The Layers of the Information Technology Agreement Impact

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Abstract

The signatories of the WTO's Information Technology Agreement eliminated import tariffs for a wide range of IT goods, not just among each other but on an MFN basis. We show that this agreement did not only lead to increased imports, but – by reducing the cost of intermediate goods – ITA members were also able to increase their exports of final goods. Our estimation strategy is based on the plausibly exogenous entry of late signatories to the agreement, who ratified the ITA as part of a broader policy objective. Using product–level data, we are able to take into account the various *layers* of ITA impact, dissecting the impact of tariff reduction, tariff elimination to zero, and over and above tariff reductions, including through firm relocation via intermediate goods channel, rather than just a single ITA dummy as in the previous literature. Our results suggest that the positive trade and value chain effects of the ITA are driven entirely by tariff-related effects. In particular, having zero tariffs is associated with more imports of intermediate than final goods, and with participation in global value chains. This finding also supports the line of thought that trade policy certainty attracts investment. Moreover, while China stands out among exogenous joiners, we show that results are not driven just by this country. Our results are robust to estimation not only with OLS, but also using Poisson estimation to correct for zero trade flows, as well as adding multilateral resistance terms. [1]

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[1] Our study of the disaggregate imports and exports required substantive preparatory work to take care of some of the issues related to product coverage and membership of the ITA that was possible with the kind help from the WTO secretariat.

1. Introduction

Among the WTO's plurilateral agreements, the ITA stands out as being probably the most wide–ranging, reducing to zero tariffs on many information technology products. This makes it the paramount case for study of the effects zero-for-zero agreements may have on trade flows. The question becomes particularly policy relevant for two reasons. First, an ITA 2 agreement is currently being debated, which could amplify the product coverage of the original ITA agreement considerably further. Second, zero-for-zero agreements in other sectors are often floated as proposals, mainly by developed countries, with the aim of bringing the Doha Round to conclusion.

Yet, the literature examining the trade impact of the ITA is surprisingly scarce. To our knowledge, only few studies have addressed this topic so far. Bora and Liu (2006) is the only econometric analysis of ITA imports for members and non-members. The paper focusses on the impact of the ITA for imports only. They use data up to 2003 on aggregate ITA imports and thus mainly covers original participants, finds that ITA signatories were on average importing more ITA goods than non-signatories.

A more recent study by Anderson and Mohs (2010) presents a mainly descriptive review of ITA experience while going further in time coverage. In their assessment of main trends in trade of ITA products the paper outlines the rapid increase in exports of developing countries that is associated with joining ITA, in particular a shift to Asia and emerging role of China. The authors attribute this effect to the lower cost of intermediate goods due to ITA. Complementarily, World Trade Organization (2012) provides a comprehensive analysis of the formation, membership and coverage overview of the ITA.[2]

Joseph and Parayil (2006) analyse early ITA trade – until 2003 – and note that some non-ITA members have outperformed the ITA members (China joined the ITA only in 2003 but was already a fast-growing country in IT goods trade). Further, the paper argues that in agreements like the ITA the developing countries have been passive adopters. In order to reap the benefits of liberalization, as the authors argue, developing countries should

[2]Dreyer and Hindley (2008) discuss that the partial and complex coverage of the ITA have led to a WTO dispute on compliance between two ITA signatories.

create a South–South framework in the IT sector; thus late joiners to the ITA may have anticipated lower gains.

Portugal-Perez et al. (2010) focus on non–tariff costs. Their results indirectly suggest that the impact of a sectoral agreement like the ITA may have further–reaching impacts if it leads to harmonisation standards. Analysing the impact of ITA on EU15 imports, the paper finds a positive trade impact when EU standards are aligned with international norms.

The Global Value Chains literature (Gawande et al. (2011), Milberg and Winkler (2010)) suggests that membership in an agreement like ITA may also promote exports. The transmission mechanism here is that lower import tariffs in intermediate goods help exporters be more competitive, thus increasing their presence on the world market. In line with this, Feenstra (2008) presents evidence of strongly magnified effect on prices from tariff cuts in ITA products because of highly fragmented production and off–shoring. And indeed, one may wonder if China would be the same IT export hub if it had not eliminated tariffs on the inputs required for this success. Using the Sturgeon classification (Sturgeon and Memedovic, 2010) for intermediate goods[3] we thus explore the impact of the ITA on trade of intermediate goods.

Some countries joined the ITA when ratifying a larger agreement, such as China upon accession to the WTO. These countries can be plausibly argued to have joined for exogenous reasons, helping us to overcome identification problems. Economic theory suggests that the decision to join an agreement is typically endogenous (Ornelas, 2005), which has important implications for empirical analysis (Baier and Bergstrand (2007) pioneered the econometric methods for this case). Furthermore, higher income countries may have adopted products covered by the ITA faster, increasing their incentive to join the agreement. But a significant number of countries became ITA signatories while pursuing other goals: since the EU joined the ITA in 1997, future members automatically became ITA parties too. Some new WTO members made a commitment to join ITA as part of their accession protocol. Finally, the US was actively promoting ITA participation as a precondition for FTAs.

Using product–level data allows us quantify ITA benefits more precisely than the previous literature, which relied on aggregates. We disentangle ITA benefits into three components: firstly, the direct effect of a reduced tariff; this effect is very well understood in the literature. Second, the elimination

[3]The classification will become part of a revised BEC classification

of tariffs reduces transaction costs of crossing borders. While small positive tariffs do not generate significant revenue for the government, they have a fixed cost for exporters through the effort required for compliance. And finally, since the ITA also sets the bound tariff rate for covered products to zero, it removes uncertainty about future tariff increases. This may influence the location decisions of MNEs through reduced policy risk.

This paper proceeds by giving a brief overview of the ITA agreement and its impact in Section 2. Section 3 then turns to a description of the data; the next section turns to the empirical strategy. Section 5 presents results, whose robustness is examined in section 6. Finally, we conclude in Section 7.

2. The ITA and a first glance at its impact

The ITA is a plurilateral agreement under the WTO, which institutes import tariff concessions by its members on certain IT-related goods. The concessions are offered on MFN basis, meaning that even WTO members that were not join the agreement enjoy duty-free (applied and bound) exports to the ITA members. The agreement was initiated by 43 countries in March 1997 and managed to increase its membership to 74 countries by March 2012. In order to be implemented within the WTO, the initial members had to cover at least 90% of world trade in IT products. The agreement is solely about tariff elimination on certain products and does not include provisions on non-tariff issues. The ITA requires the members to apply concessions to all WTO members by adjusting the MFN applied and bound tariffs. The agreement has a complex coverage of goods. In particular, there are in total 154 product lines of 6-digit HS classification affected, with 95 product lines being covered fully. The rest are covered only partially thus creating an issue for empirical analysis of the trade in ITA goods; we address these issues in more detail in the data section below.

The products covered by the ITA can be roughly classified into 7 groups of products (World Trade Organization, 2012) :

1. Computers
2. Instruments and apparatus
3. Semiconductors
4. Semiconductor manufacturing equipment

5. Data-storage media and software

6. Telecommunications equipment

7. Parts and accessories

Computers, semiconductors and parts and accessories are the most traded products, making up around 80% of trade flows.

Table 1 below shows the commitment effect of the ITA as its members continue to reduce average tariffs on ITA goods. Note that the average tariff rate of the ITA participants is slightly above zero as its recently joined members receive an implementation schedule spanning several years during which they gradually reduce the tariffs.

Table 1: Tariffs: ITA Members and Nonmembers

Country group	Tariff (%)
1997	
ITA Participants	2.47
Non-participants	9.19
2011	
ITA Participants	0.047
Non-participants	5.15

As noted earlier, the ITA membership has been expanding over time, and almost doubling the membership by 2012. This process was happening largely through three channels. First, some countries that were acceding to the WTO after 1997 members had the commitment to join the ITA in their accession protocol as a result of accession negotiations. Second, all recent members of the European Union (EU) had to adopt the trade policy of the EU upon accession or in the preparatory process and hence join the ITA, unless they had done it earlier. Third, the US was one of the initiators of the ITA and was actively encouraging during negotiations with potential FTA partners to join the ITA. This paper is determining the extent of the impact of the ITA on global trade, as well as on the development of IT value chains. Methodologically, we distinguish the countries by the circumstances at which they were joining the ITA. It follows that from this perspective we can identify two groups among current members. One group is referred to "individual joiners" and includes all the initial members and later joiners

whose accession was not associated with or tied to any larger agreement package. The other group, referred to as "exogenous joiners", consists of the ITA members that can be considered to have joined the ITA through a package of a larger agreement, mainly as a by–product of a broader policy objective (three channels outlined above).

It is particularly insightful then to look at the impact on these countries that joined the ITA as a pre-condition for another agreement rather than due to their national decision. Clearly, by offering duty-free exports on MFN basis, the consumers in these countries would most likely gain from lower prices of imported IT goods. But were these countries also able to boost their IT industries and manage to export more than the non-members?

Table 2 below presents the lists of individual and exogenous joiners as well as the year of joining the ITA. The majority of the exogenous joiners of the ITA became signatories via WTO accession, in total 13 countries. Chinese Taipei and Estonia have the ITA membership in their WTO accession protocols as well but these two countries were among the initial ITA signatories before the WTO accession and thus are classified as individual joiners. Another 15 countries were classified as exogenous joiners because of their ITA accession was related to negotiating an FTA with the US or EU accession. One can see from table 2 that exogenous joiners entered the agreement in various years.

Trade in ITA goods has evolved in rather different ways for the two groups of members. The Figures 1 and 2 below present the world import and export shares of ITA individual and exogenous members and non-members for 1996 and 2012. Note that the countries are grouped as members or non-members both in 1996 and 2012 based on their ITA membership status in 2012. This is done in order to avoid shifting shares coming from changing combination of various groups in 1996 and 2012. The world trade in IT products has seen an enormous growth of China's importance, an exogenous ITA member. Thus there is a potential concern that a large part of our results could be be driven by this increase in trade with China. To account for that, for all our later regression specifications we look at the effects on the whole sample and on the sample without China.

