ABSTRACT

How Has the Effect of the WTO on Bilateral Trade Changed Over Time?

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Using the most recent data set on bilateral trade from 1962 to 2015 and a Pseudo Poisson Maximum Likelihood (PPML) estimator with and without country-pair fixed effects, this thesis shows the overall effect of WTO/GATT membership on bilateral trade has changed over time. Moreover, the results are different across the estimation methods. PPML with country-pair fixed effects shows that the WTO has statistically significantly positive effects on total bilateral trade before 2001 but has statistically significantly negative or statistically insignificant effects in the later period. The coefficients from PPML without country-pair fixed effects show that WTO membership has large trade promoting effects, although the magnitude of the effect has changed over time. Secondly, except for textiles, the effects of WTO membership on different types of goods mostly follow the same pattern. Lastly, over most of years in the WTO period, trade among developed countries is less than trade among other pairs.

How Has the Effect of the WTO on Bilateral Trade Changed Over Time?

by

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A Thesis

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CHAPTER ONE

Introduction

Since the 1960s, world trade has seen a dramatical growth over time (Figure 1.1). In this period, trade liberalization took place under multilateral agreements and regional trade agreements. The most recognized multilateral trade institutions are the General Agreement on Tariffs and Trade (GATT) and its successor, the World Trade Organization (WTO). Since it started, GATT/WTO has held multiple rounds of trade negotiations which have helped countries decrease trade barriers and built up a more transparent and predictable trade environment.

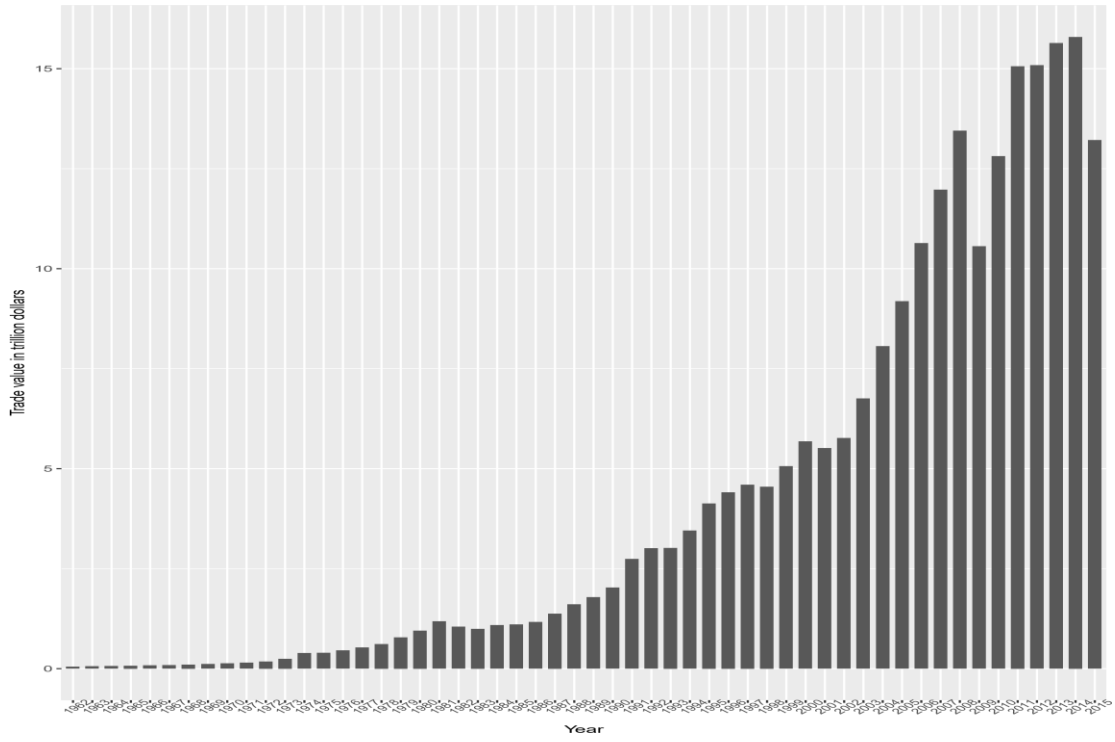

Figure 1.1 The world total exports in trillion dollars over years from 1962-2015

With the number of GATT/WTO members increasing over the years, the trade volume among GATT/WTO members has become the major portion of world trade. In 2015, 98% of total world trade was conducted among WTO members (Figure 1.2), meaning that the world trade activities are now under the WTO's rule and regulations. Therefore, it is no surprise to think that the GATT/WTO plays a major role in the world trade increase over the past years.

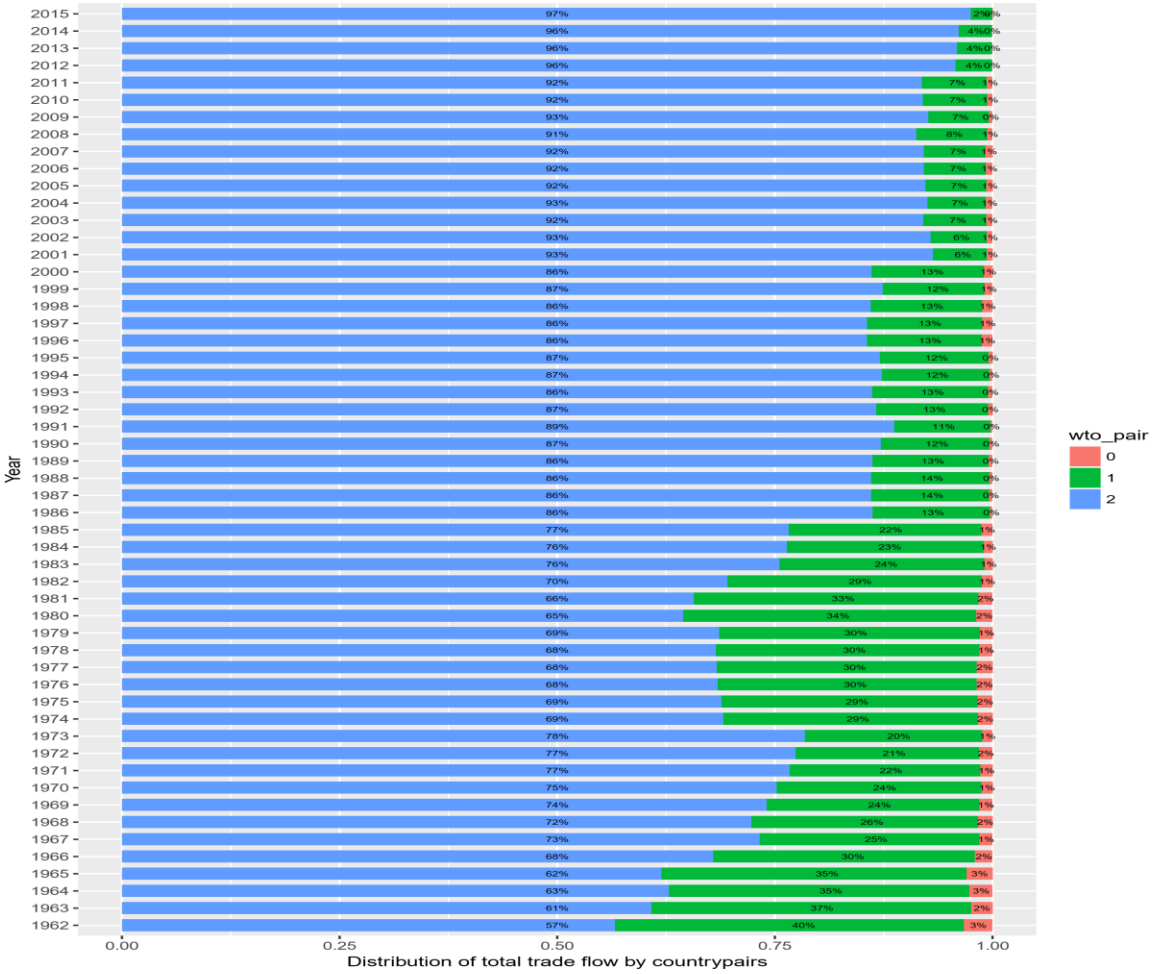

Figure 1.2. The distribution of trade year-by-year by number of WTO members in a country pair.

However, this view was challenged by Rose (2004) who used the well-known traditional gravity model and found no evidence of GATT/WTO effects on bilateral

trade. Instead, he found the positive effects on bilateral trade of other variables such as preferential trading area or currency union. Rose (2004) called it "an interesting mystery". Following Rose (2004), a remarkable number of researchers have been trying to resolve the mystery based on the development of gravity model theory and its estimation technique. However, the results are not the same across studies. Regarding the overall effect of the WTO on bilateral trade, Subramanian and Wei (2007), Eicher and Henn (2010), Felbermayr and Kohler (2010), Roy (2011) find that the effect of WTO membership on bilateral trade is not statistically significant. In contrast, Tom et al. (2007), Liu (2009), Chang and Lee (2011) suggest a large effect of the WTO on bilateral trade, and Dutt et al. (2013) and Cheong et al. (2014) find a slight impact of WTO membership on bilateral trade. In addition, the effects of the WTO on bilateral trade are different across the groups of members. While Subramanian and Wei (2007) show that WTO membership benefits trade among developed countries, but not among developing countries, Felbermayr and Kohler (2010) find the opposite.

Building on this research, this thesis aims to investigate the effects of the WTO on bilateral trade over time. There are a few things that justify this thesis. Firstly, I have employed the most recent data set from 1962 to 2015. Secondly, I look at the different econometric specifications. Specifically, in order to see the effects of WTO membership changing over time, I estimate the effects year-by-year under the presence of the regional trade agreements (RTAs) that are carefully classified following Giordano et al. (2012). Thirdly, I observe the effects of the WTO on trade of different types of goods classification: total exports, exports of manufactured goods, exports of manufactured less textiles goods, textiles, exports of homogenous, referenced-prices, and differentiated

goods following Rauch classification. The econometric estimation model used is the Pseudo Poisson Maximum Likelihood estimator with and without country-pair effects. I find that overall, the effect of the WTO has changed over the WTO period. The results are different across the estimation methods. PPML with country-pair fixed effects show that the WTO has statistically significant positive effects on total bilateral trade before 2001 but has statistically significant negative effects or statistically insignificant effects on bilateral trade in the later period. The results from PPML without country-pair fixed effects show that WTO membership has a large trade promoting effects, although the magnitude of the effects has not stayed constant. Secondly, the effects of WTO membership on different types of goods mostly follow the same patterns. Lastly, over most of years in the WTO period, trade among developed countries less than trade with others.

The thesis consists of six chapters. Followed by this introduction, chapter two provides a brief overview of previous studies about the development of gravity model which are traditionally employed for trade model and the effects of the WTO on trade. Chapter three discusses the gravity model specification and the empirical model that will be used in this thesis. Chapter four mentions data sources and description. Chapter five presents empirical results. Chapter six concludes.

CHAPTER TWO

Literature Review

The Gravity Model

The Traditional Gravity Model

Following Ravenstein (1889), the pioneer of using gravity for the migration model, Tinbergen (1962) introduces theoretical and empirical studies that uses the gravity equation for trade. The traditional gravity model is analogous to Newton's Law of Universal Gravitation. The strict application is that goods produced in origin *i* (Y_i) are attracted by the demand for those goods at the destination *j* (E_j), but the trade flow is scaled by the geographical distance between them (D_{ij}):

$$X_{ij} = \frac{Y_i E_j}{D_{ij}^2} \qquad (1)$$

According to Anderson (2011), research that uses this approach can explain 80-90% of the variation of the trade flows. Moreover, the quality of fitness increases if other proxies for trade frictions rather than distance are included, such as common language, and political relationship.

The Structural Gravity Model

Anderson and van Wincoop (2003) argue that in the traditional gravity model, only bilateral friction seems to be insufficient in capturing the effect of trade frictions on bilateral trade. The trade volume from country *i* to country *j* is not only influenced by the frictions between *i* and *j*, but also by the resistance of country *i* and *j* on other countries.

The traditional gravity model thus is not correctly identified (Anderson and van Wincoop, 2003). To fix this problem, they propose a structural gravity model that adjusts the traditional gravity model. They develop the Armington-CES model by Anderson (1979) with the assumption of constant elasticity of substitution (CES) expenditure and the differentiation of goods by places of origin. The trade flow from exporter *i* to importer *j* is given below with the elasticity of substitution, σ, when the aggregate CES prices change:

$$X_{ij} = \frac{Y_i E_j}{Y} \left(\frac{t_{ij}}{\pi_i P_j}\right)^{1-\sigma} \qquad (2)$$

where $Y = \sum_i Y_i$.

The main contribution of Anderson and van Wincoop (2003) is to decompose the trade resistance, $\left(\frac{t_{ij}}{\pi_i P_j}\right)^{1-\sigma}$, into three intuitive components. The bilateral trade cost, t_{ij} between two countries *i* and *j* is commonly proxied by various geographic and trade policy variables such as bilateral distance, common language, countries' discontinuities, tariffs, and trade policies like regional trade agreements. The outward multilateral resistance, π_i, shows the exporter *i*'s resistance to trade with all other countries, or how much exporter *i* competes with other countries (Fally, 2015). The inward multilateral resistance, P_j determines importer *j*'s resistance to trade in general, or how easy it is for other countries to gain access to country *j*'s market (Fally, 2015). Anderson (2011) states that these two resistance terms should satisfy the following constraints for the consistency of the structural gravity:

$$\pi_i^{1-\sigma} = \sum_j \left(\frac{t_{ij}}{P_j}\right)^{1-\sigma} \frac{E_j}{Y} \qquad (3)$$

$$P_j^{1-\sigma} = \sum_j \left(\frac{t_{ij}}{\pi_i}\right)^{1-\sigma} \frac{Y_j}{Y} \qquad (4)$$

There are also other models that came up with the same system of equations above. Eaton and Kortum (2002) argue that the trade cost elasticity $(1-\sigma)$ can be approximated to one of the coefficients of the Frechet distribution of productivity with product differentiation, implying that Ricardian models of trade can be consistent with the gravity model. Chaney (2008) approximates the trade cost elasticity $(1-\sigma)$ as the coefficient of the Pareto distribution of firm productivity, and the coefficient is inversely related to productivity dispersion.

To sum up, according to the structural gravity model, trade flow can be written as a product of three main components: an exporter term, an importer term, and the term reflecting the trade resistance, which consists of the bilateral trade cost, inward and outward trade resistance indexes.

Literature Review Estimating Effects of the WTO

In theory, the main purpose of the WTO/GATT is to deal with rules pertaining to global, international trade between countries. Among its principles, the reciprocity principle and the most favored nation (MFN) principle are designed for mutually agreed upon cutbacks of trade obstacles and non-discriminatory treatment among countries in bilateral trade activities. This helps governments resolve the Prisoner's dilemma, always having the tendency to unilaterally deviate from the equilibrium of tariff reduction. Moreover, through rounds of negotiations, these principles also help countries preserve their valid exceptions which they gain from other agreements. Since its start, GATT/WTO has successfully reduced average tax rates and established a significant number of international rules for trade, ranging across the tariff/ nontariff barriers, from goods to services.

Rose (2004) conducts one of the first careful and exhaustive parametric studies that challenges the conventional view of the effect of GATT/WTO on bilateral trade. Using a large data set of bilateral trade covering 175 countries over 50 years, as well as a well-recognized gravity model for international trade, Rose (2004) finds little impact of WTO on bilateral trade. Rose (2007) provides some possible explanations to support his findings. First, since most developing countries were under special and differential treatment, they were not required to open their markets. Second, the MFN status is also applied to non-GATT members. Third, although most developed countries have reduced their tariffs, they have substituted them by increasing nontariff barriers that hinder the penetration of developing countries' products. Last, he doubts that international trade flow has increased because of several factors including the reduction in transportation costs, the increase in productivity in tradable goods, etc. Despite these explanations for his negative findings, Rose (2004) calls it an "interesting mystery." Because of improvements of gravity model specifications and estimations, several authors have tried to resolve the mystery.

In the first response to Rose (2004), Tomz et al. (2007) argue that the key solution might be the misclassification of GATT/WTO membership. With meticulous work, Tomz et al (2007) reclassify GATT/WTO membership, suggesting the status of nonmember participants (including colonies, de facto, and provisional members) along with the formal membership status. Following the econometric technique in Rose (2004) with the recoded WTO data, they find the reverse result, concluding that the GATT/WTO has a significant impact on bilateral trade. Specifically, GATT/WTO helps increase bilateral trade by 75% if both countries are members, and by 30% if one of them joins.

Nevertheless, Rose (2007) raises economic concerns about the credibility and robustness of their results. For example, the GATT/WTO benefits developing countries more than developed countries, and the nonmember participants gain more from GATT/WTO than its formal members.

Subramanian and Wei (2007) focus on four main asymmetries in the GATT/WTO system between developed and developing country members, imports from GATT/WTO member and from outsiders, liberalized and exempted sectors, and the new and old developing country members. Moreover, they develop an empirical framework that allows them to control for the multilateral resistance terms on bilateral trade (Anderson and van Wincoop, 2003), and they use the import value as the proxy for bilateral trade, instead of the average number of import and export used in Rose (2004). Using five-year interval trade data from 1950-2000 and undifferentiated country members, they share the same result with Rose (2004) about the ineffectiveness of the GATT/WTO on trade. However, after controlling for the asymmetries, they find a strong positive effect of the GATT/WTO on trade among industrialized countries, but not among developing country members. One possible explanation for the difference among developed and developing countries is that developing countries excluded their commitment to trade liberalization as a WTO member, while developed countries did not. The effect of the WTO membership increases for developing country members after 1995 where the special and differential treatment was lessened. By differentiating economic sectors, they prove a significant effect of the WTO membership on trade for the liberalized manufacturing sectors in all countries and non-liberalized sectors in developed countries. Predictably, they find no effect of the WTO membership on the textiles and agriculture sector.

Felbermayr and Kohler (2010) cast doubt on the aggregation effect of the WTO membership if it is based solely on disaggregation effects. In addition, Subramanian and Wei (2007) do not take into account the partner heterogeneity or the presence of preferential trade agreements (PTAs) which might exaggerate the effects of the WTO on trade.

