

HAVE ECONOMISTS ACTUALLY SOLVED THE WTO TRADE EFFECTS MYSTERY?

By

CHANGYOU WEI

B.S., HUNAN UNIVERSITY, 2011

A REPORT

submitted in partial fulfillment of the requirements for the degree

MASTER OF ARTS

Department of Economics  
College of Arts and Sciences

KANSAS STATE UNIVERSITY  
Manhattan, Kansas

2012

Approved by:

Major Professor  
Peri da Silva

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CHANGYOU WEI

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## **Abstract**

Rose (2004) reports that GATT/WTO membership produces no positive effects on international trade. This is a remarkable determination given the widespread belief in academic and policy circles that the WTO successfully promotes trade flows by reducing barriers to international trade. Empirical literature measuring the GATT/WTO trade effects has produced notably diverse results since Rose's (2004) paper. This report introduces the history of GATT/WTO and describes the GATT/WTO's aim to promote trade using multilateral rounds of trade negotiations. It confirms that the efforts toward trade liberalization made by the GATT/WTO are partially achieved by tariff reductions and other trade obligations. In discussing the literature related to Rose's surprising results, we argue that the gravity model employed by Rose (2004) is not theoretically sound since it omits multilateral resistance terms and fails to capture unobserved bilateral heterogeneity. However, we find that even an accurate specification gravity model that controls multilateral resistance, unobserved bilateral heterogeneity, and individual regional trade agreement effect cannot fully account for Rose's GATT/WTO trade effects findings. The present report suggests that a new approach, specifically the nonparametric method used by Chang and Lee (2011), may offer sound guidance for future research attempting to understand Rose's mysterious findings.

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## **Acknowledgements**

I would like to thank my Major Professor, Dr. Peri da Silva, for his continuous support, patience, and useful guidance in this report. I was delighted to have Dr. Leilei Shen and Dr. Lance Bachmeier on my supervisory committee. I thank them for their comments and encouragement. I would also thank Kansas State University and its Economics Department for providing the opportunity to write this report. Last, but not least, I want to thank my family and friends for their unconditional love and support.

## Chapter 1 - Introduction

The General Agreement on Tariffs and Trade (GATT) and its successor the World Trade Organization (WTO)—probably the most popular multilateral organization—exist to further world trade liberalization. Currently, the WTO has 157 members and 26 observers, which represent a significant growth in terms of membership given the GATT/WTO had only 23 members in 1947. Meanwhile, global trade flows have increased at a rate higher than the growth rate of merchandise output. According to *World Trade Report 2012*, the average export growth rate from 1991-2011 was 5.4% while the average output growth rate was 3.2% (WTO 2012, p. 19-20).

The facts above seem to be consistent with trade agreement theory that argues an effective trade agreement generates gains from trade liberalization by reducing trade barriers among contracting parties (Krugman, Obstfeld and Melitz 2010, p.235; Bagwell and Staiger 2002, p. 13). However, empirical literature measuring the trade effects of GATT/WTO membership has shown surprisingly ambiguous results. Rose (2004) employed a standard gravity model and a large panel dataset covering over 50 years and 175 countries to analyze whether GATT/WTO member countries experience significantly higher trade than that of outsiders. Unexpectedly, his work showed little evidence that membership in GATT/WTO has had a strong positive effect on international trade. Rose (2004, p.112) described his negative findings as an “interesting mystery.” His paper caused a long-term debate within the profession. With Rose’s findings in mind, the purpose of this report is to evaluate the GATT/WTO trade effects from a historical and empirical perspective, to explain the sources of the divergent conclusions of economists since Rose, and to provide an objective assessment of the literature.

The remainder of this report is organized as follows: Chapter 2 describes the GATT/WTO efforts on trade liberalization in history and its universal principles in trade negotiation. The theoretical foundations of gravity model, including the cases with and without trade barriers, are introduced in Chapter 3. Chapter 4 examines Rose's (2004) and other economists' empirical work on GATT/WTO trade effects, and describes these economists' attempts at understanding Rose's GATT/WTO trade effects findings. Chapter 5 concludes with final comments and recommendations.

## **Chapter 2 - WTO Trade Effects in Historical Perspective**

One way to understand whether GATT/WTO promotes international trade is through what GATT/WTO has done in its history. Therefore, in this chapter, we briefly describe the history and design of GATT/WTO. Moreover, we attempt to clarify that the efforts made by the GATT/WTO on trade liberalization are partially achieved by tariff reductions and other trade obligations through multilateral trade negotiations under some universal principles with which GATT/WTO complied.

### **2.1 GATT/WTO Efforts on Trade Liberalization**

#### ***2.2.1 The Design of GATT***

The origin of GATT dates back to trade-policy choices made by governments in the 1920s and 1930s. The foundations of economic liberalism, badly shaken by World War I, were all but demolished by the Great Depression (Hudec 1975, p. 5). In 1930, the United States enacted the Smoot-Hawley Tariff Act to raise U.S import tariffs to its record levels, which led a large numbers of U.S. trading partners to raise their tariffs in retaliation. Ultimately, the post-



Smoot-Hawley tariff rates for major powers were generally on the order of 50 percent (Bagwell and Staiger 2002, p. 43).

As Hudec (1975, p. 4) claimed, “[t]he postwar design for international trade policy was animated by a single-minded concern to avoid repeating the disastrous errors of the 1920’s and 1930’s.” Two important lessons were absorbed by the disastrous errors. One was the conclusion that the policy of trade restriction and discrimination had been proven wrong. The other was drawn about the institutional features of international cooperation (Hudec 1975, p. 5-6).

Responding to these lessons, the major initiatives leading to the establishment of the GATT were taken by the United States during World War II, in cooperation with its allies, particularly the United Kingdom (Jackson 1997, p. 35). In 1945, the U.S. government invited a number of nations to negotiate to a multilateral agreement for the mutual reduction of tariffs (Jackson 1997, p. 36). Through a series of informal conferences, the trade experts canvassed most of the leading problems: quantitative restrictions, subsidies, export taxes, state trading, discrimination, and tariff reduction (Hudec 1975, p. 8). These trade issues confronting governments offered basic directions for GATT negotiations.

Before the design of GATT, the United States had reached some bilateral trade agreements under the Reciprocal Trade Agreements Act of 1934. The success of these bilateral trade agreements have proven that reciprocal tariff reductions could promote mutual gains (Bagwell and Staiger 2002, p. 46). The United States thus attempted to organize a multilateral institution that would build on the fundamental elements of the Reciprocal Trade Agreements Act. Negotiations began concerning the formation of an International Trade Organization (ITO) in 1946 (Jackson 1997, p. 37). The ITO would stipulate the rules under which multilateral negotiations would progress, as well as the manner in which these rules would be enforced.

Tariffs were to be lowered in reciprocal and mutually advantageous agreements, and the reduced tariffs would then be extended to all member countries through the nondiscrimination principle. Nevertheless, the ITO was never ratified by the US Congress and some other countries. One reason might be, as suggested by Hudec (1975, p. 54), that “the ITO had focused on its provisions in areas other than trade policy.”

In 1947, an interim agreement was reached. This agreement was known as the General Agreement on Tariffs and Trade (GATT), and it was drawn directly from ITO principles and obligations since it had been settled for some time that the General Agreement would be absorbed into the ITO when it came into force (Hudec 1975, p. 45). Compared to the ITO Charter, “GATT was narrower, more tentative, and made fewer of wrong concessions” (Hudec 1975, p. 54). The narrow focus of the GATT served the process of trade liberalization, and the Agreement was originally framed as a “provisional trade agreement” in order to help some governments evade domestic ratification procedures (Hudec 1975, p. 46).

The purpose of the GATT, as stated in its preamble, is to contribute to “[r]aising standards of living, ensuring full employment and a large and steadily growing volume of real income and effective demand, developing the full use of the resources of the world and expanding the production and exchange of goods” by “[e]ntering into reciprocal and mutually advantageous arrangements directed to the substantial reduction of tariffs and other barriers to trade and to the elimination of discriminatory treatment in international commerce.” Although “free trade” was never directly mentioned as an objective of GATT, measures that reduced tariff and non-tariff barriers indeed promoted trade liberalizing, and it was embraced in trade negotiation rounds sponsored by GATT.

