US exports of rice to Mexico. Similarly, Moore and Zanardi (2009) document a high number of AD cases in "Food", "Food products" and "Beverages".

[32] Sectors are defined using the SITC (revision 1) classification. See notes of Table 5 for details.

Table 5
Sectors most affected by antidumping measures.

Regressors	COMTRADEdata (1)	Excluding iron and steel (2)	Excluding chemicals (3)	Excluding textiles (4)	Excluding agriculture (5)	Excl. steel, chem., tex., ag. (6)
Overall AD measures$_{jt-1}$ tough	−0.037** (0.016)	−0.035** (0.016)	−0.030* (0.016)	−0.039** (0.016)	−0.029* (0.030)	−0.022 (0.022)
Overall AD measures$_{jt-1}$ weak	−0.029** (0.014)	−0.028** (0.013)	−0.020 (0.015)	−0.033** (0.014)	−0.054*** (0.018)	−0.065** (0.026)
AD adoption$_{jt}$ tough	−0.013 (0.056)	−0.005 (0.056)	0.007 (0.062)	0.010 (0.027)	0.042 (0.062)	0.073 (0.097)
AD adoption$_{jt}$ weak	0.005 (0.026)	0.020 (0.026)	−0.016 (0.028)	0.010 (0.054)	0.029 (0.030)	0.033 (0.044)
Openness index$_{jt}$	0.465*** (0.097)	0.472*** (0.098)	0.522*** (0.105)	0.457*** (0.098)	0.459*** (0.112)	0.557*** (0.145)
Real *GDP$_{jt}$*	0.248*** (0.029)	0.244*** (0.029)	0.253*** (0.031)	0.244*** (0.029)	0.252*** (0.032)	0.312*** (0.049)
Real *GDP$_{it}$*	0.207*** (0.044)	0.216*** (0.044)	0.224*** (0.046)	0.186*** (0.041)	0.243*** (0.048)	0.343*** (0.061)
Population$_{jt}$	1.327*** (0.291)	1.295*** (0.293)	1.397*** (0.301)	1.324*** (0.295)	1.436*** (0.359)	1.721*** (0.450)
Population$_{it}$	−0.113 (0.260)	−0.133 (0.261)	0.224*** (0.046)	−0.122 (0.260)	0.243*** (0.048)	−0.123 (0.359)
Distance$_{ij}$	−1.492*** (0.031)	−1.499*** (0.031)	−1.491*** (0.030)	−1.486*** (0.031)	−1.644*** (0.037)	−1.656*** (0.037)
Border$_{ij}$	0.637*** (0.097)	0.650*** (0.099)	0.649*** (0.095)	0.651*** (0.098)	0.621*** (0.103)	0.792*** (0.101)
Language$_{ij}$	0.533*** (0.071)	0.572*** (0.072)	0.510*** (0.072)	0.536*** (0.072)	0.737*** (0.083)	0.835*** (0.088)
Colony$_{ij}$	0.840*** (0.114)	0.857*** (0.116)	0.889*** (0.114)	0.837*** (0.114)	0.629*** (0.140)	0.706*** (0.132)
RER$_{ijt}$	−0.023** (0.009)	−0.028*** (0.009)	−0.025*** (0.010)	−0.024*** (0.009)	−0.031*** (0.010)	−0.045*** (0.012)
RTA$_{ijt}$	0.220*** (0.032)	0.225*** (0.032)	0.207*** (0.034)	0.215*** (0.032)	0.193*** (0.035)	0.217*** (0.045)
WTO$_{jt}$	0.020 (0.035)	0.005 (0.035)	0.026 (0.037)	0.025 (0.035)	0.014 (0.038)	0.014 (0.052)
AR(1): ρ	0.77	0.78	0.76	0.78	0.76	0.66
R^2	0.47	0.46	0.46	0.46	0.47	0.44
F	709.52***	691.04***	737.28***	676.31***	768.29***	839.11***
Observations	30,551	30,538	30,349	30,526	30,126	29,779