In order to control the omitted variables, Eicher and Henn (2011) develop an empirical framework to deal with multilateral resistances, unobserved membership heterogeneity and PTAs by combining three previous studies by Rose (2004), Tomz et al. (2007) and Subramanian and Wei (2007). Using the data set from Subramanian and Wei (2007) with some updates, they show the initial result of no statistical significance of the effect of WTO membership on trade, but a consistently strong effect of PTAs. In the latter two extension gravity models, which consider the WTO accession factors, they find the opposite result: a significantly positive effect on trade. Specifically, the effect of the WTO is larger for a country member before it has access to PTAs. Also, it helps stimulate the regional trade interaction. With the proxy for the WTO term-of-trade included in the gravity model, the effect of WTO membership is significantly positive for countries with greater motivations to negotiate for tariff reduction. For estimation concerns, they doubt the insufficiency of multilateral resistance controls accounts for the biased estimates in previous research and argue that country-pair fixed effects need to be included in the model to control for unobservable factors between two countries.

Taking a more detailed approach, Dutt et al. (2013) examine the impact of WTO membership on the extensive margin (the increase of newly bilateral trade relationship between two countries who did not trade in the past) and the intensive margin (the

increase of trade volume between two countries who have already trading partners) of trade. In the empirical analysis, they use disaggregated data by 6-digit number classification of product bilateral trade data from 1988-2006. Their results suggest that although the gravity model provides a good explanation for both margins, WTO membership effects mainly focus on the extensive product margin of trade. Under the importer and exporter country year fixed effects and country-pair fixed effects, WTO membership fosters the extensive margin of exports by 25%, whereas it diminishes the intensive margin of trade by 7%. In addition, they show that the impact of the WTO membership can be improved if the fixed rather than the variable costs of trade are reduced. Subsampling the importers by developed and developing countries, they scrutinize the effect of WTO membership on both margins by importers. The effect on the extensive product margin is significant and positive for all developed and developing country importers. By contrast the effect on intensive margin varies across importers: it has negative effects when importers are developing countries, and has an insignificant effect when importers are developed countries.

Cheong et al. (2014) raise the problem of the multicollinearity when estimating gravity model. They agree that by using country-year fixed effects the omitted variable biased is no longer a preoccupation when estimating the gravity model. However, the multicollinearity problem comes from the structural relationship between the two variables indicating whether one or two countries in the pair are WTO members, if the two variables are included in the model. With a large data set of 210 countries over 50 years at 5-year intervals, they point out the instability of the estimates of the effect of WTO membership under the presence of multicollinearity. They suggest using only the

dummy variable for both countries in the pair being WTO members to get more accurate and stable estimates. Their empirical results show that the joint WTO membership stimulates bilateral trade flow by 11%.

Although the studies I explain above are developed step-by-step in order to achieve a better estimate of the effect of the WTO on trade, there is another estimation of concern that none of the studies mention. None of studies explain the sample selection bias caused using traditional log-linear gravity regression, which requires the positive value of trade flow and precludes the fact that many country pairs do not trade at all. To cope with the zero-trade flow problem, Felbermayr and Kohler (2006) propose using the Tobit model to show the positive effect of WTO membership on the extensive product margin. With quite a similar approach, Helpman et al. (2008) develop a Heckman two-equation system which enables them to deal with the zero-trade flow and a large number of exporters to a large number of importers. Moreover, they argue it also helps estimate the effect of WTO on trade in both intensive and extensive margins without having a firm level data, rather than using country level data. The result shows that there is a 15% chance that WTO has a positive effect on trade if both countries in a pair are WTO members. Conversely, to address the presence of zero trade value, Roy (2011) adds a small positive constant to the trade value. Then he estimates the empirical model with $X_{ijt} + 1$ to avoid the presence of zero when taking log of the trade value. Estimating the model with 50-year data at 5-year intervals, he supports the results from Rose (2004), showing that there is no evidence of WTO membership effect on bilateral trade flows. However, according to Silva &Tenreyro (2006), these solutions may cause inconsistent estimators because of the presence of heteroskedasticity and non-normal residuals.

Liu (2009) is the first study that uses the Poisson Pseudo-Maximum Likelihood (PPML) estimator proposed by Silva &Tenreyro (2006) to estimate the effect of the GATT/WTO on trade in regard to dealing with zero-trade flows. Together with importer, exporter fixed effects and country pair fixed effects, he argues the paper has successfully dealt with the two main issues of sample selection bias and the specification of the gravity model. His result strongly supports this theory with the differentiation between extensive and intensive margins. Compared to a pair of non-WTO member countries, a pair of WTO member countries trades 60% more, holding other things constant, in which 39% for intensive margins. Moreover, trade flows between a WTO member and a non-WTO member also increase 15% with the major portion belonging to extensive margins.

Felbermayr and Kohler (2010) emphasize modelling the extensive margin of trade with PPML estimator. The effects of WTO membership on the extensive margin are examined year-by-year and by the four time-intervals based on the four negotiation rounds (pre-Kennedy, Kennedy-Tokyo, Tokyo-Uruguay, and post-Uruguay). They do not find strong evidence to support the impact of WTO membership on extensive margin although there is a strong variation across the time-intervals. In the two periods Pre-Kennedy (1948-1967) and Tokyo-Uruguay (1968-1978), their results show that GATT membership has negative impacts on bilateral trade. During Tokyo-Uruguay (1979-1994) period, there is no statistical effect of GATT membership. In contrast, the post Uruguay period has seen a positive effect. In addition, they also find a considerable difference of the effect of GATT/WTO membership between developed and developing countries. While industrialized countries suffer from their GATT membership in the first three

periods, developing countries are on the opposite side, increasing their exports as being WTO members.

With a nonparametric approach, Chang and Lee (2011) apply pair-matching, permutation tests, and sensitive analysis to investigate the effect of the GATT/WTO membership on bilateral trade flows. They claim that the parametric method can be a solution for the misspecification bias problem and allows membership heterogeneity and other potential selection bias. Their results, from both the benchmark analysis and robustness check, confirm the strong effect on international trade of being a GATT/WTO member. Moreover, compared to bilateral trade preference arrangements, the effect of generalized system of preferences (GSP) is even higher.

In summary, since Rose (2004), the empirical effects of WTO membership on bilateral trade have attracted many researchers' concerns. The mainstream of studies focuses on the WTO membership reclassification in regard to de facto or de jure members, the heterogeneity of the WTO members, the intensive or extensive effects on bilateral trade, and the estimation problem. However, the previous studies have not agreed on the overall effects of WTO membership on trade. In this thesis, I continue these studies to reexamine the relationship between WTO membership and trade. Firstly, I focus on the variation of WTO/GATT membership effect on bilateral trade year-by-year. Secondly, I view the WTO/GATT membership effect on bilateral trade with respect to different types of goods. Thirdly, I use most exhaustive data set that covers 225 countries since 1962 to 2015. Finally, following the current trend in estimating the gravity model, I employ the PPML estimator with pair-country fixed effects for model estimation. By doing that, I expect to capture more precise effects of WTO membership

on bilateral trade and generalize the changing patterns of the effects over the observed time.

CHAPTER THREE

Model Specification and Estimation Technique

The Gravity Model Specification

The traditional estimation method for the gravity model that has long been used is to take the natural log of equation (2)

$$\ln X_{ij,t} = lnE_{j,t} + lnY_{i,t} - lnY_t - (1-\sigma)lnt_{ij,t} - (1-\sigma)lnP_{j,t} - (1-\sigma)ln\pi_{i,t} + ln\varepsilon_{ij,t} \qquad (5).$$

Model specification (5) is considered the traditional version of the empirical gravity equation and has a vast history of estimating the effects of various factors on bilateral trade. The factors are added in the model specification as the proxies for the trade cost variable, $lnt_{ij,t}$, which is assumed to be the linear combination of the natural log of physical distance between two countries, dummy variables for common language, colonial relationships, free trade agreement, etc. The parameters of interests are then estimated by the mean of ordinary least square (OLS). However, many of the gravity parameters estimated above have lately been proven to be biased and inconsistent. The main causes for this are: the adjustment of the multilateral trade resistance, the specification of bilateral trade costs, zero trade values, heteroskedasticity, and the endogeneity of trade policy.

The treatment of the multilateral trade resistance has improved over time as researchers have come up with solutions. The first approach by Anderson and van Wincoop (2003) uses a structural setting to define the exporter and importer terms, then puts the constraint from equation (3) and (4) on them. They first estimate the trade costs

without imposing any constraints, then use the estimated trade cost to construct the first set of multilateral resistance terms, which are then used to re-estimate the gravity model, achieving the new set of trade costs. The process is iterated until the estimates of gravity model converge. However, this approach faces the computational difficulties of iterative custom programming. Baier and Bergstrand (2009) estimate the multilateral resistance by using Taylor series approximation for the structural gravity model. They argue that their method avoids the limit of the number of parameters by STATA packages at the time. However, Anderson (2011) argues that the approximation error of the Taylor series approximate would plague the estimate's accuracy. An alternative approach is the reduced-form by simply adding exporter and importer fixed effects to the model:

$$X_{ij} = e^{(\theta_i + \theta_j - \alpha lnT_{ij})\varepsilon_{ij}} \quad (6)$$

The term θ_i donates the vector of exporter-time fixed effects, which accounts for the outward multilateral resistances, while vector θ_j denotes the set of importer-time fixed effects to capture the inward multilateral resistances. According to the characteristics of the fixed-effects, both exporter-time and importer-time fixed effects will absorb, respectively, the exporter value of output and importer expenditure, as well as all other observable and unobservable exporters and importer-specific characteristics that may influence bilateral trade flow.

The zero-trade value is intrinsic to bilateral trade data because of a lack of commerce between several pairs of countries, the round-off error when the trade amount is too small, or missing observations which are usually wrongly coded as 0. In addition, the more disaggregated data would result in the more zero-trade data. The presence of zero trade flows becomes a big problem for the use of the log-linear form in equation (5).

Several solutions have been proposed to deal with this problem, including excluding the pairs with zero trade from the data set, estimating model with $X_{ij} + 1$, or using the Tobit estimator. However, all the solutions will lead to inconsistent and biased conclusions in estimates of interest (Silva &Tenreyro, 2006). The solution suggested by Silva and Tenreyro (2006) is to use the multiplicative form of the gravity model by applying the PPML estimator to estimate the model. By running Monte Carlo simulations, they show that the PPML estimations of the gravity model works well even with a large portion of zeroes in the data set.

Due to an awareness of Jensen's inequality ($E(ln(X)) \neq ln\, E(X)$, Silva and Tenreyro (2006) point out the presence of heteroskedasticity for any log-linearization or nonlinearization of the empirical model (5). The expected value of the log of error terms, which is the transformed error terms in the log linearization model, depends not only on the mean but also on the variance of the distribution. So, if the variance of the error term in model (5) depends on the regressors, the expected value of the transform error terms will depend on the regressors, leading to biased and inconsistent OLS estimators. Silva and Tenreyro's (2006) solution addresses the issue directly as it estimates the multiplicative gravity model without log transformation and allows for the presence of heteroskedasticity. Making the assumption that the conditional variance is proportion to the conditional mean for the Poisson model, they find that the PPML estimates are consistent with the definition of outward and inward multilateral resistance indexes and meet its two constraints. Moreover, PPML differs from non-linear least squares and gamma quasi-maximum likelihood in the weight put on observations. PPML regression puts the same weight on all observations. Non-linear least squares regression puts more

weight on big trade value observations. On the other hand, gamma quasi-maximum likelihood regression puts less weight on those observations as the result of the assumption that the conditional covariance is proportional to the square of conditional mean. Using Monte Carlo simulations with data with different patterns of heteroskedasticity, Silva and Tenreyro (2006) show that the PPML estimator performs better when compared with the two models above.

Endogeneity is also a well-recognized issue when we examine the trade policy's effects on trade flow (Trefler, 1993, Baier & Bergstrand, 2007; Felbermayr & Kohler, 2010). One possibility is that a country tends to focus on its main trading partners, reinforcing their commerce relationship by taking part in bilateral or multilateral preferable trade agreements. Thus, the trade policy variables, such as WTO or RTAs, are endogenous in the model, which potentially causes biased and inconsistent estimators. The ideal solution for endogeneity is to find strong instrumental variables (IV) to separate the effects of trade policy on the trade flow; however, such a good IV for RTAs or WTO has not been found. Baier and Bergstrand (2007) suggest using country-pair fixed effects to account for all the unobservable factors between the trade policy variables and the error terms in the gravity regressions. Also, they stated that although all other observed and unobservable time-invariant covariates between two countries are taken out of the regressions, the effects of trade policy are not affected. The pair-country fixed effects can be a better measure for the bilateral trade cost.

In the international trade literature, bilateral trade costs are proxied by the distance between two countries and a variety of dummy variables representing the characteristics of each country and pair countries. The used set of dummy variables used

in previous research as follows. *Contiguity* is a dummy variable indicating whether two countries share the same border). *ComLang* is a dummy variable which equals 1 if two countries share the same language, 0 otherwise. *Colony* is a dummy variable which equals 1 if country *i* has ever been a colony of country *j*, 0 otherwise. *Colonizer* is a dummy variable which equals 1 if country *i* has ever been a colonizer of country *j*, 0 otherwise. *Alliance* is a dummy variable which equals 1 if two countries are a formal alliance in year *t*, 0 otherwise. *ComCur* is a dummy variable which equals 1 if two countries use the same currency in year *t*, 0 otherwise. *Comrelig* is a dummy variable which equals 1 if two countries share the same religion, 0 otherwise. *Landlock* is an ordinal variable which equals the numbers of landlock nations in a pair with the set of value of 0, 1, 2. *Island* is an ordinal variable which equals the numbers of island nations in a pair with the set of value of 0, 1, 2. *Hostility* is a dummy variable which equals 1 if there is military conflict between two countries, 0 otherwise. *RTA* is a dummy variable which equals 1 if two countries join the same regional trade agreements, 0 otherwise. *GSP* is a dummy variable which equals 1 if country *i* offers general system of preference to country *j*, 0 otherwise. Yotov et. al (2016) suggest a practical series of observable variables which are considered as standard proxies for bilateral trade costs. The series consists of five variables: distance between two countries, border contiguity, common language, colonial heritage and the presence of RTAs between two countries.

Overall, it may be said that since Tinbergen (1962), the gravity model as well as its estimation methods have steadily become more accurate over time. The estimation challenges are to find the suitable adjustments for the multilateral resistance terms, to deal with the zero-trade value if the log transformation is used for the multiplicative

gravity model, to cope with the heteroskedasticity of the log transformation model for OLS estimation, or to solve the problem of endogeneity if trade policy variables are included in the gravity model. The PPML estimator together with the simple importer and exporter fixed effects has emerged as a solution for all the problems. Fally (2015) proves that the PPML estimators meet the requirements of constraints on inward and outward resistance terms and are consistent with the reduced form of the gravity model. Moreover, according to Silva and Tenreyro (2006) a superiority of PPML estimator is that it does not require the trade flows to follow a Poisson distribution.

The Empirical Model and Estimation

In this thesis, I apply the reduced form of the gravity model with the incorporation of importer exporter and pair-country fixed effects to investigate the effect of the WTO on bilateral trade flows over years, considering the presence of the RTAs. The regressions are as follows:

$$Trade_{ijt} = exp(\theta_{it} + \delta_{jt} + \rho_{ij} + \alpha GRAVITY_{ijt} + \gamma RTA_{ijt} + \sum_t \beta_t WTO_{ijt})\varepsilon_{ijt} \quad (7)$$

$$Trade_{ijt} = exp(\theta_{it} + \delta_{jt} + \rho_{ij} + \alpha GRAVITY_{ijt} + \gamma RTA_{ijt} + \beta WTO_{95-15})\varepsilon_{ijt} \quad (8)$$

$$Trade_{ijt} = exp(\theta_{it} + \delta_{jt} + \rho_{ij} + \alpha GRAVITY_{ijt} + \gamma RTA_{ijt} + \sum_t \beta_t WTO_{ijt} + \sum_t \beta_t WTO\_RTA_{ijt})\varepsilon_{ijt} \quad (9)$$

Where $Trade_{ijt}$ is the export value from country *i* to country *j* in year *t*; θ_{it} is the importer year fixed effects; δ_{jt} is the exporter year fixed effect; ρ_{ij} is the importer-exporter pair fixed effects; RTA_{ijt} is a dummy variable which equals 1 if both two countries are the participants of the same RTA and 0 otherwise; WTO_{ijt} is the dummy variable which equals 1 if both two countries are WTO members and 0 otherwise; WTO_{95-15} is the dummy variable which equals 1 if both 2 countries are WTO member in

1995-2015; ε_{ijt} is the error terms; $\alpha, \gamma, \beta_t's$ are parameters in which the set of $\beta_t's$ is the parameters of interest, showing the effect of WTO on bilateral trade over years. GRAVITY is the group of variables suggested by Yotov et al. (2016) standing for bilateral trade costs, including the natural log of the distance between two countries (*lnDist*), *Contiguity* which equals 1 if two countries share the same border, 0 otherwise, *ComLang* which equals 1 if two countries share the same language, 0 otherwise, *Colony* which equals 1 if country *i* has ever been a colony of country *j*, 0 otherwise, *Comcol* which equals 1 if two countries have a common colonizer post 1945.

Regarding the heterogeneity among WTO members, in this thesis, I focus on the difference in effects of the WTO on trade between two groups: trade among developed countries and trade among those who are not. I add the interaction between *WTO* and *DEV* to the regression model, with DEV as a dummy variable coded 1 if both two countries in a pair are developed countries, 0 otherwise:

$$Trade_{ijt} = exp(\theta_{it} + \delta_{jt} + \rho_{ij} + \alpha GRAVITY_{ijt} + \gamma RTA_{ijt} + \sum_t \beta_t WTO_{ijt} + \sum_t \beta_t WTO\_DEV_{ijt})\varepsilon_{ijt} \quad (10)$$

CHAPTER FOUR

Data

Data Sources

The data used in this thesis is at the country level, including 225 countries and special territories and special custom areas from 1962 to 2015. The data is taken from various sources, which are uniformly in Stata format. Files are merged to a consolidated file based on the mutual three-letter ISO country codes and IFS country number codes (See Table A1). All the variables are dyadic variables, containing information pertaining to country-pairs. They are split into two groups, including trade flows and trade barriers. The trade value between two countries is gauged by the exports from reporter country *i* to partner country *j* in nominal U.S dollars and does not include re-exports. The original bilateral trade data was taken from the UNComtrade, which is for public access. Although in general, the data set is from 1962 to 2015, it does not fully cover trade flows of all country pairs, especially for the 1960s to 1980s.