### 2.1.2 GATT/WTO Trade Negotiation Rounds

The efforts of GATT to boost trade were primarily through a series of trade negotiation rounds. Since its creation in 1947, eight rounds of trade negotiations had taken place. The first five of these rounds were devoted almost exclusively to tariff negotiations. The sixth round, the Kennedy Round, had as one of its goals the negotiation of non-tariff measure obligations but succeeded only in a limited way to achieve this goal. The seventh round, the Tokyo Round, was devoted more to non-tariff measures than to tariffs (Jackson 1997, p. 74).

In the history of GATT, the most resounding success has undoubtedly been the reduction of tariff levels among the contracting parties. Table 1 shows the scope and success of the tariff-reducing activity of GATT.

**Table 1 Scope and success of the tariff-reducing activity of GATT**

Round	Dates	Number of countries	Value of trade covered	Average tariff cut	Average tariffs afterward
Geneva	1947	23	\$10 billion	35%	“not available”
Annecey	1949	33	Unavailable	35%	“not available”
Torquay	1950	34	Unavailable	35%	“not available”
Geneva	1956	22	\$2.5 billion	35%	“not available”
Dillon	1960-61	45	\$4.9 billion	35%	“not available”
Kennedy	1962-67	48	\$40 billion	35%	8.7%
Tokyo	1973-79	99	\$155 billion	34%	6.3%
Uruguay	1986-94	120+	\$3.7 trillion	38%	3.9%

Source: Jackson 1997, p. 74

Note: the tariff averages refer to tariffs on non-primary products of industrial countries

According to Table 1, we know that after the Kennedy Round, the average tariff rates of industrial countries were just 8.7%, and the total value of trade covered after six rounds was more than 55 billion dollar (without accounting for two missed data). Moreover, the average

tariff cut in each negotiation round was 35%. The evidence shown above proved that the GATT succeeded with tariff reduction.

Although the GATT might have its primary significance in the field of tariffs, non-tariff barriers to trade were not ignored. A closer glance at the last two rows of Table 1 shows that the number of countries in the Tokyo Round was twice than that of the Kennedy Round, while the value of trade covered increased almost fourfold. The achievement happened because of not only tariff reduction measures, but also non-tariff barriers negotiation in Tokyo Round. The Tokyo Multilateral trade negotiation resulted in nine special agreements and four “understandings” to deal with non-tariff barriers (Jackson 1997, p. 76). These agreements and “understandings” included technical barriers to trade, government procurement, subsidies, and antidumping duties as well as some exception causes. Even though some important problems remained, such as the liberalization process of agriculture and textiles, new trade-policy issues including services, trade-related investment, and intellectual property and other trade issues, the overall impact of these results was to substantially broaden the GATT system’s scope of coverage (Jackson 1997, p. 76).

These problems mentioned above were addressed in the GATT Uruguay Round, an extraordinarily ambitious round that lasted from 1986 to 1994. It was the largest trade negotiation in history and its negotiating agenda covered every outstanding trade policy issue (WTO 2011, p. 18). In this round, governments achieved some success in the liberalization of agricultural and textile goods, extended the trade system into several new areas, including services, trade-related investment, and intellectual property, and eventually developed a full-fledged international trade organization-World Trade Organization (WTO), which brought the failed attempt in 1948 to create an International Trade Organization (ITO) to reality.

The agreement establishing the WTO is the umbrella that embraces all parts of the detailed texts (Jackson 1997, p. 47). The WTO inherited the rules and agreements made in the preceding GATT negotiations. Furthermore, the WTO has an explicit organization charter that “defines various committees, bodies, and councils, as well as the duties of and relationships between these groups” (Bagwell and Staiger 2002, p. 47). Although the WTO Charter is a mere ten pages long, it has four very important annexes, which contain all the other negotiated texts of the Uruguay Round (WTO 1995, p. 9). Finally, an important innovation associated with the WTO is a unified dispute-settlement system. The system, which is essential to the functioning of the multilateral trading system, offers an external enforcement mechanism to punish GATT/WTO violations (Bagwell and Staiger 2002, p. 52).

No matter how many trade issues were involved in the Uruguay Round, it was impossible to settle the issues once and for all. The General Agreement on Trade in Services (GATS) was developed as a sort of framework agreement for the entire landscape of services trade, which leaves a great deal unresolved, in some cases calling for specific ongoing negotiations (Jackson 1997, p. 307). The agricultural agreement has lowered the amount of export subsidies, but eliminating it altogether has proven impossible (Jackson 1997, p. 316). The agreement on trade-related investment includes an Annex with an “illustrative list” of items are inconsistent with the obligation of national treatment (Jackson 1997, p. 317). These problems and other issues without mention required additional negotiation rounds, which began in 2001 in the Doha Round.

One might wonder whether the GATT was a success. In retrospect, its success in promoting and securing world trade liberalization is indisputable. Continual reductions in tariffs to such a low level have helped spur world trade growth. The rush of new members during the

Uruguay Round demonstrated that the multilateral trading system was acknowledged as an anchor for development and an instrument of economic and trade reform (WTO 2011, p. 17).

However, some gaps have undermined GATT's credibility and effectiveness. A series of economic recessions in the 1970s and early 1980s propelled governments to contrive other forms of protection for sectors facing increased foreign competition (WTO 2011, p. 17). The trade-rule system of the GATT did not have a very effective enforcement mechanism to punish violations (Dam 1970, p. 80). Moreover, in order to raise the standards of living and to continue the progressive development of the economies of developing countries, many provisions including Article XVIII and the Articles in part IV in GATT allowed differential treatment for developing countries. These privileges included, among others, permission for 1) using that quantitative restriction to combat payment imbalances and protecting infant industries and 2) less-developed countries no longer to be required to offer "reciprocity" in tariff negotiations with developed countries (Jackson 1997, p. 319-22; Dam 1970, p. 225-55). Some new trade issues that have not been discussed were never covered in the provisions of the GATT to solve trade distortions.

One may expect that under the WTO, most of the institutional and legal problems of the GATT would have been corrected or at least improved; yet, a key question is whether the new charter for the WTO will allow the organization to efficiently adapt. Every treaty will require attention to various interpretive difficulties, due to unforeseen ambiguities or compromises in the drafting process. Furthermore, some important new subjects, such as environmental protection, competition policy, and trade-related investment might not necessarily be acceptable to all members of the very large WTO. Additionally, responding to a strong regionalism movement in the last two decades, many regional organizations have developed, which might cause challenges to the multilateral WTO (Jackson 1997, p. 343-45).

## **2.2 Trade Negotiation Principles in GATT/WTO**

Given that before the GATT/WTO acted, to some extent, as an effective agreement, one might wonder what measures members had to take to guarantee that every member would gain from trade through the agreement. To answer this question, we next probe into the fundamental principles—reciprocity, nondiscrimination, and enforcement—by which all GATT/WTO abided. These principles are the foundation of the multilateral trading system.

### ***2.2.1 Reciprocity***

The term “reciprocity” refers broadly to “the ideal of mutual changes in trade policy which bring about changes in the volume of each country’s imports that is of equal value to changes in the volume of its exports” (Bagwell and Staiger 2002, p. 57). A more basic understanding is that mutual changes in trade policy that conform to the principle of reciprocity leave the world price unchanged. Ethier (2004, p. 9) pointed out that when governments negotiate for trade agreement, they should realize all bargaining, whether bilateral or multilateral, will involve reciprocal liberalization. It offered an existent rationale for the GATT/WTO to weigh heavily the importance of the reciprocity principle.

Two applications of reciprocity are associated within GATT/WTO practice. The first reflects that governments seek a “balance of concessions and obligations” through a negotiated agreement (Jackson 1997 p. 113). Dam (1970, p. 59) explained that under the language of Article XXVIII bis, negotiations are voluntary and are to be conducted on a “reciprocal and mutually advantageous basis,” the manner that makes trade negotiation among governments more likely to occur. The second application concerns the manner in which trade agreements may be renegotiated (Bagwell and Straiger 2002, p. 65). They further explained that:

Under GATT Article XXVIII, a country might propose to modify or withdraw a concession agreed upon in a previous round of negotiation. In the case, if the country and its trading partner are unable to reach agreement regarding a renegotiated tariff structure, then the country is free to carry out the

proposed changes anyway. The notion of reciprocity is then used to moderate the response of the country's trading partner, who is permitted to withdraw substantially equivalent concessions of its own.

In sum, the principle of reciprocity acts as an implicit but significant precondition for countries to seek negotiations or renegotiations to reach the "balance of concessions and obligations" goal.

