RIETI Discussion Paper Series 14-E-003

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The Research Institute of Economy, Trade and Industry
http://www.rieti.go.jp/en/

RIETI Discussion Paper Series 14-E-003
January 2014

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Abstract

The Information Technology Agreement (ITA), enacted in 1997 as one of a few World Trade Organization (WTO) agreements realized after the Uruguay Round, lifted tariffs on a broad range of IT products such as telecommunication equipment and computers. As part of the General Agreement on Tariffs and Trade (GATT)/WTO system, the ITA is built on the most-favored nation (MFN) principle. However, since participation is not mandatory, any WTO member country can potentially free ride on the agreement. This paper empirically explores the extent to which the ITA has boosted trade in IT products. It then asks to what extent, if at all, the MFN free-rider problem has hampered the ITA's success. Using panel data on bilateral trade among 160 countries over the 1993-2007 period, we find that the ITA's trade creation effect can be observed for imports by developing countries. However, the result is fragile and depends on empirical specifications. When multilateral resistance is more appropriately controlled, the ITA's trade creation effect becomes weak or even disappears. Interestingly, there is little evidence demonstrating the existence of the MFN free-rider problem even when the trade creation effect was observed.

Keywords: GATT, WTO, ITA, MFN free-riding, Gravity model
JEL classification: F14

[1] I am grateful to Tadashi Ito, Hikaru Ishido, Isao Kamata, Yoshizumi Komoriya, Kiyoyasu Tanaka, and Hiroshi Mukunoki for helpful comments. This study is a product of an international economics project at the Research Institute of Economy, Trade and Industry (RIETI). I am grateful to RIETI for supporting this research. I thank Zhu Lianming for providing excellent research assistance. The views expressed and any errors are the author's responsibility.

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1 Introduction

The WTO's latest round of multilateral trade negotiations, the Doha Development Agenda, has been stalled since 2008, despite attempts through 2011 to move talks forward. In the absence of a concrete multilateral agreement, many countries have attempted to expand the nexuses of preferential trade arrangements (PTAs), which are not based on the most-favored nation (MNF) principle for seeking further trade liberalization. However, there is an exception: the Information Technology Agreement (ITA), an exceptional WTO agreement realized after the Uruguay Round, has since 1997 lifted tariffs on a broad range of information technology (IT) products including telecommunication equipment and computers. The agreement has been "hailed as the biggest tariff-busting deal since the Uruguay Round (WTO (2012, page 8))." Indeed, after starting with 29 WTO member countries, the ITA has grown to include 74 WTO member countries. The ITA is regarded as a successful WTO agreement despite being delinked from WTO's official trade negotiation rounds.

Despite the ITA's successful expansion, its role in boosting global IT product trade remains vague. Some reports unquestionably show that the world's IT product trade has grown substantially at a pace exceeding that of the manufactures trade during the late 1990s and 2000s (e.g., WTO (2012, Ch.3)). However, many other factors, such as rapid technological progress in IT products, could explain this observed increased volume in IT product trade.[1] Questions about the ITA's success are also raised by the fact that empirical examinations of the trade creation effect of WTO membership has so far yielded mixed results. One particularly prominent concern about the ITA's effectiveness centers on the MNF principle, which has long been suspected of generating a free-rider problem in multilateral trade negotiations. Empirical studies on MFN free-riding are scarce, but Ludema and Mayda (2009) show the existence of MFN free-riding using the U.S. tariff data.

The WTO has sought to expand the product coverage of the ITA. Nevertheless, for all reasons discussed above, the ITA's trade creation effect should not a priori be seen as inherently significant. Policymakers need to know the ITA's true effects to ensure future

[1] WTO (2012) itself highlights the possibility that trade flows in IT products were inflated by the double counting nature that can occur when IT products in global supply chains cross borders several times. While this point should certainly be considered, it must be balanced against the fact that global supply chains can be affected by trade agreements, such as by vertical production fragmentation.

policies achieve maximum efficacy. Researchers seek to empirically assess the impact of trade agreements to understand how they impact not just participating sectors and countries but also the economy as a whole. In particular, in the context of multilateral trade agreements, trade economists now broadly acknowledged that "MFN is a pillar of the GATT/WTO architecture (Bagwell and Staiger (2010))." Thus, both policymakers and researchers need a clear understanding regarding the extent to which the ITA has boosted trade in IT products as well as the extent to which, if any, the MFN free-rider problem has affected the agreement's success.

This paper empirically examines the extent to which the ITA has boosted trade in IT products as well as determines the extent to which the MFN free-rider problem has affected the ITA. For this purpose, using panel data on bilateral trade flows among 160 countries over the 1993–2007 period, a series of gravity equations for bilateral import flows in IT products are estimated. Appropriately controlling for multilateral resistance, unobserved country pair heterogeneity, and the country pair status with respect to trade agreements, these estimations generate two main insights. First, controlling for unobserved country pair heterogeneity but not sufficiently controlling for multilateral resistance reveal that ITA membership has a trade creation effect: the ITA itself pushes up trade volumes for the average member country pair by about 30% relative to the average country pair where at least one country is not a WTO member (therefore, neither an ITA member). This effect is pronounced when the importer in the country pair is a developing country: the average ITA country pair trade about 47% more than the country pair in which at least one country is not a WTO member. By contrast, when the country pair's importer is a developed country, the ITA's trade creation effect vanishes. These contrasting results appear plausible, considering the fact that developed countries applied quite low tariffs on IT products before the ITA. However, once we control multilateral resistance more sufficiently, the ITA's trade creation effect weakens, then tends to disappear. Thus, the estimation results highlight the importance in appropriately controlling for multilateral resistance in the gravity model.

In addition, the estimations find scant evidence of MFN free-riding for all specifications. Since ITA member countries extend concessionary tariff rates (zero tariffs) for all WTO member countries, it is not surprising that non-ITA countries penetrate these markets, thus

exploiting the ITA's concessionary tariffs. However, our results for the average country pair where the importer is an ITA member but the exporter is not (but does belong to the WTO) shows that trade volumes do not increase in most specifications. In some specifications, such country pairs tend to increase trade volumes. However, even in such cases, trade volumes statistically remain the same or even fall below those of the average country pair in which both countries are just WTO members. Thus, overall, MFN free-riding is not observed.

This paper is related to two strands of trade literature. First, this paper contributes to the literature on empirical studies of multilateral trade agreements and their impacts. As mentioned earlier, although many empirical researches have followed the thought-provoking study by Rose (2004), the issue of how and to what extent the GATT/WTO multilateral trade agreements have boosted international trade remains unsettled. For example, Tomz, Goldstein, and Rivers (2007) show that Rose (2004)'s results can be easily overturned by correcting the definition of WTO membership. Subramanian and Wei (2007) state that the GATT/WTO did not have a universal trade creation effect: only developed countries able to aggressively reduce tariffs in GATT/WTO trade negotiations experienced trade expansion, leaving developing countries behind. However, Eicher and Henn (2011) find that after controlling for unobserved heterogeneity among trading partners, the effect of WTO membership on trade flows is not statistically significant. Rather than examining aggregated bilateral trade flows, this study examines the impact of a multilateral trade agreement covering a limited scope of products. Thus, although the results presented here may not be directly generalizable, they have the advantage of elucidating the agreement's precise impact as the ITA is a simple agreement in the sense that it has a single liberalization measure—tariff elimination. While my estimation covers a limited range of products, it nevertheless reveals that the ITA has boosted trade unevenly (as Subramanian and Wei (2007)) if at all (as Eicher and Henn (2011)).