The total export is used for benchmark study; however, it is important to investigate exports of different types of commodities. The reason for this is that they are affected by the trade barriers differently. In this thesis, along with the total exports for benchmark study, I reclassify the trade flows according to good types: manufactured goods, textiles, manufactured goods less textiles, and goods classification following Rauch (1999). The exports of manufactured goods are constructed based on the SITC classification listed on Table A2. However, the SITC classification is not sufficiently

disaggregated to construct trade series according to the Broad Economic Categories (BEC) classification. To solve the problem, the BEC series available before 1988 and the disaggregate Harmonized System (HS) series since 1988 are utilized to construct the consolidated manufactured goods exports for the whole period between 1962-2015. According to Rauch (1999), all goods can be classified into three types: homogeneous, referenced-price and differentiated goods. The homogeneous goods are uniform and can be listed in the mercantile exchange. The referenced-price goods, although not listed on the good exchange markets, are standardized enough so that their prices are listed in the trade publications or trade websites. The differentiated goods are ones that are not suitable to be classified into the previous two categories. However, in practice, goods may not be able to be clearly classified into a single category. For these cases, Rauch (1999) proposes conservative and liberal classification. The conservative classification minimizes the number of homogenous and referenced-price goods by categorizing all the ambiguous goods as differentiated goods (see Table A3). By contrast, the liberal classification minimizes the number of differentiated goods by classifying them either into homogeneous or referenced-price goods (see Table A4).

As mentioned in section 3.2, trade barriers or multilateral trade reistantaces are proxied in this thesis by the distance between the two capital cities, common official language, common colonial heritage, continuity between two countries, and whether two countries join the same Regional Trade Agreements (RTAs). Apart from RTAs, all variables are available on the CEPII website (http://www.cepii.fr).

RTAs are considered as a factor to reduce the trade barriers because member countries of RTAs agree to cut or reduce tariffs or non-tariff barriers imposed on products

circulating among the member countries. Following Giordano et al. (2012), the RTA variable in this thesis is defined as agreements that require their members to remove or at least cut down 80% of the tariff lines. The RTA data from 1962 to 2006 is from the INTradeBID system. From 2007 to 2015, the data is added following Giordano et al. (2012) with updated RTAs available on the WTO website.

The last variable is DEV, indicating whether two countries are members of the OECD over the years of study. The list of OECD members and the years of participation for each member are available from the OECD website (http://www.oecd.org). The data set is merged with the other data sets using the mutual three-letter ISO country codes.

Data Description

The final data set contains 2,261,079 observations of 225 countries from 1962 to 2015. In order to see the different effects of the WTO on bilateral trade, I chose 10 different variables as the proxy for trade flows: total exports, exports of manufacturing, trade flows on textiles, exports of manufacturing less textiles, exports of homogeneous goods, referenced-price and differentiated goods according to conservative and liberal classifications, in which the regression using total trade flows as dependent variable will serve as the benchmark result. Also note that, although the data of Rauch classification are from 1970s, countries are not required to report their data for this classification until 1990. As mentioned in previous section about the superiority of using PPML to deal with zero-trade issue, I recoded all the missing observations to zeros. Figure 4.1provides information about distribution of country- pairs with and without trade. It can be easily seen that the active pairs dramatically increase over the year from less than 10% in 1996

to almost 45% in recent years. Together with the increase in number of active trading pairs, the total trade value has witnessed a remarkable jump over the past 50 years.

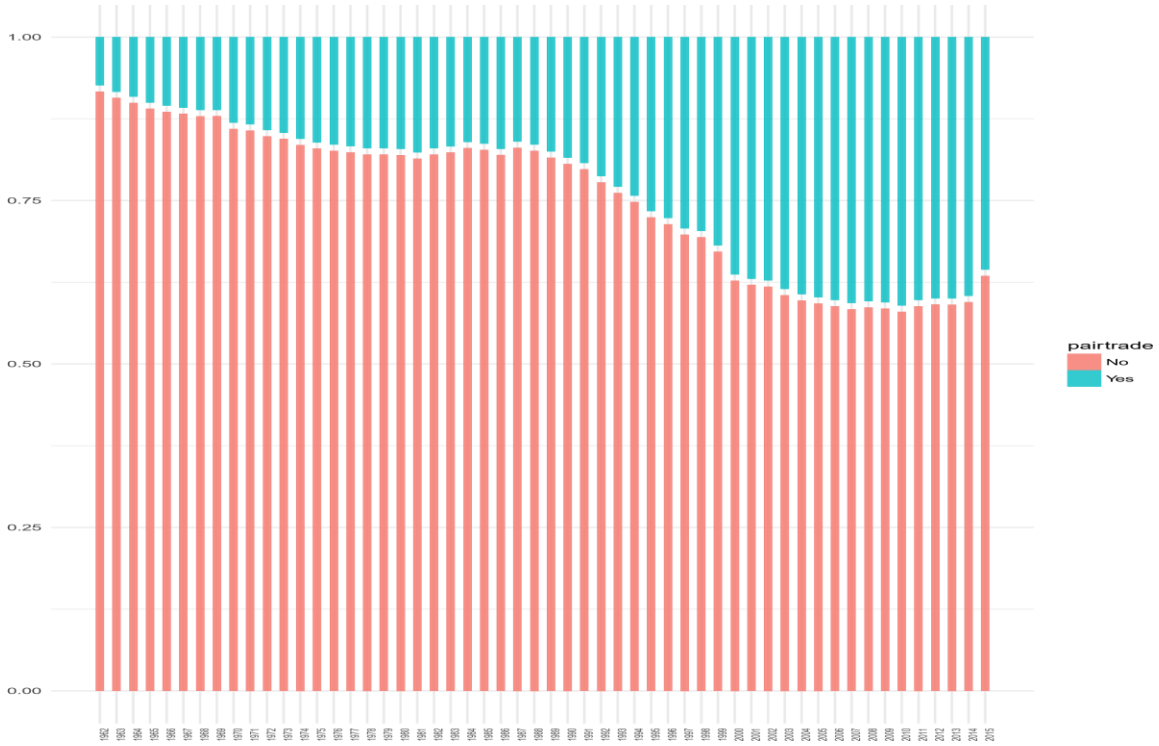

Figure 4.1. The distribution of country-pairs with trade and without trade over time.

Table 4.1 reflects the summary statistics for variables. Across the data set, the portion of zero trade data is high, ranging from 48% for total exports to 86% for trade flows of homogenous goods traded on an organized exchange. It is not surprising that the highest trade flow in the data set is the export from China to the US in 2015.

Although Tomz et al. (2007) emphasize the importance of GATT/WTO membership classification and the difference in the effects of GATT/WTO membership on the formal and informal WTO members, in this thesis I mainly focus on the formal GATT/WTO members.

Table 4.1. Summary Statistics

Variable	Obs	Mean	Std.Dev	Min	Max	Zero-obs	%Zero-obs
comtrade_total_export	2,261,079	108.535	2,191.283	0	398,692.80	1,083,072	0.48
comtrade_manuf_export	2,261,079	79.984	1,778.489	0	388,165.00	1,330,072	0.59
comtrade_export_textiles	2,261,079	5.790	141.467	0	47,195.69	1,658,895	0.73
Comtrade_manulesstextiles	2,261,079	75,115	1,678.487	0[1]	340,969.30	1,727,619	0.76
rausch_export_con_n	2,261,079	34.703	747.580	0	210,142.10	1,555,659	0.69
rausch_export_con_r	2,261,079	13.610	255.465	0	37,509.17	1,783,940	0.79
rausch_export_con_w	2,261,079	4.059	131.068	0	72,497.96	1,949,028	0.86
rausch_export_lib_n	2,261,079	32.656	704.119	0	203,275.80	1,562,707	0.69
rausch_export_lib_r	2,261,079	13.176	262.437	0	40,475.23	1,783,395	0.79
rausch_export_lib_w	2,261,079	6.541	165.635	0	75,685.27	1,893,849	0.84
dev	2,716,974	0.014	0.117	0	1		
gatt_d	2,716,974	0.478	0.500	0	1		
gatt_o	2,716,974	0.478	0.500	0	1		
wto	2,716,974	0.249	0.432	0	1		
rta	2,716,974	0.020	0.139	0	1		
wto_rta	2,716,974	.0148	.1210	0	1		5
wto_dev	2,716,974	.0137	.1162	0	1		
CE_contig	2,578,068	0.012	0.110	0	1		
CE_comlang_off	2,578,068	0.173	0.378	0	1		
CE_colony	2,578,068	0.010	0.098	0	1		
CE_dist	2,578,068	8.829	0.773	4.087	9.901		

Across the data set, 47.8 % of the observed observations are WTO members, and around 25% of the number of country pairs with both countries are WTO members. In addition, 1.37 percent of the sample are pairs with both WTO and OECD members, and 1.48 percent are pairs with both WTO and RTAs members. Other summary statistics in Table 4.1 are for the geographic distance, contiguity, common language and colonial heritage.

[1] The trade flows of manufacturing less textiles (Comtrade_manulesstextiles) is the difference between the trade flows of manufacturing and textiles. Clearly, the value of Comtrade_manulesstextiles is greater or equal to 0. However, when using the data set to calculate it, I get observations with negative trade value of manufacturing less textiles. One possibility is that for these observations, the value of export of textiles from reporter *i* to partner *j* is missing, and the UNComtrade system automatically replace the missing value with the import value from reporter *i* to partner *j*. Another possibility is that there are observations whose values of trade flows might be mistakenly imported. For these case, I replace the negative value with 0.

CHAPTER FIVE

Empirical Results

In this section, I will present the empirical study of the effects of WTO membership using reduced structural gravity model and PPML with country-pair fixed effect estimation on the data prepared in the previous section. This chapter includes two main parts. The first part is the benchmark result in which I investigate the effects of WTO membership over multiple years with the total trade flows as a dependent variable. The second part is followed with a robustness check in which I examine the effects of WTO membership on bilateral trade of different types of goods, and the effects of WTO membership after the formation of the WTO in 1995. In addition, for each dependent variable, I compare the regression results from PPML with and without country-pair fixed effect estimation.

Benchmark Results

In order to capture the changes of WTO membership effects on trade flows chronologically, I present the coefficients of the regressions in graphs. Figure 5.1 – 5.2 summarize the regression results of model (7) with total export as an independent variable with PPML country-pair and no-pair fixed effects respectively. To exhibit the statistical significance of coefficients, I color the dots of coefficients. The blue dots represent for coefficients statistically significant at less than or equal 10 percent level. Moreover, Table A.4 provides detailed regression information together with test statistics. From the specific coefficient (β) from the gravity regression, we can calculate

its effect of the corresponding variable on the trade flow, which is equal to the natural exponential of the coefficient minus one, i.e. $(e^{\beta} - 1)$. For instance, the coefficient of the WTO variable in the regression reaches a peak at 1.432 (statistically significant at 1%). It is interpreted as holding other things constant, a pair with both countries are WTO members increase their bilateral trade in 1986 by 318.7% ($e^{1.432} - 1 = 3.187$) compared to a pair with at least a non-WTO member. A general interpretation is that the dummy variables with significantly positive coefficients have positive effects on trade flows.

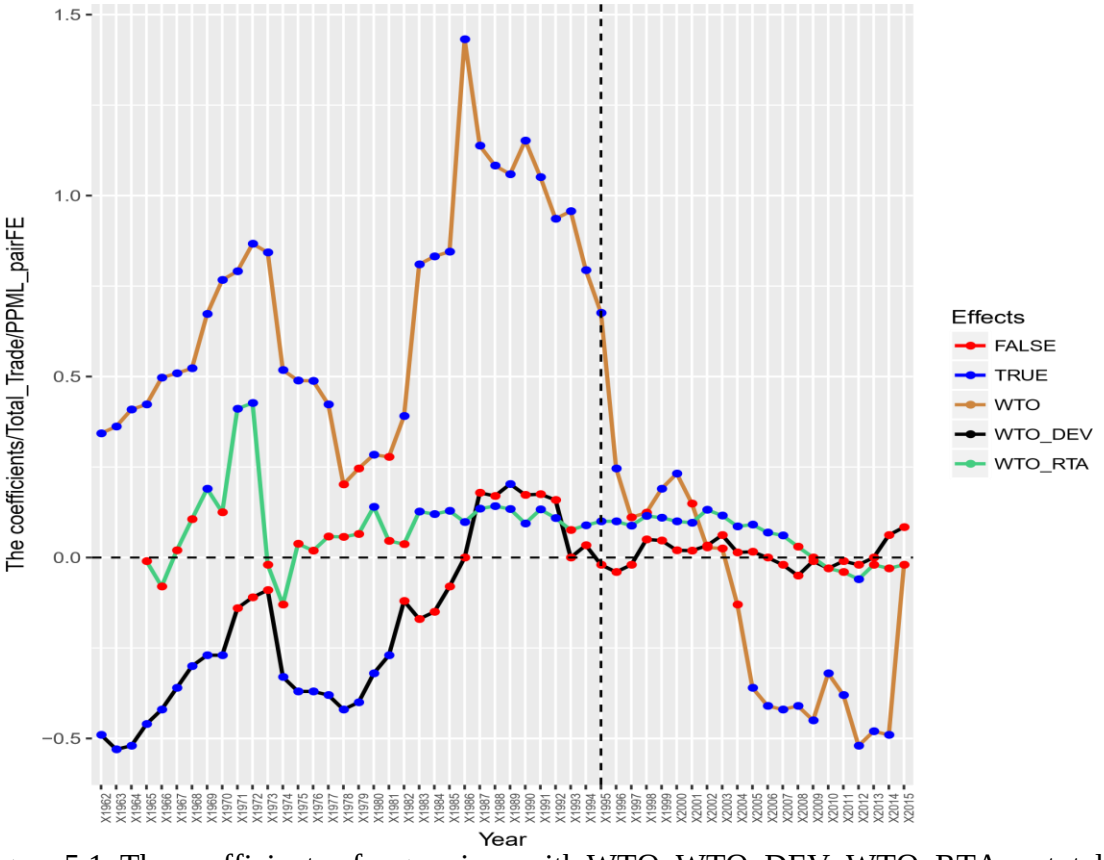

Figure 5.1. The coefficients of regressions with WTO, WTO_DEV, WTO_RTA on total exports (PPML with country-pair fixed effects)

Figure 5.1 reflects that the effects of WTO membership have changed over time, from significantly positive effects but gradually reduced in magnitude from 60s to 90s to negative effects in 2000s. Clearly, before 2001, GATT/WTO promotes bilateral trade among its members in term of total exports from reporter *i* to reporter *j*. Specifically, the effects gradually increase in the 10-year period between 1962-1972, then fall from 1972 to 1977, followed by a remarkable recovery in the next 7-year period. The GATT membership effect reaches a peak in 1986. From 2001 to 2005, the WTO seems not to have any statistically significant effect on trade, although the magnitude of coefficients declines sharply and crosses the threshold of zero. In the last 10 years, WTO membership causes negative effects on total export statistically significant at less than or equal 10 percent level, holding other things constant.

Regarding the effects of the WTO on bilateral trade between two industrialized countries, we expect significantly positive coefficients in the period before 1980s. In other words, the expectation is that the effect of WTO on bilateral trade of a developed country pair is higher than that of a developing country-pair. The expectation comes from the fact that developed countries more actively participated in the WTO in the first seven rounds of trade talk (Subramanian and Wei, 2007), whereas most of developing countries have joined the WTO later. However, the regression results contradict the expectation. In Figure 5.1, the coefficients of the interaction of the WTO_DEV are negative for years prior 1982, meaning that pairs of both WTO/GATT members and developed countries experienced a lower effect of the WTO/GATT on their bilateral trade than developing countries. Since 1982, the coefficients have increased and hovered around 0, although the

estimates are not significant. Moreover, a country-pair of both joining WTO and RTAs increased their bilateral trade compared to a pair of non-WTO and non-RTAs members.

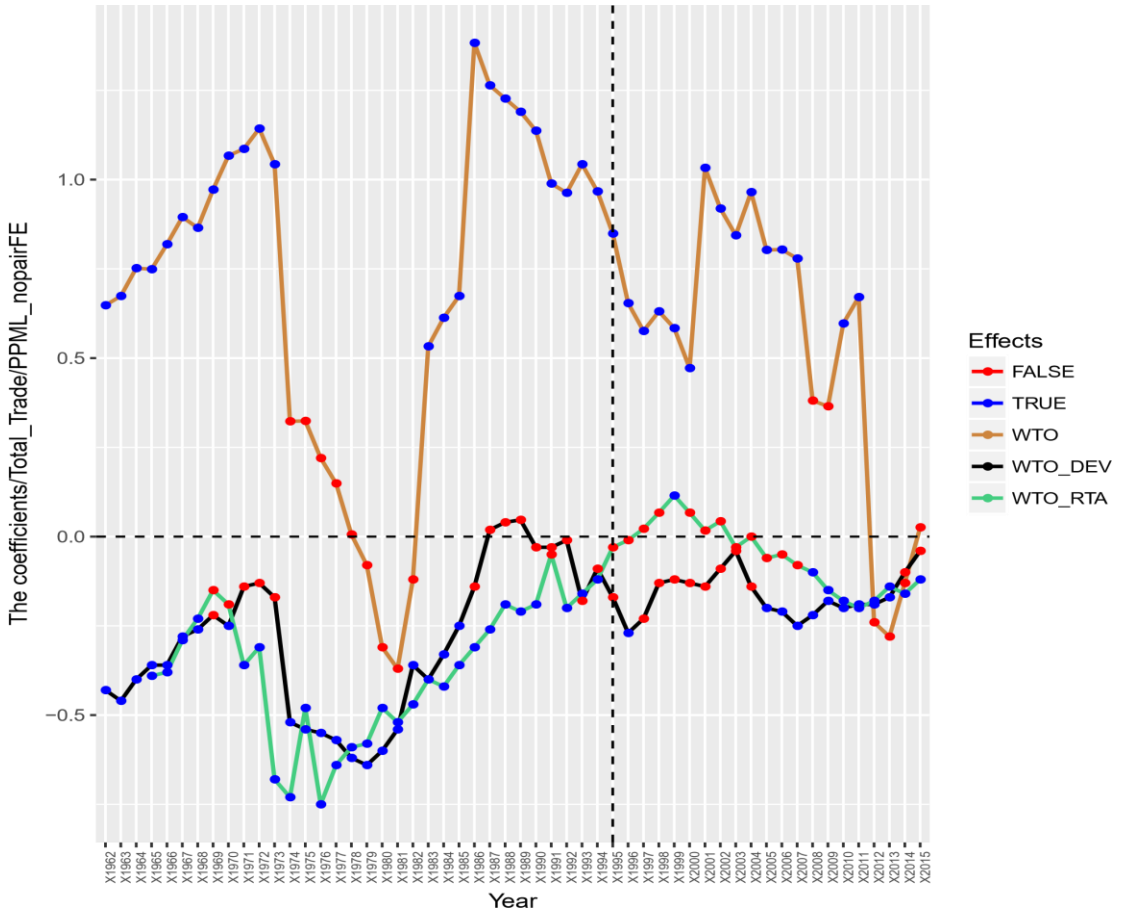

Figure 5.2. The coefficients of regressions with WTO, WTO_DEV, WTO_RTA on total exports (PPML with no-pair fixed effects)

As mentioned in the previous sections, the PPML with country-pair fixed effects has emerged as the preferred estimation technique. However, a problem might arise when we use the country-pair fixed effects. For countries, mostly developed countries, which have been the WTO membership before 1962, in the whole period the WTO status of those pairs does not change over time, it means that the WTO effect is the pair's time invariant and will be removed in the country-pair fixed effect estimation. Thus, the results might not capture the effect on those pairs. Additionally, the country-pair fixed

effects absorb all the bilateral time-invariant covariates (like distance) that are typically employed in gravity models. Moreover, the country-pair effects also account for any unobserved time-invariant trade cost components. In contrast, in models without country-pair fixed effects, the identification of the WTO coefficient will employ between and within country-pair variation. This means that trade flows of country-pairs that show now change in the WTO indicator will be used to calculate the WTO coefficients. Figure 5.2 provides the regression results of the same model specification estimated by PPML estimation with no-pair fixed effects. In comparison with the estimation with pair fixed effects, the results with no-pair fixed effect estimation are considerably different. It suggests that most of years between 1962-2015, on average a country pair of WTO members increased their trade flows compared to a pair of non-WTO members. Also, the effects of WTO membership on developed country pairs are somewhat hovering over the period with negative effects.