### ***2.2.2 Nondiscrimination***

Nondiscrimination has two major components: the most-favored-nation (MFN) rule, and the national treatment principle. The MFN rule has been a central pillar of bilateral and multilateral trade policy for centuries (Irwin 1993). The MFN rule holds that "it is an obligation to treat activities of a particular foreign country or its citizens at least as favorably as it treats the activities of any other country" (Jackson 1997, p. 160). For example, under MFN, if a trading partner supplying a specific product is granted a 5 percent tariff, this rate must be applied immediately and unconditionally to imports of this good originating from all WTO members.

Several economic policy arguments in favor of MFN are evident. First, nondiscrimination can have the salutary effect of minimizing distortions of the market principles that motivate many arguments in favor of liberal trade. Second, MFN often causes a generalization of liberalizing trade policies, so that overall more trade liberalization occurs. Third, MFN's provision of general rules applicable to all participating nations minimizes the costs of rules formation, such as the difficulty of negotiating a multitude of bilateral agreements. Finally, MFN helps minimize transaction costs, because customs officials at the border may not need to ascertain the "origin of goods" to carry out their tasks with respect to goods controlled by MFN (Jackson 1997, p. 159).



The national treatment principle, expressed primarily in Article III of GATT, requires the treatment of imported goods, once they have cleared customs and border procedures, to be no worse than that of domestically produced goods (Jackson 1997, p. 213). This rule obviously prevents domestic tax and regulatory policies from being used as protectionist measures that would defeat the purpose of tariff bindings. The national treatment rule is very wide-ranging. For example, the obligation applies whether or not a specific tariff commitment was made, and it covers taxes and other policies, which must be applied in a nondiscriminatory fashion to domestic and foreign products alike.

Despite the policies and legal obligations that support the nondiscrimination principle, substantial departures in international trade practice are evident. Kostecki (1987, p. 429) estimated that 25 percent of all world trade moves under some form of discriminatory regime that departs from MFN principles. Many loopholes and exceptions are exploited to create discriminations, among them classifications of tariff items, existence of general and security exceptions, escape clause, safeguards, and government purchases (Jackson 1997, p. 163-64, 214-28). One of the most prominent and difficult problems is found in Article XXIV, which provides exceptions for customs unions (CUs), free trade areas (FTAs), and interim agreements leading to either. This article has opened significant loophole for a wide variety of preferential agreements (Jackson 1997, p. 165). Some of these violations of nondiscrimination principle, to some degree, cripple the effectiveness of GATT/WTO's liberalization of trade.

### ***2.2.3 Enforcement***

While it is often observed that the principles of reciprocity and nondiscrimination are the pillars of GATT/WTO, the enforcement mechanisms compose the heart of the GATT/WTO system. Trade liberalization agreements have little value if they cannot be enforced. The

enforcement mechanisms can be divided into three basic elements: substantive obligations, permissible exceptions to those obligations, and dispute settlement procedures (Bagwell and Straiger 2002, p. 48).

As Jackson (1997, p. 51) explains, the substantive obligations contained in GATT can be generalized to three groups. One group is tariff commitments, including Article II and XXVIII bis, which form the “bindings” that the actual tariff is not to exceed the bound duty rate. The second group is MFN treatment (Article I) discussed above. The final is a series of other commitments that together represent a “code of conduct” regarding government behavior in the international-trade arena. This includes national treatment (Article III), anti-dumping and countervailing duties (Article VI), customs valuation and procedures (Articles VII, VIII, and X), marks of origin (Article IX), quantitative restrictions (Article XI), subsidies (Article XVI), and state-trading monopolies (Article XVII). The “code of conduct” and other obligations build the framework of GATT trade policy commitments.

The exceptions in GATT seem to be a controversial issue. On the one hand, they weaken the validity of the enforcement systems, but on the other hand, the inclusion of exceptions are necessary given the economic nature of tariff concessions and the domestic political sensitivity inherently involved in trade issues. A system that prohibiting exceptions would tend to discourage the making of concessions in the first place (Dam 1970, p. 80). The permissible exceptions thus act as “safeguards” that are designed to encourage tariff commitments and confidence in the GATT/WTO system (Bagwell and Straiger 2002, p. 50).

One of the great achievements of the Uruguay Round is the development of a unified dispute settlement system for all parts of the GATT/WTO’s system, including the new subjects of services and intellectual property. The dispute settlement procedures provide an external

enforcement mechanism to punish GATT/WTO violations. The central components of GATT/WTO dispute settlement system evolved through GATT/WTO practice with reference to the provisions contained in Articles XXII and XXIII. Article XXII calls for bilateral consultations when disputes arise, while Article XXIII (“Nullification or Impairment”) is the real centerpiece of the GATT/WTO dispute settlement process, as it defines the circumstances under which the actions by one country serve to “nullify or impair” the benefits expected under the agreement by another country (Jackson 1997, p. 115).

The GATT/WTO procedure for settling disputes involves three stages: consultation between or among the members in the dispute; investigation, ruling and recommendation by a GATT/WTO panel; and as a last resort, authorization for one or more countries to suspend GATT/WTO obligations against another. In practice, the greatest emphasis has been placed on consultation and negotiation rather than on retaliation. The threat of authorized retaliation is often the catalyst of resolution in the consultation and negotiation stage (Bagwell and Straiger 2002, p. 54).

In summary, the principles of reciprocity and nondiscrimination incentivise participation in multilateral trade negotiations under GATT/WTO and motivate the creation of mutually effective and financially beneficial trade agreements. The principle of enforcement guarantees that the achievements of the GATT/WTO are not undermined by GATT/WTO violations. All are of particular importance in maintaining the effectiveness of GATT/WTO.

## **Chapter 3 - The Gravity Model in Trade Effect Analysis**

As the previous section elucidates, the WTO may have served as an effective multilateral trade agreement by reducing, in particular, formal tariff barriers through different multilateral rounds of trade negotiations. However, Rose (2004) was not able to identify positive GATT/WTO trade effects under his empirical strategy. Since Rose's (2004) methodology is based on the popular gravity model of international trade, we describe the theoretical results related to the gravity model in this section. We leave the discussion of using the gravity model to ascertain the WTO trade effects for the next Section.

### **3.1 Literature Review**

The gravity model has a long track record of success in that it provides economically and statistically significant effects while explaining most variation in trade (Frankel 1997). It was first developed by Tinbergen (1962) and Poyhonen (1963) with only intuitive justification. In its basic form, the amount of trade between two countries is assumed to be increasing in size, as measured by their national incomes, and decreasing in the cost of transport between them, as measured by the distance between the two countries. Linnemann (1966) augmented the basic form of the gravity model and included more explanatory variables. However, despite the gravity model's empirical success in explaining trade flows, the model's predictive potential has been inhibited by the absence of strong theoretical foundations (Bergstrand 1985). Consequently the gravity model was neglected from the late 1960s to the late 1980s.

New theoretical foundations for the gravity model have been proposed with the advent of trade theories based on 1) increasing returns to scale, imperfectly competitive markets, firm-level product differentiation, and 2) within a perfect competition situation, along with product differentiation at the national level (Carrere 2006). Anderson (1979) was the first to derive the

gravity equation from models that assumed product differentiation using constant-elasticity-of-substitution (CES) preferences, also called the Armington assumption, which assumes that products were differentiated by country of origin. Anderson's primary concern was to examine the econometric properties of the resulting equations rather than to extract easily interpretable theoretical implications. Bergstrand (1985), like Anderson, used CES preferences over differentiated goods to derive a reduced form of gravity equation for bilateral trade involving price indexes. Moreover, Bergstrand (1989) assumed monopolistic competition in a two-sector economy in which monopolistically competitive sectors had different relative factor intensities. This implies that his model derives a general version of the gravity model that "fit in" with the Heckscher-Ohlin model of inter-industry trade and the Helpman-Krugman-Markusen models of intra-industry trade". Deardorff (1998) has derived the gravity equation from classical theories of the Heckscher-Ohlin framework under perfect competition assumption. These contributions built the theoretical foundations of the gravity model for empirical analysis.

