

# The WTO Does Promote Trade

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## *Abstract*

*We show that Rose's (2004a) surprising result that "The GATT/WTO does not promote trade" disappears when we account for oil exports separately. To accurately evaluate the role of the trade organization in promoting trade, we focus on trading commodities that are actually under the influence of that organization. Removing oil, the largest single commodity in world trade and the one not affected by GATT/WTO, we find robust evidence that non-oil trade is positively affected by the organization. Using an extended gravity model on annual bilateral non-oil trade data, GATT/WTO membership increases trade by approximately 23 percent when both parties are members.*

**Keywords:** Oil; Gravity Model; GATT; WTO; Trade Promotion; Trade Liberalization

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It is a commonplace among economists that trade liberalization increases trade and improves the allocation of resources. In 2004, however, Andrew K. Rose published research that suggests the GATT/WTO does not promote world trade. Until the work of Rose, the positive effects of GATT/WTO on trade was believed, but never actually empirically tested. Rose, using an extended gravity model, found that GATT/WTO membership substantially decreased bilateral trade among member countries. This finding has stimulated economists to reconsider GATT/WTO.

We reexamine what Rose calls an “...interesting mystery; the GATT/WTO does not promote trade,” and find that there is no mystery at all. GATT/WTO does increase the types of trade that are covered by the agreements. We utilize Rose’s version of the gravity model. However, we apply it to data from a different source and examine not only the same aggregate level of trade, as does he, but also consider *non-oil* trade. The oil sector<sup>1</sup> covers one of the most important trade commodities, but one with which the GATT/WTO largely does not deal. Oil prices are controlled in part by the Organization of the Petroleum Exporting Countries (OPEC)<sup>2</sup> members, and oil is subject to heavy taxation by importing nations. Thus, oil does not function like most other commodities in a relatively free trade framework.<sup>3</sup> Instead, oil responds to a data generation process distinct from that for other commodities in world trade. Furthermore, a disproportionate

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<sup>1</sup> Oil sector includes petroleum and petroleum products. Hereafter “Oil.” See Appendix 4 for a more detailed description of the oil products.

<sup>2</sup> According to OPEC, eleven Members (Iran, 1960; Iraq, 1960; Kuwait, 1960; Saudi Arabia, 1960; Venezuela, 1960; Qatar, 1961; Indonesia, 1962; Libya, 1962; United Arab Emirates, 1967; Algeria, 1969; and Nigeria, 1971 – The number is the year of OPEC accession.) collectively supply about 40 per cent of the world’s oil output, and possess more than 78 percent of the world’s total proven crude oil reserves (<http://www.opec.org/library/FAQs/CrudeOil/q3.htm>).

<sup>3</sup> OPEC collects price data on a “basket” of seven crude oils, including: Algeria’s Saharan Blend, Indonesia Minas, Nigeria Bonny Light, Saudi Arabia Arab Light, Dubai Fateh, Venezuela Tijuana and Mexico Isthmus (a non-OPEC oil). The OPEC price is an average of these oils. OPEC uses this price to monitor world oil market conditions (Taken from <http://www.eia.doe.gov/emeu/cabs/opec.html>).

number of major oil exporters were not GATT/WTO members for most of the data period (or are still not members at its end), while oil export revenues have risen greatly over time. As a result, the total trade of non-GATT/WTO members has typically risen about as much as that for members, due to the increases in oil trade, masking the effects of GATT/WTO membership. Hence, we exclude the value of oil trade from the value of total trade in order to examine GATT/WTO's influence on non-oil trade.<sup>4</sup>

Our main findings can be summarized as follows: First, like Rose, we find no evidence that GATT/WTO promotes total trade. Second, when looking at non-oil trade, the magnitude of the estimated parameters changes considerably and GATT/WTO promotes non-oil trade by about 23 percent for the member countries and about 13 percent for trade with non-member countries. Finally, separate equation results for exports and imports show an even more positive and strong effect of GATT/WTO than on average non-oil bilateral trade.

The remainder of the paper is organized as follows: Section I presents the estimation methodology, and briefly describes data and sources. Empirical results are provided in Section II. In Section III, we show some sensitivity analysis and discuss the results of our study, and Section IV concludes.

## **I. Methodology - Model Specification**

### *A. Average Total Trade Model*

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<sup>4</sup> More precisely they are average value of real total and non-oil trade. Hereafter "total trade", "oil trade" and "non-oil trade." In addition, "non-oil trade" means the average value of real total minus the average value of real oil trade.

To re-examine Rose's result, we adopt his version of the extended gravity model (Rose, 2004a), using ordinary least squares (OLS) and computing standard errors that are robust to clustering by country-pairs.<sup>5</sup> The equation for bilateral trade is as follows:

$$\begin{aligned} \ln T_{ijt} = & \beta_0 + \beta_1 \ln D_{ij} + \beta_2 \ln(Y_i Y_j)_t + \beta_3 \ln(Y_i Y_j / Pop_i Pop_j)_t \\ & + \beta_4 Lang_{ij} + \beta_5 Cont_{ij} + \beta_6 Landl_{ij} + \beta_7 Island_{ij} \\ & + \beta_8 \ln(Area_i Area_j) + \beta_9 ComCol_{ij} + \beta_{10} CurCol_{ijt} \\ & + \beta_{11} Colony_{ij} + \beta_{12} ComNat_{ij} + \beta_{13} CU_{ijt} + \beta_{14} FTA_{ijt} \\ & + \sum \Phi T_t + \gamma_1 Bothin_{ijt} + \gamma_2 Onein_{ijt} + \gamma_3 GSP_{ijt} + \varepsilon_{ijt}, \end{aligned}$$

where:

- $T_{ijt}$  denotes the annual average value of real total bilateral trade between nations  $i$  and  $j$  at time  $t$ ,
- $Y$  is real GDP,
- $Pop$  is population,
- $D$  is the distance between  $i$  and  $j$ ,
- $Lang$  is a binary dummy variable which is unity if  $i$  and  $j$  have a common language and zero otherwise,
- $Cont$  is a binary variable that is unity if  $i$  and  $j$  share a land border,
- $Landl$  is the number of landlocked countries in the country-pair (0, 1, or 2),
- $Island$  is the number of island nations in the pair (0, 1, or 2),
- $Area$  is the area of a nation (in square kilometers),
- $ComCol$  is a binary variable that is unity if  $i$  and  $j$  were ever colonies after 1945 with the same colonizer,

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<sup>5</sup> We estimate the model using the OLS absorbing by year and clustering by pairid. The same technique was used by Rose (2004a).