Bora and Liu (2010) present the single study examining the ITA's impact on trade volumes. They find that the ITA generates a significant positive trade creation effec—but only for developing countries. Related to their result, this paper presents a more graduated perspective on the ITA's trade creation effect by exerting more control over degrees of multilateral resistance. Furthermore, they did not study the issue of MFN free-riding.

Second, this paper's empirical examination of possible MFN free-riding contributes to the literature on the architecture of multilateral trading systems. The empirical results of Subramanian and Wei (2007)'s study on GATT/WTO's uneven trade creation effects suggest that the combination of the MFN principle and reciprocal tariff reductions may eliminate MFN free-riding in practice. By contrast, Ludema and Mayda (2009) propose empirical evidence for the existence of MFN free-riding, based on a theoretical model. However, Bagwell and Staiger (2011) examine data from WTO accession and find little evidence for MFN free-riding. This paper's results also support the view that MFN free-riding problem is not empirically as serious a problem as initially thought.

The rest of the paper is organized as follows: the next section outlines the ITA and MFN fee-riding issues. Section 3 describes the data and empirical methodology used in the study. Section 4 reports the estimation results, and Section 5 concludes.

2 The ITA, the MFN Principle, and Free-Riding

The ITA, enacted in 1997, is a sectoral agreement based on the MFN principle. The ITA covers a broad range of IT products such as computers, semiconductors, semiconductors manufacturing equipment, telecommunication apparatus, and data storage media and software.[2] The agreement, launched with 29 WTO member countries and expanded to more than 70 countries in 2008, is regarded as a rare successful case of a multilateral trade agreement following the Uruguay Round (WTO (2012)). ITA participants are obliged to eliminate bounded tariffs on IT products.[3]

Notably, the ITA's tariff elimination is based on the MNF principle *and* participation in the agreement is not mandatory for all WTO members. In practice, this means that tariff concessions offered by ITA member countries are automatically extended to non-ITA

[2]WTO (2012) categorizes the IT products covered by the ITA into seven product groups such as (i) computers (personal computers (PCs), laptops, and input/output units), (ii) Semiconductors (transistors, integrated circuits (ICs), microprocessors, and electronic micro-assemblies), (iii) semiconductors manufacturing equipment, (iv) telecommunication apparatus (telephones, pagers, mobilephones, switching equipment), (v) instruments and apparatus (cash registers, postage-franking machines, electric calculators), (vi) data storage media and apparatus (floppy disks, compact discs (CDs), software in physical support), and (vii) parts and accessories (parts and accessories to the other six main categories).

[3]The original 29 member countries agreed on a series of four equal tariff reduction between 1997 and 2000 with certain exceptions granted to developing countries.

members so long as they are WTO participants. Thus, the ITA offers clear potential for countries to free-ride on the fruits of trade negotiations conducted by others.

Many theoretical studies identify various potential benefits following from the MFN principle (e.g. Bagwell and Staiger (2002), Saggi (2004), and Ederington and McCalman (2003)). However, if MFN free-riding is a serious problem, those potential benefits might not manifest as countries may choose not to participate in MNF principle-based tariff negotiations, and even if countries do participate in such negotiations, their knowledge that they will be unable to internalize all potential benefits from tariff reduction dis-incentives them from sufficiently reducing tariffs.

Bagwell and Staiger (2005) argue that when tariff reduction is reciprocal, MFN free-riding may not be as serious as it first appears. Rather, they stress that MNF combined with reciprocity could minimize bilateral tariff bargaining spillovers onto a third country. The key premise of their argument is that under reciprocity, countries reduce tariffs without altering their terms of trade. When terms of trade remain unchanged, any tariff reduction on a MFN basis does not alter local relative prices in countries not participating in tariff negotiations, a result that implies non-participating countries cannot increase exports.[4]

Although Bagwell and Staiger (2005)'s argument that the MFN principle and reciprocity in tariff reduction can minimize MFN free-riding is powerful and persuasive, the extent to which their logic works in reality is debatable. Bagwell and Staiger (1999) show that tariff reduction while also maintaining terms of trade may be a more feasible policy goal than first appears since tariff reduction that does not change trade balances among negotiating parties is equivalent to maintaining terms of trade. However, from a practical standpoint, tariff

[4]Their discussion is easily illustrated by a two-good and three-country general equilibrium trade model where country 1 trades with both countries 2 and 3, but countries 2 and 3 each trade only with country 1. Letting $x(y)$ denote the natural import (export) good of country 1, the terms of trade are given by $p^w \equiv p^x/p^y$ where p^x and p^y are tariff-exclusive (world) prices for goods x and y, respectively. Country 1 imposes the tariff $\tau_i, i = 2, 3$ on imports from country i. Since the imported goods are homogenous, only one local price can exist in country 1: $p_1 \equiv \tau_2 p_2^x/p^y = \tau_3 p_3^x/p^y$. Thus, whenever $\tau_2 \neq \tau_3$, $p_2(\equiv p_2^x/p^y) \neq p_3(\equiv p_3^x/p^y)$ must hold. Under the MFN principle, country 1 sets a single tariff rate, which implies that a single equilibrium price $\tilde{p}$ prevails across countries 2 and 3 ($\tilde{p} = p_2 = p_3$). Suppose that county 3 is not involved in the negotiations and maintains its original tariff. Countries 1 and 2 reciprocally reduce their tariffs, leaving their terms of trade $\tilde{p}$ unchanged. However, the local price in country 1 ($p_1 = \tau_2\tilde{p}$) goes down while that in country 2 ($p_2 = \tilde{p}/\tau_2$) goes up. However, the local price in country 3, $p_3 = \tilde{p}/\tau_3$, does not change because the reciprocal tariff reduction between countries 1 and 2 does not affect $\tilde{p}$. Thus, nothing changes in country 3: country 3's trade volume is unaltered by the trade negotiations between countries 1 and 2 because country 3 cannot increase production capability of the exported goods.

negotiations in the real world are not necessarily based on reciprocity as defined in Bagwell and Staiger (1999). Furthermore, some observers remain dubious about the relevance of terms of trade to real world trade negotiations (e.g. Krugman (1997)).[5] In theory at least, Bagwell and Staiger (2005)'s logic only works well in the neoclassical trade framework. Ossa (2011), seeking to determine the rationslity of multilateral trade agreements other than nullifying any terms of trade-driven externality, recently proposed the role of MFN principle and reciprocity in a framework of the "new trade theory" developed by Krugman (1980). The existence of MFN free-riding can be verified even if countries follow the MFN principle and reciprocity in Ossa's model.[6] Thus, it is not necessarily clear whether the MFN principle and reciprocity can mitigate MFN free-riding (third-country spillovers).

Empirical studies offer mixed results regarding MFN free-riding. Subramanian and Wei (2007) find that GATT/WTO membership is associated with a large and significant increase in trade volumes for developed countries, while developing countries experience a weak or non-existent impact. The fact that members from developed countries have been the main participants in GATT/WTO-sponsored tariff bargaining leads to a conclusion that GATT/WTO tariff negotiations have not induced MFN free-riding. By contrast, Ludema and Mayda (2009) theoretically show that higher foreign export concentrations reduce free-riding, and thus lead to a lower tariff. They empirically test this hypothesis using sectoral-level tariff data for the U.S. Their findings support their hypothesis, indicating that MFN free-riding does exist and hinders tariff reduction. However, despite applying the same empirical methodology as Ludema and Mayda (2009) to accession negotiations in the WTO, Bagwell and Staiger (2011) find little evidence of MFN free-riding.