### 3.2 The Gravity Model without Trade Barriers

In international trade, bilateral gross aggregate trade flows are commonly explained by using the following specification:

$$X_{ij} = \beta_0 (Y_i)^{\beta_1} (Y_j)^{\beta_2} (D_{ij})^{\beta_3} (A_{ij})^{\beta_4} \mu_{ij} \quad (3.1)$$

Where  $X_{ij}$  is the value of the trade flow from country  $i$  to country  $j$ ,  $Y_i (Y_j)$  is the value of nominal GDP in  $i (j)$ ,  $D_{ij}$  is the distance from the economic center of  $i$  to that of  $j$ ,  $A_{ij}$  is any other factor(s) either aiding or resisting to trade between  $i$  and  $j$ , and  $\mu_{ij}$  is a log-normally distributed error term with  $E(\ln \mu_{ij}) = 0$ . This specification was used in Tinbergen (1962), Poyhonen (1963) and other researchers during 1960s and 1970s (Bergstrand 1985). A simpler

version of the gravity equation can be derived from under the assumption of free trade, so that all countries have identical prices. This deriving process based on Feenstra (2004) is explained next.

First, we assume that countries are specialized in different varieties of a final product. We also assume the consumer preference is identical and homothetic across countries and that trade is free (no tariffs or transport costs). Then it follows that a good produced in any country is sent to all other countries in proportion to the purchasing country's income. Now we consider a multi-country framework where  $i, j = 1, \dots, I$  denotes countries, and  $k = 1, \dots, N$  denotes products (any variety of a good counts as a distinct product). Let  $y_{ki}$  denote country  $i$ 's production of good  $k$ . Since prices are the same across all countries, we normalize them to unity, so  $y_{ki}$  actually

measures the value of production. The total income in each country is measured by  $y_i = \sum_{k=1}^N y_{ki}$ ,

and world income is  $y^W = \sum_{i=1}^I y_i$ .

Let  $s_j$  denote country  $j$ 's share of world expenditure. Assuming that trade is balanced in each country, the  $s_j$  also denotes country  $j$ 's share of world GDP, so that  $s_j = y_j / y^W$ . Then under the assumptions that all countries are producing different products and the consumer preference is identical and homothetic, the exports from country  $i$  to county  $j$  of product  $k$  are given by:

$$x_{kij} = s_j y_{ki} \quad (3.2)$$

Summing over all products  $k$ , we obtain:

$$x_{ij} = \sum_{k=1}^N x_{kij} = s_j \sum_{i=1}^I y_{ki} = s_j y_i = \frac{y_j y_i}{y^W} = s_j s_i y^W = x_{ji} \quad (3.3)$$

Summing the first and last of these terms, we therefore find that bilateral trade between two countries equals,

$$x_{ij} + x_{ji} = \left( \frac{2}{y^w} \right) y_i y_j \quad (3.4)$$

This gives our simplest derivation of the gravity equation, where the bilateral exports from country  $i$  to country  $j$  are proportional to the product of their GDP's. Next, we will loosen the assumption of free trade and allow for differing prices due to trade barriers between countries. Doing so proves important when we apply it for empirical analysis in Section 4.

### **3.3 The Gravity Model with Trade Barriers**

When there are trade barriers, such as transport costs or tariffs, it is no longer the case that prices are equalized across countries, and then the gravity equation (3.4) has to be augmented by certain variables as we discuss below. Thus, the estimation based on the gravity equation (3.4) may suffer from severe omitted variables bias. Now we introduce a new version of the gravity model that was built by Anderson and van Wincoop (2003), who used it to solve the famous border puzzle of McCallum (1995), which found trade volume between Canadian provinces to be substantially larger (a factor of 22 [2,200%]) than across the border with the United States after controlling for the usual determinants of bilateral trade, such as size and distance in the gravity model.

Base on the assumptions of Bergstrand (1989) and Deardoff (1998) by the CES preference and Heckscher-Ohlin structure under perfect competition situation along with product differentiation at the national level, Anderson and van Wincoop (2003, p. 174) first assume that all goods are differentiated by place of origin and each country is specialized in the production of only one good. The supply of each good is fixed.

They also assume identical, homothetic preferences, approximated by a CES utility function. If  $c_{ij}$  is consumption by country  $j$ 's consumers of goods from country  $i$ , and country  $j$ 's consumers choosing to maximize the utility for country  $j$ :

$$U_j = \left( \sum_i \beta_i^{(1-\sigma)/\sigma} c_{ij}^{(\sigma-1)/\sigma} \right)^{\sigma/(1-\sigma)} \quad (3.5)$$

subject to the budget constraint

$$\sum_i p_{ij} c_{ij} = y_j. \quad (3.6)$$

Here  $\sigma$  is the elasticity of substitution between all goods,  $\beta_i$  is a positive distribution parameter,  $y_j$  is the total nominal income of country  $j$  residents, and  $p_{ij}$  is the price of country  $i$ 's goods for country  $j$ 's consumers. Prices differ between countries due to trade costs that are not directly observable. Let denote  $p_i$  the exporter's supply price, net of trade costs, and let  $t_{ij}$  be the trade cost factor between  $i$  and  $j$ , then  $p_{ij} = p_i t_{ij}$ . This formulation is called "iceberg" trade costs and was introduced by Samuelson (1952).

We assume that trade costs are borne by the exporter, and for each good shipped from  $i$  to  $j$ , the exporter incurs export costs equal to  $t_{ij} - 1$  of country  $i$  goods. The exporter passes these trade costs on to the importer. The nominal value of exports from  $i$  to  $j$  is  $x_{ij} = p_{ij} c_{ij}$ , the sum of the value of production at the origin is  $p_i c_{ij}$ , and the exporter passes the sum of the trade cost  $(t_{ij} - 1)p_i c_{ij}$  on to the importer. Total income of country  $i$  is therefore  $y_i = \sum_j x_{ij}$ .

The nominal demand for country  $i$ 's goods by country  $j$ 's consumers satisfying maximization of (3.5) subject to (3.6) is



$$x_{ij} = \left( \frac{\beta_i p_i t_{ij}}{P_j} \right)^{1-\sigma} y_j, \quad (3.7)$$

where  $P_j$  is the consumer price index of  $j$ , given by

$$P_j = \left[ \sum_i^I (\beta_i p_i t_{ij})^{1-\sigma} \right]^{1/(1-\sigma)} \quad (3.8)$$

The general equilibrium structure of the model imposes market clearance, which implies:

$$y_i = \sum_j^I x_{ij} = (\beta_i p_i)^{1-\sigma} \sum_j^I (t_{ij} / P_j)^{1-\sigma} y_j, \quad (3.9)$$

Define world nominal income by  $y^w \equiv \sum_j y_j$  and income shares by  $s_j \equiv y_j / y^w$ . And we

solve for the scaled prices  $\{\beta_i p_i\}$  from the market clearing conditions (3.8) and substitute them

in the demand equation (3.6). We get:

$$x_{ij} = \frac{y_i y_j}{y^w} \left( \frac{t_{ij}}{\Pi_i P_j} \right)^{1-\sigma} \quad (3.10)$$

where

$$\Pi_i \equiv \left( \sum_{j=1}^I (t_{ij} / P_j)^{1-\sigma} s_j \right)^{1/(1-\sigma)} \quad (3.11)$$

Substituting the equilibrium scaled prices (3.11) into (3.8), we obtain

$$P_j = \left( \sum_{i=1}^I (t_{ij} / \Pi_i)^{1-\sigma} s_i \right)^{1/(1-\sigma)} \quad (3.12)$$

We assume that the trade barriers are symmetric, that is  $t_{ij} = t_{ji}$ . Under symmetry, a solution to (3.11)-(3.12) is  $\Pi_i = P_i$ . Then we get:

$$x_{ij} = \frac{y_i y_j}{y^w} \left( \frac{t_{ij}}{P_i P_j} \right)^{1-\sigma} \quad (3.13)$$

where

$$P_j^{1-\sigma} = \sum_i^I P_i^{\sigma-1} s_i t_{ij}^{1-\sigma} \quad (3.14)$$

The equation (3.13) is remarkably simple, whereby bilateral trade between countries depends on their GDP's and also their implicit price indexes. Anderson and van Wincoop (2003) call  $P_i$  and  $P_j$  “indexes of multilateral resistance” because they depend on all bilateral resistances  $t_{ij}$  in (3.14). These indexes are unobserved, but Anderson and van Wincoop (2003) argue that we can solve for them by using equation (3.14) in combination with a formula for the trade costs  $t_{ij}$ .