- *CurCol* is a binary variable that is unity if *i* and *j* are colonies at time *t*,
- *Colony* is a binary variable that is unity if *i* ever colonized *j* or vice versa,
- *ComNat* is a binary variable that is unity if *i* and *j* remained part of the same nation during the sample (e.g., France and Guadeloupe),
- *CU* is a binary variable that is unity if *i* and *j* use the same currency at time *t*,
- *FTA* is a binary variable that is unity if *i* and *j* both belong to the same regional trade agreement,
- $\{T_t\}$  is a comprehensive set of time fixed effects,
- $\beta$  and  $\Phi$  are vectors of coefficients,
- *Bothin<sub>ijt</sub>* is a binary variable that is unity if both *i* and *j* are GATT/WTO members at *t*,
- *Onein<sub>ijt</sub>* is a binary variable that is unity if either *i* or *j* is a GATT/WTO member at *t*,
- *GSP<sub>ijt</sub>* is a binary variable that is unity if *i* was a GSP beneficiary of *j* or vice versa at *t*, and
- $\varepsilon_t$  represents the other omitted influences on bilateral trade, assumed to be well behaved.

The parameters of interest in this test are the same as Rose (2004a):  $\gamma_1$  and  $\gamma_2$ .

The hypotheses<sup>6</sup> tested are

- 1) *if trade is created when both countries are in the GATT/WTO,  $\gamma_1$  should be positive, (implies that if both countries are in the GATT/WTO, bilateral trade among the member countries is increased), and*

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<sup>6</sup> The hypotheses are the same throughout this paper.

2) *if trade is diverted from a non-member, then  $\gamma_2$  may be negative, (implies that if one country is in the GATT/WTO, bilateral trade between member and non-member countries is decreased).*

After we examine the same analysis as Rose for total trade, we then consider the effect of the oil trade by subtracting it from the value of total trade - this we call “non-oil trade.” Our dependent variable is an average value of exports and imports. We then separately look at exports and imports instead of average trade.

### ***B. Non-Oil Trade Model***

Although GATT/WTO is aimed at lowering trade barriers, a number of key sectors are exempt, not yet included in previous negotiation rounds (Subramanian and Wei, 2003). They argue that exemption resulted in higher tariffs in these sectors and that the rules prohibiting quantitative restrictions are not effective.

Rose’s study indicates that regardless of whether one or both countries in a trading relationship are members of GATT/WTO, trade is not promoted. Excluding oil can help determine whether Rose’s argument is truly robust, as GATT/WTO largely does not deal with oil. Using United Nations (UN) Commodity Trade Statistics Database (COMTRADE) data in this model and excluding oil, the dependent variable changes from the average value of real total bilateral trade to the average value of real non-oil bilateral trade.

The exclusion of oil from the auspices of GATT/WTO can be attributed to several factors. Petroleum is known not just as an economic commodity, but also as a strategic commodity. A ‘gentleman’s agreement’ appears to have existed to consciously exclude oil from GATT negotiations, despite attempts during the Uruguay Round by some countries to include it. It is also important to note that the fundamental principle of GATT 1994 prohibiting quantitative restrictions is subject to exceptions, to quote UN (2000):<sup>7</sup>

*“During the early history of the GATT, issues relating to trade in and prices of crude petroleum were not addressed. ... A fundamental principle of GATT 1994 is the prohibition of quantitative restrictions on trade, which in principle applies equally to exports and imports (Article XI). It is subject, however, to a number of exceptions. The most relevant exceptions with respect to petroleum trade are to be found in Article XX (general exceptions) and Article XXI (national security). Of special interest to petroleum-exporting states is Article XX (g), which generally exempts from normal GATT disciplines those measures “relating to the conservation of exhaustible natural resources if such measures are made effective in conjunction with restrictions on domestic production or consumption. ... There were no negotiations under the Uruguay Round on tariffs applied to petroleum and petroleum products ....”*

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<sup>7</sup> Trade Agreement, Petroleum and Energy Policies (Chapter 1, Treatment of, and implications for, petroleum and petroleum products under the WTO Agreements)

For these reasons, oil trade is beyond GATT/WTO influence. To examine GATT/WTO's influence on trade, the value of oil trade should be excluded from the value of total trade. Once this sectoral asymmetry is taken into account by subtracting this sector from total trade, this paper seeks to analyze whether GATT/WTO membership has an effect on trade flows.

### *C. Data and Sources*

Although the same models are used, Rose's and our study differ in that the data are from different sources. Whereas Rose acquires his trade data from the Direction of Trade (DOT), we use the COMTRADE developed by the UN.<sup>8</sup>

According to the UN, the availability of COMTRADE data depends on the classification of commodities and reporting countries. COMTRADE collected all data in reporting countries' original classifications and converts this data to its own classifications.<sup>9</sup> About 120-140 countries or areas report their trade statistics to the UN and the market share of these reporting countries together covers more than 90 percent and perhaps even as much as 95 percent of world trade. Each country reports trade by commodity and trading partner. The trading partners cover up to 230 different countries or areas, excluding regional not elsewhere specified (NES) areas.<sup>10</sup> In addition, DOT does not have trade records for intermediate commodities, whereas COMTRADE contains all detailed merchandise trade records.

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<sup>8</sup> UN data can be obtained from UN COMTRADE website <http://unstats.un.org/unsd/comtrade/>.

<sup>9</sup> e.g., if country A reported 1997 data in HS88, COMTRADE will store A's 1997 data in HS88, SITC.3, SITC.2 and SITC.1.

<sup>10</sup> A total number of 173 countries are used for this test.

The time period of Rose's data is longer (1948-1999). However, the values are in millions of US\$ and it is thus possible that small amounts of trade (less than US\$500,000) between small nations can be overlooked or treated as zero. COMTRADE data period is 1962 to 1999, shorter than Rose's, but the units are in US\$. Regardless of how small the amount of trade might be, it is not treated as insignificant. Also, using Rose's data, it is impossible to discern the influence of oil trade. The first reason is that Rose's data do not disaggregate the items that are in total trade. COMTRADE data not only indicate the total trade amount, as well as individual trade commodities. Second, one could subtract the COMTRADE oil trade amount from the DOT total trade data, but this often results in negative non-oil trade amounts.<sup>11</sup> We, therefore, use only COMTRADE for our analysis of non-oil trade, but first look at total trade to compare with Rose.<sup>12</sup>

## **II. Empirical Results**

### ***A. Results***

In this section, we present regression results briefly. Basically there are three different dependent variables, total trade, non-oil trade and oil trade.