Similarly, other exogenous ITA members also experienced a large increase in their trade share. The rising importance of exogenous ITA members displaced individual ITA members with regards to world IT market share, while the non-members largely retained their small world market share. Notably both for China and other exogenous ITA members the increase in market

Table 2: List of ITA members categorized by motivation driving their ITA accession

"Individual" ITA joiners, including all founding members 1/		
Australia	Hong Kong, China	New Zealand
Austria	Iceland	Norway
Belgium	India	Philippines
Canada	Indonesia	Poland
Chinese Taipei 3/	Ireland	Portugal
Costa Rica	Israel	Romania
Czech Republic	Italy	Singapore
Denmark	Japan	Slovak Republic
Egypt (2003)	Korea, Republic of	Spain
El Salvador	Kuwait (2010)	Sweden
Estonia 3/	Liechtenstein	Switzerland
European Union	Luxembourg	Thailand
Finland	Macao, China	Turkey
France	Malaysia	United Arab Emirates (2007)
Germany	Mauritius (1999)	United Kingdom
Greece	Netherlands	United States of America
"Exogenous" ITA joiners, whose ITA accession was likely significantly motivated by...		
WTO accession	EU accession	US FTA
Albania (1999) 4/	Bulgaria (2002)	Bahrain, Kingdom of (2003)
China (2003)	Cyprus (2000)	Colombia (2012)
Croatia (1999) 4/	Hungary (2004)	Dominican Republic (2006)
Georgia (1999) 4/	Malta (2004)	Guatemala (2005)
Jordan (1999) 4/	Slovenia (2000)	Honduras (2005)
Kyrgyz Republic (1999)	Morocco (2003)	
Latvia (1999)	Nicaragua (2005)	
Lithuania (1999) 4/	Panama (1998)	
Moldova, Republic of (2001)	Peru (2008)	
Oman (2000)		
Saudi Arabia, Kingdom of (2005)		
Ukraine (2008)		
Viet Nam (2006) 4/		

Sources: Authors' compilation based on WTO (2012) and information obtained through interviews of various WTO Secretariat staff.
2/ ITA founding members joined in 1997. Accession year for all non-founding members is given in parentheses.
3/ Among ITA founding members, Chinese Taipei and Estonia were the only ones which only joined the WTO subsequently (in 2002 and 1999, respectively).
4/ These countries already joined the ITA during their WTO accession process in the calendar year before WTO accession (only Lithuania acceeded the WTO two calendar years later, in 2001).

Figure 1: World Import Market Shares in ITA products, 1996 and 2012

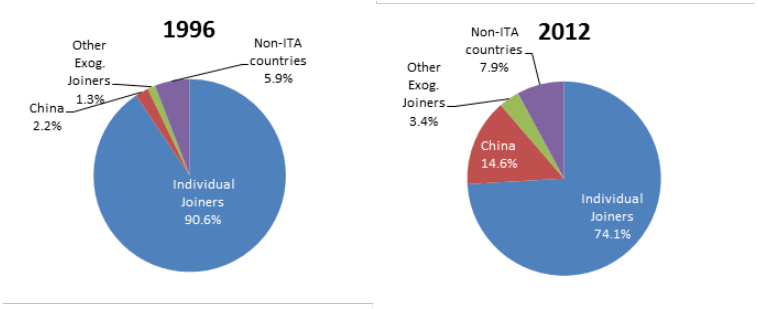
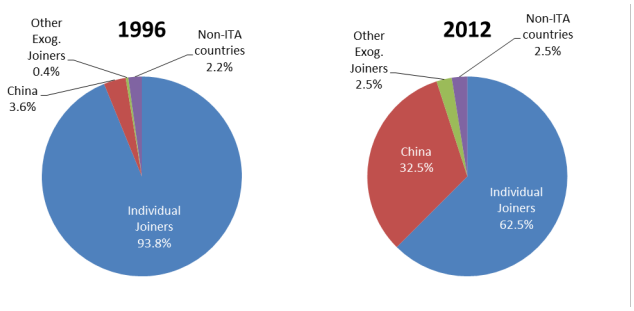


Figure 2: World Export Market Shares in ITA products, 1996 and 2012

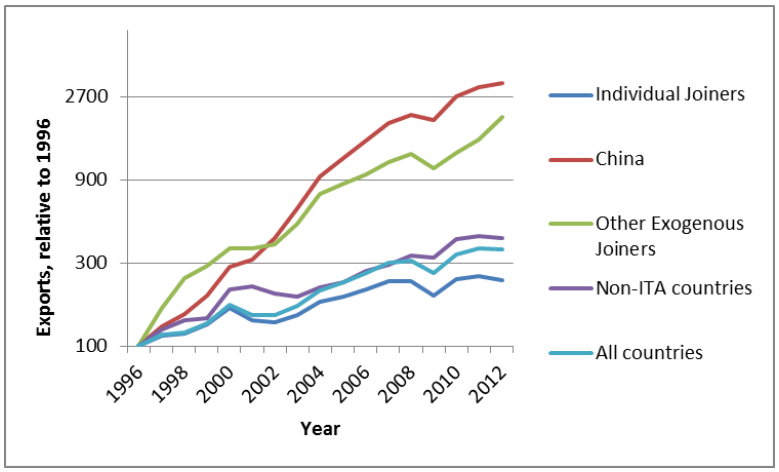


share is more impressive for exports than imports. On the flip side, the individual joiners lost more of their importance in exports than imports. One may therefore hypothesise that the demand for ITA goods is relatively stable over time. In contrast, the geographical origin of products changed significantly in the last decades, driven by location decisions of MNEs.

Figure 3 presents the nominal export value of ITA products by country groups with 1996 values indexed at 100. Exports of all groups have seen an increase and exports of individual ITA members and non-ITA members exports as well as the total world trade show a similar pattern. Exogenous ITA members instead have a much steeper slope. Given that they generally acceded to the ITA a few years after 1997, this graph does not allow to identify whether this impressive pattern is related to ITA accession alone.

Indeed, exogenous joiners were not in ITA yet in earlier years. To obtain a first notion of whether ITA accession may have boosted exports of exogenous joiners, we therefore look at how their exports have evolved prior to ITA accession. To eliminate influences of global fluctuations in ITA trade, we

Figure 3: Exports of ITA products: Market Shares (index, 1996=100)



again look at market shares, which we rescale to 100 in the entry year to allow simple averaging across countries. To retain a sufficient number of countries in the sample, we focus only on the 7 years before the ITA entry year and 5 years after. Figure 4 presents the results. Twelve exogenous joiners can be observed for such a length of time. In the Figure 4 they are referred to as the "Constant Sample". To check the robustness of the ITA exports pattern over time across larger set of exogenous joiners, we look at all exogenous joiners ("Changing Sample") during this 12 year period. Both for the constant and changing sample of countries, the increase in export market share is visibly steeper after joining the ITA.

3. Data

Coverage of the ITA by codes: The empirical analysis of the ITA has been complicated by the issues related to its product coverage, as also noted by Anderson and Mohs (2010). The ITA was initially signed in HS1996, however some of the lines were considered to be covered only partially. In cases when it was considered that the ITA covers a small share of the products in 6-digit line, the line was dropped. As the definitions of the product lines were changing in different HS classifications, the coverage had to be reassessed instead of being simply mapped. For instance, Line C may have covered a lot of ITA products (relative to non-ITA products) in 1996 and therefore was considered an ITA product line. However, in 2002, this line may not be con-

Figure 4: Exports of ITA products (index, entry year=100)

sidered an ITA tariff line any more, due to (i) changing trade structure with now more non-ITA products being traded or (ii) because the ITA products became technologically obsolete. The lines that are covered by the ITA vary for each of the vintages. With this procedure in place, we obtained the product lines covered by the ITA in HS1996, HS2002 and HS2007 classifications, respectively.

Data on Trade values: The bilateral trade flows data was obtained from UN Comtrade. Using the three coverage sets we obtained three datasets for, respectively, 1996-2001 in HS1996, 2001-2006 in HS2002, 2007-2012 in HS2007. The lines were then mapped into HS1996 using the correspondence tables.

Not all products are present in all three sets mapped into HS1996, and this has the drawback that some products will not be observed in all years and therefore any product fixed effects may be less reliable for some products.

We use the import flow data and complement with mirror data whenever possible. We apply the mirror data whenever a certain import-reporter didn't report in the particular year at all. We restrict the mirror data to such cases only because if a country reports in the particular year the bilateral trade but doesn't specify some line or it is zero while it is present in the mirror data, then it is not actually a lack of reporting issue but a difference in methodology of classifying products.

Our data cover 234 countries and 106 HS1996 6-digit ITA products over the period 1996-2012.

Data on Tariffs: Data on tariffs for ITA lines was downloaded from Trains database from WITS in HSCombined for years 1996-2012. Using the sets of ITA coverage for HS1996, HS2002, HS2007, only the lines covered in each time frame were left. Next, using the correspondence tables, the lines from HS2002 and HS2007 were converted into HS1996. Note that the coverage in HS1996 in this manner implies that different lines in HS1996 were covered in different periods. Further, we had to take into account that the EU is presented as one country in TRAINS so we had to append the dataset to include all individual members in various years to have time-consistency.
Sturgeon data on intermediate/final: Sturgeon and Memedovic (2010) emphasizes the importance of intermediate goods to understanding global value chains. They develop a novel classification scheme, dividing goods into final and intermediate categories. Improving on the UN's Broad Economic Categories (BEC) scheme, they group capital and consumption goods as final; others are considered intermediate. The data were kindly provided by the authors, and are used in the estimation section to investigate how ITA affects GVC.
Other RHS variables: Furthermore, we collect any standard gravity variables, which vary across time within any country or country-pair.[4] GDP and GDP per capita were taken from Penn World Table Version 8.0. RTA and currency union membership data are taken from De Sousa (2012).[5] A remoteness measure was computed analogue to those commonly used in the literature.[6]. WTO membership data was collected from the WTO website.

[4]Non-time variant variables such as distance are controlled for by country-pair fixed effects in all our specifications.