A drawback to the estimation of the gravity equation (3.13) is that it requires custom programming to perform the constrained minimization and obtain standard errors (Feenstra 2004, Ch. 5). An approach to estimating the gravity equation, while using ordinary least squares, is to use fixed effect to account for the unobserved price indexes. Fixed effects have been used in the gravity equation by a number of authors, including Harrigan (1996), Rose and van Wincoop (2003), and Redding and Venables (2004). Feenstra (2004, Ch. 5) suggests that fixed effects might be the preferred empirical method because it can produce consistent estimates of the average border effect across countries, and it is easy to implement.

We have introduced two versions of gravity equation: one version contains the multilateral resistance terms, and the other does not. In the next chapter, we will show that significantly different conclusions might be drawn by the different versions of gravity model to analyze the GATT/WTO trade effects.

## **Chapter 4 - Empirical Analysis for WTO Trade Effects**

In this chapter, we will review Rose's (2004) empirical strategy and conclusions in analyzing the GATT/WTO trade effects. Moreover, we introduce other economists' solutions to Rose's problematic GATT/WTO trade effects findings by arguing that the specification gravity model employed by Rose (2004) might omit important variables, particularly multilateral resistance terms.

### **4.1 GATT/WTO Trade Effects without Multilateral Resistance**

In order to quantify the effects of the multilateral trade agreements (GATT/WTO) on international trade, Rose's (2004) empirical work relied on the standard gravity model of bilateral trade. Furthermore, Rose (2005) used the same empirical strategy and dataset to estimate whether international organizations such as GATT/WTO, IMF, and OEEC/OECD encourage international trade. I review the results of Rose (2005) to offer a robustness check. Considering that one of the most important procedures for empirical study is to obtain suitable data, we first introduce the dataset that Rose (2004; 2005) used.

#### ***4.1.1 Data***

One noteworthy contribution of Rose (2004) was a large panel dataset that enabled economists to examine the GATT/WTO trade effects empirically. In Rose's dataset, the trade data came from the "Direction of Trade" (DoT) CD-ROM dataset developed by the International Monetary Fund (IMF). It covered bilateral merchandise trade between 178 IMF trading entities between 1948 and 1999; a list of the countries could be found in Rose (2004, Table A1). Bilateral trade on FOB exports and CIF imports was recorded in American dollars; Rose (2004) deflated trade by the American CPI for all urban consumers (1982-1984=100; taken from

*www.freelunch.com*). An average value of bilateral trade between a pair of countries was created by averaging all of the (four possible) measures of trade volume (exports from  $i$  to  $j$ , imports into  $j$  from  $i$ , and so forth). Population and real GDP data (in constant American dollars) were obtained from the Penn World Table, the World Bank's World Development Indicators, and the IMF's International Financial Statistics. Rose (2004) utilized the CIA's World Factbook to get a number of country-specific variables, including: latitude and longitude, land area, landlocked and island status, physically contiguous neighbors, language, colonizers, and dates of independence. He also used it to create great-circle distance and the other controls.

Rose (2004) added information on whether the pair of countries was involved in a currency union, using Glick-Rose (2002). He obtained data from the World Trade Organization to create an indicator of regional trade agreements, and included: ASEAN, EEC/EC/EU, US-Israel FTA, NAFTA, CARICOM, PATCRA, ANZCERTA, CACM, SPARTECA, and Mercosur.

Finally, Rose (2004) added the key variables of GATT/WTO membership. The WTO website provides dates for accession of its members to the GATT/WTO (Note that these members are *de jure* GATT/WTO membership defined by Tomz, *et al.* [2007, henceforth TGR]). The UN published *Operation and Effects of the Generalized System of Preferences (GSP)* at intervals; these booklets contained information on which industrial countries extended trade concessions to which developing country beneficiaries under the GSP. Rose (2004) obtained this pamphlet for 1974, 1979, and 1984 and used this information to construct bilateral time-varying GSP relationships. The dataset for Rose (2004) can now be obtained from Rose's website (<http://faculty.haas.berkeley.edu/aroze/>).

#### ***4.1.2 Specification Gravity Model without Trade Barriers for Rose (2004)***

The exact specification of gravity model used by Rose (2004) is as follows:

$$\begin{aligned}
\ln(X_{ijt}) = & \beta_0 + \beta_1 \ln D_{ij} + \beta_2 \ln(Y_i Y_j) + \beta_3 \ln(Y_i Y_j / Pop_i Pop_j) \\
& + \beta_4 Lang_{ij} + \beta_5 Cont_{ij} + \beta_6 Landl_{ij} + \beta_7 Island_{ij} \\
& + \beta_8 \ln(Area_i Area_j) + \beta_9 ComCol_{ij} + \beta_{10} CurCol_{ijt} \\
& + \beta_{11} Colony_{ij} + \beta_{12} ComNat_{ij} + \beta_{13} CU_{ijt} + \beta_{14} GSP_{ijt} \\
& + \beta_{15} FTA_{ijt} + \sum_t \phi_t T_t + \gamma_1 Bothin_{ijt} + \gamma_2 Onein_{ijt} + \varepsilon_{ijt}
\end{aligned} \tag{4.1}$$

where  $i$  and  $j$  denote trading partners,  $t$  denotes time, and the variables are defined as:

- ◆  $X_{ijt}$  denotes the average value of real bilateral trade between  $i$  and  $j$  at time  $t$ ,
- ◆  $Y_i(Y_j)$  is real GDP of country  $i(j)$ ,
- ◆  $Pop_i(Pop_j)$  is population of country  $i(j)$ ,
- ◆  $D_{ij}$  is the distance between  $i$  and  $j$ ,
- ◆  $Lang_{ij}$  is a binary “dummy” variable which is unity if  $i$  and  $j$  have a common language and zero otherwise,
- ◆  $Cont_{ij}$  is a binary variable which is unity if  $i$  and  $j$  share a land border,
- ◆  $Landl_{ij}$  is the number of landlocked countries in the country-pair (0, 1, or 2),
- ◆  $Island_{ij}$  is the number of island nations in the pair (0, 1, or 2),
- ◆  $Area_{ij}$  is the area of the country (in square kilometers),
- ◆  $ComCol_{ij}$  is a binary variable which is unity if  $i$  and  $j$  were ever colonies after 1945 with the same colonizer,
- ◆  $CurCol_{ijt}$  is a binary variable which is unity if  $i$  is a colony of  $j$  at time  $t$  or vice versa,
- ◆  $Colony_{ij}$  is a binary variable which is unity if  $i$  ever colonized  $j$  or vice versa,
- ◆  $ComNat_{ij}$  is a binary variable which is unity if  $i$  and  $j$  remained part of the same nation during the sample (e.g., France and Guadeloupe),

- ◆  $CU_{ijt}$  is a binary variable which is unity if  $i$  and  $j$  use the same currency at time  $t$ ,
- ◆  $GSP_{ijt}$  is a binary variable which is unity if  $i$  was a GSP beneficiary of  $j$  or vice versa at  $t$ ,
- ◆  $FTA_{ijt}$  is a binary variable which is unity if  $i$  and  $j$  both belong to the same regional trade agreement at time  $t$ ,
- ◆  $\{T_t\}$  is a comprehensive set of time “fixed effects”,
- ◆  $\beta$  and  $\phi$  are vectors of nuisance coefficients,
- ◆  $Bothin_{ijt}$  is a binary variable which is unity if both  $i$  and  $j$  are GATT/WTO members at  $t$ ,
- ◆  $Onein_{ijt}$  is a binary variable which is unity if either  $i$  or  $j$  is a GATT/WTO member at  $t$ ,
- ◆  $\varepsilon_{ijt}$  represents the omitted other influences on bilateral trade, assumed to be well-behaved.

Rose (2004) estimated the gravity model using ordinary least squares, computing standard errors that were robust to clustering by country-pairs. He also included a comprehensive set of year-specific “fixed” effects to account for factors such as the value of the dollar, the global business cycle, the extent of globalization, oil shocks, and so forth. Since the dataset was a (country-pair  $\times$  time) panel, he used “random effects” (GLS) and “fixed effects” estimators as robustness checks.