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<sup>11</sup> e.g. Suppose an average total trade between country *A* and *B* is \$1,000 (\$500 for oil trade and \$500 for non-oil trade) at time *t*. In this example, DOT data records it as \$0 since the value is in millions, and COMTRADE records it as \$1,000 for total trade and \$500 for oil trade. If we subtract oil trade from DOT's total trade, the non-oil trade values between two countries is -\$500. When we subtract oil trade from DOT total trade, 2,215 country pairs' non-oil trade generates negative values.

<sup>12</sup> We check the correlation between DOT and COMTRADE data sets. The correlation of the two data sets is 0.999 before taking a natural log and 0.966 after taking natural logs (presented in Appendix 2). For identical nation-years, these data are very similar, yet not identical.

Equation (1) above is estimated taking all variables for 188,442 observations.<sup>13</sup> Table 1 provides the core regression results.<sup>14</sup> Control variable results are as expected. These results show that countries that are farther apart trade less and economically large countries trade more. The Generalized System of Preferences (GSP) has a positive effect on trade. Countries in the same region and in a currency union trade more. Sharing a language or land border also has a positive effect on trade. A former colonial relationship encourages trade. Finally, landlocked countries and physically larger countries trade less.

Now consider the parameters of interest, those for membership in GATT/WTO. The result for total trade confirms Rose (2004a), in that membership in the GATT/WTO has no significant effect on total trade since both  $\gamma_1$  and  $\gamma_2$  are small and positive, but statistically insignificant at conventional levels.<sup>15</sup>

However, membership has a statistically and economically significant positive effect on non-oil trade: the coefficient if both countries are in GATT/WTO is 0.206 whereas the coefficient is 0.124 if only one country is in GATT/WTO. This finding is in line with our own expectations. Further,  $\gamma_2$  is also positive but  $\gamma_1$  is larger than  $\gamma_2$ . This implies that GATT/WTO membership has a substantial positive effect, i.e. it raises non-oil trade by about 23 percent since  $\exp(0.206)-1 = 0.23$  compared to both being non-members and 13 percent when only one country is a member. The results for oil trade

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<sup>13</sup> The data set is an unbalanced panel (country-pair x time with some missing observations).

<sup>14</sup> Rose (2004a) states that "... multicollinearity is not a problem for the coefficients of interest." We also check variance inflation factor (VIF) for the variables to see if they are 10 or greater because it cause for concern. We are convinced that there is no serious collinearity problem.

<sup>15</sup> These results are the same as Rose (2004a) except the signs of the coefficients. Rose's result for  $\gamma_1$  is -0.04 (0.05) and  $\gamma_2$  is -0.06 (0.05) (Robust standard errors are in parentheses.). Neither is statistically different from zero at conventional significance levels. In addition, we may think year and country selection bias because CPMTRADE data set is not fully match with DOT trade data set. Therefore, we select exactly same DOT country pairs data set which are available in CPMTRADE data set and the comparing results are shown in the Appendix 3.

seem opposite to non-oil's results for the parameters of interest and GSP. For instance,  $\gamma_1$ ,  $\gamma_2$  and GSP are positive for non-oil trade, but negative for oil trade.

### ***B. Unidirectional Trade Model***

Since the gravity model was developed by Tinbergen (1962) and Pöyhönen (1963) as an economic theory, numerous adjustments and additions have been proposed to this standard model, and choosing imports versus total trade as the dependent variable has been discussed.<sup>16</sup> Rose (2004a) used the average value of trade (averaging exports and imports) as the dependent variable. However, Dhar and Panagariya (1999) argue that total trade should not be the dependent variable since it imposes equality on the coefficients for exports and imports. They propose estimating separate equations for exports and imports.

Further, according to Subramanian and Wei (2003), it is better to use import values alone, rather than the average of bilateral exports and imports. This criticism is extensively acknowledged. In reality, most economists estimate the gravity equation using import data, under the assumption that countries are inclined to monitor their imports more cautiously than their exports (Baldwin, 1994).<sup>17</sup>

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<sup>16</sup> Molinari (2003) argues that it is not yet clear in the gravity literature whether choosing imports or exports is the best option to proxy trade flows but this is a 'mere' measurement issue.

<sup>17</sup> Baldwin (1994) also argues that imports seem to suffer from lower measurement error, but most models use exports as the dependent variable mainly due to better price data availability.

In addition, if the Lerner (1936) symmetry theorem<sup>18</sup> holds, exports will have a similar pattern (e.g., a change in imports leads to an equal change in the value of exports) as imports over the long-run. Thus, we also examine the results by changing the dependent variable of the regression. Two separate equations (imports and exports as the dependent variables) are thus also used to examine explicitly the effects of the selected variables on exports and imports.

Table 2 reports the results for exports and imports separately. In contrast to the results for total trade, but like that for non-oil trade,  $\gamma_1$  is positive and significant for exports and imports separately meaning that membership in the GATT/WTO has a strong positive effect on both exports and imports. However,  $\gamma_2$  is not significant. Furthermore, the coefficients in the export and import equations are both higher than the coefficients for average total trade. As expected,  $\gamma_1$  estimates are always higher than those for  $\gamma_2$ . These indicate that GATT/WTO increase total trade, another result contradictory to that of Rose.

Summarizing, for total trade, the results confirm Rose's finding that there is no indication that membership in GATT/WTO has a positive effect on trade. For non-oil trade, however, membership in GATT/WTO has a strong positive effect on trade. In addition, in separate tests for exports and imports, joining the GATT/WTO promotes trade among member countries and the size of these coefficients is higher than that for total trade.

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<sup>18</sup> The proposition is that a tax on all imports has the same effect as an equal tax on all exports, if the revenue is spent in the same way. The result depends critically on balanced trade, as in a real model, so that a change in imports leads to an equal change in the value of exports.