[5]De Sousa (2012) data only cover currency union relationships up to 2009. To extent the data, we added Estonia joining the Euro in 2011. As we are not aware of any other countries joining or exiting a currency union after 2009 and before 2013, we assume that no further changes in currency union membership occurred after this time. Like the Glick and Rose (2002) currency union definition, ours is also transitive, i.e. if country-pairs x–y, and x–z are in currency unions, then y–z is a currency union. Therefore with both El Salvador and Ecuador having adopted the U.S. Dollar, they would both be considered to be in a currency union with the United States as well as each other.

[6]Our remoteness measure is computed for importers and exporters using the standard formula, weighting bilateral distances by trading partner shares in World GDP (see e.g. UNCTAD and WTO (2012)). To obtain a single remoteness measures for any bilateral pair in the interest of parsimony, importer and exporter remoteness are then multiplied before taking the natural logarithm.

4. Empirical Strategy

4.1. Gravity Model of Trade

The paper follows the basic structural model of gravity equation developed by Anderson and Van Wincoop (2003) for cross-sectional aggregate trade flows. However in adopting the panel approach and varying trade costs across goods, the structural model and estimation specification have to be adjusted.

Already Anderson and Van Wincoop (2004) discuss the advantages of using the disaggregate data to account for varying trade costs and elasticities across goods as this study does. The basic model adapted for the industry level analysis is as follows:

$$x_{ij}^k = \frac{y_i^k x_j^k}{y^k} (\frac{T_{ij}^k}{\Pi_i^k P_j^k})^{1-\sigma_k} \tag{1}$$

where x_{ij}^k denote import of country j from country i of good k, y_i^k - total production of good k by firms from country i, x_j^k - total expenditure for good k in country j. Further, T_{ij}^k stands for bilateral trade costs, Π_i^k is outward trade barriers of country i and P_j^k are inward trade barriers of country j. The latter two terms comprise the multilateral resistance and lead to higher bilateral trade.

The traditional structural gravity model is not adapted for the panel data. Baldwin and Taglioni (2006) argue that the gravity equation with time-invariant controls developed for cross-sectional data cannot be used for panel data. To account for changing multilateral trade resistance, the authors recommend to use pair fixed effects and country-time fixed effects. Olivero and Yotov (2012) develop a dynamic version of the structural gravity model that leads to the estimation equation for panel dataset. We follow their approach by using appropriate fixed effects.

4.2. Estimation on aggregate data

In our first baseline specification we replicate the closest study on the ITA, Bora and Liu (2010) with our extended time coverage:[7]

[7]We report the results without the GDP per capita. The estimation with the GDP per capita is overall very similar, albeit with slightly smaller trade creation magnitude.

$$
\begin{aligned}
lnI_{ijt} &= \alpha(ITAExporter)_{ijt} + \beta(ITAImporter)ijt + \delta(Non-ITAWTOImporter)_{ijt} \\
&+ \theta(OneinWTO)_{ijt} + \gamma Controls_{ijt} + \alpha_{ij} + y_t \qquad (2)
\end{aligned}
$$

where the ITA importer dummy only takes a value of one in case the exporter is a WTO member; this is because the concessions of ITA are only guaranteed to the WTO members. However it makes more sense to define the exporter ITA membership variable equal to one simply when the exporter is an ITA member vis-a-vis any trading partner, not just WTO or ITA members, as higher exports due to more technology transfer should not necessarily only go to WTO (or other ITA) members.

We first extend this model to test whether ITA exporters were really those who mainly got the benefits of signing the ITA, because IT industry relocated to these countries. We do so by introducing instead a exporter-ITA participation dummy.

4.3. Product and tariff controls

The empirical analysis on aggregate bilateral trade has a number of problems. In particular, when assessing the impact of an agreement, sectors pooled together hide inside varying impact of the agreement across sectors due to differences in elasticity, preference margins, trade costs and etc. It follows that using product-level data has the advantage that it avoids and aggregation bias, which may occur on account of trade costs or elasticities with respect to these costs varying by products or groups of products. This has been acknowledged in the literature (See Clausing (2001), Anderson and Yotov (2010b),Anderson and Van Wincoop (2004), Anderson and Yotov (2010a)).

Thus we augment the baseline model to account for such differences by controlling for country-pair-product and product-time fixed effects and import tariffs, obtaining direct estimate of the elasticity of tariffs.

In light of our panel being unbalanced, traditional estimation would require that one set of fixed effect dummies be held in memory. As each

Overall, we get the message that GDP per capita seems to work well in regressions without country-pair fixed effects. There it picks up a propensity for richer countries to trade more. However, it does not seem to be the case that large increases in income between years translate in a straightforward way also into significant increases in trade in those years.

dummy would be more than 3 million observations long, computer memory constraints bind. Traditionally these constraints implied that only one high-dimensional fixed effect could be considered by transforming the estimation equation (Greene (2003))[8]. Labor economists have devised solutions to the challenges of multiple high-dimensional fixed effects, starting with approximations in Abowd et al. (1999). Guimaraes and Portugal (2010) provide an iterative technique to obtain exact estimates of equations with two high-dimensional fixed effects in a computationally manageable way and we rely on their technique here[9].

Once we control for tariffs, we can include the zero tariff dummy as well. This dummy quantifies whether for IT products there was an additional impact of reducing tariffs to zero. The intuition here is that reducing tariffs from 2 to 0% would have a bigger impact than reducing them from 4 to 2%, because the reduction to 0% also implies that a lot of bureaucratic hurdles in clearing customs will vanish – and there is a growing "time in trade" literature[10]. The latter, as discussed above, is supposed to test the extent to which levying no tariff rather than a small positive tariff reduces trade costs. This constitutes to the following empirical specification:

$$\begin{aligned} lnI_{ijkt} &= \mu ln(1+\text{tariff}) + \lambda t0 + \alpha(ITAExporter)_{jt} + \beta(ITAImporter)_{ijt} \\ &+ \delta(Non-ITAWTOImporter)_{ijt} + \theta(OneinWTO)_{ijt} \\ &+ \gamma Controls_{ijt} + \alpha_{ijk} + y_t \end{aligned} \tag{3}$$

4.4. Addressing endogeneity

This strategy brings to our main specifications where we control for the reason for joining the agreement, be it individual (endogenous participation) or through a larger package (exogenous participation). We distinguish the importer- and exporter-related ITA participation variables across the two types of participants:

[8]In a balanced panel, two sets of fixed effects could be stripped algebraically.

[9]Their technique, available as Stata command reg2hdfe, relies on the notion that the matrices for the computation of the coefficient estimates are sparse and only identifies non-zero entries. This reduces memory constraints at the cost of higher computation time.

[10]Freund and Pierola (2012) show that customs clearings times have a big impact on trade.

$$
\begin{aligned}
lnI_{ijkt} &= \mu ln(1+\text{tariff}) + \lambda t0 + \alpha 1(ITAExporterInd)_{jt} + \beta 1(ITAImporterInd)_{ijt} \\
&+ \alpha 2(ITAExporterExog)_{jt} + \beta 2(ITAImporterExog)_{ijt} \\
&+ \delta(Non-ITAWTOImporter)_{ijt}\theta(OneinWTO)_{ijt} + \gamma Controls_{ijt} + \alpha_{ijk} + y_t
\end{aligned} \tag{4}
$$

4.5. Did joining the ITA lead to higher GVC participation in the IT sector?

Here we assess the GVC participation in IT sector using the (Sturgeon and Memedovic, 2010) data on mapping several sectors of HS2007 6-digit classification into electronic components, parts of electronic devices, and final goods. Overall, 47 goods covered by the ITA in HS1996 classification, were mapped into raw, intermediate and final goods. We have split the sample into intermediate (parts and components) and final goods. This gives us an IT sector GVC participation measure through trade in parts and components versus trade in final goods.

Many of the countries that grouped as exogenous ITA participants are associated with being offshoring destination for manufacturing, especially for IT products. This phenomenon is at the center of the global value chains discussions. According to that understanding, the exogenous ITA participants, by offering guaranteed duty-free imports to all WTO members, could serve as promising offshoring destinations. The hypothesis that follows from this is that the exogenous ITA participants are expected to import more of the intermediate products and export final products. Similarly, the endogenous participants, many of which are high-income countries with developed IT industries, are home to the companies that would be offshoring. Thus we would expect these countries to import less of the intermediate products and more of the final products.

4.6. Robustness check estimations

Zero trade flows

All the estimations above contain only the positive trade flows, ignoring the product lines with no trade. Eliminating zero trade flows by taking logs of the gravity equation had crucial advantages in deriving our main results discussed above. Foremost, it allowed us to introduce the two high-dimensional fixed effect controls on an already very large dataset of more than 3 million observations. This ensured that omitted variable bias is kept to a minimum on product level data which can be subject to many unobserved determinants with respect to importers, exporters, products, and time. Baldwin

and Taglioni (2007) underscore the importance of adding such comprehensive fixed effect controls by calling their exclusion the "gold metal mistake" of gravity estimation.

Nonetheless, we recognize that the existence of zero trade flows is a pervasive problem in log gravity equations, because it can induce selection bias (Helpman et al., 2008). The most straightforward common way to handle this, and we will pursue it here, is to avoid taking logs altogether, thereby preserving the zero trade flows, and estimate the gravity equation in multiplicative form using Poisson estimation as proposed by Silva and Tenreyro (2006). We will illustrate that results from such an estimation are broadly comparable to those obtained by least squares on a log gravity equation. However as inclusion of zero trade lines makes the size of dataset unworkably large. we switch from the HS 6-digit products to only having the 7 groups of products (Computers, Instruments and apparatus, Semiconductors, Semiconductor manufacturing equipment, Data-storage media and software, Telecommunications equipment, Parts and accessories)

Multilateral Resistance

Our main estimations addressed multilateral resistance through a combination of three elements. First, country-pair-product fixed effects accounted for average multilateral resistance patterns during the sample period. Second, we proxied for the time-varying element of multilateral resistance through two instruments: inclusion of GDP, whose variation tends to be associated with that of multilateral resistance Anderson and Yotov (2010b) and a distance-based remoteness index. Latter two instruments can naturally only imperfectly capture any time variation of multilateral resistance. We therefore implement in this subsection an alternative estimation strategy to account for multilateral resistance.