[5] However, recent empirical evidence indicates that optimal tariff consideration does in fact motivate tariff settings. See Broda, Limao, and Weinstein (2008) and Bagwell and Staiger (2011).

[6] Ossa (2011) himself does not clearly show this point because his main interest lies in showing that the MFN principle and reciprocity can solve the delocation externality. Ossa considers a framework of three countries similar to that used in the main text: country 1 trades with both countries 2 and 3, but countries 2 and 3 only trade with country 1. In the appendix, he posts the number of firms in equilibrium (from equations (A11) to (A23)). These equations show that when countries 1 and 2 reduce tariffs reciprocally and country 1 applies the same tariff rate to country 3, then country 3 can gain by delocating country 1's firms.

3 Data and Methodology

3.1 The Data

The raw data set consists of annual observations covering the period 1993–2007 for more than one hundred countries. The data set contains annual bilateral trade flows extracted from the UN comtrade database. The ITA defines covered products by the Harmonized Schedule (HS) codes along with a list of complementary product descriptions.[7] According to the ITA, the product descriptions are intended to list specific products to be covered by this agreement wherever they are classified in the HS. Accordingly, we construct trade data based on the listed 6-digit HS codes. However, the HS codes in the ITA have one problem: although the ITA covers semiconductor manufacturing equipment, the agreement only vaguely identifies covered items related to semiconductor manufacturing equipment since there is no such HS code precisely identifying the products considered semiconductor manufacturing equipment. Consequently, the ITA uses descriptive lists along with the related HS codes to identify the items related to semiconductor manufacturing equipment. Hence, in this study, we omit semiconductor manufacturing equipment from our data rather than risk including unrelated products.

Information on the countries that joined the ITA comes from WTO (2012). A list of participants can be found in the Appendix. Data on preferential trade arrangements (PTAs) were obtained from the WTO website. Data on real GDP are taken from the World Bank's *World Development Indicators*.

Combining these data, the analysis covers a panel of 151 countries between 1993 and 2007, which means each year contains 22,650 import flows (160×159 country pairs) including instances of zero trade. The list of countries is presented in Table 6 in the Appendix. A total of 26 importing countries joined the ITA in 1997, whereas the WTO had 100 members. The number of ITA member countries has gradually increased, reaching 63 in 2007, with WTO membership totaling 126. By contrast, the number of countries that join at least one PTA was 127 in 1997, reaching 144 in 2007.

[7] The ITA is Ministerial Declaration on Trade in Information Technology Products issued on December 13, 1996. The declaration has two attachments (Attachment A and Attachment B) specifying the covered products. Attachment A lists the HS codes for the covered products while Attachment B describes them.

3.2 Empirical Specifications

3.2.1 Gravity equation

Many recent leading trade models are known to generate similar forms of gravity equations. These models include the Anderson and van Wincoop (2003) model that emphasizes multilateral resistance, the many country Ricardian model developed by Eaton and Kortum (2002), and the monopolistic competition model with heterogenous firms by Chaney (2008) and Melitz (2003).[8] These models all emphasize the role of prices. This study follows Anderson and van Wincoop (2004) for deriving a gravity equation in sector k, but greatly simplifies it by adding specifications to the underlying model.

More specifically, using the CES demand structure, Anderson and van Wincoop (2004) give the value of the trade flow from exporter j to importer i in sector k by

$$X_{ij}^k = \frac{E_i^k Y_j^k}{Y^k} \left[\frac{T_{ij}^k}{P_i^k \Pi_j^k} \right]^{1-\sigma^k}, \tag{1}$$

where Y_j^k represents the value of production in exporter j for sector k, E_i^k is the value of expenditure in importer i for sector k, Y^k is the value of world production for sector k, and T_{ij}^k is the bilateral trade cost between i and j. P_i^k and Π_j^k are inward and outward multilateral resistance, respectively. Equation (1) indicates that trade flows between country i and country j depend on relative trade barriers: holding other things constant, greater P_i^k or Π_j^k raises trade flows between i and j.

Equation (1) can be appropriately estimated using fixed effects for the importer and exporter to control P_i^k and Π_j^k. Using country specific fixed effects is especially attractive for estimating the sectoral gravity equation in (1) because the country specific fixed effects also control Y_j^j and E_i^k, factors for which collecting reasonably precise data is not easy. However, this method can increase coefficients to be estimated by a significant degree. P_i^k and Π_j^k (as well as E_i^k and Y_j^k) are variable over time. Controlling them properly requires country $\times$ time specific fixed effects. However, introducing country- and year-specific dummies tend to make estimation computationally infeasible, and this is the case for our data. Thus, this

[8] Early contributions to the formal economic foundations of gravity equations include Bergstrand (1985), Bergstrand (1989), and Deardorff (1998).

study employs alternative means to control the multilateral resistance terms, adding more specifications to the model behind the gravity equation given in (1).

Suppose that there are N countries that have a single production input, labor. Each country produces a numeraire good via a linear homogenous technology. The numeraire good is internationally traded in a costless manner, which implies the wage rate is equalized to 1 across all countries. Sector k is a monopolistic competition sector where the varieties of differentiated good are assumed to be symmetric. Suppose that all countries have the same increasing returns to scale technology in sector k. Thus, the same factory-gate price, $p_j = \sigma^k/(\sigma^k - 1)$, prevails across all countries. The value of imports by country i from country j is given by

$$X_{ij}^k = n_j^k E_i^k \left[\frac{T_{ij}^k}{P_i^k}\right]^{1-\sigma^k}, \tag{2}$$

where n_j^k is the number of varieties in sector k supplied by country j. As is standard, the price index in sector k is expressed by

$$P_i^k = \left[\sum_j^N n_j^k T_{ij}^{1-\sigma^k}\right]^{1/(1-\sigma^k)}. \tag{3}$$

Since in this setting of constant demands elasticity, each variety's output level is equal across countries, the number of varieties n_j^k is equivalent to Y_j^k in equation (1). For the given E_i and n_j, equations (2) and (3) uniquely determine X_{ij}. Following Martin, Mayer, and Thoenig (2008) and others, the value of imports X_{ij} are normalized by country i from country j by dividing it by the value of imports from a reference country. The U.S. is used as the reference exporter. Thus, the relative imports by country i from country j is given by

$$\frac{X_{ij}^k}{X_{i,us}^k} = \frac{n_j^k}{n_{us}^k}\left[\frac{T_{ij}^k}{T_{i,us}^k}\right]^{1-\sigma^k}, \tag{4}$$

which will be estimated later.[9]

To estimate this equation, data for n_j^k are needed. If the estimation covers total bilateral imports, n_j may be proxied by GDP since the standard monopolistic competition model

[9] A possible candidate for reference trade volumes is internal trade such that X_{ii} (e.g. Eaton and Kortum (2002)). However, collecting data for X_{ii}^k across a broad range of countries is difficult, particularly because X_{ii}^k are sectoral internal trade flows.

discussed above suggests that the total number of varieties is proportional to labor endowment (in efficiency units). Since direct proxy data for n_j^k for the relevant ITA products are unavailable, this study assumes that n_j^k is proportional to $k_j GDP_j$ where k_j is a country specific constant. Using logarithms, the equation to be estimated is given by

$$\ln\left[\frac{X_{ij}^k}{X_{i,us}^k}\right] = \ln\left[\frac{k_j}{k_{us}}\right] + \ln\left[\frac{GDP_j}{GDP_{us}}\right] + (1-\sigma^k)\ln\left[\frac{T_{ij}^k}{T_{i,us}^k}\right]. \tag{5}$$

Alternatively, as Head and Mayer (2013) suggest, another reference country for imports may eliminate the output capability terms, n_j^k and n_{us}^k, from the gravity equation in (4). By choosing another reference country for imports and using the relative import by the reference country such that

$$\frac{X_{r,j}}{X_{r,us}} = \frac{n_j^k}{n_{us}^k}\left[\frac{T_{r,j}^k}{T_{r,us}^k}\right]^{1-\sigma^k}, \tag{6}$$

we obtain the ratios of rations of imports without the output capability terms:

$$\frac{X_{ij}^k/X_{i,us}^k}{X_{r,j}^k/X_{r,us}^k} = \left[\frac{T_{ij}^k/T_{i,us}^k}{T_{r,j}^k/T_{r,us}^k}\right]^{1-\sigma^k}. \tag{7}$$

The gravity equation in (7) is superior to the one in (4) in the sense that the output capability terms, which may pose data collection problems, are eradicated. However, choosing two reference countries may reduce the sample size. Furthermore, no good guidelines exist for selecting the reference countries. Hence, the estimations will mainly focus on the gravity equation in (5).