### III. Sensitivity Analysis and Discussion of Results

Results from a variety of sensitivity analyses<sup>19</sup> are reported in Table 3 onwards. We report only the key variables of interest, that both countries are in GATT/WTO,  $\gamma_1$ , and that only one country is in GATT/WTO,  $\gamma_2$ ; average trade regression results are reported, not separate tests for exports and imports. For comparison, we report in column 1 results from total trade. Column 2 results from non-oil trade, Column 3 results from oil trade.

For the time subsampling, we divide the data by decade (e.g., 1960s, 1970s, etc.) with the results shown in Table 3. For total trade,  $\gamma_1$  and  $\gamma_2$  are positive and significant in the 1960s, but shrink from the 1970s and turn negative in the 1990s. For non-oil trade, the data from the 1960s to 1970s show positive and significant effects of GATT/WTO membership on trade turning negative in the 1990s. As we can see, all the columns show that coefficients are positive, with  $\gamma_1 > \gamma_2$  and significant in the 1960s, but negative in the 1990s. This is a puzzle discussed further in the Conclusions that we are still unable to completely explain.

Table 3 also presents selections of group years of the data set (e.g., 1960s-1970s, 1960s-1980s, 1970s-1980s, etc.). The results are similar to the results for the decade group panel. The earlier group of period samples shows that membership of GATT/WTO has a positive effect on trade and shrinks in the middle years group, and turns negative (except non-oil trade for 1970s-1990s) end years group (e.g., 1970s-1990s and 1980s-1990s) but no negative coefficients are significant for either total or non-oil trade.

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<sup>19</sup> We follow a procedure similar to Rose (2004a, e.g., varying the sample and method of estimation).

For the final time subsampling, we divide the data into four periods reflecting the GATT rounds<sup>20</sup> and report the results in Table 4. The coefficient  $\gamma_1$  for total trade is positive and significant until the Kennedy Round, but shrinks after that. For non-oil trade, GATT/WTO membership has a positive and significant effect on trade until the initiation of the Uruguay Round. The results are similar to the earlier results, showing that the coefficients for non-oil trade decline more gradually as compared to total trade, but both  $\gamma_1$  and  $\gamma_2$  are negative after the start of the Uruguay Round.

### ***A. Fixed and Random Effects***

In addition, we include country-pair-specific fixed effects and random effects as robustness checks because the data are panel data.<sup>21</sup> The results are presented in Table 5. The estimation technique choice between country-pair-specific fixed effects and country-specific fixed effects has been widely discussed among researchers (e.g., Subramanian and Wei (2003), Anderson and van Wincoop (2003), and Rose (2004b)). For the fixed effects model, we report country-pair-specific (“dyadic”) fixed effects. These take into account trade resistance and other unobservable features of the relationship between each pair of countries.

### ***B. Agriculture and Textile/Apparel Sectors***

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<sup>20</sup> There were eight rounds under the GATT system but we divide the period by using later four rounds (e.g., Dillon to Kennedy, Kennedy to Tokyo, Tokyo to Uruguay and after Uruguay Round) because of the data availability.

<sup>21</sup> The Hausman test indicates that the hypothesis of no systematic differences between fixed and random coefficients is rejected for our model, with fixed effects having a much larger  $R^2$ .

We also examine the agricultural and the textiles/apparel sectors with oil sector.<sup>22</sup> The tests are conducted in a variety ways (e.g. non-agricultural, non-textiles, non-oil & agricultural, non-oil & textiles, non-agricultural & textiles and non-oil & agricultural & textiles trade<sup>23</sup>). Whenever oil products are subtracted from total trade, the WTO dummy,  $\gamma_1$ , is positive and significant, regardless of what other sectors are included or excluded. Based on these results, it would appear that the strong positive effect of GATT/WTO on non-oil trade generates the results for the other combined dependent variables. Thus, we conclude that the only sector of trade that caused problems for Rose's estimation was oil trade.

### ***C. DOT vs. COMTRADE Data***

Finally, we see an answer for the question of the year and country selection results as between the DOT and COMTRADE trade data sets. Therefore, we consider possible year and countries selections changes between the DOT and COMTRADE trade data and present in Appendix 3. Appendix 3 shows the results of the various data samples that reflect the change from Rose's dataset to ours.<sup>24</sup> In Appendix 3, all regressands are log real values of DOT data (Rose data). Column 1 of Appendix 3 (1948-1999\*) contains the results for the whole Rose (2004a) data set. As one can see, the values of the coefficients ( $\gamma_1$  and  $\gamma_2$ ) are exactly the same as Rose's (2004a) implying our regression

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<sup>22</sup> Specific test results are available upon request.

<sup>23</sup> Non-oil & agricultural & textiles means total trade excludes oil, agricultural and textiles trade (total trade – (oil trade + agricultural trade + textiles trade)). The same rule applies to the other use of &.

<sup>24</sup> DOT covers 178 countries and COMTRADE covers 173 countries for a sample period of 1962-1999. South Africa, Botswana, Lesotho, Namibia and Swaziland are not covered by COMTRADE since their data are only available from 2000.

technique is the same. Then, we drop observations before 1962 in the DOT data set (19,243 observations are dropped and 215,354 observations are left) and run a regression to check whether the coefficients of  $\gamma_1$  and  $\gamma_2$  during the shorter period (Column 1 of Appendix 3; 1962-1999<sup>\*\*</sup>) are different. Results for the shorter period are also insignificant for  $\gamma_1$  and  $\gamma_2$ . Finally, during the 1962-1999 period for DOT data, we also drop the observations that are not available in COMTRADE data. For example, when countries  $i$  and  $j$ 's trade data are available from 1962 to 1999 for DOT data but from 1963 to 1999 for COMTRADE data, we drop the missing year's data (1962) of the DOT (26,912 observations are dropped and 188,442 observations are left for total trade), and run a regression. Results are shown in the Column 2 of Appendix 3 (1962-1999<sup>\*\*\*</sup>). No matter how we select the DOT data (e.g., 1948-1999, 1962-1999 and match with COMTRADE data), none of coefficients is significant. Therefore, we conclude that the sample differences do not explain the difference between Rose's results and ours.

#### **IV. Conclusion**

In this paper, we evaluate the effect of GATT/WTO membership on trade flows. By using a large bilateral panel trade data set, we focus on non-oil trade, as the oil sector is not under the control of GATT/WTO.