This alternative recognizes that the most common and often preferred way of controlling for multilateral resistance in the empirical literature is by including country-time or a combination of importer-time and exporter-time effects (e.g. Feenstra, 2002; Baldwin and Taglioni, 2007). However, in our application including such effects would eliminate most of our explanatory variables of interest, which also only have variation in the country-time dimension. In order to retain these variables, we thus follow some other authors by instead adding a set of "country-period" dummies as a third set of fixed effects. Each period covers either 4 or 5 years, giving us four of such periods

for our sample.[11] The assumption is that multilateral resistance would not vary too considerably within such periods to introduce serious bias into the estimation.[12]

5. Results

5.1. An initial benchmark: Bora and Liu (2010)

Bora and Liu (2010) (BL) have undertaken the, to our knowledge, most comprehensive investigation of ITA trade impacts to date. We therefore start our results discussion from their preferred specification. BL conduct their estimation on aggregate data, i.e. their panel dataset includes one observation per country-pair in each year with the total trade value in ITA products. We repeat BL's results for comparison purposes at the beginning of table 3.[13] They decompose the "Both in WTO" dummy, which is commonly used in studies on the trade impact of joint WTO membership (Rose (2004) and subsequent literature), into two dummies by whether the importing WTO member is also an ITA member or not.

By doing so, they can analyse trade creation and diversion of the ITA. BL find that countries experience trade creation from joining the ITA. After accession, they import 7.25 per cent ($= exp(0.07) - 1$) more from other WTO members. ITA preferences apply to all WTO members on an MFN basis. WTO exporters, in light of these preferences, may therefore have reoriented their exports toward ITA members and away from non-ITA WTO importers. BL's estimates suggest that such trade diversion does occur with non-ITA WTO importers now importing 6 per cent less. Taking these two estimates for ITA trade creation and ITA trade diversion (within the WTO)

[11] Our periods are 1996-2000, 2001-04, 2005-08 and 2009-12. Limiting ourselves to 4 periods keeps the problem computationally manageable as these dummies need to be created in memory and added as dummies into the reg2hdfe estimation routine of Guimaraes and Portugal (2010), which can only handle two sets of fixed effects on its own. The division between the 2004-08 and 2009-12 periods is consciously chosen to coincide with the great trade collapse induced by the global crisis, so as to obtain two relatively homogeneous periods. Other authors that have implemented such approach in a gravity setting are Bora and Liu (2010), using biannual dummies in a robustness check, and Ruiz and Vilarrubia (2007) using triennial and quinquennial dummies.

[12] We exclude the remoteness index from all our regressions including country-period effects; its continued inclusion would not affect results.

[13] See Bora and Liu (2010), Table 2.3, column 2.

together, BL conclude that a WTO member should see its imports increase by 14% ($=exp[0.07-(-0.06)]-1$) upon joining the ITA. We report this important linear combination of coefficients throughout our tables below the direct regression output.

In addition, BL find that the WTO also diverts trade away from non-members, as highlighted by the "One in WTO" coefficient; that RTAs boost bilateral trade substantially; but they fail to find a significant positive impact of currency unions.

5.2. An updated sample: A changing world economy and the rise of China

To ensure comparability to BL, we also report our initial regressions on aggregate data. Regression 1 is our closest analogue. It differs mainly in terms of our updated sample, covering 1996-2012 (versus BL's of 1988-2012).[14] Our sample therefore covers many more years of trade within the ITA after its establishment in 1997, including the rise of emerging Asia and particularly China as IT production hubs.

[14]Apart from the different sample coverage, the second main difference is that Bora and Liu maintain GDP per capita regressors. Arguably, BL include them, because they start their analysis from specifications which do not include country-pair fixed effects. In regressions without country-pair fixed effects, such regressors can serve a purpose, capturing that, from a cross-sectional perspective, richer countries trade more, for instance to better transport connections and domestic infrastructure in addition to higher preference for variety. However, as BL's estimates suggest that such relations do not hold within a country over the short time-frame portrayed by the sample periods, country-pair fixed effects are included and thereby only variation across time within any country-pair is considered. Their inclusion seems to capture effects typically captured by GDPs, as their coefficients are diminished, even becoming negative for importers, while GDP per capita coefficients take very high values (1.96*** for importers and 1.16*** for exporters in BL's preferred regression). We therefore do not include GDP per capita in our regressions, as we maintain country-pair (or more detailed) fixed effects throughout to forestall possibly substantial omitted variable bias from unobservable country-pair characteristics (Baldwin and Taglioni, 2007). Dropping GDP per capita variables does not affect our main results, particularly on the impact of the ITA on exporters, and in later tables, the impact of tariffs and zero tariffs. In the aggregate regressions of Table 3, however, exclusion of GDP per capita does increase the magnitude of the ITA importer coefficient by around 0.2. Furthermore there are a couple of further minor differences of our regression 1 vis-a-vis BL. BL also include a couple of other variables which are not commonly included in gravity equations and we therefore drop. These variables are dummies for political alliances and for presence of a Generalized System of Preferences scheme. Any bias that could be introduced by exclusion of the latter will be addressed by inclusion of the tariff directly in our further analysis from Table 4 forward.

Table 3: Aggregate Data: A benchmark and extension for ITA exporter effects 3/

Time coverage of sample	1988-2003	1996-2012			
Includes China's Exports	Yes	Yes	No	Yes	No
Regression No.	BL (2010) 4/	1	2	3	4
ITA Exporter	0.404***	0.312***			
	(17.31)	(12.88)			
ITA Importer 1/	0.07*	0.422***	0.156**	0.267***	0.0478
	(2.29)	(8.49)	(3.00)	(5.29)	(0.91)
Non-ITA WTO Importer 1/	−0.06*	0.235***	−0.105	0.0646	−0.224***
	(−2.07)	(4.57)	(−1.95)	(1.24)	(−4.11)
One in WTO	−0.16***	−0.00948	−0.184***	−0.0598	−0.216***
	(−5.11)	(−0.21)	(−3.96)	(−1.35)	(−4.66)
RTA	0.42***	0.270***	0.271***	0.240***	0.248***
	(10.88)	(11.20)	(11.16)	(9.90)	(10.17)
Currency Union	0.48	0.293***	0.264***	0.266***	0.245***
	(0.59)	(4.39)	(3.96)	(3.98)	(3.67)
ln(Remoteness)	0.65	−1.176***	−1.177***	−1.216***	−1.218***
	(1.21)	(−8.75)	(−8.70)	(−9.06)	(−9.01)
ln(Importer GDP)	−0.86***	1.307***	1.271***	1.303***	1.269***
	(−6.79)	(32.70)	(31.46)	(32.61)	(31.41)
ln(Exporter GDP)	0.20	1.200***	0.787***	1.142***	0.769***
	(1.51)	(27.21)	(16.96)	(25.84)	(16.59)
Number of observations	133,352	173,124	170,657	173,124	170,657
R2 adjusted (per cent)	82.0	84.74	84.47	84.76	84.49
Linear combination of coefficients: 2/					
ITA Importer minus	0.13*	0.187***	0.260***	0.202***	0.262***
Non-ITA WTO Importer		(4.96)	(6.97)	(5.35)	(6.97)

All regressions include country-pair and time fixed effects.

1/ ITA importer variables only take the value of one if exporter is a WTO member.

2/ The difference of these two variables – ITA trade creation and ITA trade diversion within the WTO – expresses how much more ITA importers import compared to non-ITA WTO members. In other words, this would be the amount that a country, which is already a WTO member, could expect to import more from other WTO members by joining the ITA. Statistical significance for the linear combination of coefficients of Bora and Liu (2010) cannot be computed without access to their dataset. However, it would seem likely that it might be significant at the 5% level (which we assume here), given that the two individual coefficients are significant at this level.

3/ All regressions include country-pair and time fixed effects. * , ** , *** denote 5, 1, 0.1 per cent significance levels. T-statistics in parentheses, based on robust standard errors clustered by country-pair combinations.

4/ Bora and Liu's (2010) preferred specification (their Table 2.3, column 2). In addition, Bora and Liu also include (logs of) importer and exporter GDP per capitas, a dummy variable for a formal alliance between countries and dummies for existence of a GSP preference scheme, which we do not report in this table.

The updated sample gives a markedly different view of the ITA's impact. Contrary to BL, our results do not show trade diversion. WTO members import 26 per cent more IT products, as highlighted by the non-ITA importer coefficient. ITA membership boosts imports by a further 21 per cent.[15] Also, we do not find any trade diversion of the WTO. With regards to currency union membership, we now find it to be statistically significant, in line with much previous literature (again started by Rose, 2000), boosting trade similarly as RTA membership by 30-35 per cent.[16]

We follow BL by including remoteness in most of our regressions. To obtain a single remoteness measures for any bilateral pair in the interest of parsimony, importer and exporter remoteness are then multiplied before taking the natural logarithm. Anderson and Van Wincoop (2003) have highlighted the importance of controlling for "multilateral resistance, i.e. general equilibrium effects represented by a country's overall trade cost (with the rest of the world in general). If a country faces relatively high overall trade costs, for instance because it is very remote, it will trade more with the few trade partners that are relatively proximate. We agree with Anderson and Van Wincoop (2003) that a remoteness index is not theoretically adequate to control for multilateral resistance, as it is only based on distance, and overall trade costs are determined by various factors.[17] Nonetheless it constitutes a limited distance-based proxy, which can be valuable in applications such as ours, where inclusion of more complete multilateral resistance controls has important drawbacks in eliminating identifying variation; we will elaborate on this further below).Furthermore, Anderson and Yotov (2010a) illustrate that multilateral resistance is correlated with country size and therefore including GDPs as explanatory variables will likely address some of the variation attributable to multilateral resistance.

In Regression 1, remoteness takes a statistically significant negative sign. In presence of the country-pair fixed effects, this implies that, when coun-

[15] Equals $exp(0.187) - 1$. See the linear combination of coefficients at the bottom of Table 3.

[16] It is furthermore noteworthy that (given that GDP per capita are not included) both our GDP coefficients take values close to unity as suggested by many theoretical models (e.g Anderson and Van Wincoop (2003)).

[17] For instance, a country that is proximate to many other countries that represent a significant share of the world economy could nonetheless face high overall trade costs, if it is politically and economically isolated vis–a–vis those neighbouring countries.

tries become more remote, they will trade less on average.[18] Coefficients on remoteness remain negative and statistically significant in the vast majority of our regressions.