Rose’s (2004) empirical strategy was to control for as many “natural” causes of trade as possible and then search for effects of multilateral agreements in the residual. Once other factors had been taken into account, he compared trade patterns for countries in the GATT/WTO with those outside the system. He searched for this effect using variation across countries (since not all countries are in the system) and time (since membership of the GATT/WTO has grown). If the GATT/WTO has a large effect on trade, one can expect that members have significantly higher trade than outsiders. That is, the parameters of interest to us are  $\gamma_1$  and  $\gamma_2$ . If trade is

created when both countries are in the GATT/WTO,  $\gamma_1$  should be positive; if trade is diverted from non-members, then  $\gamma_2$  may be negative because under nondiscrimination principle, members of GATT/WTO are under no obligation to extend MFN and national treatment to nonmembers.

#### ***4.1.3 Results of Rose (2004; 2005) and Comments by TGR (2007)***

The empirical results of GATT/WTO trade effects based on Rose (2004; 2005) can be found in Table 2. Since we are interested in just the GATT/WTO trade effects, we do not report other regressors except the GSP and regional trade agreement variable that Rose and other economists were interested in. However, full results are available from Rose (2004; 2005).

Column 1 of Table 2 contains the benchmark regression results of Rose (2004). Both dummy variables for one or both of the countries being GATT/WTO members have small negative coefficients and neither is statistically different from zero at conventional significance levels. Since no reasonable person believes that membership in the GATT or WTO actually reduces trade, Rose (2004) interpreted the negative coefficients as an interesting mystery. Rose (2004) also added country-specific fixed effects to the benchmark equation, and these results are presented in column 2 of Table 2. However, these results show a small positive GATT/WTO trade effects. The coefficient of both in GATT/WTO ( $\gamma_1$ ) indicates that a pair of countries both in the GATT/WTO traded only 16% ( $\approx e^{0.15} - 1$ ) more than a pair of countries outside the GATT/WTO. This is rather small compared to other effects such as GSP and regional FTA.

In order to show the results were not based on a peculiar or idiosyncratic methodology, Rose (2004, Table 2-7) demonstrated a substantial sensitive analysis. Eventually, his paper reported 82 sets of estimates of the parameters of interest, including 79 estimates of  $\gamma_1$ , the effect

of GATT/WTO membership by both countries on trade. The mean estimate across these  $\gamma_1$  estimates was 0.05; the median was 0.01; 39 of the estimates were negative, while only four were greater than 0.69 (implying that GATT/WTO membership doubled trade). Fifty-seven (or 71%) of the associated  $t$ -statistics were insignificant at conventional confidence levels (Rose 2004, p. 111). So Rose (2004) concluded that membership in the GATT/WTO had no strong positive effect on international trade.

**Table 2 GATT/WTO trade effects based on Rose (2004; 2005) and TGR (2007)**

Regression from		Dependent variable: log average value of real bilateral trade					
		Rose (2004)		Rose (2005)		TGR (2007)	
Estimation method		Time fixed effects	Country -specific fixed effects	Time fixed effects	Country -pair fixed effects	Time fixed effects	Country -pair fixed effects
Both in GATT/WTO	Both <i>de jure</i> member	-0.04 (0.05)	0.15 (0.05)	-0.12 (0.05)	0.27 (0.02)	0.17 (0.07)	0.48 (0.06)
	<i>de jure</i> and <i>de facto</i> member					0.80 (0.14)	0.88 (0.09)
	Both <i>de facto</i> Member					0.41 (0.07)	0.56 (0.06)
Only one in GATT/WTO	<i>de jure</i> member	-0.06 (0.05)	0.05 (0.04)	-0.11 (0.05)	0.16 (0.02)	0.06 (0.07)	0.23 (0.06)
	<i>de facto</i> member					0.33 (0.09)	0.34 (0.07)
GSP		0.86 (0.03)	0.70 (0.03)	0.66 (0.03)	0.18 (0.01)	0.85 (0.03)	0.18 (0.03)
Regional FTA		1.20 (0.11)	0.94 (0.13)	1.17 (0.11)	0.78 (0.04)	1.19 (0.11)	0.76 (0.07)
Obs.		234597	234597	234597	234597	234597	234597
Standard error of regression		0.65	0.70	0.65	0.53	0.649	0.853
		1.98	1.82			1.976	1.313

Source from: Rose (2004) Table 1; Rose (2005) Table 1; TGR (2007) Table 2, (3) and (5).

Notes: other regressors in equation (4.1) do not report. Robust standard errors (clustered by country-pairs) are in parentheses.



Columns 3 and 4 of Table 2 illustrate the results of Rose (2005). He used the same specification gravity model and dataset as Rose (2004) did. The difference was that he added two other dummy variables of IMF and OEEC/OECD membership to evaluate whether these international organizations encourage international trade. In his benchmark regression (column 3), he even obtained larger significantly negative coefficients. But when he used country-pair fixed effects to estimate his model, both coefficients became positive and statistically significant. Since the country-pair fixed effects take into account trade resistance and other unobservable features of the relationship between each pair of countries, they are used to control unobserved bilateral heterogeneity. Consequently, one may expect that the Rose (2004) specification gravity model might omit important variables and his results might be confronted with potential omitted variable bias. Subramanian and Wei (2007, henceforth SW) suggested that the absence of multilateral resistance controls in Rose (2004; 2005) biased his GATT/WTO results downward. We will introduce SW (2007) specification gravity model later on.

Regarding Rose's (2004) GATT/WTO trade effects mystery, TGR (2007) argued that Rose had overlooked a large proportion of countries to which the GATT applied and mistakenly classified them as non-participants, when in fact these countries had rights and obligations under the GATT. This caused a downward bias in Rose's estimates of the GATT/WTO trade effect, because his gravity regressions compared the trade levels of *de jure* members to the trade levels of a group that included many participants (TGR 2007, p. 2005). Moreover, TGR (2007) documented that the GATT gave rights and obligations not only to *de jure* members but also to three categories of nonmember participants: colonies, *de facto* members, and provisional members.

In order to verify their standpoint, TGR (2007) updated Rose's dataset to include both *de jure* and *de facto* GATT/WTO membership and employed Rose's methodology in their empirical work. The last two columns of Table 2 show the results of TGR (2007). The estimated models of TGR (2007) added indicators for whether the countries in each country-pair were nonmember participants. After they did this, they found significantly higher trade when both countries had GATT rights and obligations, either as formal members or as nonmember participants, compared with country-pairs in which neither country belonged to the GATT/WTO. According to the last column of Table 2, trade between two formal members was about 62 percent higher than trade between pairs of non-participants. When one country was a formal member and the other was a nonmember participant, trade was estimated to increase by about 141 percent, compared to the outsiders. Trade between two nonmember participants was estimated to be 75 percent higher than trade between countries without GATT rights and obligations.

Even though TGR (2007) provided a solution to solve the GATT/WTO trade effects mystery by accounting for *de facto* GATT/WTO membership, they did not solve the mystery completely. When we look back on Rose's (2004) specification gravity model, we can observe that the model omits the multilateral resistance terms. Omitting these terms means that both Rose (2004; 2005) and TGR (2007) evaluated the GATT/WTO trade effects without considering the existence of trade barriers between countries. Thus, the results of Rose (2004; 2005) and TGR (2007) might have omitted variable bias. Next, we will introduce the specification gravity model of SW (2007). Their gravity model attempted to solve Rose's GATT/WTO trade effects mystery by including multilateral resistance terms.

## 4.2 GATT/WTO Trade Effects with Multilateral Resistance

### 4.2.1 The Specification Gravity Model Based on SW (2007)

SW (2007) preferred their benchmark specification was of the following form:

$$\begin{aligned} \text{Log Im port}_{ijt} = & Z_{ij}\gamma + \sum_m \alpha_m M_{mt} + \sum_x \theta_x X_{xt} + \beta_1 FTA_{ijt} + \beta_2 GSP_{ijt} \\ & + \beta_3 WTO\_DVED_{ijt} + \beta_4 WTO\_DING_{ijt} + \varepsilon_{ijt} \end{aligned} \quad (4.2)$$

- ◆  $\text{Logimport}_{ijt}$  is log of bilateral import of importer  $i$  from exporter  $j$  in year  $t$ ,
- ◆  $Z_{ij}$  is a list of variables, including greater circle distance between  $i$  and  $j$ , dummies for common language, colonial links, shared borders, and common currencies, the list includes all the covariates in Rose (2004),
- ◆  $M_{mt}$ 's are a list of time-varying importer dummies (that take the value of one if  $m = i$ , and zero otherwise) to proxy for “multilateral resistance” of importer,
- ◆  $X_{xt}$ 's are a list of time-varying exporter dummies (that take the value of one if  $x = j$ , and zero otherwise) to proxy for “multilateral resistance” of exporter,
- ◆  $FTA_{ijt}$  is a dummy variable that takes on a value of 1 if  $i$  and  $j$  belong to a common regional trade agreement in year  $t$ ,
- ◆  $GSP_{ijt}$  is a dummy variable that takes on a value of 1 if the importing industrial country grants preferences under the GSP to exporting country  $j$  in year  $t$  and where  $i$  and  $j$  are not members of a common regional trade agreement in year  $t$ ,
- ◆  $WTO\_DVED_{ijt}$  is a dummy variable for importer  $i$  that is a developed country GATT/WTO member and where  $i$  and  $j$  are not in a common regional trade agreement and where  $i$  does not grant GSP preferences to  $j$  in year  $t$ ,
- ◆  $WTO\_DING_{ijt}$  is a dummy variable for importer  $i$  that is a developing country GATT/WTO

member and where  $i$  and  $j$  are not in a common regional trade agreement and where  $i$  does not grant GSP preferences to  $j$  in year  $t$ ,

- ◆  $\varepsilon_{ijt}$  is a normally distributed random error term that has a zero mean and a constant variance.