Notes: (i) The dependent variable is the log of real exports from country i to country j (using COMTRADE data). Industrial sectors defined using the SITC (revision 1) classification, as follows: iron and steel=SITC 67; chemicals=SITC 5, textiles=SITC 65, agriculture=SITC 0+1+4; (ii) all variables, except dummies, are in logs; (iii) year dummies, importer and exporter fixed effects included in all specifications; (iv) robust standard errors in parenthesis. *denotes significance at the 10% level, **5% level and ***1% level; (v) the errors are assumed to follow an AR(1) process and the Prais–Winsten estimator is used, which implies estimating $y_t-\rho y_{t-1}=\beta x_t-\beta\rho x_{t-1}+\mu_t$. The estimated autocorrelation parameter ρ is reported at the bottom of the table.

or when focusing on the heaviest targeted newly industrialized countries (NICs) (i.e., Brazil, China and India, which is the sixth most targeted exporter).[33]

In conclusion, these results suggest that the trade effects are equally felt across trade partners, which is consistent with a chilling effect that depends on the overall AD stance of a country.

5.5. Economic significance

The estimated coefficients from the previous sections can be used in an attempt to put a dollar value on the extent to which trade flows are chilled as a result of AD laws. Using the short run elasticity on tough users in column (4) of Table 3 of −0.034, together with the fact that new *tough* users impose on average five AD measures a year after adoption of the AD law, we conclude that the annual reduction of global imports to the new tough users is 5.9%.[34] Using average values of total annual imports to new tough users from 1995 to 2000, this percentage implies that annual imports to new tough users are reduced by around 14 billion US$ (in 1995 prices). Table 6 reports detailed figures for each of the new tough users and discloses substantial heterogeneity. For example, Mexico's AD caseload leads to a 7.2% reduction in imports, while Taiwan's AD actions imply a 2.3% reduction.

In order to put these numbers into perspective, it is worth comparing them with the gains in terms of trade volumes accomplished as a result of trade liberalization. Toward this end, we exploit the fact that the openness index is always positive and highly significant with a coefficient of 0.409 significant at the 1% in column (4) of Table 3. We then calculate the gains in trade volumes due to trade liberalization by using the change in the openness index for the years from the beginning of their trade liberalization process until the end of the sample period.[35] Despite our rudimentary approach, the relative magnitudes that the regression coefficients allow us to derive are interesting to compare. For instance, Mexico's

[33] In view of the insignificant results, these specifications are not reported but are available upon request.

[34] The effect of five AD measures is given by $(6^{-0.034}-1^{-0.034})/1^{-0.034}\approx 5.9\%$, since the regressor takes the form of ln(1+AD measures). In what follows, similar calculations are used.

[35] Trade liberalization dates from Jonsson and Subramanian (2001), Li (2004), Liu (2002), Refaat (2000).

Table 6
Are the gains in trade volumes from trade liberalization offset by antidumping measures?

	First year of trade liberalization (1)	Year of first AD measure (2)	%Δ in annual imports due to AD (3)	%Δ in annual imports due to liberalization (4)	Δ annual imports due to AD (billion US$) (5)	Δ annual imports due to liberalization (billion US$) (6)
Brazil	1988	1989	−5.9% (2.65)	34.6% (9.94)	−2.92	17.12
India	1991	1993	−6.8% (3.05)	17.4% (4.70)	−1.83	4.69
Mexico	1985	1987	−7.2% (3.21)	28.2% (7.91)	−6.51	25.49
Taiwan	1986	1986	−2.3% (1.07)	4.9% (1.26)	−1.24	2.64
Turkey	1980	1990	−5.3% (2.40)	52.7% (16.07)	−1.27	12.63
Total					−13.77	62.56

Notes: (i) Robust standard errors in parenthesis calculated using the delta method; (ii) trade liberalization episodes from Jonsson and Subramanian (2001), Li (2004), Liu (2002) and Refaat (2000); (iii) percentage changes calculated using the coefficients from column (4) of Table 3; (iv) figures in columns (5) and (6) are in 1995 real prices.