Robustness Checks

In this section, I will analyze the robustness of the benchmark findings regarding to different types of goods and with a time interval before and after the formation of WTO in 1995.

The Effects of WTO Membership on bilateral trade of Different Types of Goods

Technically, the WTO agreements mainly cover manufactured goods, thus, we expected the WTO has positive effects on bilateral trade on manufactured goods. Moreover, textiles were under special agreements (MFA- Multifiber Arrangement- from 1974-1994, and ATC-The Agreement on Textiles and Clothing- for 10-year transitional

program from 1995-2005) before integrating the sector fully to GATT rules of non-discrimination. Therefore, I also look at the data on manufactured less textile trade flows separately. Following Rauch's (1999) conservative and liberal classifications, goods are classified into homogenous, referenced-price, and differentiated goods which are quite close to manufactured goods. Thus, we examine the effect of the WTO on trade flows of differentiated goods. Figure 5.3-5.11 show the coefficients of the regressions on 9 different dependent variables. There are two charts in each figure: the chart above represents the results from the econometric model with country-pair fixed effects and the chart below without country-pair fixed effects.

In figure 5.3 and 5.4, the coefficients in the regressions with PPML country-pair fixed effects of manufactured goods and manufactured goods less textiles are close over time. The effects of WTO membership are positive on bilateral trade before mid-1990s, then has changed to negative after. In terms of the effect magnitude, they both reaches a peak in 1986, then followed a downward trend to 2015. In addition, the results do not show statistically significant effects of WTO on trade on manufactured (less textiles) among developed members or members who are also members of the same RTAs. In contrast, the results from regression without country-pair fixed effects prove that WTO membership has positive effect on trade over time, although the magnitude of the effects do not stay the same. For developed countries, it provides the same collusion that there is no significant effect on their bilateral trade on manufactured (or less textiles) goods. Also, the result suggests that being WTO members and joining the same RTAs do not help countries trade more.

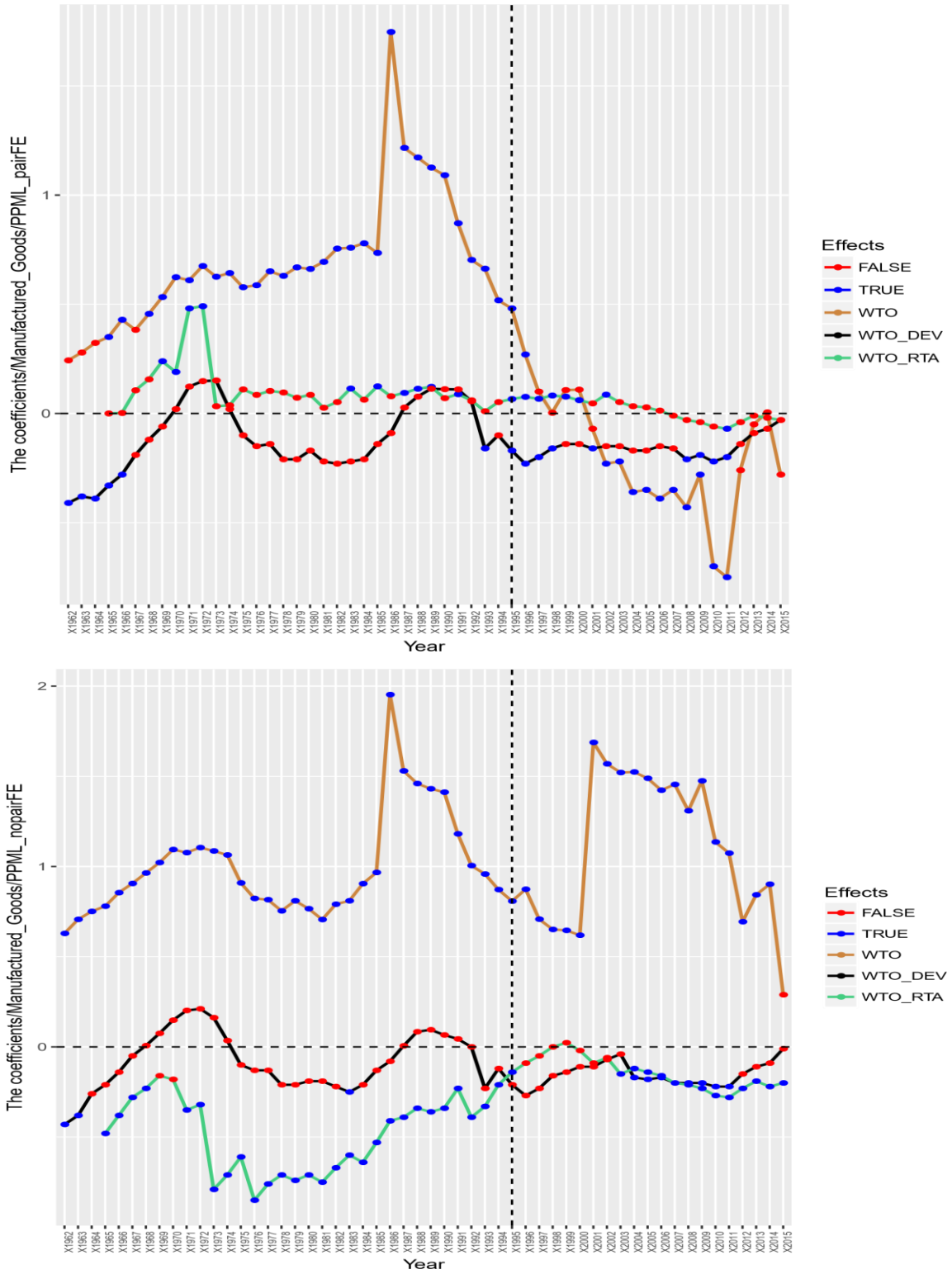

Figure 5.3. The coefficients of WTO, WTO_DEV, WTO_RTA on exports of manufactured goods (PPML estimation with country-pair (above) and no-pair (below) fixed effects)

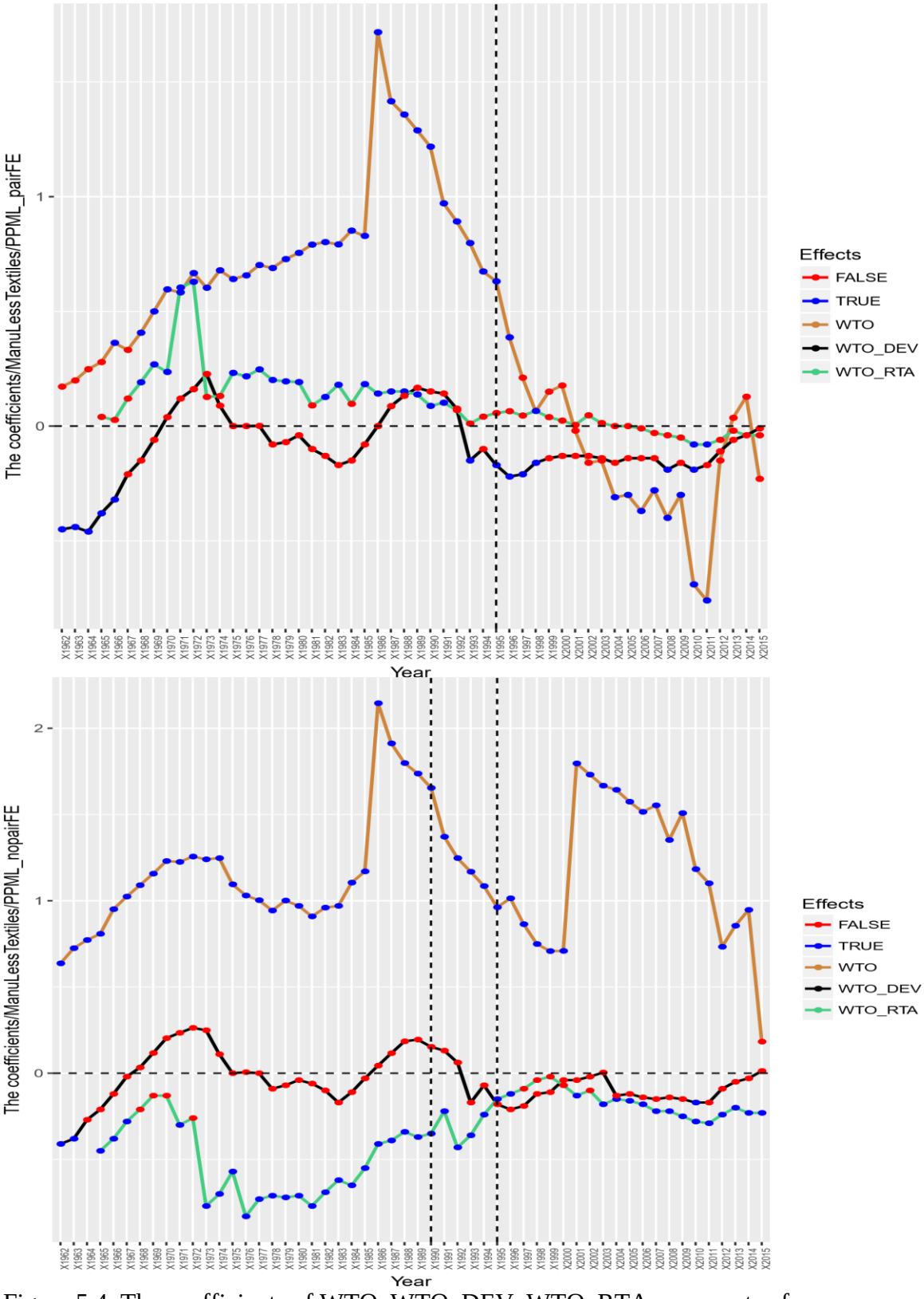

Figure 5.4. The coefficients of WTO, WTO_DEV, WTO_RTA on exports of manufactured goods less textiles (PPML estimation with country-pair (above) and no-pair (below) fixed effects)

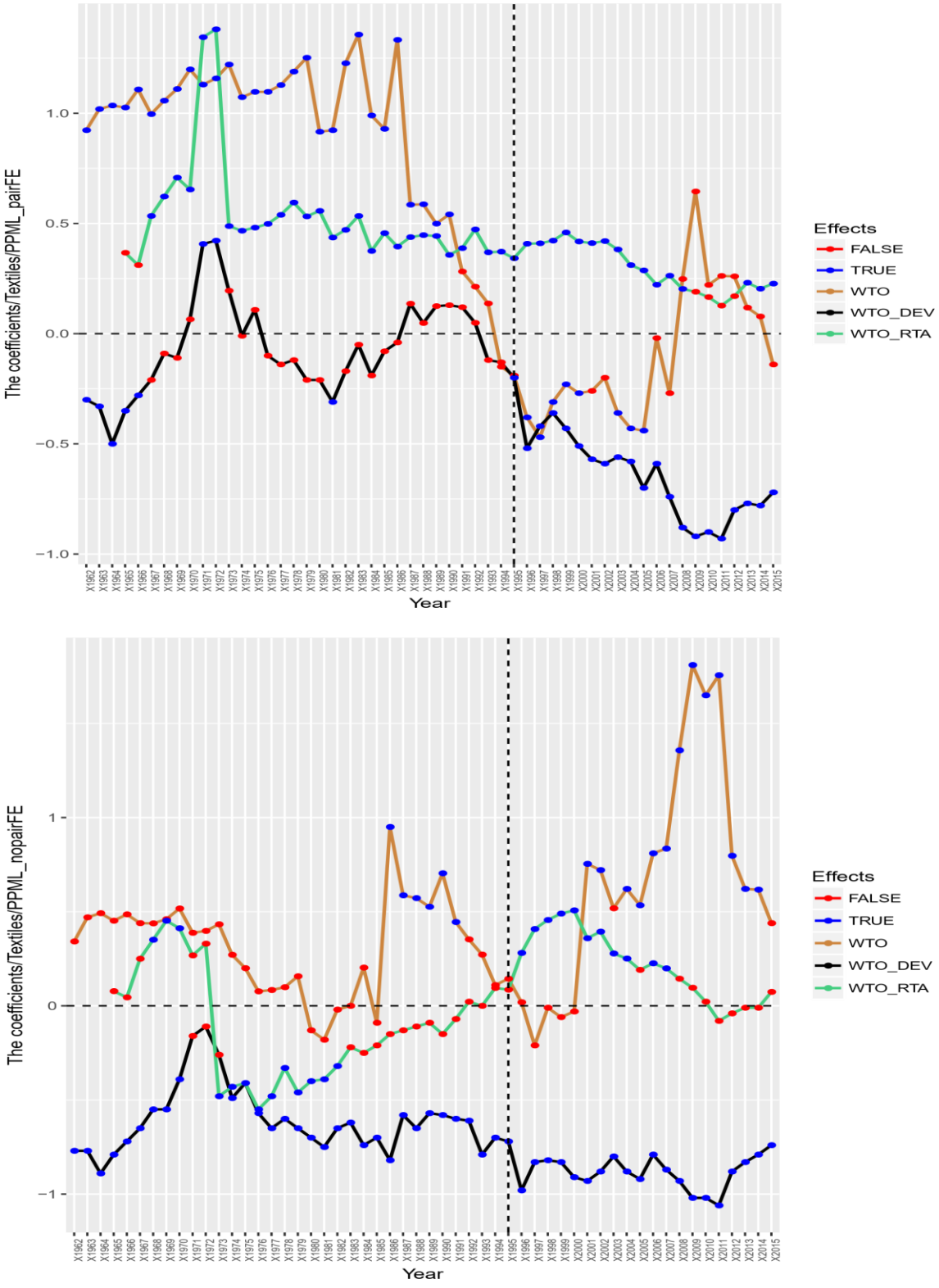

Figure 5.5. The coefficients of WTO, WTO_DEV, WTO_RTA on bilateral trade of textiles (PPML estimation with country-pair (above) and no-pair (below) fixed effects)

Figure 5.5 reveals the effects of WTO membership on bilateral trade on textiles. The regressions with and without country-pair fixed effects provide the opposed results. GATT has significantly positive effects most of the years before 1990, and no significant or negative effect on in econometric model with country-pair fixed effects. Whereas, in model without country-pair effects, the WTO positively impacts on bilateral trade on textiles. Trade on textiles among developed countries was significantly negatively influenced by WTO after 1995 in the models with pair fixed effects.

Figure 5.6 gives us an overview of effects of WTO membership on bilateral trade of different types of goods according to Rauch conservative versus liberal classification (PPML country-pair fixed effects). Overall, despite the difference when classifying the ambiguous goods according to a conservative or liberal point of view, it does not affect the regression results much in both signs and magnitude of the coefficients.

Figure 5.7-5.11 exhibit the regression results for those different types of goods in both econometric models with and without country-pair effects. As mentioned in the data description section, the Rauch classification data are sufficient after 1990s. I mainly focus on the coefficients after 1990 for empirical result interpretation.

Because of the difference between the estimation with and without country-pair fixed effects, the regression results from the two models are significantly different after 1995. Figure 5.12 shows that in model with country-pair fixed effects, the coefficients of WTO over year after 1995 have decreased and cross the threshold of 0, in which most of them are insignificant. It can be interpreted that WTO has negative or no effects on bilateral trade of differentiated goods after 1995. In contrast, the model without country-

pair fixed effects results in significantly positive coefficients on WTO, meaning that WTO has positive effects on bilateral trade of differentiated goods.

The Effects of WTO Membership on Bilateral Trade After the Formation of the WTO

Table 5.1 and 5.3 display the regression results of models (8) with and without country-pair fixed effects respectively. The coefficients of WTO after 1995 in models with country-pair fixed effects are negative across all dependent variables, most of them are statistically significant. Conversely, on average the coefficients in models without country-pair fixed effects are significantly positive across all dependent variables.

Table 5.2 (model estimation with country-pair effects) and Table 5.4 (without country-pair effects) show the effects of GATT/WTO membership on developed countries by incorporating a dummy variable showing a pair of developed WTO members in the model (8). The results from both tables show that on average pairs of developed members trade less than others after 1995.