3.2.2 Trade agreements

The trade cost term T_{ij}^k follows the standard specification such that

$$T_{ij}^k = \exp\left[\sum_h \beta_h TA_{h,ij}\right], \tag{8}$$

where $TA_{h,ij}$ represents trade arrangement h between country i and j. These trade arrangements include the WTO, the ITA, and PTAs. All typical gravity explanatory variables such as bilateral distance and dummy variables indicating the usage of common languages, border sharing, and the existence of former colonial ties are absorbed by country-pair fixed effects so that they are excluded from T_{ij}^k.

Since this study attempts to capture the impact of the ITA on trade flows by binary variables, it is important to appropriately classify country pairs. Ignoring PTAs for the moment, each country of a country pair can be classified as an ITA member, a WTO but not an ITA member, or a non-WTO member. However, if the importer of a country-pair is not an ITA member but is a WTO member, whether or not the exporter is an ITA member should not affect import flows, given that the exporter must also belong to the WTO. Likewise, if at least one of a country-pair is not a WTO member, the import flow between the country-pair is not affected by the partner's status with respect to the ITA and WTO. Thus, there are four categories of country-pairs. For each category, a country-pair may or may not be in a common PTA. Eventually, seven mutually-exclusive categories are identified as follows:

1. Both countries of a country-pair are ITA members but do not belong to a common PTA. This is the pure ITA effect (ITA–ITA, category 1).

2. Both countries of a country-pair are ITA members and simultaneously are in a common PTA (ITA–ITA+PTA, category 2).

3. The importer is an ITA member while the explorer is not an ITA member but is a WTO member. They do not belong to a common FTA (ITA–WTO, category 3).

4. Both countries of a country-pair are in a common PTA. The importer is an ITA member while the exporter is not an ITA member but is a WTO member (ITA–WTO,+PTA, category 4).

5. The importer is not an ITA member but is a WTO member while the exporter is at least a WTO member. They do not belong to a common PTA. This is the pure WTO effect (WTO\ITA–WTO, category 5).

6. Both countries of a county-pair are in a common PTA. The importer is not a member of the ITA but is a WTO member. The exporter is at least a WTO member (WTO\ITA–WTO+PTA, category 6).

7. Both county pair members belong to a common PTA, but at least one is not a WTO member. This is the pure PTA effect (non-WTO+PTA, category 7)[10].

Table 1 in the Appendix shows that the distribution of country-pairs according to the above categories. The table indicates that not very many country-pairs are in a common PTA (from 11.7% to 15.7% in total). In contrast, the number of country-pairs in which the importer extends ITA tariffs to the exporter is much greater (from 12.5% to 34.2 %). This difference reflects the fact that the ITA liberalizes trade on a MFN basis. This difference becomes sharper when we compare the number of countries that have PTAs with those that joined the ITA. While the former was 127 in 1997 and 144 in 2007, the latter was only 26 in 1997 and 62 in 2007.

Using the above categories as binomial variables, the estimation base is a country-pair such that both are not in a common PTA and at least one of them does not belong to the WTO. The coefficient for category 1 dummy represents the pure ITA effect. Similarly, the coefficient for category 5 dummy is the pure WTO effect while the coefficient for category 7 dummy is the pure PTA effect. This study is primarily interested in whether the coefficient for the category 1 dummy variable is greater than that for the category 5 dummy variable. Furthermore, the coefficient for the category 3 dummy variable indicates the extent to which WTO member countries that do not belong to the ITA can free-ride on the ITA's tariff reductions.

3.2.3 Other econometric issues

Some additional econometric issues need to be noted. First, countries do not randomly join trade agreements. For example, Baier and Bergstrand (2004) empirically show that two countries tend to form a free trade agreement in the following circumstances: the larger and more similar their GDPs; the closer their geographical proximity but the more remote they are from the rest of the world; the greater their difference in capital-labor endowment ratios; and the wider (narrower) the difference in their relative factor endowments with respect to each other (ROW). Factors influencing membership in the ITA and/or the WTO

[10]Hence, the benchmark country-pair is that both countries are not in a common PTA and at least one does not belong to the WTO (non-WTO).

should also be mentioned, though the full scope of such an analysis is beyond the scope of this paper. However, ignoring non-randomness with respect to trade-agreement membership causes selection bias (e.g. Baier and Bergstrand (2007)).[11]

In this paper, exploiting the panel structure of the sample data, country-pair fixed effects absorb all unobservable effects that may affect countries' decisions regarding joining trade agreements.[12] Based on the discussions above, the estimation equation is expressed by

$$\ln\left[\frac{X^k_{ij,t}}{X^k_{i,us,t}}\right] = \ln\left[\frac{GDP_{jt}}{GDP_{us,t}}\right] + \sum_h (1-\sigma^k)\beta_h(TA_{h,ij,t} - TA_{h,i,us}) + d_{ij} + d_t + \epsilon_{ij,t}, \quad (9)$$

where d_{it} denotes the country-pair fixed effect, d_t is the time fixed effect, and $\epsilon_{ij,t}$ is white noise. The assumption of homoskedasticity in $\epsilon_{ij,t}$ will be discussed in a subsequent section.

4 Empirical Results

This section reports the results of the estimations conducted to determine the ITA's impact on bilateral trade flows of the ITA-covered products. As a first step, the WTO's impact on trade volumes of the ITA-covered products will be presented. Although the main purpose of this study is to highlight the ITA's effect, it is useful to see the WTO's impact first because the ITA's tariff reductions are deeper than the WTO's. Further, estimation of the WTO's treatment effect on its own is interesting since previous literature exploring the WTO's impact on (aggregate) bilateral trade exhibit mixed results.[13]

[11] An example proposed by Baier and Bergstrand (2007) is extensive unmeasurable domestic regulations such as internal shipping regulations that inhibit trade, resulting in a negative shock in the error term in the gravity equation. Such domestic regulations may encourage the two governments to conclude an FTA if it not only abolishes tariff barriers but also reduces the trade barriers caused by domestic regulations. In such a case, the error term and the FTA dummy are negatively correlated, leading to an underestimated coefficient for the FTA dummy.

[12] Baier and Bergstrand (2007) highlight two other potential sources of estimation bias, namely, simultaneity bias and measurement error bias. Simultaneous bias can arise when a pair's desire to possibly trade more than their "natural" level, as suggested by a typical gravity model, may create political pressures to avoid trade liberalization. This in turn would cause a negative simultaneity bias in the FTA coefficient estimate. Meanwhile, measurement errors in explanatory variables are likely to exist because the 0-1 trade agreement dummy variable would be positively correlated with the measurement error, leading the attenuation bias of FTA's coefficient estimate toward zero.