trade liberalization began essentially in 1985. A back of the envelope calculation based on the change of Mexico's openness index from 1985 up to 2000 shows an increase in imports of 28.2% over this period.[36] Interestingly, Mexico first imposed an AD measure in 1987, and its AD policy resulted in trade volume losses of 7.2%, thereby undoing an important part of what had been accomplished with the liberalization reforms. Other new tough users also face similar situations; India, in particular, eliminated a substantial part of its gains in terms of trade volumes from liberalization.[37] Note that for most of the new tough users, the first AD measures were imposed right after the start of their liberalization efforts, possibly suggesting that AD may function as a safety valve. When we compare the percentage loss in imports due to AD measures and the gains in import volumes due to trade liberalization, the true chilling effects of AD are both apparent and too large to be dismissed as a 'small price to pay' for further trade liberalization. Moreover, Moore and Zanardi (2009) provide evidence contrary to the safety valve argument for a relatively large sample of developing countries.

Overall, these numbers illustrate the chilling trade effects that AD policy can have. This observation, together with the evidence on the proliferation of AD regimes, should sound an alarm in opposition to the rhetoric asserting that the effects of AD protection are small and insignificant.

6. Conclusions

The recent proliferation of AD laws across mainly developing countries introduced a structural break in the trade policy regimes of the "new adopters". This structural break, given by the date of the adoption of the AD laws, allows us to identify the trade flows before and after adoption and to estimate the effect on aggregate trade of the adopters. This unique policy change across a wide set of countries makes it possible to go beyond previous studies and to look for effects that exceed product-level trade flows. While the maintained assumption thus far was that aggregate effects must be negligible, our analysis contrasts this popular view. Without controlling for AD law adoption, the effects of AD measures are likely to be an underestimate of the true effects since trade flows may be chilled throughout. Thus, studying the impact of AD measures on trade flows towards countries of destinations that long had AD laws can never capture their true trade chilling effects. While one may observe a drop in product-level trade before and after the introduction of a particular AD measure, this can never capture the deterring effect that these measures may have on other products simply because one does not observe the correct counterfactual (i.e., trade flows to the country of destination prior to its adoption of an AD law).

Since some theoretical papers suggest that the deterrent effect may apply also to other products shipped from a particular country of origin, not just on the products that actually get hit with AD measures at a later date in time, in this paper we focus on aggregate trade flows. When controlling for adoption and counterfactual trade flows, the trade chilling effects of AD measures are strong. While they appear in the aggregate bilateral flows, they are uneven across sectors. Sector level trade in chemicals and agriculture suffer most from the unintended implications of trade policy that go beyond the products onto which it is imposed.

[36] Trade volume gains from liberalization are calculated as $(7.85^{0.409}-4.28^{0.409})/4.28^{0.409} \approx 28.2\%$, where 7.85 and 4.28 are the values of the openness index in 2000 and 1985, respectively. Since trade liberalization has been a cumulative process, the value of the index in 2000 summarizes the total liberalization process over the period.

[37] According to Table 5, also Taiwan neutralized most of the gains. However, in 1986 its openness index was already very high (i.e., 7.12 out of 10).

The results presented here refute the notion that AD laws are merely a small price to pay. They clearly indicate that the trade chilling effects of AD on bilateral trade flows are non-negligible. Based on our estimations, we infer that the new tough users of AD laws have their annual imports reduced by 5.9%, which corresponds to 14 billion US$—all because of their AD measures.

These conclusions are worrisome given the continuing proliferation of AD regimes among developing countries, whose efforts of substantial tariff reductions risk to be neutralized by AD actions. The possibility that the list of active AD users expands and more countries adopt AD laws is very likely. In this respect, this paper casts a new light on AD and its use, and shows that AD is less innocuous than its advocates would like us to believe. All the more relevant for developed countries (now main targets from new users) and developing countries to engage in a multilateral (i.e., at the WTO level) reform of the AD system.