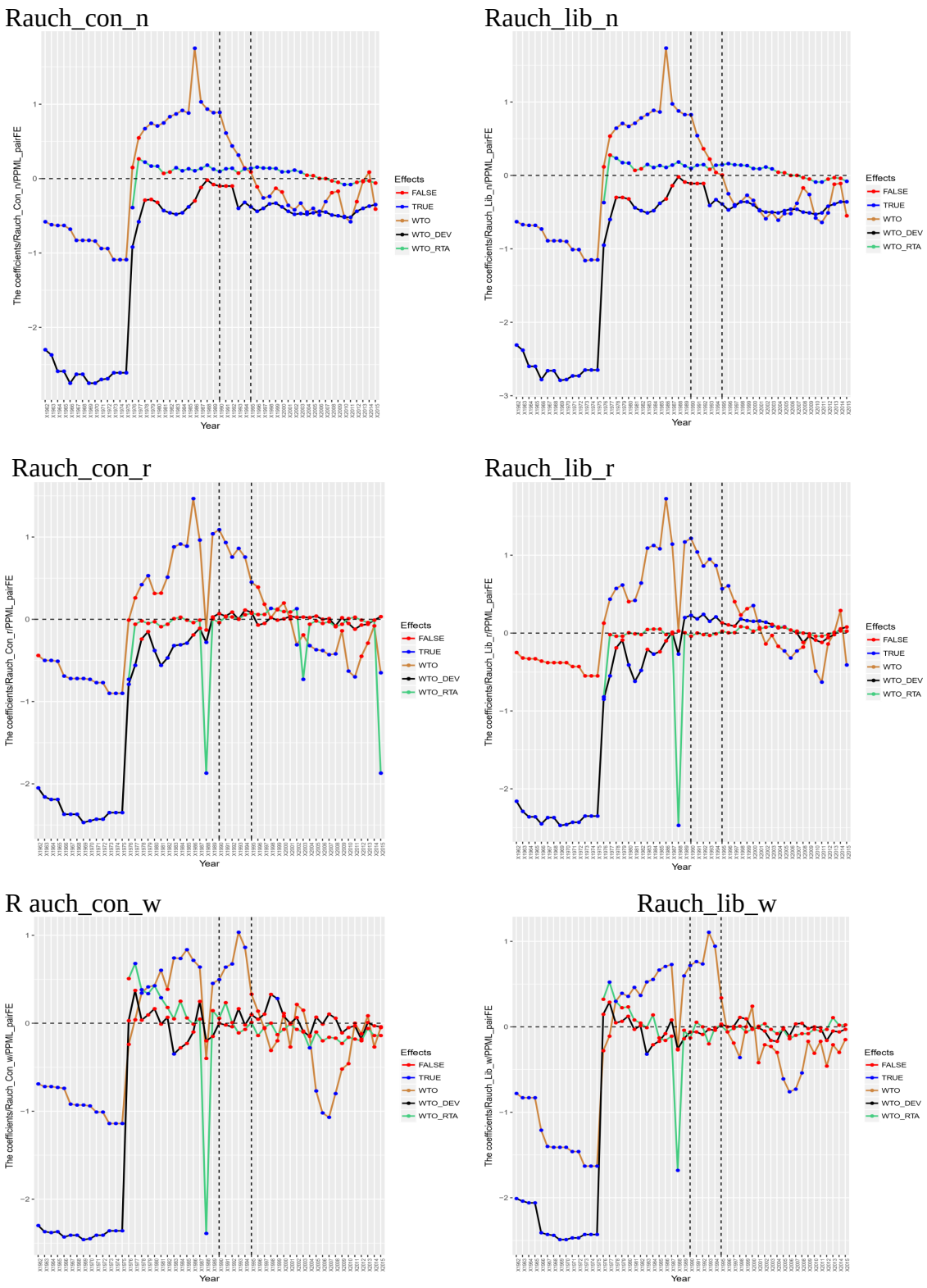

Figure 5.6 The comparison of effects of WTO membership on bilateral trade of different types of goods according to Rauch conservative versus liberal classification (PPML country-pair fixed effects)

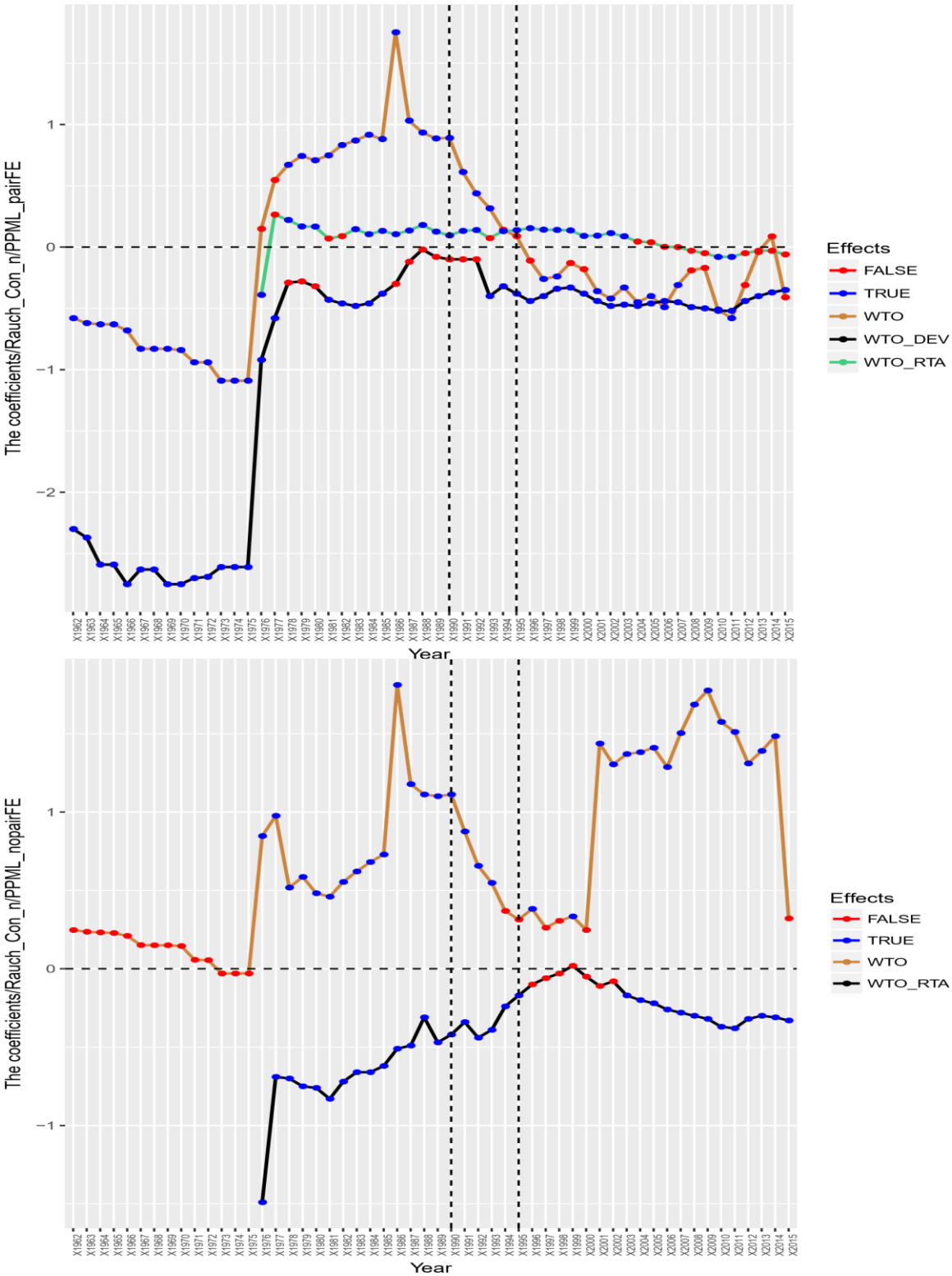

Figure 5.7. The coefficients of WTO, WTO_DEV, WTO_RTA on bilateral trade of differentiated goods, Rauch conservative classification (PPML with country-pair (above) and no-pair (below) fixed effects).

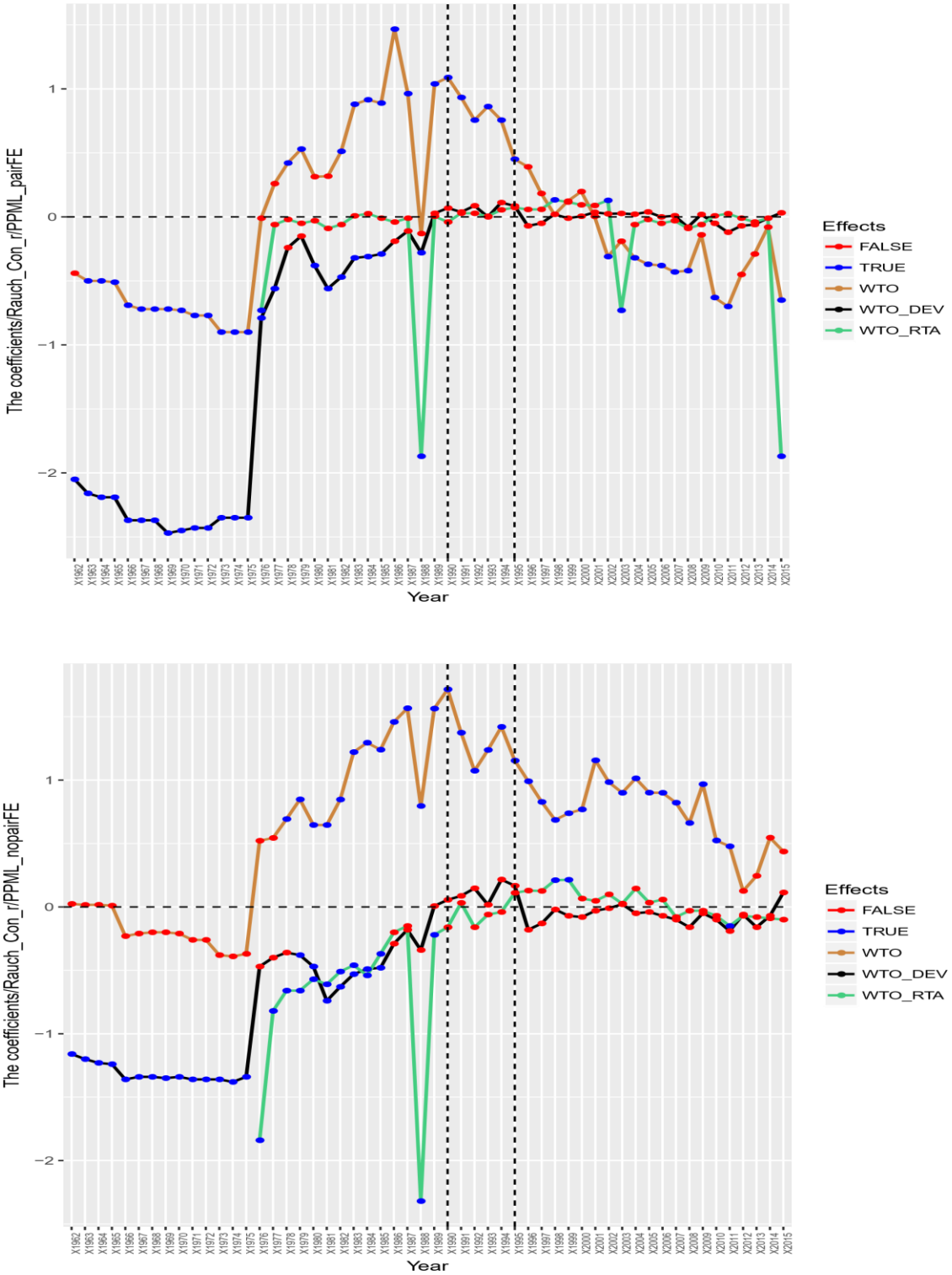

Figure 5.8. The coefficients of WTO, WTO_DEV, WTO_RTA on bilateral trade of referenced-price goods, Rauch conservative classification (PPML with country-pair (above) and no-pair (below) fixed effects)

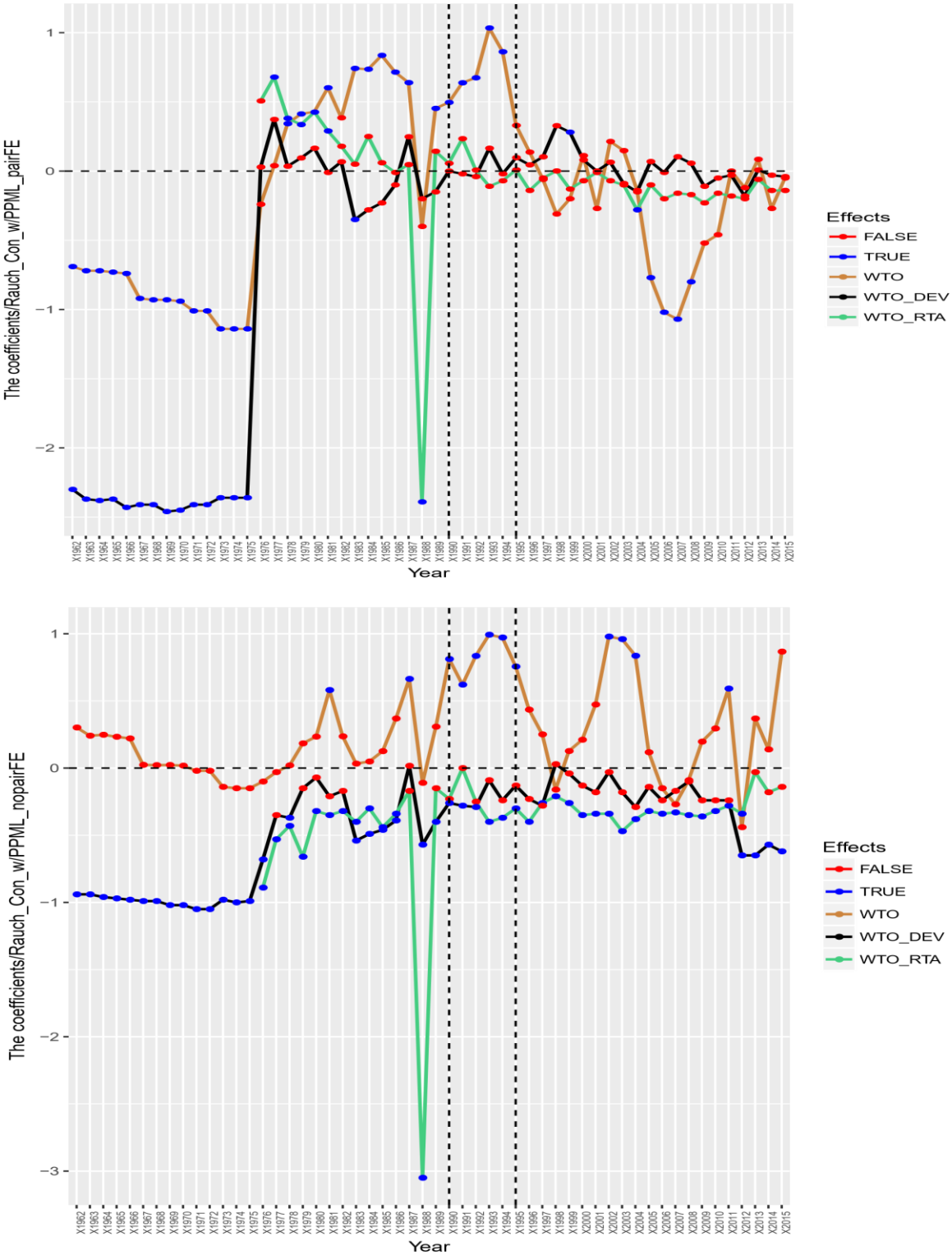

Figure 5.9. The coefficients of WTO, WTO_DEV, WTO_RTA on bilateral trade of homogeneous goods, Rauch conservative classification (PPML with country-pair (above) and no-pair (below) fixed effects)

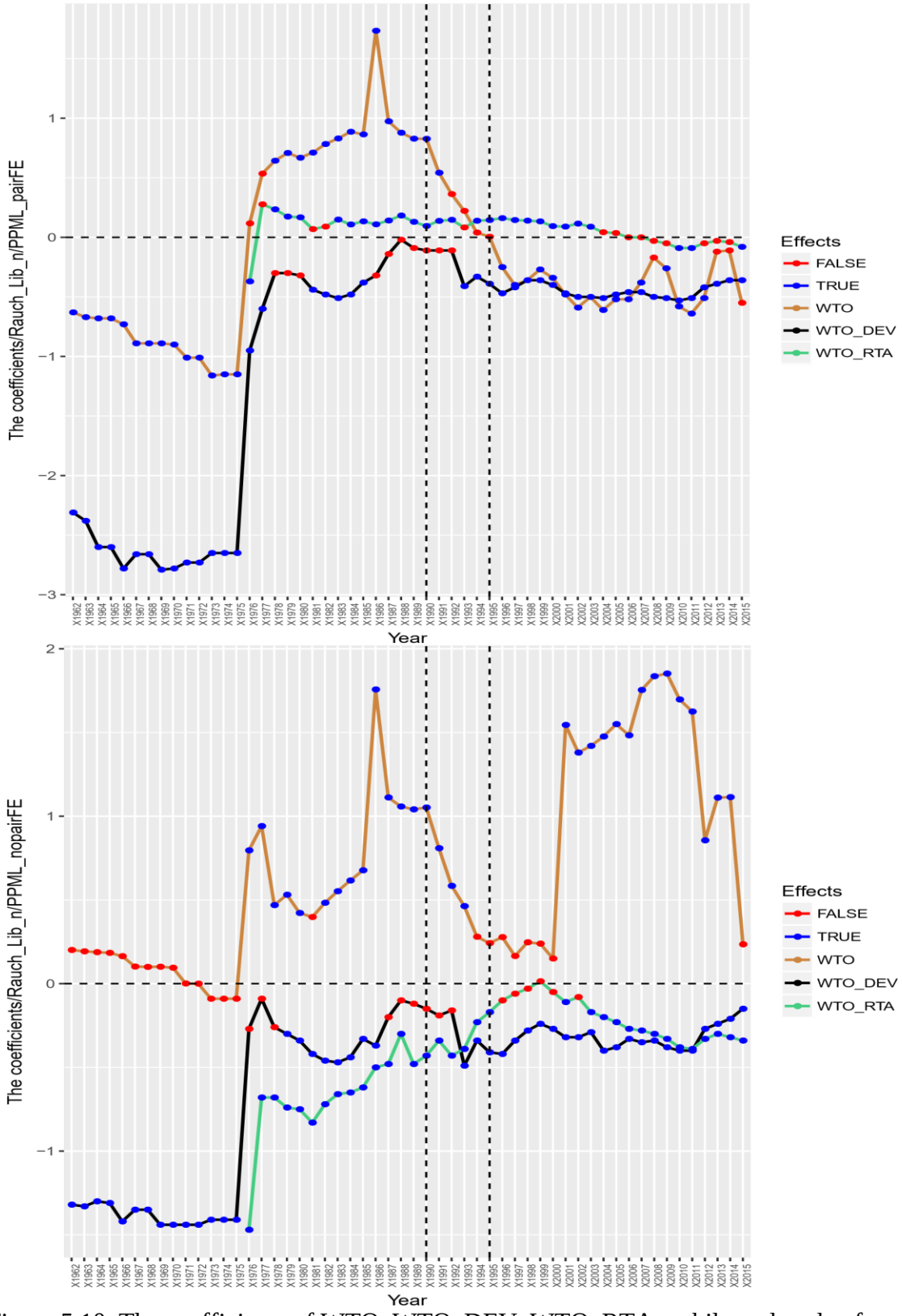

Figure 5.10. The coefficients of WTO, WTO_DEV, WTO_RTA on bilateral trade of differentiated goods, Rauch liberal classification (PPML with country-pair (above) and no-pair (below) fixed effects)