[13] Rose (2004) find little evidence that GATT and WTO members trade more than countries outside the organization. Tomz, Goldstein, and Rivers (2007) stated that the definition of the GATT/WTO membership used in Rose (2004) was too narrow, and used a corrected definition of organization membership to show that participation in the GATT/WTO substantially increased trade. Subramanian and Wei (2007) find that the WTO has exerted a significant positive effect on trade, but only for industrial countries. Eicher

4.1 Impact of the WTO

Table 2 presents the results of a series of regressions for the WTO's impact on bilateral imports of ITA-covered products.[14] For reference, the estimation results without multilateral resistance consideration are reported (specifications (1) and (2) in Table 2). Both the country-pair fixed effects and time fixed effects in these specifications control multilateral resistance to some degree, though they are not sufficient. The results show that the average country pair in which both countries are WTO members but not in a common PTA (shown as "WTO" in Table 2) trades about 18% ($\exp[0.169] - 1$) more than the average country pair in which at least one party does not belong to the WTO and neither are in a common PTA.

The average country pair in which both countries are WTO members and form a common PTA see the biggest trade increases ($exp[0.457] - 1 \simeq 0.58$), implying that trade liberalization through PTAs is deeper than through the GATT/WTO. Interestingly, when at least one party in a country-pair is not a WTO member, the formation of a PTA is ineffective for at least the ITA-covered products. This may suggest that PTAs that include non-WTO member countries do not substantially facilitate international trade.

When trade agreement categories are divided according to whether importers are developed (deved-WTO) or developing countries (deving-WTO), the positive impact of WTO membership is observably greater for importers from developed countries (specification (2)). For importers from developed countries, the WTO membership coefficient is 0.234, which is greater than 0.175, the coefficient for developing country importers. However, the difference is not very large and a Wald test cannot reject the null hypothesis that the two coefficients are the same.[15] This result contradicts with Subramanian and Wei (2007)'s observation that industrial countries witnessed a large increase in trade since they participated more actively in the GATT/WTO's tariff negotiations than developing countries. However, it should be noted that specifications (1) and (2) do not sufficiently control multilateral resistance.

Specifications (3) and the remainder in the table provide a fuller examination of mul-

and Henn (2011) find that the WTO's effect on trade flows are not statistically significant, while PTAs also generate strong but uneven trade effects.

[14] All dependent variables are logarithms so all zero trade observations are dropped from the regression.

[15] The F statistics is 0.51.

tilateral resistance. Specifications (3) and (4) are based on the estimation in equation (9). As a general tendency, these specifications have greater coefficients than previous ones. The WTO membership coefficient is now 0.282, meaning that that the average country-pair in which both countries belong to the WTO but are not in a common PTA will trade about 33% ($\exp[0.282] - 1$) more than the average country-pair in which at least one party does not belong to the WTO and neither are in a common PTA (specification (3)).

Furthermore, the tendency is magnified that WTO-member importers from developed countries are more likely than those from developing countries to experience increased trade with other WTO member countries. Their coefficient value for WTO membership, 0.461, is much greater than 0.124, the coefficient value for developing country importers. Indeed, the Wald test can reject the null hypothesis that the two coefficients are the same at the 1% level.[16] Thus, these results not only show that the impact of WTO membership on trade volumes of ITA-covered products is qualitatively consistent with Subramanian and Wei (2007)'s observation but also indicate the importance of appropriately controlling multilateral resistance.

The last two columns in Table 2 report the estimation results based on equation (7). The U.K. serves as the reference importer simply because it had the greatest number of import origin countries out of the sample countries in 1993, the sample data's initial year. WTO membership shows an enhanced impact even in this specification: the WTO coefficient value of 0.542 indicates that despite not forming any PTAs, the average WTO member pair trades about 72% more than the average country-pair in which at least one country does not belong to the WTO. The magnitude of this trade-creating effect is very similar to that seen for the average country-pair in which both members belong to the WTO and have a common PTA. The greater impact for developed country importers relative to developing country importers continues to hold as the Wald test cannot reject the null hypothesis at the 1% level.[17]

[16] The F statistics is 12.73.
[17] The F statistics is 11.52.

4.2 Impact of the ITA

We now turn to the ITA's impact on trade volumes. Table 3 presents the results from a series of regressions using the eight categories of country-pairs defined eariler. As described in the previous section, all country pairs are exclusively sorted into the one of eight categories depending on their trade agreement status. The base category is composed of a country-pair in which at least one country does not belong to the WTO and neither country is in a common PTA. Only country-pair fixed effects are used in specification 1 along with time fixed effects. The coefficient value of ITA–ITA indicates that on average, a country-pair in which both parties are in the ITA trades about 43% more than that in the base category ($\exp[0.359] - 1$). This coefficient is significantly greater than the one for WTO–WTO, where both countries are WTO members but are not in a common PTA. The WTO–WTO's coefficient value suggests that countries in this category on average trade about 13% ($\exp[0.118] - 1$) more than those in the base category, which implies that the ITA itself boosts trade volumes by about 30%. Further, the ITA's positive impact can be seen by comparing the average ITA country-pair with a common PTA (ITA–ITA, PTA) and the average WTO country-pair with a common PTA (WTO–WTO, PTA). These coefficients reveal that the former trades about 72% ($\exp[0.545] - 1$) more while the latter trades about 44% ($\exp[0.364] - 1$) more than the average country-pair in the base category. Therefore, the ITA's net impact can be determined to be around 20%.

Interestingly, the coefficient for the average country-pair in which the importer is an ITA member but the exporter ("ITA–WTO") is not statistically significant. Since the ITA members are obliged to eliminate tariffs for ITA-covered items on an MFN basis, exporting countries do not suffer discrimination by the ITA in terms of tariffs so long as they belong to the WTO. Thus, this estimation result indicates that MFN free-riding is unlikely to have occurred in the ITA's case; therefore, indirectly supporting the Bagwell and Staiger (2005)'s reasoning as to why third country spillovers are unlikely for trade negotiation under the MFN principle and reciprocity in tariff reduction.

Further, the estimation results in column 1 show that PTAs tend to produce deeper trade liberalization than the ITA. All comparisons between a pair in a common PTA and

one without a common PTA reveal that the first case trades significantly more than the latter.[18] These results fit expectations since the ITA focuses on tariff elimination only while PTAs in general cover a broader range of tariff barriers such as border procedures. The only exception is a country-pair in which at least one country is not a WTO member. In this case, PTAs do not demonstrate a statistically significant impact (the coefficient for "non-WTO+PTA" is not different from zero).

Columns 2 and 3 present the results from the same estimation as column 1 but the sample countries are separated according to whether the importers are developed (column 2) or developing countries (column 3). Two things are noteworthy. First, the coefficients for ITA–WTO are statistically insignificant for both subsamples, a finding that confirms the relative rarity of MFN free-riding.