We apply an extended gravity model to annual bilateral total and non-oil trade. Empirical results clearly demonstrate that GATT/WTO membership has had a significant positive effect on non-oil trade. The GATT/WTO both-in membership dummy variable is positive in sign and statistically significant. Between GATT/WTO members and non-

member countries non-oil trade increases as well, but less than among members. Because a disproportionate share of oil exports was by non-GATT/WTO members, and this trade rose in volume much as did non-oil trade, looking at both added together gives misleading results, as Rose (2004) found.

Our results also suggest that the impact of GATT/WTO membership on trade may have diminished over time. The magnitude of the coefficient in the early days of GATT/WTO is higher than for the whole period, but gradually declines and finally turns negative in the 1990s. Note, however, that the data only cover five years since the establishment of WTO. One possible explanation is lags in the effects of the new WTO. Another possibility arises when one notes the number of non-members has fallen over time (less than 5% of the number of bilateral trade flows by the early 1980s). The very few members may now represent a major problem of sample selection that deserves more careful attention.

Overall, the results suggest that GATT/WTO promotes non-oil trade by about 23 percent between member countries and by about 13 percent for trade with non-member countries.

Table 1: Core Regressions

	total trade	non-oil trade	oil trade
Both in GATT/WTO ( $\gamma_1$ )	0.003 (0.058)	<b>0.206</b> (0.058)	<b>-0.958</b> (0.171)
One in GATT/WTO ( $\gamma_2$ )	0.019 (0.056)	<b>0.124</b> (0.056)	-0.092 (0.165)
GSP	<b>0.761</b> (0.032)	<b>0.852</b> (0.032)	<b>-0.455</b> (0.091)
Log Distance	<b>-1.080</b> (0.022)	<b>-1.008</b> (0.022)	<b>-1.511</b> (0.059)
Log Product real GDP	<b>0.913</b> (0.009)	<b>0.929</b> (0.009)	<b>0.566</b> (0.028)
Log Product real GDP p/c	<b>0.283</b> (0.014)	<b>0.223</b> (0.014)	<b>0.426</b> (0.041)
Regional FTA	<b>1.207</b> (0.102)	<b>1.436</b> (0.102)	-0.014 (0.192)
Currency Union	<b>1.109</b> (0.123)	<b>1.128</b> (0.122)	<b>0.753</b> (0.253)
Common language	<b>0.332</b> (0.041)	<b>0.337</b> (0.041)	0.017 (0.118)
Land border	<b>0.614</b> (0.104)	<b>0.744</b> (0.105)	0.036 (0.183)
Number landlocked	<b>-0.300</b> (0.031)	<b>-0.209</b> (0.031)	<b>-1.509</b> (0.084)
Number islands	-0.006 (0.037)	-0.046 (0.037)	<b>0.422</b> (0.103)
Log product land area	<b>-0.108</b> (0.008)	<b>-0.134</b> (0.008)	<b>0.125</b> (0.022)
Common colonizer	<b>0.584</b> (0.066)	<b>0.535</b> (0.066)	<b>1.149</b> (0.197)
Currently colonized	<b>1.233</b> (0.358)	<b>1.239</b> (0.366)	0.760 (0.454)
Ever colony	<b>1.299</b> (0.110)	<b>1.341</b> (0.113)	<b>1.394</b> (0.202)
Common country	-0.346 (1.114)	-0.291 (1.120)	-1.115 (1.014)
Observation	188,442	187,606	81,076
R <sup>2</sup>	0.686	0.687	0.303
RMSE	1.740	1.722	3.170

*Notes:* Values significant at the 5 percent level are marked in bold. All regressands are in log real values. OLS with year effects (intercepts not reported). Robust standard errors (clustering by country-pairs) are in parentheses.

Table 2: Results of separate test (Exports/Imports)

	Exports			Imports		
	total	non-oil	oil	total	non-oil	oil
Both in GATT/WTO ( $\gamma_1$ )	<b>0.142</b> (0.067)	<b>0.290</b> (0.068)	<b>-0.439</b> (0.182)	<b>0.220</b> (0.065)	<b>0.432</b> (0.064)	<b>-0.549</b> (0.179)
One in GATT/WTO ( $\gamma_2$ )	0.101 (0.065)	<b>0.172</b> (0.066)	-0.166 (0.179)	0.096 (0.063)	0.104 (0.062)	<b>0.412</b> (0.173)
GSP	<b>0.642</b> (0.035)	<b>0.675</b> (0.036)	<b>-0.174</b> (0.083)	<b>0.682</b> (0.035)	<b>0.715</b> (0.036)	<b>-0.212</b> (0.093)
Log Distance	<b>-1.104</b> (0.024)	<b>-1.036</b> (0.024)	<b>-1.286</b> (0.057)	<b>-1.110</b> (0.024)	<b>-1.025</b> (0.024)	<b>-1.260</b> (0.058)
Log Product real GDP	<b>0.926</b> (0.011)	<b>0.936</b> (0.011)	<b>0.570</b> (0.027)	<b>0.971</b> (0.011)	<b>0.978</b> (0.011)	<b>0.507</b> (0.029)
Log Product real GDP p/c	<b>0.319</b> (0.016)	<b>0.272</b> (0.016)	<b>0.098</b> (0.038)	<b>0.320</b> (0.016)	<b>0.234</b> (0.017)	<b>0.250</b> (0.041)
Regional FTA	<b>1.346</b> (0.103)	<b>1.514</b> (0.103)	<b>0.419</b> (0.173)	<b>1.326</b> (0.115)	<b>1.587</b> (0.113)	0.082 (0.186)
Currency Union	<b>1.169</b> (0.131)	<b>1.204</b> (0.129)	0.443 (0.268)	<b>0.956</b> (0.128)	<b>0.890</b> (0.128)	<b>0.766</b> (0.273)
Common language	<b>0.354</b> (0.046)	<b>0.341</b> (0.047)	0.190 (0.116)	<b>0.316</b> (0.045)	<b>0.344</b> (0.046)	-0.038 (0.124)
Land border	<b>0.684</b> (0.115)	<b>0.780</b> (0.116)	0.235 (0.181)	<b>0.493</b> (0.113)	<b>0.638</b> (0.115)	-0.130 (0.181)
Number landlocked	<b>-0.292</b> (0.036)	<b>-0.215</b> (0.036)	<b>-1.404</b> (0.085)	<b>-0.153</b> (0.035)	-0.046 (0.036)	<b>-1.406</b> (0.097)
Number islands	-0.025 (0.041)	-0.047 (0.042)	<b>0.551</b> (0.096)	0.067 (0.039)	0.062 (0.041)	<b>0.285</b> (0.108)
Log product land area	<b>-0.112</b> (0.009)	<b>-0.131</b> (0.009)	0.040 (0.022)	<b>-0.094</b> (0.009)	<b>-0.123</b> (0.009)	<b>0.103</b> (0.022)
Common colonizer	<b>0.596</b> (0.076)	<b>0.557</b> (0.077)	<b>0.875</b> (0.209)	<b>0.685</b> (0.072)	<b>0.582</b> (0.072)	<b>1.170</b> (0.227)
Currently colonized	<b>1.484</b> (0.353)	<b>1.510</b> (0.361)	0.322 (0.431)	<b>1.205</b> (0.404)	<b>1.111</b> (0.411)	0.587 (0.596)
Ever colony	<b>1.448</b> (0.121)	<b>1.470</b> (0.125)	<b>1.189</b> (0.174)	<b>1.418</b> (0.115)	<b>1.462</b> (0.120)	<b>1.193</b> (0.187)
Common country	-0.740 (1.199)	-0.718 (1.194)	-1.081 (0.720)	-0.200 (1.179)	-0.103 (1.198)	-0.449 (1.044)
Observation	265,408	263,520	84,362	278,048	276,193	80,295
R <sup>2</sup>	0.594	0.589	0.263	0.621	0.608	0.228
RMSE	2.112	2.115	2.957	2.106	2.115	3.247