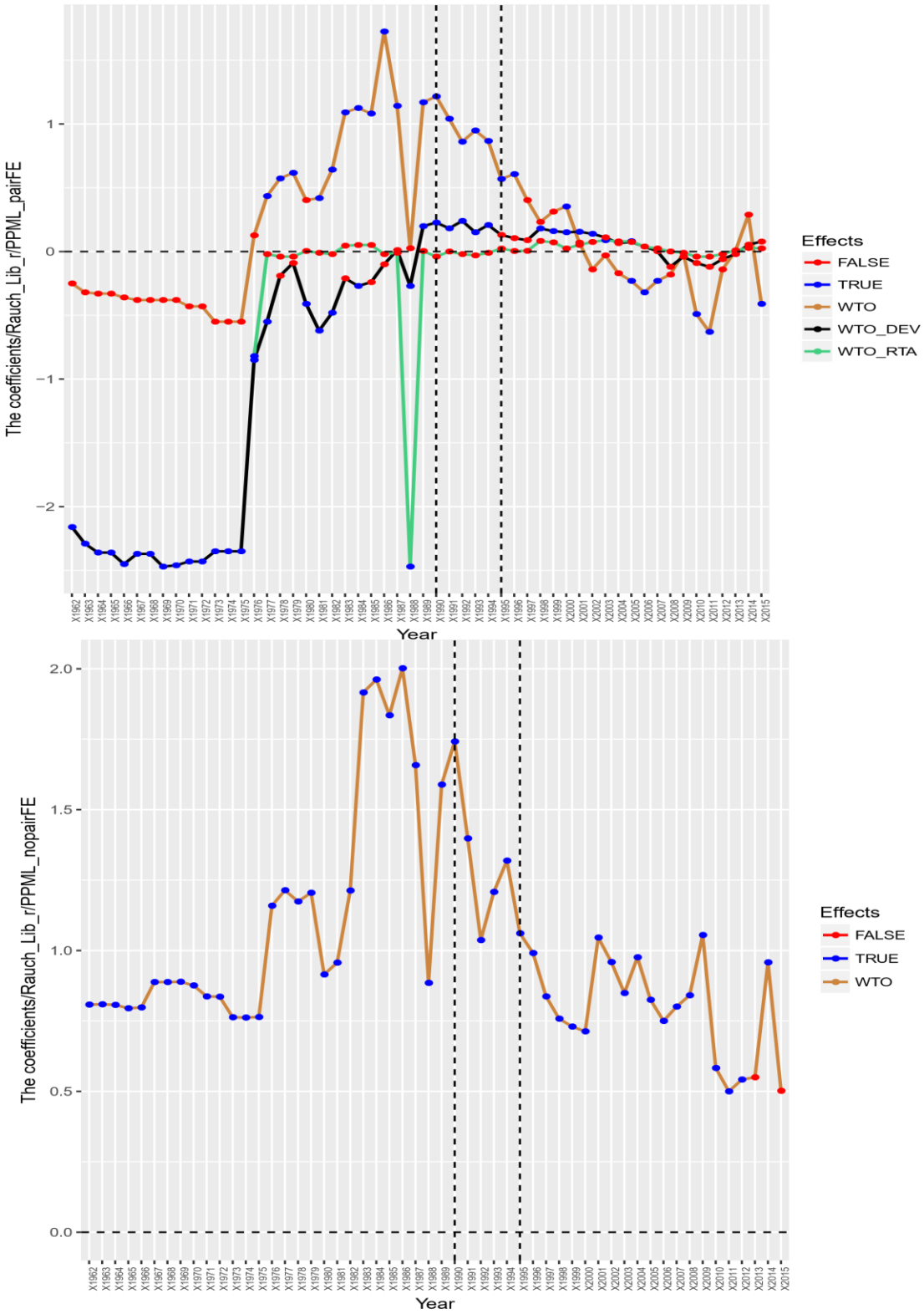

Figure 5.11. The coefficients of WTO, WTO_DEV, WTO_RTA on bilateral trade of referenced-price goods, Rauch liberal classification (PPML with country-pair (above) and no-pair (below) fixed effects)

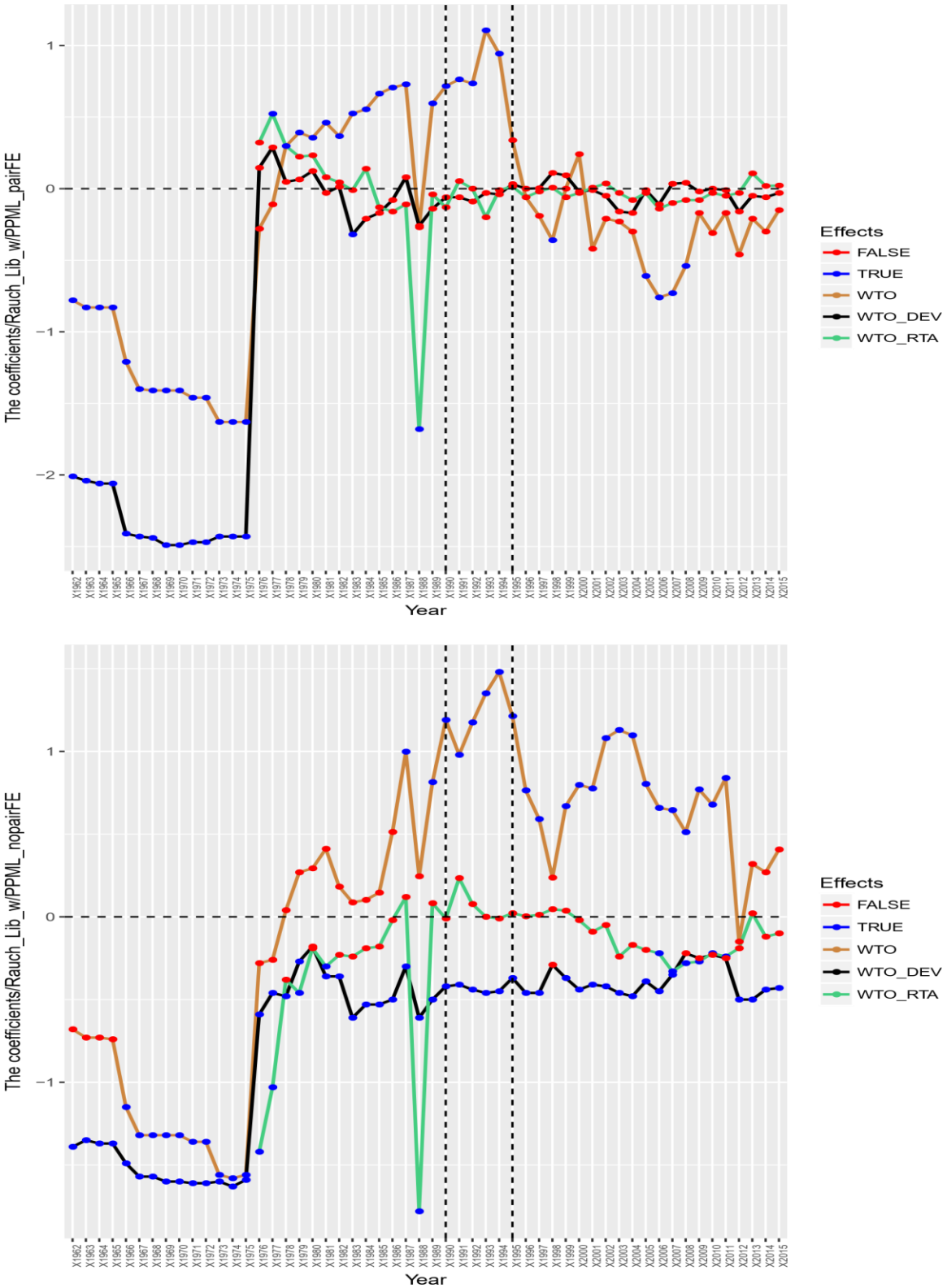

Figure 5.12. The coefficients of WTO, WTO_DEV, WTO_RTA on bilateral trade of homogeneous goods, Rauch liberal classification (PPML with country-pair (above) and no-pair (below) fixed effects)

Table 5.1. WTO membership effects on trade flows in the period 1995-2015
(PPML country- pair fixed effects)

Variables	Total Export	Manu_ goods	Manu_Less Textiles	Textiles	Rauch_con _n	Rauch_con _r	Rauch_con_w	Rauch_lib_n	Rauch_lib_r	Rauch_lib_w
rta	0.007	-0.009	0.002	0.095**	-0.028	0.009	0.072	-0.026	0.019	0.027
	(0.027)	(0.028)	(0.025)	(0.044)	(0.032)	(0.031)	(0.051)	(0.032)	(0.025)	(0.048)
wto95_15	-0.239***	-0.261***	-0.233***	-0.372***	-0.322***	-0.219**	-0.323	-0.421***	-0.083	-0.319**
	(0.057)	(0.077)	(0.084)	(0.101)	(0.077)	(0.109)	(0.212)	(0.066)	(0.131)	(0.149)
Obs	1,705,014	1,575,552		1,243,114	1,506,163	1,225,271	944,212	1,500,887	1,219,761	1,076,428
R-squared	0.992	0.994		0.979	0.990	0.981	0.940	0.990	0.988	0.932

Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 5.2. WTO membership on bilateral trade flows in the period 1995-2015 between two developed countries
(PPML country-pair fixed effects)

Variables	Total Export	Manu_ goods	Manu_Less _Textiles	Textiles	Rauch_con _n	Rauch_con _r	Rauch_con_w	Rauch_lib_n	Rauch_lib_r	Rauch_lib_w
rta	0.011	-0.003	0.008	0.123***	-0.019	0.010	0.072	-0.018	0.021	0.028
	(0.025)	(0.026)	(0.024)	(0.041)	(0.029)	(0.030)	(0.051)	(0.029)	(0.024)	(0.047)
wto_95_15	-0.223***	-0.238***	-0.210**	-0.295***	-0.301***	-0.217**	-0.323	-0.401***	-0.077	-0.318**
	(0.055)	(0.077)	(0.083)	(0.097)	(0.076)	(0.108)	(0.211)	(0.065)	(0.131)	(0.149)
wto_dev_95_15	-0.106	-0.233***	-0.238***	-0.739***	-0.324***	-0.031	-0.002	-0.316***	-0.083	-0.017
	(0.065)	(0.078)	(0.075)	(0.116)	(0.085)	(0.073)	(0.085)	(0.087)	(0.072)	(0.062)
Obs	1,705,014	1,575,552	1,132,391	1,243,114	1,506,163	1,225,271	944,212	1,500,887	1,219,761	1,076,428
R-squared	0.992	0.994	0.995	0.981	0.990	0.982	0.940	0.990	0.988	0.932

Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 5.3. WTO membership effects on trade flows in the period 1995-2015
(PPML no-pair fixed effects)

Variables	Total Export	Manu_ goods	Manu_Less_ Textiles	Textiles	Rauch_con _n	Rauch_con _r	Rauch_con_ w	Rauch_lib_n	Rauch_lib_r	Rauch_lib_ w
CE_contig	0.537***	0.500***	0.506***	0.542***	0.485***	0.390***	0.725***	0.482***	0.473***	0.521***
	(0.018)	(0.018)	(0.019)	(0.021)	(0.018)	(0.024)	(0.041)	(0.018)	(0.021)	(0.041)
CE_comlan g_off	0.199***	0.270***	0.269***	0.451***	0.306***	0.171***	-0.079*	0.308***	0.225***	0.006
	(0.017)	(0.016)	(0.017)	(0.023)	(0.018)	(0.024)	(0.047)	(0.018)	(0.021)	(0.039)
CE_colony	0.297***	0.216***	0.205***	0.370***	0.353***	0.421***	0.737***	0.362***	0.254***	0.794***
	(0.019)	(0.019)	(0.019)	(0.028)	(0.020)	(0.025)	(0.048)	(0.020)	(0.024)	(0.039)
CE_dist	-0.650***	-0.644***	-0.639***	-0.692***	-0.641***	-0.721***	-0.715***	-0.630***	-0.791***	-0.593***
	(0.006)	(0.007)	(0.007)	(0.010)	(0.007)	(0.009)	(0.019)	(0.007)	(0.009)	(0.017)
rta	0.437***	0.478***	0.489***	0.567***	0.381***	0.550***	0.489***	0.385***	0.538***	0.537***
	(0.015)	(0.015)	(0.016)	(0.022)	(0.014)	(0.021)	(0.048)	(0.015)	(0.020)	(0.036)
wto95_15	0.632***	1.105***	1.210***	0.374***	0.971***	0.791***	0.290***	0.954***	0.800***	0.716***
	(0.052)	(0.054)	(0.057)	(0.070)	(0.065)	(0.050)	(0.090)	(0.070)	(0.051)	(0.066)
Obs	2,306,016	2,024,355	1,902,193	1,961,846	1,940,002	1,889,396	1,751,813	1,939,657	1,873,216	1,844,986
R-squared	0.880	0.901	0.902	0.880	0.895	0.790	0.657	0.894	0.832	0.641

Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 5.4. WTO membership effects on bilateral trade flows in the period 1995-2015 between two developed countries (PPML no-pair fixed effects)

Variables	Total Export	Manu_ goods	Manu_Les s_Textiles	Textiles	Rauch_con _n	Rauch_con _r	Rauch_con_w	Rauch_lib_n	Rauch_lib_r	Rauch_lib_w
CE_contig	0.553***	0.515***	0.516***	0.636***	0.515***	0.397***	0.749***	0.512***	0.472***	0.550***
	(0.018)	(0.018)	(0.019)	(0.021)	(0.018)	(0.025)	(0.042)	(0.018)	(0.021)	(0.042)
CE_comlang_off	0.199***	0.270***	0.269***	0.435***	0.305***	0.170***	-0.084*	0.308***	0.225***	-0.003
	(0.017)	(0.016)	(0.017)	(0.022)	(0.017)	(0.024)	(0.046)	(0.017)	(0.021)	(0.039)
CE_colony	0.307***	0.225***	0.211***	0.390***	0.371***	0.426***	0.743***	0.380***	0.253***	0.801***
	(0.018)	(0.019)	(0.019)	(0.024)	(0.019)	(0.024)	(0.048)	(0.020)	(0.024)	(0.039)
CE_dist	-0.652***	-0.646***	-0.640***	-0.698***	-0.643***	-0.723***	-0.734***	-0.633***	-0.791***	-0.613***
	(0.007)	(0.007)	(0.007)	(0.009)	(0.007)	(0.009)	(0.018)	(0.007)	(0.009)	(0.016)
rta	0.456***	0.496***	0.501***	0.685***	0.416***	0.557***	0.514***	0.421***	0.537***	0.559***
	(0.015)	(0.015)	(0.016)	(0.021)	(0.015)	(0.022)	(0.048)	(0.015)	(0.021)	(0.035)
wto_95_15	0.691***	1.166***	1.252***	0.654***	1.094***	0.819***	0.390***	1.084***	0.797***	0.817***
	(0.053)	(0.056)	(0.059)	(0.069)	(0.065)	(0.052)	(0.093)	(0.070)	(0.053)	(0.068)
wto_dev_95_15	-0.170***	-0.159***	-0.110***	-0.874***	-0.309***	-0.080**	-0.365***	-0.318***	0.008	-0.379***
	(0.024)	(0.025)	(0.026)	(0.031)	(0.024)	(0.034)	(0.065)	(0.024)	(0.033)	(0.050)
Obs	2,306,016	2,024,355	1,902,193	1,961,846	1,940,002	1,889,396	1,751,813	1,939,657	1,873,216	1,844,986
R-squared	0.880	0.902	0.902	0.882	0.900	0.790	0.658	0.900	0.832	0.642

Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.

CHAPTER SIX

Conclusion

The world trade has seen a spectacular increase in the last 50 years. It is reasonable for the GATT/WTO to take credit because during the time, GATT/WTO has increased its membership and helped its members reduce their trade barriers and stimulate trade liberalization. A typical example is a considerable reduction of tariff for industrial products form 40% to less than 4%. However, empirical studies have shown the mixed results. Together with the development of the gravity model which is widely employed for international trade, and the econometric model, the researchers have been trying to gauge the more precise effects of the WTO on bilateral trade.

This thesis aims to answer the question how the effect of WTO has changed over time. I used the most sufficient data set covering bilateral trade flows of 225 countries from 1962 to 2015. I also look at the different econometric specifications. Specifically, in order to see the effects of WTO membership changing over time, I estimate the effects year-by-year under the presence of the regional trade agreements that were carefully classified following Giordano et al. (2012). In addition, the effects of the WTO on trade are examined in the context of different types of goods classification: total exports, exports of manufactured goods, exports of manufactured less textiles goods, exports of homogenous, referenced-prices, and differentiated goods following Rauch classification. The econometric estimation model used is the PPML estimator with and without country-pair effects. Because PPML with pair effects absorb all the observable and unobservable

time-invariant variables between two countries, it excludes the observations of country pairs with the WTO membership status unchanged over the period. In contrast, the PPML without country-pair fixed effects use both between and within country pair variation for coefficient estimation. Thus, I present the results in both estimations.