One of the main novelties of our dataset compared to BL is that it covers a substantial period of time after China's ITA accession. This allows us to analyse to which extent China's performance has differed from that of other ITA members. As section II already highlighted, China's importance in trade of ITA products has increased immensely on the export side, and to a lesser extent on the import side.[19] Interestingly, however, excluding China's imports from the sample hardly changes results; in other words, in terms of its import behaviour regarding ITA product, China does not act significantly differently from other countries.[20] However, on the export side, China has a substantial impact on results, i.e. its export performance has been much different from other countries. To analyse which results hold for other ITA members and to gauge China's impact, we therefore present results for the whole sample and the sample excluding China's exports side-by-side in all our tables.[21]

Regression 2 excludes China's exports. This implies that we are looking at ITA importer coefficients derived from an incomplete import sample, which is somewhat artificial from the viewpoint of importers. However, from the viewpoint of non-Chinese exporters they provide a notion of how much more sales can be expected to these importer groups. The ITA importer coefficient is now much lower, signalling that much of ITA members' increased imports originated from China. There is also some weak evidence that exporters are diverting shipments away from non-ITA WTO importers. Meanwhile, China defies this trend, exporting strongly to non-ITA WTO members.[22] The same is true for non-WTO members, from which WTO members deviate trade away, while China aggressively orients its exports also toward these

[18]The remoteness index varies over time as the geographical composition of world GDP shifts. Thereby countries close to Asia, for instance, have become less remote over time.

[19]Higher Chinese IT imports are partly also a result of its higher exports given its high integration into supply chains.

[20]These results are not reported in the tables for space reasons. They are available from the authors upon request.

[21]This can of course also be seen as an ongoing first robustness test of our results.

[22]This interpretation results from the decrease in the "Non-ITA WTO importer" coefficient from Regression 1 to Regression 2.

countries.[23] On the whole, the Regression 2 results are much closer to the BL specification, which seems intuitive, because BL's sample excludes much of China's rise to being a powerful exporter of IT products. On the flipside, this suggests that when imports from China are disregarded, import patterns have not changed as much since BL's sample end in 2003. However, we still estimate that a country joining the ITA would increase its imports from countries other than China by 30 per cent – more than double BL's estimate.

5.3. How does the ITA boost trade: Peeling away the layers

We posit that there may be various layers to the ITA's impact on trade. As their quantification requires tariff data, these can hardly be quantified in aggregate data, requiring product-level data instead. We hold that the ITA's impact on imports may be three-layered and there may also be a fourth layer operating through ITA members' exports.

The three layers on the import side are the following. First, the ITA may boost imports by reducing tariffs. Introducing tariffs directly as an explanatory variable in the estimation will identify this impact.

Second, reducing tariffs to zero may have an additional impact on imports beyond tariff reduction. Reducing the tariff to zero implies that there might less transaction and administrative costs related to clearing customs and have a positive impact on trade (e.g. Freund and Pierola (2012)). However one must note that in the case of ITA these gains could be smaller due to complexities of product coverage of ITA.

Third, the ITA may have a further positive trade impact apart from tariff reductions. This is suggested by the literature positing that trade policy uncertainty has an impact on investment and entry decisions of firms, including through firm location (Handley and Limao (2012) and Handley and Limão (2013)), which in light of global production sharing depend increasingly on importers.

This last layer may apply also on the export side. It is well documented that the IT sector (see Milberg and Winkler (2013) chapter 2 for analysis of US economy) is among those most strongly characterized by global production sharing. Given that in global production chains, imports are crucial inputs, particularly for downstream firms, the trade policy certainty inherent in ITA membership can be positive for exports.

[23] This interpretation results from the decrease in the "One in WTO" coefficient from Regression 1 to Regression 2.

We proceed in reverse in introducing these layers into the estimation, starting from the exporter side. This is because an ITA exporter dummy (for the fourth layer) can also be added already to specifications on aggregate data.[24] Obtaining an estimate of the exporter impact on aggregate data is useful for comparison purposes, because such aggregation may reduce noise inherent in disaggregate product level data.

Regressions 3 and 4 suggest that this ITA impact on exports may indeed by positive and strong – a 50 per cent boost in exports for all ITA members and a 37 per cent boost for ITA exporters other than China – with estimates highly statistically significant. These export boosts are across all importers on average. In addition, imports by ITA members also remain higher, but mainly on account of exports from China, as the comparison between the two regressions highlights.[25]

Table 4 uses product-level data, which allows quantification all four layers of ITA trade impacts. Fixed effect controls consequently generalize to country-pair-product to also account for any product-specific characteristics in bilateral relationships. Likewise, the time fixed effects generalize to product-time to account for any global shocks to trade in different products.[26]

Results experience some important changes when we use product-level data and subsequently allow for different layers of impacts in the import side by introducing tariffs and the zero tariff dummy.

First, purely moving to product-level data mutes ITA exporter trade impacts for countries other than China. Joining the ITA increases these countries' exports by about 8-9 per cent across all importers (Regressions 6 and 8). Yet, some additional impact for these exporters is now contained in the ITA importer and non-ITA WTO importer coefficients, which rise across specifi-

[24]Unlike the ITA importer dummy, the ITA exporter dummy will take the value of "1" for all ITA exporter observations, regardless if the importer is WTO member or not. Making the dummy's value dependent on an importer's status would not make sense as any barriers to exporting from a country would not vary depending on such status. The same applies consequently to any potential exporter analogue to the trade diversion variable on the import side ("Non-ITA WTO importer" in Table 3).

[25]Evidence in Regression 4 also suggests that exporters other than China are diverting away shipments from non-ITA importers, but this result does not hold up in later specifications.

[26]Evidence in Regression 4 also suggests that exporters other than China are diverting away shipments from non-ITA importers, but this result does not hold up in later specifications.

Table 4: Product-level data: The layers of ITA trade creation

Includes China's Exports	Yes	No	Yes	No
Regression No.	5	6	7	8
ITA Exporter	0.349***	0.0767***	0.362***	0.0886***
	(26.54)	(4.82)	(23.95)	(4.77)
ln(1+tariff)			−0.248**	−0.198*
			(−2.77)	(−2.17)
Zero tariff			0.108***	0.105***
			(19.78)	(18.99)
ITA Importer 1/	0.317***	0.168***	0.343***	0.243***
	(15.87)	(8.29)	(14.14)	(9.81)
Non-ITA WTO Importer 1/	0.227***	0.0525*	0.337***	0.198***
	(10.91)	(2.47)	(13.33)	(7.71)
One in WTO	0.00710	−0.0231	0.0725**	0.0786***
	(0.38)	(−1.25)	(3.18)	(3.44)
RTA	0.0640***	0.0846***	0.0475***	0.0742***
	(6.38)	(8.31)	(3.89)	(5.98)
Currency Union	0.178***	0.168***	0.137***	0.128***
	(9.40)	(8.86)	(7.22)	(6.72)
ln(remoteness)	−0.314***	−0.586***	−0.192*	−0.447***
	(−4.81)	(−8.89)	(−2.43)	(−5.60)
ln(Importer GDP)	0.956***	0.897***	1.104***	1.031***
	(45.72)	(42.46)	(39.28)	(36.16)
ln(Exporter GDP)	1.439***	0.517***	1.417***	0.537***
	(55.96)	(17.83)	(47.00)	(15.64)
Number of observations	3,216,747	3,100,247	2,477,294	2,386,043
R2 adjusted (per cent)	74.58	74.24	76.39	76.02
Linear combination of coefficients: 2/				
ITA Importer minus	0.090***	0.116***	0.007	0.044***
Non-ITA WTO Importer	(9.28)	(11.75)	(0.55)	(3.57)

All regressions include country-pair-product and product-time fixed effects.
Notes 1/ and 2/, see Table 2. Note 3/ of Table 2 also applies.

cations. These export boosts are accessible to all WTO members, however, regardless of ITA membership. To see this, recall that these two dummies are a decomposition of a "Both in WTO" dummy. When the non-ITA WTO importer coefficient becomes positive as in table 4, its interpretation changes from ITA trade diversion (within the WTO) to WTO trade creation. The additional impact of ITA accession on imports – expressed by the difference between the ITA importer and non-ITA WTO importer coefficients – is meanwhile much diminished (see bottom of table 4).[27]

Second, when tariffs and the zero tariff dummy are introduced directly into estimation, the ITA importer effect in fact disappears completely (Regression 7). However, it is crucial to highlight that after these additional variables are included, the interpretation of the ITA importer effect changes: It now quantifies only the third layer of ITA trade creation, i.e. benefits over and above those of tariff reductions and setting the tariff to zero, for instance those related to trade policy certainty. Thus, that the ITA importer effect in Regression 7 "peels away" completely suggests that for importers ITA accession's benefits are exclusively related to the tariff reductions and "zeroing" of tariffs that the agreement institutes.[28] Not surprisingly, exporter impacts stays the same in response to introducing tariffs and zero tariffs, because these really only decompose effects related to the importer side.

Our tariff coefficient signals that each one percentage point reduction in tariffs would result in an import increase of 0.25 per cent, i.e. an import demand elasticity of -0.25. This is low relative to most import demand elasticities reported in the literature and derived based on aggregate trade (rather than ITA products). For instance, Kee et al. (2008) and Tokarick (2014) estimate such elasticities for many different countries and come up with averages in the range of -1.1 to -1.2. Only an earlier study by Senhadji (1998) is relatively close to our value, at -0.32.

The reason for this divergence seems to be that the impact of tariff reductions on import demand seems to be highly non-linear. Reducing tariffs to zero has an immense impact on imports, boosting them by over 11 per cent. Thus, making the last effort to reduce small tariffs, say from 1 to 0 per cent, will bring double the impact than reducing a high tariff by 20 percentage

[27]This is shown by the linear combination of the ITA importer trade creation and diversion coefficients, reported at the bottom of all regression tables.