Notes: Values significant at the 5 percent level are marked in bold. All regressands are in log real values. OLS with year effects (intercepts not reported). Robust standard errors (clustering by country-pairs) are in parentheses.

Table 3: Year Group Panel

	total trade	non-oil trade	oil trade	total trade	non-oil trade	oil trade
	1960s			1960s-1970s		
Both in GATT/WTO	<b>0.354</b> (0.071)	<b>0.753</b> (0.081)	<b>-1.492</b> (0.217)	0.096 (0.066)	<b>0.399</b> (0.069)	<b>-1.335</b> (0.203)
One in GATT/WTO	<b>0.290</b> (0.066)	<b>0.499</b> (0.076)	<b>-0.646</b> (0.206)	<b>0.134</b> (0.063)	<b>0.282</b> (0.066)	<b>-0.429</b> (0.194)
Observation	22,094	21,894	9,996	69,702	69,137	29,610
Both in = 1	8,214	8,187	4,233	29,999	29,891	14,065
One in = 1	10,756	10,655	4,754	32,044	31,747	13,182
	1970s			1960s-1980s		
Both in GATT/WTO	-0.026 (0.081)	<b>0.231</b> (0.079)	<b>-1.233</b> (0.244)	0.051 (0.065)	<b>0.298</b> (0.065)	<b>-1.063</b> (0.194)
One in GATT/WTO	0.056 (0.079)	<b>0.168</b> (0.077)	-0.287 (0.239)	0.066 (0.062)	<b>0.188</b> (0.062)	-0.156 (0.185)
Observation	47,608	47,243	19,614	123,800	123,064	52,261
Both in = 1	21,785	21,704	9,832	56,901	56,763	26,388
One in = 1	21,288	21,092	8,428	55,574	55,185	22,338
	1980s			1970s-1980s		
Both in GATT/WTO	-0.019 (0.090)	0.150 (0.085)	<b>-0.574</b> (0.269)	-0.018 (0.075)	<b>0.193</b> (0.072)	<b>-0.897</b> (0.224)
One in GATT/WTO	-0.029 (0.089)	0.043 (0.084)	0.390 (0.265)	0.012 (0.073)	0.107 (0.070)	0.044 (0.218)
Observation	54,098	53,927	22,651	101,706	101,170	42,265
Both in = 1	26,902	26,872	12,323	48,687	47,498	22,155
One in = 1	23,530	23,438	9,156	44,818	43,052	17,584
	1990s			1970s-1990s		
Both in GATT/WTO	<b>-0.279</b> (0.091)	<b>-0.236</b> (0.087)	<b>-0.660</b> (0.231)	-0.069 (0.065)	0.104 (0.063)	<b>-0.823</b> (0.189)
One in GATT/WTO	<b>-0.299</b> (0.091)	<b>-0.303</b> (0.087)	0.071 (0.232)	-0.043 (0.064)	0.038 (0.061)	0.058 (0.185)
Observation	64,642	64,542	28,815	166,348	165,712	71,080
Both in = 1	42,056	42,003	19,625	90,743	90,579	41,780
One in = 1	20,477	20,436	8,282	65,295	64,966	25,866
				1980s-1990s		
Both in GATT/WTO				-0.129 (0.072)	-0.010 (0.069)	<b>-0.584</b> (0.205)
One in GATT/WTO				-0.130 (0.071)	-0.079 (0.068)	0.253 (0.203)
Observation				118,740	118,469	51,466
Both in = 1				68,958	68,875	31,948
One in = 1				44,007	43,874	17,438

Notes: Values significant at the 5 percent level are marked in bold. All regressands are in log real values. OLS with year effects (intercepts not reported). Regressors not recorded: regional FTA; currency union; log distance; log product real GDP; log product real GDP p/c; common language; land border; number landlocked; number islands; log product land area; common colonizer; currently colonized; ever colony; and common country. Robust standard errors (clustering by country-pairs) are in parentheses.

Table 4: Each GATT Round

	total trade	non-oil trade	oil trade
Dillon to Kennedy Round (1967)			
Both in GATT/WTO	<b>0.308</b> (0.074)	<b>0.674</b> (0.085)	<b>-1.173</b> (0.223)
One in GATT/WTO	<b>0.246</b> (0.070)	<b>0.448</b> (0.082)	<b>-0.519</b> (0.219)
Kennedy to Tokyo Round (1979)			
Both in GATT/WTO	0.100 (0.075)	<b>0.371</b> (0.076)	<b>-1.250</b> (0.238)
One in GATT/WTO	<b>0.152</b> (0.074)	<b>0.267</b> (0.075)	-0.264 (0.235)
Tokyo to Uruguay Round (1994)			
Both in GATT/WTO	0.025 (0.082)	<b>0.177</b> (0.077)	-0.370 (0.242)
One in GATT/WTO	-0.014 (0.081)	0.059 (0.076)	<b>0.493</b> (0.241)
After Uruguay Round			
Both in GATT/WTO	<b>-0.786</b> (0.107)	<b>-0.747</b> (0.103)	<b>-1.523</b> (0.248)
One in GATT/WTO	<b>-0.698</b> (0.108)	<b>-0.701</b> (0.104)	<b>-0.739</b> (0.250)
Observation	188,442	187,606	81,067
R <sup>2</sup>	0.686	0.688	0.304
RMSE	1.738	1.719	3.168

*Notes:* Values significant at the 5 percent level are marked in bold. All regressands are in log real values. OLS with year effects (intercepts not reported). Regressors not recorded: regional FTA; currency union; log distance; log product real GDP; log product real GDP p/c; common language; land border; number landlocked; number islands; log product land area; common colonizer; currently colonized; ever colony; and common country. Robust standard errors (clustering by country-pairs) are in parentheses.