I find that overall, the effect of the WTO has changed over the WTO/GATT period. The results are different across the estimation method. The PPML estimation with country-pair fixed effects states that the WTO has statistically significant positive effects on total bilateral trade before 2001 but has statistically significant negative effects or statistically insignificant effects on bilateral trade in the later period. The results from the PPML estimation without country-pair fixed effects show that WTO membership has large trade promoting effects, although the magnitude of the effect has changed over time. Secondly, the effects of WTO membership on different types of goods mostly follow the same patterns. Lastly, over most of years in the WTO period, trade among developed countries less than trade among other pairs.

APPENDIX

Tables

Table A1

List of Countries

Iso3	Country	Iso3	Country	Iso3	Country	Iso3	Country	Iso3	Country
ABW	Aruba	CPV	Cape Verde	HRV	Croatia	MOZ	Mozambique	SLE	Sierra Leone
AFG	Afghanistan	CRI	Costa Rica	HTI	Haiti	MRT	Mauritania	SLV	El Salvador
AGO	Angola	CSK	Czechoslovakia	HUN	Hungary	MSR	Montserrat	SMR	San Marino
AIA	Anguila	CUB	Cuba	IDN	Indonesia	MTQ	Martinique	SOM	Somalia
ALB	Albania	CXR	Christmas Island	IND	India	MUS	Mauritius	SPM	Saint Pierre and Miquelon
AND	Andorra	CYM	Cayman Islands	IRL	Ireland	MWI	Malawi	STP	Sao Tome and Principe
ANT	Netherlands Antilles	CYP	Cyprus	IRN	Iran, Islamic Rep.	MYS	Malaysia	SUR	Suriname
ARE	United Arab Emirates	CZE	Czech Republic	IRQ	Iraq	NAM	Namibia	SVK	Slovak Republic
ARG	Argentina	DEU	Germany	ISL	Iceland	NCL	New Caledonia	SVN	Slovenia
ARM	Armenia	DJI	Djibouti	ISR	Israel	NER	Niger	SWE	Sweden
ATG	Antigua and Barbuda	DMA	Dominica	ITA	Italy	NFK	Norfolk Island	SWZ	Swaziland
AUS	Australia	DNK	Denmark	JAM	Jamaica	NGA	Nigeria	SYC	Seychelles
AUT	Austria	DOM	Dominican Republic	JOR	Jordan	NIC	Nicaragua	SYR	Syrian Arab Republic
AZE	Azerbaijan	DZA	Algeria	JPN	Japan	NIU	Niue	TCA	Turks and Caicos Isl.
BDI	Burundi	ECU	Ecuador	KAZ	Kazakhstan	NLD	Netherlands	TCD	Chad
BEL	Belgium	EGY	Egypt, Arab Rep.	KEN	Kenya	NOR	Norway	TGO	Togo
BEN	Benin	ERI	Eritrea	KGZ	Kyrgyz Republic	NPL	Nepal	THA	Thailand
BFA	Burkina Faso	ESH	Western Sahara	KHM	Cambodia	NRU	Nauru	TJK	Tajikistan
BGD	Bangladesh	ESP	Spain	KIR	Kiribati	NZL	New Zealand	TKL	Tokelau
BGR	Bulgaria	EST	Estonia	KNA	St. Kitts and Nevis	OMN	Oman	TKM	Turkmenistan
BHR	Bahrain	ETH	Ethiopia (excludes Eritrea)	KOR	Korea, Rep.	PAK	Pakistan	TMP	East Timor
BHS	Bahamas, The	FIN	Finland	KWT	Kuwait	PAN	Panama	TON	Tonga
BIH	Bosnia and Herzegovina	FJI	Fiji	LAO	Lao PDR	PCN	Pitcairn	TTO	Trinidad and Tobago

Iso3	Country	Iso3	Country	Iso3	Country	Iso3	Country	Iso3	Country
BLR	Belarus	FLK	Falkland Island	LBN	Lebanon	PER	Peru	TUN	Tunisia
BLZ	Belize	FRA	France	LBR	Liberia	PHL	Philippines	TUR	Turkey
BMU	Bermuda	FRO	Faeroe Islands	LBY	Libya	PLW	Palau	TUV	Tuvalu
BOL	Bolivia	FSM	Micronesia, Fed. Sts.	LCA	St. Lucia	PNG	Papua New Guinea	TWN	Taiwan
BRA	Brazil	GAB	Gabon	LKA	Sri Lanka	POL	Poland	TZA	Tanzania
BRB	Barbados	GBR	United Kingdom	LSO	Lesotho	PRI	Puerto Rico	UGA	Uganda
BRN	Brunei	GEO	Georgia	LTU	Lithuania	PRK	Korea, Dem. Rep.	UKR	Ukraine
BTN	Bhutan	GHA	Ghana	LUX	Luxembourg	PRT	Portugal	URY	Uruguay
BWA	Botswana	GIB	Gibraltar	LVA	Latvia	PRY	Paraguay	USA	United States
CAF	Central African Republic	GIN	Guinea	MAC	Macao	PSE	Palestinian Territory	UZB	Uzbekistan
CAN	Canada	GLP	Guadeloupe	MAR	Morocco	PYF	French Polynesia	VCT	St. Vincent and the Grenadines
CCK	Cocos (Keeling) Islands	GMB	Gambia, The	MDA	Moldova	QAT	Qatar	VEN	Venezuela
CHE	Switzerland	GNB	Guinea-Bissau	MDG	Madagascar	REU	Reunion	VGB	British Virgin Islands
CHL	Chile	GNQ	Equatorial Guinea	MDV	Maldives	ROM	Romania	VNM	Vietnam
CHN	China	GRC	Greece	MEX	Mexico	RUS	Russian Federation	VUT	Vanuatu
CIV	Cote d'Ivoire	GRD	Grenada	MHL	Marshall Islands	RWA	Rwanda	WLF	Wallis and Futura Isl.
CMR	Cameroon	GRL	Greenland	MKD	Macedonia, FYR	SAU	Saudi Arabia	WSM	Samoa
COD	Congo, Dem. Rep.	GTM	Guatemala	MLI	Mali	SDN	Sudan	YEM	Yemen, Rep.
COG	Congo, Rep.	GUF	French Guiana	MLT	Malta	SEN	Senegal	YUG	Yugoslavia, FR (Serbia/Montene
COK	Cook Islands	GUY	Guyana	MMR	Myanmar	SGP	Singapore	ZAF	South Africa
COL	Colombia	HKG	Hong Kong, China	MNG	Mongolia	SHN	Saint Helena	ZMB	Zambia
COM	Comoros	HND	Honduras	MNP	Northern Mariana Islands	SLB	Solomon Islands	ZWE	Zimbabwe

Table A2

SITC industries considered to be manufacturing according to the SITC classification revision.

SITC	Included SITC Sections	Excluded SITC Codes
Revision 1	5, 6, 7, and 8	Division 68, Non-ferrous metals
		Subgroup 8943, Non-military arms
		Subgroup 5714, Hunting and sporting ammunition
Revision 2	5, 6, 7, and 8	Division 68, Non-ferrous metals
		Subgroup 8946, Non-military arms and ammunition therefor
Revision 3	5, 6, 7, and 8	Division 68, Non-ferrous metals
		Group 891, Arms and ammunition
Revision 4	5, 6, 7, and 8	Division 68, Non-ferrous metals
		Group 891, Arms and ammunition

Table A3

Definition of Rausch (1999)'s conservative typology of goods based on 4-digit SITC Rev. 2 classification

Homogeneous.																
0010	0011	0012	0013	0014	0110	0111	0113	0116	0120	0121	0122	0123	0125	0350	0351	0352
0410	0411	0412	0420	0421	0422	0423	0430	0440	0449	0450	0451	0452	0453	0459	0541	0570
0573	0577	0585	0591	0592	0599	0610	0611	0612	0615	0710	0711	0713	0721	0740	0741	0743
0751	0810	0813	0910	0913	1211	1212	2220	2222	2227	2311	2312	2320	2321	2322	2610	2613
2614	2630	2631	2640	2641	2649	2651	2654	2680	2681	2682	2710	2721	2722	2810	2814	2815
2816	2820	2821	2822	2823	3330	3340	3341	3342	3343	3344	4110	4112	4113	4212	4213	4215
4216	4217	4218	4222	4225	4229	4230	4232	4234	4236	4239	4240	4241	4242	4243	4245	4249
5222	6512	6513	6810	6811	6812	6820	6821	6823	6824	6825	6826	6827	6830	6831	6840	6841
6850	6851	6860	6861	6870	6871	6872	6891	9610	9710	4215	4216	4217	4218	4222	4225	4229

Referenced price																
0019	0112	0114	0129	0140	0142	0149	0161	0168	0171	0172	0173	0174	0175	0176	0179	0220
0221	0222	0223	0224	0230	0240	0250	0251	0252	0253	0340	0341	0343	0344	0345	0360	0361
0362	0363	0370	0371	0372	0470	0471	0481	0540	0542	0544	0545	0546	0547	0548	0561	0564
0571	0572	0574	0575	0579	0586	0616	0620	0621	0622	0720	0722	0723	0750	0752	0811	0812
0814	0819	1120	1121	1123	1124	1210	1220	1222	1223	2110	2111	2119	2221	2223	2224	2225
2226	2232	2234	2460	2462	2470	2471	2472	2474	2475	2479	2510	2511	2512	2516	2517	2518
2519	2632	2633	2650	2657	2658	2659	2660	2665	2666	2667	2670	2671	2687	2712	2730	2732
2733	2734	2740	2741	2780	2782	2783	2785	2786	2851	2852	2860	2870	2871	2872	2873	2874
2875	2876	2877	2878	2879	2880	2881	2882	2890	2925	3211	3220	3230	3232	3250	3345	3351
3352	3353	3410	3413	3425	3510	4111	4310	4311	4312	5110	5111	5112	5113	5114	5119	5120
5121	5122	5123	5124	5130	5137	5138	5139	5140	5145	5146	5147	5148	5150	5154	5155	5156
5157	5158	5160	5161	5162	5163	5169	5220	5221	5223	5224	5225	5226	5230	5231	5232	5233
5234	5235	5236	5237	5238	5239	5240	5243	5249	5251	5259	5310	5311	5312	5320	5322	5323
5331	5411	5620	5621	5622	5623	5629	5711	5712	5719	5729	5731	5739	5741	5742	5743	5751
5752	5753	5754	5755	5759	5791	5792	5793	5799	5811	5812	5813	5816	5817	5820	5821	5822
5823	5824	5825	5826	5827	5829	5830	5831	5832	5833	5834	5835	5837	5840	5843	5849	5851
5911	5920	5922	5931	5972	5977	5981	6113	6340	6341	6342	6343	6345	6410	6411	6412	6413
6414	6415	6416	6417	6418	6421	6510	6514	6515	6516	6517	6521	6531	6532	6534	6545	6551
6610	6611	6612	6670	6672	6710	6712	6713	6714	6715	6716	6730	6731	6732	6734	6740	6741
6742	6743	6744	6745	6746	6747	6748	6749	6750	6751	6753	6755	6757	6760	6761	6762	6763
6764	6768	6770	6822	6832	6842	6852	6863	6880	6890	6898	6899	6932				
Differentiated: remaining industries																

Table A4

Definition of Rausch (1999)'s liberal typology of goods based on 4-digit SITC Rev. 2 classification

Homogeneous																
0010	0011	0012	0013	0014	0110	0111	0113	0116	0120	0121	0122	0123	0125	0350	0351	0352
0410	0411	0412	0420	0421	0422	0423	0430	0440	0449	0450	0451	0452	0453	0459	0541	0570
0573	0577	0585	0591	0592	0599	0610	0611	0612	0615	0710	0711	0713	0721	0740	0741	0743
0751	0810	0813	0910	0913	1211	1212	2220	2222	2227	2311	2312	2320	2321	2322	2610	2613
2614	2630	2631	2640	2641	2649	2651	2654	2680	2681	2682	2710	2721	2722	2810	2814	2815

Homogeneous																
2816	2820	2821	2822	2823	3330	3340	3341	3342	3343	3344	4110	4112	4113	4212	4213	4230
4232	4234	4236	4239	4240	4241	4242	4243	4245	4249	5222	6512	6513	6810	6811	6812	6820
6821	6823	6824	6825	6826	6827	6830	6831	6840	6841	6850	6851	6860	6861	6870	6871	6872
6891	9610	9710	0220	0221	0222	0224	0230	0240	0250	0251	0253	0542	0720	0750	0752	2110
2111	2221	2223	2224	2225	2226	2460	2462	2470	2471	2472	2474	2475	2510	2517	2632	2633
2650	2657	2658	2659	2687	2851	2852	2860	2870	2871	2872	2873	2874	2875	2876	2877	2878
2879	2880	2882	2890	5220	5225	5226	5622	5623	6340	6342	6345	6670	6672	6880	6890	6898
6899																
Referenced price																
0019	0112	0114	0129	0140	0142	0149	0161	0168	0171	0172	0173	0174	0175	0176	0179	0223
0252	0340	0341	0343	0344	0345	0360	0361	0362	0363	0370	0371	0372	0470	0471	0481	0540
0544	0545	0546	0547	0548	0561	0564	0571	0572	0574	0575	0579	0586	0616	0620	0621	0622
0722	0723	0811	0812	0814	0819	1120	1121	1123	1124	1210	1220	1222	1223	2119	2232	2234
2479	2511	2512	2516	2518	2519	2660	2665	2666	2667	2670	2671	2712	2730	2732	2733	2734
2740	2741	2780	2782	2783	2785	2786	2881	2925	3211	3220	3230	3232	3250	3345	3351	3352
3353	3410	3413	3425	3510	4111	4310	4311	4312	5110	5111	5112	5113	5114	5119	5120	5121
5122	5123	5124	5130	5137	5138	5139	5140	5145	5146	5147	5148	5150	5154	5155	5156	5157
5158	5160	5161	5162	5163	5169	5221	5223	5224	5230	5231	5232	5233	5234	5235	5236	5237
5238	5239	5240	5243	5249	5251	5259	5310	5311	5312	5320	5322	5323	5331	5411	5620	5621
5629	5711	5712	5719	5729	5731	5739	5741	5742	5743	5751	5752	5753	5754	5755	5759	5791
5792	5793	5799	5811	5812	5813	5816	5817	5820	5821	5822	5823	5824	5825	5826	5827	5829
5830	5831	5832	5833	5834	5835	5837	5840	5843	5849	5851	5911	5920	5922	5931	5972	5977
5981	6113	6341	6343	6410	6411	6412	6413	6414	6415	6416	6417	6418	6421	6510	6514	6515
6516	6517	6521	6531	6532	6534	6545	6551	6610	6611	6612	6710	6712	6713	6714	6715	6716
6730	6731	6732	6734	6740	6741	6742	6743	6744	6745	6746	6747	6748	6749	6750	6751	6753
6755	6757	6760	6761	6762	6763	6764	6768	6770	6822	6832	6842	6852	6863	6932	0118	0141
0460	0461	0580	0581	0589	0742	0914	1122	2330	2331	2683	2789	3221	4314	5413	5836	5850
5852	6112	6518	6530	6533	6618	6620	6623	6720	6725	6783	6785	6930	6931	6996	7760	7764
7780	7781	7786	7788													
Differentiated: remaining industries																

Table A5

The regression results of WTO membership effects on trade flows
(PPML country-pair fixed effects.)