[28]Recall that odd-numbered regressions, which include Chinese exports, are the relevant ones from importers' perspective, as they cover all imports.

points without reaching zero. The big deal about the ITA is therefore that it gets tariffs down to zero. That there is an additional impact of "zeroing" the tariff seems intuitive, because zero tariffs reduce border formalities considerably. In our view, these results have a broader significance than the IT sector. We believe that it would seem reasonable to expect such non-linearity also in other sectors, particularly in light of aforementioned literature on trading costs, as well as the large empirical literature on preferential trade agreements (PTAs). The large PTA trade impacts often found in the latter literature also suggest that there may be additional impacts of reducing tariffs to zero, as many of these agreements do. With regards to policy, these results make strong cases for countries (i) to expand the ITA's product coverage through an ITA 2 agreement, (ii) to pursue further zero-for-zero sectoral agreements and/or (iii) unilateral, non-discriminatory, tariff reductions to zero. There is a particularly strong case for reducing those tariffs to zero that are already small

In concluding our discussion of Table 4, we note a few other interesting changes in these product-level results. Any evidence of WTO trade diversion disappears. If anything, trade between WTO and non-WTO members is higher than that between two non-WTO members – by an order of 8 per cent. The magnitudes of RTAs' and currency unions' effects on trade are diminished to 8 and 16 per cent, respectively. These smaller effects are maintained in our further specifications going forward. These results are retained, as we continue to introduce further refinements.

5.4. Exogenous versus individual joiners

We next explore whether impacts of the ITA were different among individual and exogenous joiners. Recall that the graphical evidence in section II pointed to higher impacts for exogenous exporters. To explore this comprehensively, we split both the ITA importer and exporter dummies into individual and exogenous joiners. Regressions 9 and 10 in Table 5 present the results.

Among exporters, indeed exogenous ITA joiners seem to be the only ones profiting from accession. The average exogenous joiner increases its exports by about 14 per cent (Regression 10), when China is disregarded, whose out-performance persists throughout our estimates. Exports of individual joiners, on the other hand, experience a statistically significant 7 per cent decrease with China partly crowding out their exports (Regression 9). This is intuitive in view of China's strongly rising and (individual joiners' strongly

Table 5: A natural experiment to control for endogeneity

Goods type	All goods				Intermed. Goods 5/		Final goods 5/	
China's Exp.	Yes	No	Yes	No	Yes	No	Yes	No
Reg. No.	9	10	11	12	13	14	15	16
Individual	−0.0752***	0.00602	−0.0739**	−0.00126	−0.0253	0.0604	−0.109**	−0.0801*
ITA Exporter	(−3.32)	(0.25)	(−3.25)	(−0.05)	(−0.59)	(1.32)	(−2.94)	(−2.04)
Exogenous	0.480***	0.128***	0.429***	0.0177	0.393***	0.0597	0.507***	0.0808*
ITA Exporter	(26.56)	(5.55)	(23.41)	(0.75)	(12.17)	(1.48)	(16.05)	(2.01)
ln(1+tariff)	−0.262**	−0.185*	−0.347***	−0.296**	−0.116	−0.142	−0.677***	−0.560***
	(−2.92)	(−2.03)	(−3.87)	(−3.25)	(−0.66)	(−0.80)	(−4.18)	(−3.41)
Zero tariff	0.104***	0.103***	0.101***	0.101***	0.130***	0.131***	0.0709***	0.0683***
	(19.13)	(18.61)	(18.60)	(18.09)	(12.90)	(12.77)	(7.81)	(7.37)
Individual	0.290***	0.173***	0.336***	0.393***	0.405***	0.448***	0.339***	0.437***
ITA Imp. 1/	(10.84)	(6.23)	(10.58)	(12.35)	(6.76)	(7.36)	(6.13)	(7.98)
Exogenous	0.327***	0.269***	0.349***	0.381***	0.478***	0.497***	0.347***	0.380***
ITA Imp. 1/	(12.78)	(10.36)	(13.02)	(14.13)	(9.59)	(9.84)	(7.54)	(8.23)
Non-ITA	0.293***	0.191***	0.325***	0.340***	0.446***	0.453***	0.265***	0.281***
WTO Imp. 1/	(11.58)	(7.41)	(11.55)	(12.02)	(8.43)	(8.47)	(5.43)	(5.76)
One in	0.0669**	0.0723**	0.0702**	0.101***	0.0656	0.0907*	0.181***	0.207***
WTO	(2.93)	(3.16)	(3.12)	(4.50)	(1.61)	(2.20)	(4.45)	(5.16)
Exporter late			−0.0357	−0.256***	−0.0468	−0.249***	−0.0265	−0.294***
WTO joiner 3/			(−1.32)	(−8.85)	(−0.94)	(−4.70)	(−0.57)	(−6.03)
Exporter late			0.480***	0.665***	0.376***	0.534***	0.823***	1.013***
EU joiner 4/			(16.69)	(23.12)	(7.31)	(10.39)	(16.49)	(20.32)
Exporter late			−0.116	0.0860	−0.0686	0.133	0.0178	0.229
US-FTA joiner 4/			(−1.58)	(1.18)	(−0.53)	(1.05)	(0.15)	(1.94)
No. obs.	2,477,294	2,386,043	2,477,294	2,386,043	680,728	658,002	825,203	793,820
R2 adj. (%)	76.40	76.02	76.41	76.05	79.26	78.90	74.24	73.71
Linear combinations of coefficients: 2/								
Indiv. ITA Im.	−0.003	−0.018	0.010	0.052***	−0.041	0.005	0.074**	0.156***
- non-ITA WTO Im.	(−0.21)	(−1.14)	(−0.63)	(3.21)	(−1.36)	(−0.16)	(2.57)	(5.49)
Exog. ITA Im.	0.034*	0.078***	0.023	0.041*	0.032	0.044	0.082**	0.099***
- non-ITA WTO Im.	(2.27)	(5.00)	(1.49)	(2.56)	(1.08)	(1.44)	(3.08)	(3.67)

All regressions include country-pair-product and product-time fixed effects. They also include the standard gravity variables as in Table 2 before (coefficients not reported). Notes 1/ and 2/, see Table 2. Note 3/ of Table 2 also applies. 3/ Takes the value of one for all exporters that acceeded to WTO after 1997. 4/ Takes the value for exports of "1" for intra-EU trade (after accession) of all countries that joined the EU after 1997. Analogously for US FTA. 5/ Intermediate/final goods classification based on that developed for electronics by Sturgeon and Memedovic (2010). Unfortunately, their classification only covers about half of our ITA products, resulting in a loss of usable observations in these regressions.

falling) market share in world IT export markets during our sample period, as illustrated in Section II.

One explanation why only exogenous joiners may gain from ITA accession may be based on political economy considerations.[29] Many individual joiners may have already had an established domestic IT industry, which lobbied them to join; thereby their decision to pursue ITA membership as a policy objective in and out of itself. Through ITA membership, the domestic IT industry in these countries realized cost savings through lower trade costs, which in this highly competitive industry may have been at least partly passed on to consumers.[30] As a result, export value did not rise much. Exogenous joiners, on the other hand, more likely did not yet have a domestic IT sector (because they joined the ITA mainly to achieve another broader policy objective). As a result, ITA membership and increased ease of importing may have led to the development of a domestic IT sector, which took to exporting. ITA membership may have been a particularly important catalyst in these cases, because countries which are only starting to develop their capabilities tend to initially integrate in downstream production stages such as manufacturing and assembly, where access to imports is very important (Gereffi et al., 2005; Park et al., 2013).

Returning to the results of Regressions 9 and 10, we note that not much changes on the import side. The impacts of tariff reductions, in general and to zero, remain on the same order as before. ITA accession does not increase imports compared to other WTO importers, neither for individual nor for exogenous joiners.[31]

We point out here again that exogenous joiners approximate a natural experiment, having joined the ITA to a significant extent as a by-product of a broader policy objective. The results of Regressions 9 and 10 therefore also shed light also on whether endogeneity bias may be a concern mainly in the estimates for the individual joiners. As Baier and Bergstrand (2007)

[29] See Grossman and Helpman (1994) and subsequent literature on the political economy of trade policy.

[30] Hallak and Schott (2011) for instance, show that Malaysia, whose exports are heavily concentrated in electronics, needs to upgrade the quality of its exports at a fast pace only to maintain the price of its exports constant.

[31] To be exact, there is an economically small impact of 3 per cent in Regression 9 for imports of exogenous joiners, but it is less statistically significant and does not hold up as we move to Regression 11.

rightly highlight, joining a trade agreement is a policy decision, which may more likely be taken affirmatively if a country produces a lot of the products covered by the prospective agreement. In this case, estimates could be biased upwards and we agree with the authors' recommendation to incorporate country-pair-product fixed effects, in our case as controls, to limit such bias. But incorporation of such fixed effects may not suffice if individual joiners accede to the ITA, because they can already foresee that their production and exports of ITA products will rise disproportionately in the future. For this case our individual/exogenous split serves a distinct purpose. That estimates for exogenous joiners are higher throughout than those for individual ones, suggests that endogeneity bias is not a big concern for latter countries, for which – in contrast to the exogenous joiners – it is hard to rule out such reverse causation.

We now present a second robustness check, which (along the sample split to exclude China) is directly incorporated into our main analysis. Indeed this robustness check is sufficiently important that we consider the resulting Regressions 11 and 12 our preferred specifications covering all ITA goods. This check questions whether the export increases identified for exogenous joiners were really due to ITA accession, or whether they were caused by achievement of the broader policy objective, i.e. WTO accession, EU accession, or accession to an FTA with the United States.

We control for this by including three additional variables. The first is a WTO membership dummy, which is one for the exports of all countries that joined the WTO late, i.e. after 1997. The research by Tang and Wei (2009) suggest that WTO accession for such late joiners often included far-reaching reforms. To the extent that thereby WTO accession (unrelated to the ITA) had a bigger effect on their trade than for earlies WTO joiners, it would not be correctly picked up in the regression and could bias the ITA exogenous exporter coefficient upwards.[32] The second variable is a dummy for exports to other EU members after EU accession for those countries that joined the EU after 1997. Because EU members are also ITA members, this variable helps avoid that intra-EU trade creation is identified as ITA trade creation. The third variable is an U.S. FTA analogue to this EU late joiner dummy.

[32]In Table 5, this would be picked up by the combination of the individual and exogenous ITA importer and non-ITA WTO importer dummies, which, as pointed out previously, together make up a "Both in WTO" dummy.