Second, the coefficients for ITA–ITA are still positive and statistically significant in both columns 2 and 3. In the absence of a common PTA, the average country-pair in which both countries join the ITA trades more than the average country-pair in which at least one country does not belong to the WTO, regardless whether the importer is a developed or developing country. However, when the importer is a developed country, the coefficient for WTO–WTO does not statistically differ from that for ITA–ITA (i.e., 0.306 for ITA–ITA and 0.270 for WTO–WTO). Thus, for developed countries, the ITA is unlikely to produce additional impact in terms of trade creation. By contrast, the coefficient for WTO–WTO is not statistically different from zero for the case in which the importer is a developing country, while that for the ITA–ITA case remains positive and significant (column 3). These results are consistent with the fact that the ITA's tariff reduction for developed countries was not very large because they generally had quite low tariffs on IT products even before the ITA. The estimation result of no significant impact from WTO membership for developing countries is in keeping with existing literature given the fact that developing countries have not aggressively reduced their tariffs in trade negotiations under the GATT/WTO. This result is consistent with the finding of Subramanian and Wei (2007). In essence, the estimation results shown in columns 1–3 suggest that (i) the ITA has helped promote trade liberalization for developed countries, while not generating any

[18] The F statistics for the Wald test for equal coefficients are 10.37 for ITA–ITA and 18.79 for WTO–WTO.

additional trade creation effect for developed countries; and (ii) there is little evidence that the ITA has brought about a MFN-free-riding problem.

However, once we exert increased control over the factor of multilateral resistance, some important results show changes, starting with the estimation of relative imports (column 4–6). Note that all coefficient values for ITA–ITA decline relative to their counterparts in specifications 1–3. Furthermore, columns 3 and 4 reveal that the coefficient for ITA–ITA is *lower* than that for WTO–WTO, indicating that the ITA has not had any additional trade creation effect for all countries, not merely for developed ones. But for developing countries, additional trade creation at the margin of about 14% ($\exp[0.298]/\exp[0.164]-1$) can be attributed to the ITA.

However, after controlling for multilateral resistance entirely by taking ratios of imports, the ITA's additional trade creation effect for developing countries appears to evaporate: the coefficient for ITA–ITA is 0.345 while that for WTO–WTO is 0.454 (column 9).

In terms of MFN free-riding, the coefficient for ITA–WTO becomes positive and statistically significant for all sample countries (column 7). The coefficient value is greater than that for ITA–ITA, and this difference is statistically significant. The F statistics is 8.73 and the hypothesis that the coefficient for ITA–ITA is not statistically different from that for ITA–WTO can be rejected. This result may appear to hint the existence of MFN free-riding. However, the coefficient for WTO–WTO is almost the same magnetite as that for ITA–WTO (i.e, 0.586 for WTO–WTO and 0.574 for ITA–WTO). Hence, this result makes the existence of MFN free-riding upon the ITA much less plausible. Therefore, taking account all specification results, the conclusion can be drawn that there is little empirical evidence for MFN free-riding upon the ITA. However, the extent to which the ITA has exerted a trade creation effect apart from WTO membership is limited. At most, such an effect, if any, may exist only for developing countries, and there no evidence exists for its impact on developed countries.

4.3 Robustness

In this subsection, I discuss the robustness of the estimation results obtained thus far. First, all three specifications are re-estimated using finer country category dummies: each

category is separated into developed and developing importing countries. This robustness check is motivated by the fact that specification 8 in Table 3 does not work well so that estimates for developed countries have not been obtained.[19] Table 4 reports the results, which are generally qualitatively consistent with the observations in Table 3. In column 2, the coefficient for a country pair in which the importer is a developed country and a member of the ITA, but the exporter, although a WTO member, does not belong to the ITA, is positive and significant (deved–ITA–WTO). This result differs from the corresponding coefficient in Table 3, which shows that the same country pair is not statistically significant (ITA–WTO in column 5 in Table 3). Although for developed countries the coefficient is nearly identical to that for ITA–ITA, the coefficient for WTO–WTO is much greater than either. Thus, the coefficient for deved–ITA–ITA does not provide sufficient evidence for MFN free-riding.

In column 3 in Table 4, as predicted, for developed countries, the ITA–ITA coefficient is not greater than the WTO–WTO coefficient. Again, no evidence supports the assertion that the ITA generates an additional trade creation effect. Thus, the results reported in Table 4 largely confirm the results in the previous section.

The issue of zero trade also needs to be addressed. It has long been known that zero trade flows do not randomly appear in bilateral trade flow data.[20] Since ignoring zero trade flows may cause omitted variable bias, several remedies have been proposed.[21] Following Santos Silva and Tenreyro (2006), the gravity equations are re-estimated here using the Poisson quasi-maximum likelihood estimator (QMLE). The results are reported in Table 5. Overall, the ITA does not affect IT product trade volumes: for every specification, the coefficients for WTO–WTO outweigh those for ITA–ITA. Furthermore, in most specifications, the coefficients for ITA–WTO turn out to be positive and statistically significant. However, those for WTO–WTO exhibit greater effects for trade creation. Therefore, the tendency of significant coefficients for ITA–WTO do not necessarily provide evidence of

[19] Specifications 7 through 9 use only categorical variables for explanatory variables. One possible reason for specification 7's reduced accuracy may be that the sample data does not have sufficiently varied explanatory variables.

[20] As a recent comprehensive survey for this issue, see Head and Mayer (2013).

[21] Recent examples include Santos Silva and Tenreyro (2006) and Helpman, Melitz, and Rubinstein (2008). Head and Mayer (2013) provide an excellent and useful survey on gravity equations including this topic.

MFN free-riding.

5 Conclusions

The ITA, one of only several multilateral trade agreements initiated after the Uruguay Round of trade talks, has since 1997 eliminated tariffs on a broad range of IT products. As a WTO trade agreement, the ITA upholds the MFN principle. However, participation in the ITA is not mandatory for WTO member countries, meaning that any WTO member country can potentially free-ride on the agreement. This paper uses panel data of bilateral trade among 160 countries over the 1993-2007 period to empirically examine the extent to which the ITA has boosted trade in IT products.

When controlling for unobserved country-pair heterogeneity but not sufficiently controlling for multilateral resistance, ITA membership has an observable trade creation effect. On average, the ITA boosts trade volumes for an ITA member country-pair by about 30%, compared to a country-pair in which at least one country is not a WTO member. This effect is enhanced when the importer of the country-pair is a developing country: the average ITA country pair trades about 47% more. By contrast, when the importer of a country pair is a developed country, the the ITA does not exhibit an observable trade creation effect. The ITA's uneven effects fit predictions since applied tariffs by developed countries were quite low for IT products even before the ITA.

However, once we exert more appropriate control on multilateral resistance by using import flows normalized by those from a reference exporter (the U.S. is used in this study), the ITA's trade creation effect substantially weakens. Furthermore, when using ratios of ratios in import flows by employing a reference importer (the U.K. is used in this study), it tends to disappear. Thus, the analysis in this paper leads to the conclusion that it is unlikely that the ITA has contributed to trade expansion.

Second, the data reveal little evidence of an MFN free-rider problem occurring during the study period. Comparing the average country-pair in which both countries are the ITA members to the average country-pair in which only the importer is an ITA member but the explorer remains a WTO member, a series of estimations show that the coefficient for the latter pair is either insignificant or, if positive and significant, its size is never greater

than the coefficient size for a country-pair in which both countries are in the WTO but not ITA participants. Therefore, it is highly unlikely that MFN free-riding will pose a problem. Furthermore, the study's findings empirically support the theoretical argument proposed by Bagwell and Staiger (2005) regarding how the MFN principle can avoid MFN free-riding when co-working with reciprocity.

Despite these conclusions, other issues require further consideration. First, this paper deals with the ITA as a treatment and uses dummy variables. Although approach follows the literature of empirical assessment of trade agreements, measurement errors are inevitable. Therefore, an approach focusing on certain countries and using finer data such as tariffs for each item could yield more precise results. Second, this paper focuses on the ITA's impact on trade volumes. However, the trade agreements such as the ITA may affect many other interesting aspects such as industry structure and firms behavior such as foreign direct investment or R&D. All these are left for future research.