Table 5: Country-Pair-Specific Fixed Effects and Random Effects (GLS)

	Fixed			Random		
	total	non-oil	oil	total	non-oil	oil
Both in GATT/WTO	<b>0.280</b> (0.064)	<b>0.272</b> (0.066)	<b>0.401</b> (0.116)	<b>0.080</b> (0.019)	<b>0.133</b> (0.019)	-0.078 (0.059)
One in GATT/WTO	<b>0.149</b> (0.029)	<b>0.177</b> (0.035)	<b>0.365</b> (0.091)	<b>0.049</b> (0.011)	<b>0.109</b> (0.017)	0.073 (0.055)
Observation	188,442	187,606	81,076	188,442	187,606	81,706
R2	0.874	0.854	0.730	0.678	0.679	0.281
RMSE	1.137	1.343	2.057			
Exports						
Both in GATT/WTO	<b>0.338</b> (0.066)	<b>0.363</b> (0.067)	0.258 (0.148)	<b>0.142</b> (0.024)	<b>0.220</b> (0.024)	<b>-0.346</b> (0.068)
One in GATT/WTO	<b>0.203</b> (0.039)	<b>0.234</b> (0.043)	0.143 (0.111)	<b>0.103</b> (0.022)	<b>0.165</b> (0.022)	<b>-0.262</b> (0.066)
Observation	265,408	263,520	84,362	265,408	263,520	84,362
R2	0.763	0.761	0.587	0.655	0.655	0.258
RMSE	1.646	1.645	2.289			
Imports						
Both in GATT/WTO	<b>0.375</b> (0.067)	<b>0.349</b> (0.066)	<b>0.256</b> (0.127)	<b>0.120</b> (0.023)	<b>0.165</b> (0.023)	<b>-0.181</b> (0.072)
One in GATT/WTO	<b>0.205</b> (0.041)	<b>0.195</b> (0.044)	<b>0.261</b> (0.105)	<b>0.077</b> (0.021)	<b>0.101</b> (0.021)	0.062 (0.069)
Observation	278,048	279,193	80,295	278,048	276,193	80,295
R2	0.781	0.774	0.573	0.666	0.666	0.229
RMSE	1.631	1.636	2.498			

*Notes:* Values significant at the 5 percent level are marked in bold. All regressands are in log real values. Regressors not recorded: regional FTA; currency union; log product real GDP; log product real GDP p/c; and currently colonized for fixed effects, and regional FTA; currency union; log distance; log product real GDP; log product real GDP p/c; common language; land border; number landlocked; number islands; log product land area; common colonizer; currently colonized; ever colony; and common country for random effects. Robust standard errors are in parentheses.

## Appendix 1: Descriptive Statistics

Variable	Mean	Std. Dev.	Min	Max
Total trade	10.24475	3.102352	1.142141	20.78767
Non-oil trade	10.10388	3.075641	0.7472053	20.76191
Oil trade	7.901276	3.795315	-.6188197	18.48548
Total exports	10.39647	3.315233	1.113065	20.92283
Non-oil exports	10.29186	3.296713	1.113065	20.8878
Oil exports	8.214212	3.445192	0.9317976	19.16744
Total imports	10.29974	3.420388	1.111091	20.90504
Non-oil imports	10.12535	3.378196	1.111091	20.85751
Oil imports	8.865129	3.693293	0.8395782	19.19648
For Total trade				
Both in GATT/WTO	0.5123425	0.4998488	0	1
One in GATT/WTO	0.4105334	0.4919317	0	1
GSP	0.2520733	0.4342041	0	1
Log Distance	8.167325	0.8070344	3.782556	9.421514
Log Product real GDP	47.91051	2.712081	35.3876	59.08996
Log Product real GDP p/c	16.08825	1.518596	9.716514	21.59728
Regional FTA	0.0157555	0.1245283	0	1
Currency Union	0.0136055	0.1158467	0	1
Common language	0.2214726	0.4152388	0	1
Land border	0.0296164	0.1695269	0	1
Number landlocked	0.2538007	0.4719696	0	2
Number islands	0.3460117	0.5429116	0	2
Log product land area	24.10709	3.311855	9.638662	32.76884
Common colonizer	0.1052221	0.3068401	0	1
Currently colonized	0.0013466	0.0366717	0	1
Ever colony	0.019382	0.1378639	0	1
Common country	0.0002925	0.0171014	0	1

Appendix 2: Correlation between DOT and COMTRADE trade data

	DOT log real trade	COMTRADE log real trade	DOT real trade	COMTRADE real trade
log real trade (DOT)	1.000			
log real trade (COMTRADE)	0.966	1.000		
real trade (DOT)	0.249	0.252	1.000	
real trade (COMTRADE)	0.248	0.252	0.999	1.000

observations: 188,442

Appendix 3: Selections Problem (Year & Country between DOT and COMTRADE data)

	DOT data	DOT data match with	
		total UN data	non-oil UN data
<hr/>			
1948-1999*			
Both in GATT/WTO	-0.042 (0.053)		
One in GATT/WTO	-0.058 (0.049)		
Observation	234,597		
<hr/>			
1962-1999**			
Both in GATT/WTO	-0.072 (0.060)		
One in GATT/WTO	-0.080 (0.057)		
Observation	215,354		
<hr/>			
1962-1999***			
Both in GATT/WTO		-0.062 (0.058)	-0.042 (0.058)
One in GATT/WTO		-0.042 (0.056)	-0.024 (0.055)
Observation		188,442	187,606

*Notes:* None of these are significant at 5 percent level. OLS with year effects. All regressands are in log real values of DOT data. OLS with year effects (intercepts not reported). Regressors not recorded: regional FTA; currency union; log distance; log product real GDP; log product real GDP p/c; common language; land border; number landlocked; number islands; log product land area; common colonizer; currently colonized; ever colony; and common country. Robust standard errors (clustering by country-pairs) are in parentheses. \* denotes whole data set of DOT (Rose, 2004a). \*\* denotes 1962-1999 period of DOT data set. \*\*\* denotes during the 1962-1999 period for DOT data, we also drop the observations which are not available at COMTRADE data (total and non-oil trade).