There were several important differences between SW (2007) specification and that in Rose (2004) that should be emphasized. First, SW focused on imports by country  $i$  from country  $j$  as the regressand, whereas Rose focused on the average of  $i$ 's imports from  $j$  and  $i$ 's exports to  $j$ . Second, SW stressed that trade between any two countries would depend on the multilateral resistance of both importers and exporters, and they used time-varying importer and exporter fixed effects ( $M_{mt}$  and  $X_{xt}$ ) to capture the multilateral resistance. Third, SW's definition of the GSP and GATT/WTO dummies was different from that in Rose (2004). They relied on the fact that FTAs, the GSP, and the GATT/WTO involved different degrees of liberalization, and hence defined them *mutually exclusive* in order to be able to isolate the impact of each other. Therefore, the GATT/WTO dummies in SW's were coded to exclude country pairs belonging to the same regional trade agreement or involved in GSP relationships. Similarly, the GSP dummy was coded to exclude country pairs belonging to a regional trade agreement (SW 2007, p. 157-58).

#### **4.2.2 Data and Results of SW (2007)**

Most of the data that SW (2007) used were from Rose (2004), including incomes, population, and distance, as well as geographical, cultural, and historical information. Therefore SW (2007) evaluated the GATT/WTO trade effects based on *de jure* GATT/WTO membership. The main difference was that they used imports rather than total trade as the dependent variable, which they obtained from the IMF's Direction of Trade Statistics and deflated imports by the US consumer price index (1982-1984=100) for urban areas. Moreover, they updated all the Rose

variables to the year 2000 and selected five-year data periods in Rose's dataset, starting from 1950. Thus, the SW's dataset finally covered 172 countries during the five-year periods from 1950 to 2000.

Table 3 contains the core results for GATT/WTO trade effects based on SW (2007). The basic Rose's (2004) finding that the GATT/WTO does not increase trade is illustrated in Regression I. When membership in the GATT/WTO was treated undifferentiated, SW's result showed that the GATT/WTO had done even worse in promoting trade

$((e^{-0.252} - 1) < (e^{-0.04} + e^{-0.06} - 2))$  than in Rose (2004), since the coefficient on imports of GATT/WTO members was  $-0.252$  (See column 1, Table 2; Regression I, Table 3). While Rose (2004) found that GATT/WTO membership had no effect on trade, SW found that membership had a significantly negative effect on trade. The average GATT/WTO members traded about 22%  $(= e^{-0.252} - 1)$  less than the average non-GATT/WTO members (Regression I, Table 3).

However, when they distinguished between developing countries and industrial countries, the coefficient on industrial country members of the GATT/WTO importer dummy ( $\beta_3$ ) became positive (1.865) and highly significant, and the coefficient on the developing country WTO importer dummy ( $\beta_4$ ) was negative (-0.313) and significant (Regression II, Table 3). The net imports of GATT/WTO members were about 519%  $(\approx e^{1.865} + e^{-0.313} - 2)$  larger than that of the non-GATT/WTO members (Regression II).

Regression III was a robustness check for excluding observations with values of trade less than \$500,000. They did this for the plausible reason that small-valued observations were subject to more sampling and measurement errors. Accordingly, the remaining reported results by SW (2007) excluded observations with trade values less than \$500,000, and they claimed that the exclusion would not alter their basic conclusions (SW 2007, p. 161). The results of

Regression III show that the negative coefficient on the developing country WTO importer dummy turned positive but not significant.

**Table 3 WTO trade effects with multilateral resistance based on SW (2007)**

Regression #	Dependent variable: bilateral imports				
	I	II	III	IV	V
Importer WTO member	-0.252 (0.044)				
Industrial country importer member		1.865 (0.144)	1.010 (0.092)	0.336 (0.058)	0.306 (0.032)
Developing country importer member		-0.313 (0.043)	0.017 (0.036)	0.017 (0.025)	0.137 (0.016)
GSP	0.234 (0.075)	2.149 (0.146)	0.806 (0.096)	-0.097 (0.032)	0.188 (0.038)
FTA	0.661 (0.097)	1.65 (0.105)	1.165 (0.073)	0.755 (0.046)	0.945 (0.039)
Time-varying importer and exporter fixed effects	Yes	Yes	Yes	Yes	Yes
Time fixed effects	No	No	No	Yes	Yes
Country-pair random effects	No	No	No	No	Yes
Obs.	76094	76094	55831		
$R^2$	0.74	0.75	0.75		
Standard error of regression	1.679	1.673	1.113		

Source from: Subramanian and Wei (2007) Table 4 (1), (2), (4); Table 5 row 1, 4.

Note: Regression I based on Rose (2004) specification; for Regression II-V, WTO dummy in I is disaggregated further into two dummies, and Regressions III-V exclude observations with trade values less than \$500,000. Regression IV is Rose (2004) definition of GSP and WTO dummies. Intercepts and coefficients for additional regressors do not report. Robust standard errors (clustered by country-pairs) report below coefficient estimates.

Regression IV used Rose's definition of GSP and GATT/WTO dummies to do a robustness check. The GATT/WTO trade effects decreased with the Rose definition of GSP and

GATT/WTO. However, Rose's definition still produced a positive and statistically significant effect of GATT/WTO on trade volume when SW's specification gravity model was employed.

Regression V was another robustness check for including country-pair random effects with importer and exporter fixed effects; the coefficient on industrial country members of the GATT/WTO importer dummy became much smaller but still significant. The good news was that the coefficient on the developing country WTO importer dummy was now larger and significant, compared to Regression II and III.

After considering the special treatment of developing countries and multilateral resistance terms, SW concluded that the GATT/WTO promoted international trade strongly in industrial countries given that imports by developed-country members of the GATT/WTO increased by 174% ( $e^{1.01} - 1 \approx 1.74$ ) relative to non-WTO members, but not to developing countries (Regression III). This conclusion seems to be an easily acceptable accounting of Rose's puzzling findings regarding GATT/WTO trade effects. However, Eicher and Henn (2011, henceforth EH) argued that when they extended SW's (2007) specification gravity model to account for unobserved bilateral heterogeneity and individual FTA trade effect, they found that the industrialized country's GATT/WTO trade effects in SW's results were actually industrialized FTA effects if SW's mutually exclusive coding convention and their dataset were employed (Eicher and Henn 2011, p. 141). Moreover, once they used a unified specification gravity model to examine GATT/WTO trade effects by controlling multilateral resistance, unobserved bilateral heterogeneity, and individual FTA trade effect together, their specification gravity model produced no evidence of positive GATT/WTO trade effects. Next, I will introduce this unified specification gravity model and EH's results.