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Table 1: Country pair distribution by the trade agreement categories

(Importer, Exporter)	1997	2002	2007
(ITA, ITA) & no PTA	1.3	7.4	10.6
(ITA, ITA) & PTA	1.2	3.4	5.3
(ITA, WTO) & no PTA	8.4	14.3	15.8
(ITA, WTO) & PTA	0.9	1.5	1.8
(WTO, ITA or WTO) & no PTA	35.2	32.2	30.8
(WTO, ITA or WTO) & PTA	6.3	6.0	5.8
No WTO & no PTA	43.5	32.0	27.3
No WTO & PTA	3.1	3.1	2.6
PTA	11.6	14.1	15.5
ITA	11.9	26.7	33.5

Notes: Numbers are percents. The left item in the parentheses indicates the trade agreement status for the importer of a country-pair while the item on the right in the parentheses indicates the trade agreement status for the exporter. For example, (WTO, ITA or WTO) means that the importer is a member of the WTO but not a member of the ITA whereas the exporter is at least a member of the WTO. No WTO in the last two rows means that at least one country of a pair does not belong to the WTO. PTA indicates that a pair of country is in a common PTA.

Table 2: Impact of the WTO on imports of the ITA products

	(1) X_{ij}	(2) X_{ij}	(3) $\frac{X_{ij}}{X_{i,us}}$	(4) $\frac{X_{ij}}{X_{i,us}}$	(5) $\frac{X_{ij}/X_{i\bar{j}}}{X_{\bar{i}j}/X_{r\bar{j}}}$	(6) $\frac{X_{ij}/X_{i\bar{j}}}{X_{\bar{i}j}/X_{r\bar{j}}}$
GDP_i	1.042**	1.054**				
	(0.075)	(0.075)				
GDP_j	1.608**	1.603**				
	(0.087)	(0.088)				
GDP_i/GDP_j			1.702**	1.705**		
			(0.088)	(0.088)		
WTO	0.169**		0.282**		0.542**	
	(0.036)		(0.048)		(0.104)	
WTO	0.457**		0.577**		0.521**	
+PTA	(0.056)		(0.062)		(0.109)	
non-WTO	−0.065		−0.001		−0.211**	
+PTA	(0.068)		(0.066)		(0.067)	
deved-WTO		0.234**		0.461**		0.654**
		(0.071)		(0.071)		(0.110)
deved-WTO		0.560**		0.882**		0.671**
+PTA		(0.082)		(0.080)		(0.112)
deving-WTO		0.175**		0.124*		0.413**
		(0.041)		(0.063)		(0.109)
deving-WTO		0.508**		0.391**		0.478**
+PTA		(0.063)		(0.074)		(0.118)
deving-nonWTO		0.162*		0.180*		0.157+
+PTA		(0.077)		(0.079)		(0.093)
Observations	145,128	145,128	145,128	145,128	140,880	140,880
Within R^2	0.091	0.091	0.068	0.068	0.005	0.005

Notes: Heteroskedasticity-robust standard errors are in parentheses. **, *, and + indicate significance at the 1%, 5%, and 10% levels, respectively. Country-pair fixed effects and time fixed effects are included in all regressions. Fixed effect results are not reported. All variables except for dummy variables are taken logarithm so that zero trade flows are omitted from the regression. Deved and deving indicate that importing countries are developed countries and developing countries, respectively.

Table 3: Impact of the ITA on imports of the ITA products

	(1) All X_{ij}	(2) Deved X_{ij}	(3) Deving X_{ij}	(4) All $\frac{X_{ij}}{X_{i\bar{j}}}$	(5) Deved $\frac{X_{ij}}{X_{i\bar{j}}}$	(6) Deving $\frac{X_{ij}}{X_{i\bar{j}}}$	(7) All $\frac{X_{ij}/X_{i\bar{j}}}{X_{\bar{i}j}/X_{r\bar{j}}}$	(8) Deved $\frac{X_{ij}/X_{i\bar{j}}}{X_{\bar{i}j}/X_{r\bar{j}}}$	(9) Deving $\frac{X_{ij}/X_{i\bar{j}}}{X_{\bar{i}j}/X_{r\bar{j}}}$
GDP_i	1.036**	0.144	1.032**						
	(0.074)	(0.251)	(0.082)						
GDP_j	1.603**	1.314**	1.782**						
	(0.087)	(0.136)	(0.111)						
GDP_i/GDP_j				1.692**	1.296**	1.857**			
				(0.088)	(0.135)	(0.113)			
ITA–ITA	0.359**	0.306**	0.384**	0.235**	0.245**	0.298**	0.451**	0.006	0.345**
	(0.043)	(0.086)	(0.051)	(0.058)	(0.087)	(0.086)	(0.107)	(0.193)	(0.108)
ITA–ITA +PTA	0.545**	0.572**	0.499**	0.611**	0.438**	0.624**	0.627**	−0.024	0.480**
	(0.060)	(0.106)	(0.075)	(0.072)	(0.103)	(0.104)	(0.114)	(0.188)	(0.116)
ITA–WTO	−0.033	0.016	−0.102	0.099	0.004	−0.009	0.574**	0.369**	0.409**
	(0.048)	(0.085)	(0.070)	(0.063)	(0.087)	(0.100)	(0.113)	(0.114)	(0.113)
ITA–WTO +PTA	0.412**	0.415**	0.398**	0.493**	0.337**	0.570**	0.287*	–	0.143
	(0.072)	(0.107)	(0.110)	(0.082)	(0.108)	(0.127)	(0.118)		(0.120)
WTO–WTO	0.118**	0.270**	0.066	0.342∗∗	0.340**	0.164*	0.586**	−0.092	0.454**
	(0.039)	(0.083)	(0.045)	(0.054)	(0.086)	(0.069)	(0.108)	(0.384)	(0.109)
WTO–WTO +PTA	0.364**	0.400**	0.392**	0.511**	0.380**	0.445**	0.613**	−0.189	0.542**
	(0.060)	(0.107)	(0.074)	(0.069)	(0.105)	(0.090)	(0.115)	(0.377)	(0.117)
nonWTO +PTA	−0.065	−0.332**	0.027	0.004	−0.395**	0.095	−0.162*	−0.139	−0.193**
	(0.067)	(0.122)	(0.080)	(0.066)	(0.122)	(0.078)	(0.067)	(0.223)	(0.070)
Observations	145,128	38,727	106,401	145,128	38,727	106,401	140,880	37,422	103,458
Within R^2	0.093	0.092	0.095	0.069	0.148	0.049	0.006	0.013	0.009

Notes: Heteroskedasticity-robust standard errors are in parentheses. **, *, and $^+$ indicate significance at the 1%, 5%, and 10% levels, respectively. Country-pair fixed effects and time fixed effects are included in all regressions. Fixed effect results are not reported. All variables except for dummy variables are taken logarithm so that zero trade flows are omitted from the regression. Deved and deving indicate that importing countries are developed countries and developing countries, respectively.