#### Appendix 4: Description of Oil Products (SITC Revision 1)

Code	Name and Description
33	Name: Petroleum and petroleum products Description: Petroleum and petroleum products
331	Name: Petroleum, crude and partly refined Description: Petroleum, crude and partly refined
3310	Name: Petroleum, crude & partly refined Description: Petroleum, crude & partly refined
33101	Name: Crude petroleum
33102	Name: Petroleum, partly refined (incl. topped crudes) Description: Petroleum, partly refined (incl. topped crudes)
332	Name: Petroleum products Description: Petroleum products
3321	Name: Motor spirit, gasoline and other light oils Description: Motor spirit, gasoline and other light oils
3322	Name: Lamp oil and white spirit Description: Lamp oil and white spirit
3323	Name: Distillate fuels Description: Distillate fuels
3324	Name: Residual fuel oils Description: Residual fuel oils
3325	Name: Lubricating oils and greases Description: Lubricating oils and greases
33251	Name: Lubricating prep. cont.>70% by weight of petr. Description: Lubricating prep. cont.>70% by weight of petr.
33252	Name: Lubricating prep. cont.<70% by weight of petr. Description: Lubricating prep. cont.<70% by weight of petr.
3326	Name: Mineral jelly and waxes incl. petrolatum Description: Mineral jelly and waxes incl. petrolatum
33261	Name: Petroleum jelly (petrolatum) Description: Petroleum jelly (petrolatum)
33262	Name: Mineral waxes Description: Mineral waxes
3329	Name: Pitch, resin, petroleum asphalt etc. Description: Pitch, resin, petroleum asphalt etc.

Appendix 5: List of the Countries in Sample  
(Dates of GATT/WTO accession in parenthesis)

Albania (2000)	Dominican Rep. (1950)	Luxembourg (1948)	Spain (1963)
Algeria	Ecuador (1996)	Macedonia (2003)	Sri Lanka (1948)
Angola (1994)	Egypt (1970)	Madagascar (1963)	St. Kitts & Nevis (1994)
Antigua and Barbuda (1987)	El Salvador (1991)	Malawi (1964)	St. Lucia (1993)
Argentina (1967)	Equatorial Guinea	Malaysia (1957)	St. Vincent & Grenada (1993)
Armenia (2003)	Estonia (1999)	Maldives (1983)	Sudan
Australia (1948)	Ethiopia	Mali (1993)	Suriname (1978)
Austria (1951)	Fiji (1993)	Malta (1964)	Sweden (1950)
Azerbaijan	Finland (1950)	Mauritania (1963)	Switzerland (1966)
Bahamas	France (1948)	Mauritius (1970)	Syria
Bahrain (1993)	Gabon (1963)	Mexico (1986)	Tajikistan
Bangladesh (1972)	Gambia (1965)	Moldova (2001)	Tanzania (1961)
Barbados (1967)	Georgia (2000)	Mongolia (1997)	Thailand (1982)
Belarus	Germany (1951)	Morocco (1987)	Togo (1964)
Belgium (1948)	Ghana (1957)	Mozambique (1992)	Tonga
Belize (1983)	Greece (1950)	Nepal (2004)	Trinidad & Tobago (1962)
Benin (1963)	Grenada (1994)	Netherlands (1948)	Tunisia (1990)
Bermuda	Guatemala (1991)	New Zealand (1948)	Turkey (1951)
Bhutan	Guinea (1994)	Nicaragua (1950)	Turkmenistan
Bolivia (1990)	Guinea-Bissau (1994)	Niger (1963)	Uganda (1962)
Brazil (1948)	Guyana (1966)	Nigeria (1960)	Ukraine
Bulgaria (1996)	Haiti (1950)	Norway (1948)	United Arab Emirates (1994)
Burkina Faso (1963)	Honduras (1994)	Oman (2000)	United Kingdom (1948)
Burma(Myanmar) (1948)	Hong Kong (1986)	Pakistan (1948)	United States (1948)
Burundi (1965)	Hungary (1973)	Panama (1997)	Uruguay (1953)
Cambodia (2004)	Iceland (1968)	Papua N. Guinea (1994)	Uzbekistan
Cameroon (1963)	India (1948)	Paraguay (1994)	Vanuatu
Canada (1948)	Indonesia (1950)	Peru (1951)	Venezuela (1990)
Cape Verde	Iran	Philippines (1979)	Vietnam
Central African Rep. (1963)	Iraq	Poland (1967)	Yemen, Republic of
Chad (1963)	Ireland (1967)	Portugal (1962)	Yugoslavia, Socialist Fed. R. (1966)
Chile (1949)	Israel (1962)	Qatar (1994)	Zambia (1982)
China (2001)	Italy (1950)	Reunion	Zimbabwe (1948)
Colombia (1981)	Jamaica (1963)	Romania (1971)	
Comoros	Japan (1955)	Russia	
Congo, Dem. Rep. of (Zaire) (1971)	Jordan (2000)	Rwanda (1966)	
Congo, Rep. (1963)	Kazakhstan	Samoa	
Costa Rica (1990)	Kenya (1964)	Sao Tome & Principe	
Cote D'Ivoire (Ivory Coast) (1963)	Kiribati	Saudi Arabia	
Croatia (2000)	Korea, South (R) (1967)	Senegal (1963)	
Cyprus (1963)	Kuwait (1963)	Seychelles	
Czech Republic (1993)	Kyrgyz Republic (1998)	Sierra Leone (1961)	
Denmark (1950)	Lao People's Dem. Rep.	Singapore (1973)	
Djibouti (1994)	Latvia (1999)	Slovak Republic (1993)	
Dominica (1993)	Lebanon	Slovenia (1994)	
	Liberia	Solomon Islands (1994)	
	Libya	Somalia	
	Lithuania (2001)		

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