	PPML country-pair fixed effects			PPML no-pair fixed effects		
Variables	Model (7)	Model (9)	Model (10)	Model (7)	Model (9)	Model (10)
CE_contig				0.532***	0.533***	0.549***
				(0.018)	(0.018)	(0.018)
CE_comlang_off				0.200***	0.198***	0.200***
				(0.017)	(0.017)	(0.017)
CE_colony				0.292***	0.288***	0.299***
				(0.019)	(0.018)	(0.018)
CE_dist				-0.651***	-0.651***	-0.653***
				(0.006)	(0.007)	(0.007)
rta1	0.017	-0.014	0.017	0.436***	0.546***	0.455***
	(0.027)	(0.036)	(0.025)	(0.015)	(0.031)	(0.015)
wto_1962	0.343**	0.334**	0.618***	0.648***	0.648***	0.871***
	(0.147)	(0.146)	(0.172)	(0.189)	(0.189)	(0.183)
wto_1963	0.362**	0.352**	0.660***	0.674***	0.674***	0.910***
	(0.149)	(0.148)	(0.169)	(0.186)	(0.186)	(0.179)
wto_1964	0.409***	0.399***	0.737***	0.752***	0.752***	0.980***
	(0.148)	(0.147)	(0.175)	(0.184)	(0.185)	(0.182)
wto_1965	0.423***	0.414***	0.717***	0.749***	0.754***	0.957***
	(0.145)	(0.145)	(0.172)	(0.181)	(0.181)	(0.178)
wto_1966	0.497***	0.490***	0.772***	0.819***	0.825***	1.028***
	(0.154)	(0.154)	(0.178)	(0.186)	(0.186)	(0.181)
wto_1967	0.509***	0.497***	0.746***	0.895***	0.899***	1.051***
	(0.173)	(0.172)	(0.193)	(0.195)	(0.196)	(0.188)

	PPML country-pair fixed effects			PPML no-pair fixed effects		
Variables	Model (7)	Model (9)	Model (10)	Model (7)	Model (9)	Model (10)
wto_1968	0.523***	0.508***	0.723***	0.865***	0.869***	1.011***
	(0.168)	(0.168)	(0.187)	(0.192)	(0.192)	(0.184)
wto_1969	0.673***	0.656***	0.859***	0.972***	0.973***	1.102***
	(0.164)	(0.164)	(0.183)	(0.190)	(0.191)	(0.184)
wto_1970	0.767***	0.751***	0.955***	1.067***	1.070***	1.215***
	(0.166)	(0.165)	(0.179)	(0.190)	(0.190)	(0.183)
wto_1971	0.791***	0.725***	0.897***	1.086***	1.106***	1.168***
	(0.168)	(0.168)	(0.181)	(0.192)	(0.190)	(0.185)
wto_1972	0.867***	0.798***	0.952***	1.143***	1.160***	1.218***
	(0.164)	(0.164)	(0.176)	(0.190)	(0.188)	(0.184)
wto_1973	0.843***	0.840***	0.914***	1.043***	1.126***	1.145***
	(0.174)	(0.173)	(0.183)	(0.195)	(0.193)	(0.192)
wto_1974	0.518***	0.538***	0.756***	0.323	0.411*	0.661***
	(0.167)	(0.166)	(0.175)	(0.229)	(0.227)	(0.229)
wto_1975	0.489***	0.475***	0.752***	0.324	0.376*	0.663***
	(0.167)	(0.166)	(0.173)	(0.227)	(0.227)	(0.224)
wto_1976	0.488***	0.477***	0.748***	0.220	0.313	0.570**
	(0.164)	(0.162)	(0.170)	(0.233)	(0.233)	(0.231)
wto_1977	0.423***	0.405**	0.691***	0.149	0.230	0.513**
	(0.162)	(0.161)	(0.170)	(0.231)	(0.232)	(0.230)
wto_1978	0.202	0.184	0.502***	0.006	0.077	0.403*
	(0.182)	(0.179)	(0.187)	(0.235)	(0.237)	(0.235)
wto_1979	0.246	0.227	0.529***	-0.083	-0.013	0.330
	(0.179)	(0.177)	(0.186)	(0.237)	(0.238)	(0.239)
wto_1980	0.284*	0.252	0.514***	-0.311	-0.255	0.073
	(0.171)	(0.169)	(0.179)	(0.236)	(0.236)	(0.237)

	PPML country-pair fixed effects			PPML no-pair fixed effects		
Variables	Model (7)	Model (9)	Model (10)	Model (7)	Model (9)	Model (10)
wto_1981	0.278	0.263	0.469***	-0.377	-0.318	-0.041
	(0.170)	(0.168)	(0.179)	(0.242)	(0.241)	(0.245)
wto_1982	0.391**	0.376**	0.483***	-0.127	-0.076	0.090
	(0.176)	(0.174)	(0.183)	(0.261)	(0.262)	(0.261)
wto_1983	0.810***	0.777***	0.937***	0.533**	0.572***	0.788***
	(0.177)	(0.176)	(0.184)	(0.215)	(0.216)	(0.214)
wto_1984	0.832***	0.803***	0.943***	0.613***	0.647***	0.821***
	(0.168)	(0.167)	(0.174)	(0.215)	(0.215)	(0.211)
wto_1985	0.845***	0.811***	0.908***	0.674***	0.707***	0.837***
	(0.177)	(0.176)	(0.181)	(0.214)	(0.214)	(0.210)
wto_1986	1.432***	1.400***	1.433***	1.383***	1.417***	1.467***
	(0.184)	(0.182)	(0.187)	(0.232)	(0.231)	(0.233)
wto_1987	1.138***	1.101***	1.024***	1.264***	1.287***	1.240***
	(0.191)	(0.189)	(0.225)	(0.238)	(0.239)	(0.267)
wto_1988	1.083***	1.046***	0.977***	1.227***	1.238***	1.192***
	(0.195)	(0.193)	(0.233)	(0.245)	(0.246)	(0.278)
wto_1989	1.059***	1.027***	0.937***	1.190***	1.200***	1.151***
	(0.195)	(0.193)	(0.231)	(0.245)	(0.246)	(0.278)
wto_1990	1.152***	1.128***	1.048***	1.137***	1.145***	1.142***
	(0.225)	(0.224)	(0.262)	(0.288)	(0.290)	(0.316)
wto_1991	1.051***	1.019***	0.950***	0.989***	0.973***	0.997***
	(0.236)	(0.234)	(0.269)	(0.297)	(0.299)	(0.326)
wto_1992	0.936***	0.909***	0.849***	0.963***	0.974***	0.960***
	(0.220)	(0.219)	(0.247)	(0.289)	(0.292)	(0.317)
wto_1993	0.957***	0.936***	0.958***	1.043***	1.046***	1.128***
	(0.156)	(0.153)	(0.166)	(0.249)	(0.251)	(0.265)

	PPML country-pair fixed effects			PPML no-pair fixed effects		
Variables	Model (7)	Model (9)	Model (10)	Model (7)	Model (9)	Model (10)
wto_1994	0.794***	0.767***	0.777***	0.967***	0.971***	1.001***
	(0.184)	(0.180)	(0.194)	(0.274)	(0.274)	(0.289)
wto_1995	0.676***	0.643***	0.689***	0.849***	0.834***	0.923***
	(0.172)	(0.168)	(0.180)	(0.255)	(0.255)	(0.270)
wto_1996	0.246**	0.204*	0.275**	0.654***	0.621***	0.798***
	(0.121)	(0.121)	(0.130)	(0.180)	(0.177)	(0.223)
wto_1997	0.111	0.073	0.129	0.576***	0.530***	0.700***
	(0.106)	(0.107)	(0.119)	(0.173)	(0.171)	(0.218)
wto_1998	0.124	0.072	0.092	0.631***	0.574***	0.694***
	(0.096)	(0.097)	(0.105)	(0.180)	(0.179)	(0.212)
wto_1999	0.190*	0.143	0.163	0.584***	0.517***	0.640***
	(0.103)	(0.103)	(0.109)	(0.177)	(0.176)	(0.208)
wto_2000	0.232**	0.191*	0.221*	0.472***	0.426**	0.535**
	(0.112)	(0.113)	(0.116)	(0.182)	(0.181)	(0.211)
wto_2001	0.149	0.086	0.140	1.033***	0.982***	1.093***
	(0.116)	(0.117)	(0.119)	(0.221)	(0.222)	(0.223)
wto_2002	0.028	-0.047	0.012	0.919***	0.849***	0.944***
	(0.115)	(0.117)	(0.117)	(0.227)	(0.230)	(0.228)
wto_2003	0.025	-0.047	-0.007	0.844***	0.809***	0.848***
	(0.108)	(0.110)	(0.109)	(0.220)	(0.221)	(0.221)
wto_2004	-0.132	-0.194**	-0.137	0.965***	0.898***	1.013***
	(0.090)	(0.092)	(0.092)	(0.208)	(0.212)	(0.209)
wto_2005	-0.361***	-0.415***	-0.367***	0.803***	0.732***	0.874***
	(0.080)	(0.082)	(0.083)	(0.176)	(0.175)	(0.176)
wto_2006	-0.416***	-0.457***	-0.412***	0.804***	0.725***	0.875***
	(0.088)	(0.089)	(0.092)	(0.184)	(0.185)	(0.183)

	PPML country-pair fixed effects			PPML no-pair fixed effects		
Variables	Model (7)	Model (9)	Model (10)	Model (7)	Model (9)	Model (10)
wto_2007	-0.428***	-0.466***	-0.414***	0.779***	0.695***	0.865***
	(0.092)	(0.092)	(0.095)	(0.187)	(0.189)	(0.187)
wto_2008	-0.414***	-0.432***	-0.386***	0.381	0.322	0.446*
	(0.124)	(0.125)	(0.125)	(0.271)	(0.269)	(0.268)
wto_2009	-0.454***	-0.454***	-0.443***	0.365	0.336	0.414*
	(0.160)	(0.160)	(0.160)	(0.229)	(0.228)	(0.228)
wto_2010	-0.324**	-0.312**	-0.306**	0.597***	0.581**	0.655***
	(0.127)	(0.126)	(0.127)	(0.228)	(0.226)	(0.228)
wto_2011	-0.383***	-0.362***	-0.371***	0.671***	0.658***	0.720***
	(0.109)	(0.108)	(0.110)	(0.227)	(0.226)	(0.227)
wto_2012	-0.526**	-0.509**	-0.516**	-0.242	-0.230	-0.196
	(0.238)	(0.235)	(0.237)	(0.264)	(0.266)	(0.267)
wto_2013	-0.488**	-0.482**	-0.482*	-0.284	-0.288	-0.246
	(0.246)	(0.244)	(0.246)	(0.284)	(0.287)	(0.287)
wto_2014	-0.490**	-0.481**	-0.501**	-0.139	-0.137	-0.124
	(0.238)	(0.236)	(0.241)	(0.291)	(0.294)	(0.295)
wto_2015	-0.026	-0.013	-0.049	0.026	0.051	0.066
	(0.215)	(0.215)	(0.213)	(0.493)	(0.486)	(0.485)
wto_dev_1962			-0.490***			-0.437**
			(0.140)			(0.171)
wto_dev_1963			-0.531***			-0.463***
			(0.127)			(0.159)
wto_dev_1964			-0.521***			-0.401**
			(0.137)			(0.168)
wto_dev_1965			-0.460***			-0.362**
			(0.134)			(0.164)

	PPML country-pair fixed effects			PPML no-pair fixed effects		
Variables	Model (7)	Model (9)	Model (10)	Model (7)	Model (9)	Model (10)
wto_dev_1966			-0.423***			-0.360**
			(0.130)			(0.163)
wto_dev_1967			-0.368***			-0.287*
			(0.123)			(0.155)
wto_dev_1968			-0.305**			-0.263*
			(0.119)			(0.151)
wto_dev_1969			-0.271**			-0.225
			(0.120)			(0.153)
wto_dev_1970			-0.272**			-0.251*
			(0.115)			(0.150)
wto_dev_1971			-0.145			-0.145
			(0.118)			(0.149)
wto_dev_1972			-0.115			-0.131
			(0.113)			(0.143)
wto_dev_1973			-0.094			-0.173
			(0.117)			(0.132)
wto_dev_1974			-0.333***			-0.529***
			(0.123)			(0.129)
wto_dev_1975			-0.377***			-0.545***
			(0.117)			(0.117)
wto_dev_1976			-0.371***			-0.556***
			(0.119)			(0.120)
wto_dev_1977			-0.383***			-0.579***
			(0.117)			(0.118)
wto_dev_1978			-0.428***			-0.620***
			(0.115)			(0.114)

	PPML country-pair fixed effects			PPML no-pair fixed effects		
Variables	Model (7)	Model (9)	Model (10)	Model (7)	Model (9)	Model (10)
wto_dev_1979			-0.403***			-0.649***
			(0.112)			(0.112)
wto_dev_1980			-0.326***			-0.603***
			(0.111)			(0.115)
wto_dev_1981			-0.274**			-0.547***
			(0.115)			(0.119)
wto_dev_1982			-0.128			-0.364***
			(0.117)			(0.122)
wto_dev_1983			-0.177			-0.405***
			(0.113)			(0.117)
wto_dev_1984			-0.154			-0.330***
			(0.112)			(0.124)
wto_dev_1985			-0.084			-0.256**
			(0.114)			(0.127)
wto_dev_1986			-0.001			-0.148
			(0.114)			(0.136)
wto_dev_1987			0.179			0.019
			(0.127)			(0.159)
wto_dev_1988			0.170			0.040
			(0.129)			(0.165)
wto_dev_1989			0.203*			0.047
			(0.121)			(0.162)
wto_dev_1990			0.173			-0.030
			(0.118)			(0.160)
wto_dev_1991			0.175			-0.037
			(0.112)			(0.161)

	PPML country-pair fixed effects			PPML no-pair fixed effects		
Variables	Model (7)	Model (9)	Model (10)	Model (7)	Model (9)	Model (10)
wto_dev_1992			0.159			-0.018
			(0.101)			(0.155)
wto_dev_1993			-0.002			-0.189
			(0.078)			(0.141)
wto_dev_1994			0.034			-0.090
			(0.077)			(0.144)
wto_dev_1995			-0.027			-0.174
			(0.075)			(0.140)
wto_dev_1996			-0.045			-0.270*
			(0.081)			(0.158)
wto_dev_1997			-0.029			-0.239
			(0.081)			(0.157)
wto_dev_1998			0.050			-0.135
			(0.081)			(0.143)
wto_dev_1999			0.047			-0.124
			(0.079)			(0.138)
wto_dev_2000			0.020			-0.138
			(0.079)			(0.134)
wto_dev_2001			0.019			-0.148
			(0.081)			(0.124)
wto_dev_2002			0.033			-0.090
			(0.083)			(0.117)
wto_dev_2003			0.062			-0.046
			(0.090)			(0.108)
wto_dev_2004			0.014			-0.140
			(0.089)			(0.090)

	PPML country-pair fixed effects			PPML no-pair fixed effects		
Variables	Model (7)	Model (9)	Model (10)	Model (7)	Model (9)	Model (10)
wto_dev_2005			0.016			-0.204**
			(0.092)			(0.091)
wto_dev_2006			-0.003			-0.214**
			(0.092)			(0.090)
wto_dev_2007			-0.020			-0.253***
			(0.093)			(0.089)
wto_dev_2008			-0.053			-0.223***
			(0.093)			(0.084)
wto_dev_2009			-0.015			-0.185**
			(0.097)			(0.090)
wto_dev_2010			-0.032			-0.206**
			(0.098)			(0.095)
wto_dev_2011			-0.016			-0.199**
			(0.097)			(0.096)
wto_dev_2012			-0.026			-0.192*
			(0.096)			(0.101)
wto_dev_2013			-0.006			-0.175*
			(0.099)			(0.105)
wto_dev_2014			0.062			-0.109
			(0.097)			(0.099)
wto_dev_2015			0.084			-0.048
			(0.100)			(0.103)
wto_rta_1965		-0.011			-0.395**	
		(0.140)			(0.181)	
wto_rta_1966		-0.080			-0.387***	
		(0.096)			(0.146)	

	PPML country-pair fixed effects			PPML no-pair fixed effects		
Variables	Model (7)	Model (9)	Model (10)	Model (7)	Model (9)	Model (10)
wto_rta_1967		0.020			-0.290**	
		(0.102)			(0.142)	
wto_rta_1968		0.106			-0.238*	
		(0.099)			(0.141)	
wto_rta_1969		0.190**			-0.158	
		(0.093)			(0.136)	
wto_rta_1970		0.125			-0.198	
		(0.091)			(0.125)	
wto_rta_1971		0.411***			-0.361**	
		(0.080)			(0.156)	
wto_rta_1972		0.427***			-0.313**	
		(0.076)			(0.149)	
wto_rta_1973		-0.023			-0.689***	
		(0.090)			(0.123)	
wto_rta_1974		-0.139			-0.739***	
		(0.088)			(0.121)	
wto_rta_1975		0.038			-0.489***	
		(0.081)			(0.114)	
wto_rta_1976		0.019			-0.759***	
		(0.079)			(0.117)	
wto_rta_1977		0.058			-0.642***	
		(0.076)			(0.116)	
wto_rta_1978		0.057			-0.595***	
		(0.069)			(0.110)	
wto_rta_1979		0.065			-0.585***	
		(0.065)			(0.112)	

	PPML country-pair fixed effects			PPML no-pair fixed effects		
Variables	Model (7)	Model (9)	Model (10)	Model (7)	Model (9)	Model (10)
wto_rta_1980		0.140**			-0.486***	
		(0.067)			(0.116)	
wto_rta_1981		0.046			-0.527***	
		(0.063)			(0.110)	
wto_rta_1982		0.037			-0.475***	
		(0.060)			(0.112)	
wto_rta_1983		0.127**			-0.404***	
		(0.055)			(0.104)	
wto_rta_1984		0.120**			-0.424***	
		(0.053)			(0.107)	
wto_rta_1985		0.129**			-0.369***	
		(0.054)			(0.105)	
wto_rta_1986		0.098**			-0.313***	
		(0.050)			(0.106)	
wto_rta_1987		0.135***			-0.265**	
		(0.051)			(0.104)	
wto_rta_1988		0.142***			-0.196*	
		(0.051)			(0.100)	
wto_rta_1989		0.134***			-0.210**	
		(0.047)			(0.095)	
wto_rta_1990		0.094**			-0.195**	
		(0.047)			(0.089)	
wto_rta_1991		0.133***			-0.051	
		(0.047)			(0.094)	
wto_rta_1992		0.109**			-0.209*	
		(0.050)			(0.116)	

	PPML country-pair fixed effects			PPML no-pair fixed effects		
Variables	Model (7)	Model (9)	Model (10)	Model (7)	Model (9)	Model (10)
wto_rta_1993		0.076			-0.161*	
		(0.046)			(0.087)	
wto_rta_1994		0.089**			-0.121*	
		(0.041)			(0.071)	
wto_rta_1995		0.100**			-0.033	
		(0.040)			(0.071)	
wto_rta_1996		0.100***			-0.013	
		(0.039)			(0.068)	
wto_rta_1997		0.088**			0.022	
		(0.039)			(0.069)	
wto_rta_1998		0.115***			0.067	
		(0.037)			(0.074)	
wto_rta_1999		0.110***			0.115*	
		(0.037)			(0.068)	
wto_rta_2000		0.100***			0.067	
		(0.037)			(0.077)	
wto_rta_2001		0.096***			0.017	
		(0.037)			(0.067)	
wto_rta_2002		0.132***			0.043	
		(0.035)			(0.067)	
wto_rta_2003		0.116***			-0.038	
		(0.035)			(0.067)	
wto_rta_2004		0.086**			-0.001	
		(0.034)			(0.063)	
wto_rta_2005		0.091**			-0.061	
		(0.037)			(0.064)	

	PPML country-pair fixed effects			PPML no-pair fixed effects		
Variables	Model (7)	Model (9)	Model (10)	Model (7)	Model (9)	Model (10)
wto_rta_2006		0.069*			-0.057	
		(0.036)			(0.065)	
wto_rta_2007		0.061*			-0.087	
		(0.037)			(0.062)	
wto_rta_2008		0.030			-0.105*	
		(0.036)			(0.061)	
wto_rta_2009		-0.007			-0.155**	
		(0.037)			(0.063)	
wto_rta_2010		-0.033			-0.189***	
		(0.038)			(0.065)	
wto_rta_2011		-0.047			-0.207***	
		(0.038)			(0.066)	
wto_rta_2012		-0.063*			-0.183***	
		(0.036)			(0.067)	
wto_rta_2013		-0.027			-0.147**	
		(0.037)			(0.068)	
wto_rta_2014		-0.032			-0.161**	
		(0.039)			(0.067)	
wto_rta_2015		-0.027			-0.121*	
		(0.039)			(0.065)	
Observations	1,705,014	1,705,014	1,705,014	2,306,016	2,306,016	2,306,016
R-squared	0.992	0.992	0.992	0.880	0.882	0.880
r2	0.992	0.992	0.992	0.880	0.882	0.880

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