It is one for the exports to the United States of those countries that have joined an FTA with the U.S. after 1997. It can be necessary to avoid bias if some RTAs' trade impact differs from that that of RTAs on average, as captured by the RTA dummy. Such heterogeneous impacts are suggested by some of the empirical literature analysing trade impacts of many individual RTAs (e.g. Eicher et al., 2011).

In Regressions 11 and 12, we add these three additional dummies. As these dummies speak to export, we note that, as expected, the results on imports including tariff and zero tariff elasticities remain the same. Inclusion of the 3 additional dummies, however, shows that intra-EU trade in IT products is substantially higher. And some of this impact was attributed to the ITA exogenous exporter effect previously. Thus, as a result of including these additional effects, the exogenous ITA exporter effect vanishes for countries other than China – but only for the moment.

5.5. Intermediate versus final goods

The literature on global value chains highlights that different countries occupy different positions in these chains with some (upstream) countries focusing on the production of intermediate components while other countries are more engaged in downstream stages including assembly (see Park et al., 2013 for a comprehensive review of this literature). It is therefore likely that impact of ITA membership differ depending on a country's position in these supply chains. We therefore rerun our preferred regressions on separate samples only containing intermediate and final goods, respectively. The classification of electronics products by Sturgeon and Memedovic (2010), which is set to become part of an updated BEC classification, allows us to classify half of our HS 6-digit ITA product lines into these two categories and retain over 60 per cent of our observations.[33]

The results are presented in Regressions 13-16. As expected, the exogenous ITA exporter dummy regains statistical significance in the final goods regressions, signaling an 8 per cent increase in exports for downstream countries in response to ITA membership. This seems intuitive, given that these countries rely highly on imports for production of their exports; therefore a

[33]The other half of ITA product lines are not covered by the Sturgeon and Memedovic (2010) classification either because they are not electronics or because they cannot be identified as being predominantly intermediate or final goods.

liberal and certain trade regime as created by ITA accession will bring the most benefits for these countries.

ITA accession has just a single-layered effect on intermediate goods imports, but three-layered effects on final goods imports. First, a one percentage point tariff reduction stimulates final goods imports by 0.7 per cent, closer to the import demand elasticities by Kee et al. (2008) and Tokarick (2014) cited above.

Second, zero tariffs have favourable trade impacts for both intermediate and final goods imports, intermediate goods double those of final goods (14 versus 7 per cent). This is also intuitive from a supply chain perspective: Being able to bypass transaction and administrative costs inherent in border formalities is most trade-enhancing for downstream countries, which rely heavily on imported inputs.

Third, ITA members, whether individual or exogenous, also import 8 per cent more final goods imports than non-ITA WTO members – above and beyond the impact of tariff reductions. With tariff costs borne by consumers in these countries, ITA membership seems to be valuable in assuring durable absence of zero tariffs. Thereby it may motivate deeper investments by exporters in distribution and marketing in ITA countries (given that continuity in competitive position is assured not to suddenly change in response to tariff increases). This may then in turn explain deviation of more final products by exporters toward ITA importers.

6. Robustness

Alongside our main results, we already incorporated two robustness checks, for China's exceptionalism and for WTO, EU, and U.S. FTA trade creation among late accession countries to such agreements. This section adds a further two robustness checks to address econometric concerns: First, we address the issue of zero trade flow observations. Second, we consider an alternative way of controlling for multilateral resistance.

6.1. Zero trade flows

To be able to ensure that non-linear Poisson estimation achieves convergence in our application, we need to first improve its tractability in various ways. We start by reducing the number of observations in our data set in two ways. First, we aggregate the data along the 7 broad product categories of

World Trade Organization (2012) described in section II. Second, we eliminate all countries that do not account for at least 0.25 per cent of world trade in either imports of exports in at least one of the seven product categories in 2010. This reduces the number of countries by half to 112, while still retaining more than 97 per cent of world trade in the sample. In addition, we need to simplify the dimensionality of the fixed effects. We therefore substitute time fixed effects for the more detailed product-time controls.

We start in Table 6 by presenting least squares analogues to our preferred specifications 11 and 12, which only incorporate the changes in fixed effects while maintaining the 6-digit product disaggregation (Regressions 17 and 18). Coefficient estimates remain very similar throughout, suggesting that global shocks are relatively symmetric across ITA products.[34]

Regressions 19 and 20 then incorporate in addition the aggregation into product categories and reduction in the number of countries. As also noted before, when we moved from aggregate to product-level data, the estimates now change a bit more. However, they remain broadly comparable. Mainly, the elasticity of tariff reductions rises considerably, while the zero tariff dummy now carries a little intuitive negative sign.

Regressions 21 and 22 then repeat the exact exercise using Poisson estimation. We find that magnitudes of some coefficients, and in a few instances their statistical significance, can indeed vary somewhat. We, however, take comfort that the general pattern of results remains the same with respect to the four layers of ITA effects, which are our main focus.

One drawback of regressions 21 and 22 as robustness checks is that ultimately only about 12 per cent of their sample consists of zero trade flows. The culprits behind this are the tariff data, which are missing for many of those zero trade observations. Therefore, Annex Table 8 repeats regressions 19-22 without the tariff regressors, which increases the fraction of zero observations to about one third of the sample. Reassuringly, the general pattern of results again remains comparable between the least squares and Poisson regressions.

6.2. Multilateral resistance

This subsection presents results from an estimation strategy to account for multilateral resistance that includes a set of "country-period" dummies

[34]Regressions 11 and 12 with the product-time fixed effects are, however, statistically preferred at higher than the 0.1 per cent level based on F-statistics.

Table 6: Robustness I: Addressing zero trade flows with Poisson estimation

Estimation technique	Least Squares				Poisson	
Data disaggregation	6-digit products		Prod. Categories 5/		Prod. Categories 5/	
Zero trade flows	No	No	Yes	Yes	Yes	Yes
Includes China's Exports	Yes	No	Yes	No	Yes	No
Regression No.	17	18	19	20	21	22
Individual ITA Exporter	−0.134***	−0.0820***	−0.0360	−0.0159	−0.629***	−0.901***
	(−5.83)	(−3.36)	(−0.62)	(−0.26)	(−5.30)	(−5.57)
Exogenous ITA Exporter	0.413***	0.0580*	0.315***	0.162*	0.783***	0.245
	(21.79)	(2.41)	(5.38)	(2.22)	(8.35)	(1.58)
ln(1+tariff)	−0.416***	−0.356***	−1.576***	−1.545***	−3.855***	−3.492***
	(−4.47)	(−3.77)	(−4.78)	(−4.56)	(−4.26)	(−3.71)
Zero tariff	0.0669***	0.0672***	−0.176***	−0.172***	−0.215**	−0.238***
	(12.02)	(11.82)	(−6.41)	(−6.12)	(−3.21)	(−3.31)
Individual ITA Importer 1/	0.333***	0.377***	0.390***	0.401***	0.0116	−0.0349
	(10.16)	(11.52)	(4.00)	(3.99)	(0.08)	(−0.21)
Exogenous ITA Importer 1/	0.350***	0.379***	0.489***	0.437***	0.794***	0.827***
	(12.73)	(13.70)	(6.30)	(5.47)	(5.24)	(5.31)
Non-ITA WTO Importer 1/	0.318***	0.331***	0.459***	0.414***	0.396***	0.394***
	(11.01)	(11.40)	(5.29)	(4.69)	(3.54)	(3.46)
One in WTO	0.0674**	0.0933***	0.106	0.0354	0.0565	0.0746
	(2.91)	(4.02)	(1.52)	(0.49)	(0.52)	(0.66)
Exporter late WTO joiner 3/	−0.0793**	−0.277***	−0.100	−0.189	0.194	0.174
	(−2.81)	(−9.10)	(−1.13)	(−1.95)	(1.15)	(0.88)
Exporter late EU joiner 4/	0.518***	0.682***	1.307***	1.372***	0.955***	1.187***
	(17.61)	(23.16)	(16.64)	(17.39)	(5.74)	(8.70)
Exporter late US-FTA joiner 4/	−0.110	0.0681	−0.0275	0.0156	−0.556	−0.478
	(−1.43)	(0.90)	(−0.12)	(0.07)	(−1.95)	(−1.67)
Number of observations	2,477,294	2,386,043	230,386	224,840	262,011	256,240
R2 adjusted (per cent)	75.39	75.03	84.30	83.92	N/A	N/A
Linear combinations of coefficients: 2/						
Individual ITA Importer minus	0.015	0.046**	−0.069	−0.014	−0.385***	−0.426***
non-ITA WTO Importer	(0.86)	(2.69)	(−1.39)	(−0.26)	(−4.18)	(−3.88)
Exogenous ITA Importer minus	0.031	0.048**	0.030	0.022	0.398***	0.432***
non-ITA WTO Importer	(1.93)	(2.90)	(0.50)	(0.36)	(4.13)	(4.41)

All regressions include the standard gravity variables as in Table 2 before (coefficients not reported). They also include country-pair-product and time fixed effects. While the time fixed effects regressions 17 and 18 are statistically rejected in favor of the product-time fixed effects of our analog preferred specifications (Regressions 11 and 12) at the 0.1 percent level or higher by F-Statistics, Poisson estimation does not achieve convergence in the presence of the high dimensional product-time fixed effects.

Notes 1/ and 2/, see Table 2. Notes 3/ and 4/, see Table 4. Note 3/ of Table 2 also applies.

5/ For these regressions the dataset is collapsed to the 7 broad ITA product categories described in Section II. In addition all countries are dropped which do not make up at least 0.25 per cent of either world imports or exports within at least one of these categories; this reduces the number of countries to 112 (from 235), while retaining more than 97 percent of global trade. This reduction in the dimensionality of the dataset is necessary in order to include zero trade flows, while still allowing the Poisson estimation to converge. In these regressions the Zero tariff variable, instead of being a 0-1 dummy, describes the fraction of product tariff lines within the category in which the tariff is zero. Thus, it takes values between 0 and 1.

as another set of fixed effects. Our identification relies on time variation. The obvious drawback of introducing the country-period dummies is therefore that we curtail our identifying variation. A concrete example is useful to illustrate this point. Vietnam joined the ITA in 2006. In our baseline estimation, we therefore identify the ITA impacts for Vietnam by comparing its trade during 1996-2005 to that of 2006-12. Introduction of the country-period effects implies that the comparison is now shortened to 2005 versus 2006-2008. Thus, to the extent that (i) ITA impacts build over longer periods of time, as the graphs in Section II suggest or (ii) trade flows are volatile, as is typically the case in product-level data or (iii) 2005 was an abnormal year for Vietnam's ITA trade, we run the risk of obtaining misleading estimates.