Table 4: Impact of the ITA on Trade Volumes

	(1) X_{ij}	(2) $\frac{X_{ij}}{X_{i\tilde{j}}}$	(3) $\frac{X_{ij}/X_{i\tilde{j}}}{X_{\tilde{i}j}/X_{r\tilde{j}}}$
GDP_i	1.032**		
	(0.075)		
GDP_j	1.610**		
	(0.088)		
GDP_i/GDP_j		1.708**	
		(0.088)	
Deved-ITA–ITA	0.334**	0.233**	0.406**
	(0.077)	(0.080)	(0.113)
Deved-ITA–ITA	0.651**	0.763**	0.732**
+PTA	(0.087)	(0.090)	(0.117)
Deving-ITA–ITA	0.418**	0.296**	0.276*
	(0.050)	(0.086)	(0.123)
Deving-ITA–ITA	0.575**	0.554**	0.268*
+PTA	(0.070)	(0.098)	(0.134)
Deved-ITA–WTO	0.087	0.248**	0.627**
	(0.076)	(0.082)	(0.117)
Deved-ITA–WTO	0.523**	0.646**	0.331**
+PTA	(0.091)	(0.097)	(0.120)
Deving-ITA–WTO	−0.077	−0.055	0.201
	(0.070)	(0.101)	(0.139)
Deving-ITA–WTO	0.450**	0.496**	0.391*
+PTA	(0.105)	(0.122)	(0.153)
Deved-WTO–WTO	0.253**	0.610**	0.735**
	(0.076)	(0.081)	(0.120)
Deved-WTO–WTO	0.412**	0.741**	0.805**
+PTA	(0.093)	(0.096)	(0.124)
Deving-WTO–WTO	0.093*	0.116+	0.425**
	(0.045)	(0.070)	(0.115)
Deving-WTO–WTO	0.447**	0.377**	0.638**
+PTA	(0.068)	(0.083)	(0.126)
Deving-nonWTO	0.158*	0.163*	0.152+
+PTA	(0.077)	(0.079)	(0.091)
Observations	145,128	145,128	140,880
Within R^2	0.093	0.070	0.008

Notes: Heteroskedasticity-robust standard errors are in parentheses. **, *, and $^+$ indicate significance at the 1%, 5%, and 10% levels, respectively. Country-pair fixed effects and time fixed effects are included in all regressions. Fixed effect results are not reported. All variables except for dummy variables are taken logarithm so that zero trade flows are omitted from the regression. Deved and deving indicate that importing countries are developed countries and developing countries, respectively.

Table 5: Impact of the ITA on Trade Volumes (QMLE)

	(1) All X_{ij}	(2) Deved X_{ij}	(3) Deving X_{ij}	(4) All $\frac{X_{ij}}{X_{i\bar{j}}}$	(5) Deved $\frac{X_{ij}}{X_{i\bar{j}}}$	(6) Deving $\frac{X_{ij}}{X_{i\bar{j}}}$	(7) All $\frac{X_{ij}/X_{i\bar{j}}}{X_{\bar{i}j}/X_{r\bar{j}}}$	(8) Deved $\frac{X_{ij}/X_{i\bar{j}}}{X_{\bar{i}j}/X_{r\bar{j}}}$	(9) Deving $\frac{X_{ij}/X_{i\bar{j}}}{X_{\bar{i}j}/X_{r\bar{j}}}$
GDP_i	1.109**	0.245	1.212**						
	(0.219)	(0.290)	(0.367)						
GDP_j	1.660**	1.318**	1.640**						
	(0.168)	(0.204)	(0.272)						
GDP_i/GDP_j				2.162**	1.375**	2.284**			
				(0.596)	(0.382)	(0.639)			
ITA–ITA	0.593**	0.976**	0.348**	0.388	0.875**	0.187	0.580	−0.788	0.549
	(0.094)	(0.136)	(0.130)	(0.260)	(0.158)	(0.315)	(0.679)	(0.964)	(0.680)
ITA–ITA +PTA	0.545**	1.101**	0.356+	1.118**	1.090**	0.900*	0.580	−0.172	0.567
	(0.206)	(0.173)	(0.209)	(0.359)	(0.190)	(0.390)	(0.902)	(0.794)	(0.905)
ITA–WTO	0.514**	0.774**	0.361*	−0.269	0.570**	−0.422	2.106**	−1.224	2.133**
	(0.099)	(0.086)	(0.164)	(0.246)	(0.102)	(0.323)	(0.726)	(1.098)	(0.731)
ITA–WTO +PTA	0.521*	1.087**	0.337	0.908*	0.926**	0.870*	1.180	−1.719	1.199
	(0.214)	(0.176)	(0.236)	(0.384)	(0.199)	(0.426)	(0.832)	(1.104)	(0.833)
WTO–WTO	0.742**	1.343**	0.553**	0.829**	1.503**	0.731**	1.371*	0.247	1.423*
	(0.099)	(0.162)	(0.125)	(0.260)	(0.255)	(0.263)	(0.599)	(0.450)	(0.617)
WTO–WTO +PTA	0.617**	1.382**	0.352	1.227**	1.362**	1.256**	2.271*		2.384*
	(0.207)	(0.193)	(0.231)	(0.376)	(0.262)	(0.395)	(1.108)		(1.146)
nonWTO +PTA	−0.470+	0.421*	−0.567*	1.051**	0.547**	1.079**	0.368	−2.044**	0.397
	(0.279)	(0.171)	(0.275)	(0.334)	(0.180)	(0.341)	(0.535)	(0.740)	(0.536)
Observations	259,590	53,295	206,295	259,590	53,295	206,295	245112	49,262	195,850

Notes: Robust standard errors are in parentheses. **, *, and $^+$ indicate significance at the 1%, 5%, and 10% levels, respectively. Country-pair fixed effects and time fixed effects are included in all regressions. Fixed effect results are not reported. All variables except for dummy variables are taken logarithm so that zero trade flows are omitted from the regression. Deved and deving indicate that importing countries are developed countries and developing countries, respectively.

A Member List of the ITA

Table 6: Member Countries of the ITA

Participant	Date of participation				
Albania	September	1999	Kuwait	September	2010
Australia	March	1997	Kyrgyz	February	1999
Austria	March	1997	Latvia	February	1999
Bahrain	July	2003	Liechtenstein	March	1997
Belgium	March	1997	Lithuania	July	1999
Bulgaria	January	2007	Luxembourg	March	1997
Canada	March	1997	Macao (China)	March	1997
China	April	2003	Malaysia	March	1997
Chinese Taipei	March	1997	Malta	May	2004
Colombia	March	2012	Mauritius	July	1999
Costa Rika	March	1997	Moldova	November	2001
Croatia	September	1999	Morocco	November	2003
Cyprus	October	2000	Netherlands	March	1997
Czech Republic	March	1997	New Zealand	March	1997
Denmark	March	1997	Nicaragua	October	2005
Dominican Republic	July	2006	Norway	March	1997
Egypt	April	2003	Oman	November	2000
El Salvador	May	1997	Panama	June	1998
Estonia	March	1997	Peru	November	2008
Finland	March	1997	Philippines	April	1997
France	March	1997	Poland	March	1997
Georgia	September	1999	Portugal	March	1997
Germany	March	1997	Romania	March	1997
Greece	March	1997	Saudi Arabia	October	2005
Guatemala	December	2005	Singapore	March	1997
Honduras	October	2005	Slovak Republic	March	1997
Hong Kong	March	1997	Slovenia	June	2000
Hungary	May	2004	Spain	March	1997
Iceland	March	1997	Sweden	March	1997
India	March	1997	Switzerland	March	1997
Indonesia	March	1997	Thailand	March	1997
Ireland	March	1997	Turkey	March	1997
Israel	March	1997	Ukraine	January	2008
Italy	March	1997	United Arab Emirates	March	2007
Japan	March	1997	United Kingdom	March	1997
Jordan	December	1999	Unites States of America	March	1997
Korea, Republic of	March	1997	Viet Nam	September	2006

Source: WTO (2012).