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Appendix 1

See Table A1.

Appendix 2

See Table A2.

Table A1
List of exporters in the dataset.

Albania	Dominica	Lebanon	Slovenia
Algeria	Dominican Republic	Libya	South Africa
Antigua and Barbuda	Ecuador	Lithuania	South Korea
Argentina	Egypt	Luxemburg	Spain
Aruba	El Salvador	Macao	Sri Lanka
Australia	Equatorial Guinea	Macedonia, FYR	St. Kitts and Nevis
Austria	Estonia	Malaysia	St. Lucia
Bahamas	Fiji	Maldives	St. Vincent and Grenadines
Bahrain	Finland	Malta	Suriname
Barbados	France	Mauritius	Sweden
Belarus	Gabon	Mexico	Switzerland
Belgium	Germany	Morocco	Syrian Arab Republic
Belize	Greece	Netherlands	Taiwan, Province of China
Bermuda	Grenada	Netherlands Antilles	Thailand
Bolivia	Guatemala	New Zealand	Tonga
Bosnia and Herzegovina	Guyana	Norway	Trinidad and Tobago
Brazil	Honduras	Oman	Tunisia
Brunei Darussalam	Hungary	Panama	Turkey
Bulgaria	Iceland	Papua New Guinea	Turkmenistan
Canada	India	Paraguay	United Arab Emirates
Cape Verde	Iran	Peru	United Kingdom
Chile	Iraq	Philippines	United States
China	Ireland	Poland	Uruguay
China, Hong Kong	Israel	Portugal	Vanuatu
Colombia	Italy	Qatar	Venezuela
Costa Rica	Jamaica	Romania	
Croatia	Japan	Russia	
Cuba	Jordan	Samoa	
Cyprus	Kazakhstan	Saudi Arabia	
Czech Republic	Kiribati	Seychelles	
Denmark	Kuwait	Singapore	
Djibouti	Latvia	Slovak Republic	

Table A2
Data sources.

Variables	Description	Sources
AD adoption	Dummy variable equals 1 in the year when a country has an AD law	Authors' own calculations
AD measures received in past two years	Cumulative AD measures received by an importer in the last two years	Authors' own calculations
Border	Dummy variable equal to 1 when countries share a land border	CIA World Factbook
Colony	Dummy variable equal to 1 when countries had colonial ties	CIA World Factbook
Distance	Great circle distance in km between capitals	Authors' own calculations
KOF index	Index of Economic Globalization	Dreher (2006)
Language	Dummy variable equal to 1 when countries share an official language	CIA World Factbook
Openness index	Freedom to Trade with Foreigners index from the Economic Freedom Index (interpolated)	Fraser Institute, Canada
%Δ Openness index	Percentage change over two years of the openness index	Fraser Institute, Canada
Overall AD initiations	The number of AD initiations in a particular year against all other countries	Authors' own calculations
Overall AD measures	The number of AD measures (duties or undertakings) in a particular year against all other countries	Authors' own calculations
Population	Population in millions	IFS and CHELEM
Real exports	Real value of exports deflated by US GDP deflator	IFS and CHELEM
Real GDP	Real value of GDP deflated by US GDP deflator	IFS and CHELEM
RER	Real exchange rate: $(CPI_i/CPI_j)/(NER_{j\$}/NER_{i\$})$ where CPI and NER are the consumption price index and the nominal exchange rate with respect to the US$, respectively	IFS and CHELEM
RTA	Regional Trade Agreements: as from Baier and Bergstrand (2007) and Horn et al. (2009)	WTO
WTO	Dummy variable equal to 1 in the years a country is member of the GATT/WTO	WTO
Years from joining WTO	Number of years since a country joined the GATT/WTO	WTO
Years from joining WTO post UR	Number of years since a country joined the GATT/WTO, for countries that joined after 1994	WTO
Years from joining WTO pre UR	Number of years since a country joined the GATT/WTO, for countries that joined before 1995	WTO

Notes: CHELEM is a dataset made available by CEPII, Paris, France.

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