Table 7 presents the results. It is an exact analogue to Table 5 with added country-period effects. As expected, the magnitudes of most all coefficients are muted against the background of the reduced identifying variation. The main exception is the zero tariff coefficient, which suffers from less of such a loss as it is also driven non-ITA members that have reduced tariffs to zero on certain products. However, a few effects that were closer to zero or less statistically significant in our baseline results now become insignificant. These include for instance the 8 per cent ITA exogenous exporter impact in final goods of Regression 16, which is now negated. Most importantly, however, the pattern of results resembles otherwise very closely the one of Table 5, albeit with smaller magnitudes and some reductions in statistical significance. We therefore draw much comfort from this robustness check and look forward to exploring further alternatives to control for multilateral resistance in future work.[35]

7. Conclusion

The Information Technology Agreement (ITA) is perhaps the most significant plurilateral tariff reduction agreement to date. Under the aegis of the WTO, 75 countries eliminated all import tariffs on a wide range of IT–related goods. The broad coverage within the sector, as well as comprehensive implementation of the agreement, makes the ITA an ideal case study to understand

[35]Yet other alternatives to control for multilateral resistance would be to introduce a control sector of non-ITA products and then rely on between-product variation within any year and country pair to identify ITA trade impacts. Yet another option may be to apply the approximation method of Baier and Bergstrand (2007).

Table 7: Robustness II: Addressing multilateral resistance using country-period effects

Goods type	All goods				Intermed. Goods 5/		Final goods 5/	
China's Exp.	Yes	No	Yes	No	Yes	No	Yes	No
Reg. No.	23	24	25	26	27	28	29	30
Individual	−0.0554*	−0.000232	−0.0469*	0.00585	−0.00150	0.0641	−0.0872*	−0.0732
ITA Exporter	(−2.56)	(−0.01)	(−2.16)	(0.25)	(−0.04)	(1.48)	(−2.48)	(−1.93)
Exogenous	0.232***	0.00669	0.190***	−0.0731**	0.173***	−0.0339	0.249***	−0.0522
ITA Exporter	(13.57)	(0.30)	(10.91)	(−3.14)	(5.65)	(−0.86)	(8.40)	(−1.32)
ln(1+tariff)	−0.0640	−0.0144	−0.0619	−0.0171	−0.480*	−0.377	0.151	0.0962
	(−0.65)	(−0.14)	(−0.63)	(−0.17)	(−2.43)	(−1.88)	(0.84)	(0.53)
Zero tariff	0.0790***	0.0800***	0.0792***	0.0806***	0.0974***	0.101***	0.0590***	0.0576***
	(14.32)	(14.18)	(14.35)	(14.28)	(9.57)	(9.72)	(6.43)	(6.14)
Individual	0.114***	0.180***	0.0531	0.204***	0.152*	0.299***	0.0854	0.298***
ITA Imp. 1/	(4.15)	(6.39)	(1.63)	(6.08)	(2.46)	(4.57)	(1.53)	(5.33)
Exogenous	0.0857**	0.157***	0.0533	0.176***	0.149**	0.270***	0.0868	0.250***
ITA Imp. 1/	(3.18)	(5.76)	(1.89)	(6.10)	(2.78)	(4.75)	(1.82)	(5.22)
Non-ITA	0.116***	0.166***	0.0634*	0.179***	0.219***	0.329***	0.0233	0.195***
WTO Imp. 1/	(4.41)	(6.25)	(2.15)	(5.85)	(3.90)	(5.48)	(0.46)	(3.81)
One in	0.101***	0.107***	0.0798***	0.104***	0.0551	0.0661	0.182***	0.214***
WTO	(4.41)	(4.58)	(3.56)	(4.58)	(1.38)	(1.63)	(4.59)	(5.36)
Exporter late			0.0697*	−0.0264	0.0691	−0.0273	0.101*	−0.0580
WTO joiner 3/			(2.47)	(−0.82)	(1.34)	(−0.46)	(2.12)	(−1.10)
Exporter late			0.377***	0.491***	0.175***	0.277***	0.702***	0.822***
EU joiner 4/			(12.81)	(16.56)	(3.31)	(5.21)	(13.86)	(16.13)
Exporter late			0.00444	0.119	0.120	0.227	0.0662	0.205
US-FTA joiner 4/			(0.06)	(1.66)	(0.99)	(1.89)	(0.56)	(1.72)
No. obs.	2,477,294	2,386,043	2,477,294	2,386,043	680,728	658,002	825,203	793,820
R2 adj. (%)	76.40	76.02	76.41	76.05	79.26	78.90	74.24	73.71
Linear combinations of coefficients: 2/								
Indiv. ITA Im.	−0.003	−0.018	0.010	0.052***	−0.041	0.005	0.074**	0.156***
- non-ITA WTO Im.	(−0.21)	(−1.14)	(−0.63)	(3.21)	(−1.36)	(−0.16)	(2.57)	(5.49)
Exog. ITA Im.	0.034*	0.078***	0.023	0.041*	0.032	0.044	0.082**	0.099***
- non-ITA WTO Im.	(2.27)	(5.00)	(1.49)	(2.56)	(1.08)	(1.44)	(3.08)	(3.67)

All regressions include country-pair-product, product-time and country period effects. They also include the standard gravity variables as in Table 2 before (coefficients not reported), except for the remoteness regressor, because the country-period fixed effects now proxy for Anderson and van Wincoop's (2003) multilateral resistance effects. Retaining the remoteness regressor would leave results virtually unchanged. All regressions in Table 7 are statistically preferred to their analogs excluding country-period effects. Specifically, Table 3 specifications are rejected at the 0.1 per cent level or higher by F-Statistics in favor of the corresponding Table 7 specifications.
Notes 1/ and 2/, see Table 2. Notes 3/ to 5/, see Table 4. Note 3/ of Table 2 also applies.

the impacts of tariff reduction – or indeed elimination – agreements.

This paper contributed to the understanding of the impact of the ITA in three ways. First, by using a large panel data set of product–level data, we were able to dissect the layers through which the agreement affects trade flows. In particular, we distinguish three effects: the tariff reduction effect, tariff elimination effect and value chain effect (through intermediate goods prices). Second, we carefully investigate the role of China and verify that ITA effects are not driven just by the experience of this single country. Finally, we use Poisson maximium likelihood regression to correct for the presence of zero trade flows.

The positive impact of the ITA on trade is driven by tariff–related factors. In particular, the elimination of tariffs has a benign impact over and above the trade gains predicted from tariff reductions alone. After controlling for these tariff policies, the ITA dummy is no longer significant. This creates some hope that similar tariff elimination treaties in other sectors may promote trade just as strongly. Furthermore, elimination of tariffs on intermediate IT goods due to ITA helps to promote exports in two ways: first, by creating policy certainty, it affects the location decisions of MNEs. Second, lowering the cost of inputs makes producers more competitive when exporting. This is reflected in a much higher ITA semi–elasticity for zero tariffs in intermediate goods vis–a–vis final goods.

While China is clearly a key beneficiary of the ITA, having become a dominant exporter of electronics products in the world, a careful investigation reveals that other "exogenous joiners" also benefited from the agreement. In particular, the layers identified earlier are robust to estimation on a sub–sample containing all signatories except China. Finally, Poisson maximum likelihood regression confirms the robustness of our results to taking into account zero trade flows.

8. Appendix

Table 8: Maximizing the number of zero observations in the Poisson

Estimation technique	Least Squares		Poisson	
Includes China's Exports	Yes	No	Yes	No
Regression No.	A1	A2	A3	A4
Individual ITA Exporter	−0.129*	−0.0675	−0.350**	−0.882***
	(−2.56)	(−1.23)	(−2.97)	(−5.86)
Exogenous ITA Exporter	0.319***	0.159*	0.761***	0.345*
	(5.58)	(2.25)	(8.19)	(2.28)
Individual ITA Importer 1/	0.491***	0.512***	0.0753	0.0473
	(5.34)	(5.48)	(0.51)	(0.31)
Exogenous ITA Importer 1/	0.564***	0.488***	0.963***	0.970***
	(7.36)	(6.22)	(6.64)	(6.55)
Non-ITA WTO Importer 1/	0.473***	0.418***	0.502***	0.511***
	(5.47)	(4.77)	(4.27)	(4.31)
One in WTO	0.200**	0.0993	0.101	0.120
	(2.92)	(1.40)	(0.95)	(1.09)
Exporter late WTO joiner 3/	−0.0742	−0.212*	0.182	0.180
	(−0.90)	(−2.36)	(1.22)	(1.02)
Exporter late EU joiner 4/	1.348***	1.418***	0.987***	1.179***
	(17.51)	(18.35)	(6.20)	(8.72)
Exporter late US-FTA joiner 4/	−0.0710	−0.0279	−0.564	−0.486
	(−0.30)	(−0.12)	(−1.90)	(−1.64)
Number of observations	268,438	261,936	392,416	384,816
R2 adjusted (per cent)	0.836	0.832	N/A	N/A
Linear combinations of coefficients: 2/				
Individual ITA Importer minus	0.018	0.093*	−0.426***	−0.463***
non-ITA WTO Importer	(0.48)	(2.44)	(−5.96)	(−5.71)
Exogenous ITA Importer minus	0.091	0.070	0.461***	0.459***
non-ITA WTO Importer	(1.58)	(1.20)	(5.39)	(5.28)

In all regressions, the dataset is collapsed to the 7 broad product categories described in Section II and includes zero trade flows; see also note 5/ of Table 5.
Notes 1/ and 2/, see Table 2. Notes 3/ and 4/, see Table 4. Note 3/ of Table 2 also applies.

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