## 4.3 Unified Specification Gravity Model Accounting for WTO Trade Effects

### 4.3.1 The Unified Specification Gravity Model

EH's (2011) specification replicated SW's preferred specification by adding time fixed dummies and replacing time-invariant variables with country-pair-specific dummies. Furthermore, the FTA variable was defined by a set of dummies that allowed each FTA to account for its own individual effect on bilateral imports. The unified specification gravity model was of the following form:

$$\begin{aligned} \text{Logimport}_{ijt} = & \gamma \text{CPD}_{mx} + \sum_t \phi_t T_t + \sum_m \alpha_{mt} M_{mt} + \sum_x \theta_{xt} X_{xt} \\ & + \beta_1 \text{FTA}_{ijt} + \beta_2 \text{GSP}_{ijt} + \beta_3 \text{WTO\_DVED}_{ijt} \\ & + \beta_4 \text{WTO\_DING}_{ijt} + \beta_5 \text{CU}_{ijt} + \beta_6 \text{CulCol}_{ijt} + \varepsilon_{ijt} \end{aligned} \quad (4.3)$$

- ◆  $\text{Logimport}_{ijt}$  is log of bilateral import of importer  $i$  from exporter  $j$  in year  $t$ ,
- ◆  $\text{CPD}_{mx}$  are a list of country-pair specific dummies (that take the value of one if  $m = i$  and  $x = j$ , and zero otherwise) to control for all time-invariant (observed and unobserved) bilateral heterogeneity,
- ◆  $\{T_t\}$  is a comprehensive set of time “fixed effects”,
- ◆  $M_{mt}$  's are a list of time-varying importer dummies (that take the value of one if  $m = i$ , and zero otherwise) to proxy for “multilateral resistance” of importer,
- ◆  $X_{xt}$  's are a list of time-varying exporter dummies (that take the value of one if  $x = j$ , and zero otherwise) to proxy for “multilateral resistance” of exporter,
- ◆  $\text{FTA}_{ijt}$  is a list of dummies that takes on a value of 1 if  $i$  and  $j$  belong to a common individual regional trade agreement in year  $t$ ,
- ◆  $\text{GSP}_{ijt}$  is a dummy variable that takes on a value of 1 if importer  $i$  was a GSP beneficiary of



exporter  $j$  or vice versa at  $t$ ,

- ◆  $WTO\_DVED_{ijt}$  is a dummy variable for importer  $i$  that is a developed country WTO member,
- ◆  $WTO\_DING_{ijt}$  is a dummy variable for importer  $i$  that is a developing country WTO member,
- ◆  $CU_{ijt}$  is a binary variable which is unity if importer  $i$  and exporter  $j$  use the same currency at time  $t$ ,
- ◆  $CurCol_{ijt}$  is a binary variable which is unity if importer  $i$  is a colony of exporter  $j$  at time  $t$  or vice versa,
- ◆  $\varepsilon_{ijt}$  is a normally distributed random error term that has a zero mean and a constant variance.

#### **4.3.2 Data and Results of EH (2011)**

EH's data was based on an updated version of SW's unbalanced panel. They adjusted the SW's dataset to attribute a value of zero to GSP country-pairs that represent an industrialized country exporting to a developing country. The reasoning is that GSP is granted as a unilateral preference for industrialized countries' imports from developing countries only. They also identified Luxembourg as a member of the European Union (EU) in 2000, and corrected other minor coding errors identified by TGR (2007). To illustrate that GATT/WTO trade effects vanished even when accounting for *de facto* membership, they used TGR's WTO membership definition throughout. They also extended the SW dataset and introduced a more extensive set of FTAs used by Rose (2005) and Eicher *et al.* (2012) to properly account for the trade effects of a large set of individual FTAs. Subsequent sections further modified the SW's dataset by using Rose's (2004) mutually inclusive coding convention if necessary.

**Table 4 GATT/WTO trade effects based on EH (2011)**

Dependent variable: bilateral imports						
Regression #	1	2	3	4	5	6
WTO dummy coding	SW	SW	SW	Rose	Rose	Rose
WTO Membership definition	TGR	TGR	TGR	TGR	TGR	TGR
WTO_DING	0.210 (0.147)	-0.207 (0.148)	-0.254 (0.082)	-0.051 (0.069)	-0.054 (0.069)	-0.035 (0.068)
WTO_DVED	0.393 (0.165)	0.124 (0.189)	-0.068 (0.092)	-0.028 (0.068)	-0.026 (0.068)	-0.002 (0.066)
GSP	-0.242 (0.049)	-0.233 (0.049)	-0.181 (0.047)	-0.252 (0.048)	-0.228 (0.049)	-0.187 (0.048)
FTA				0.473 (0.045)		
FTA_DVED	0.361 (0.055)					
FTA_DING	0.545 (0.082)					
Importer and exporter fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Country-pair fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
<i>Adj R</i> <sup>2</sup>	0.8747	0.8751	0.8760	0.8747	0.8751	0.8760

Source from: Eicher and Henn (2011) Table 1a column 4-6; Table 2 column 4-6

Note: Individual FTA coefficients of Regression # 2-3 and # 4-6 do not report. Additional regressors in (4.2) also do not report. Robust standard errors (clustered by country-pairs) are in parentheses.

Table 4 reports the core results of EH's (2007) examination of GATT/WTO trade effects.

All regressions controlled the multilateral resistance and unobserved bilateral heterogeneity.

Regression 2-3 and 5-6 also contained individual regional trade agreement effects. Regression 1 reexamined SW's results by controlling unobserved bilateral heterogeneity and obtained a much smaller coefficient (0.393) of industrial country importer GATT/WTO members than that of SW (2007) (See Regression III, Table 3; Regression 1, Table 4). Regression 2 added individual regional trade agreements that were included in Rose's dataset except US-Israel FTA, and PATCRA. Regression 3 updated some new FTAs omitted from Rose's dataset, such as EFTA, EEA, AP, LAIA, and APEC. The result was a dramatic decrease of GATT/WTO induced trade effects, even for industrialized countries.

When they used Rose's GATT/WTO dummy coding invention, all GATT/WTO trade effects had become negative but were very close to zero (Regression 4-6 in Table 4). Since Rose's (2005) results showed that GATT/WTO membership had a small but significant positive effect on trade flows without considering multilateral resistance terms, it seemed that controlling multilateral resistance would negate GATT/WTO trade effects. Thus, EH (2011) drew the same conclusion as Rose that there was no empirical evidence to prove that GATT/WTO membership had a positive effect on trade flow, even when we controlled the multilateral resistance, unobserved bilateral heterogeneity, and individual FTA trade effect.

These economists' empirical work to understand the GATT/WTO trade effects mystery shows that, even though TGR (2007) and SW (2007) cast light on some possible explanations, the mystery remains. We certainly do not dismiss their work; it encourages further research and offers useful guidance to future attempts at deciphering the effects of trade agreements or international trade institutions on trade. For example, Chang and Lee (2011) proposed a nonparametric method to re-evaluate the GATT/WTO trade effects and obtained large GATT/WTO trade-promoting effects. Their estimates suggest that membership in the

GATT/WTO by both countries on average raises bilateral trade volume by 74% ( $= e^{0.553} - 1$ ) to 277% ( $= e^{1.328} - 1$ ) for country-pairs that both chose to be in the GATT/WTO (Chang and Lee 2011, Table 4). Since their methods are outside the scope of our inquiry, we will not introduce it, but they offered a new scope of methodology that can be employed to solve Rose's mysterious findings.

## Chapter 5 - Remarks and Conclusion

An in-depth consideration of Rose's (2004) and other economists' empirical work on measuring the GATT/WTO trade effects on international trade illuminate their remarkably diverse results. We attribute the divergent conclusions to the following: The first divergence concerns the use of *de jure* versus *de facto* definitions of membership. When TGR (2007) used *de facto* membership to measure GATT/WTO trade effects, their results were extraordinarily positive. The second divergence resulted when holding that the gravity model omitted multilateral resistance; however, the consensus is that this would be more likely to have a negative effect on international trade.

The third divergence came when treating developing countries differently. Differential treatment effects could partially explain Rose's findings, but one might argue that if the GATT/WTO had uneven trade effects on its members, then the validity of GATT/WTO trade effects might be unpersuasive. The fourth divergence occurred when taking unobserved bilateral heterogeneity into consideration. Even though Rose (2004) used substantial time-invariant variables to capture bilateral heterogeneity, it was not enough because it was difficult to include every potential source of bilateral heterogeneity; thus, using country-pair fixed effects might be a preferred replacement. Taking individual regional trade agreement effects into consideration

produced yet another divergence. As Chapter 2 explains, the regionalism movement may cause challenges to the multilateral GATT/WTO. According to EH's (2011) empirical work, regional trade agreements seemed to be more effective in promoting trade flow than did the GATT/WTO.

In this report, we briefly describe the history and design of GATT/WTO and we also have clarified that the GATT/WTO, which serves as a relatively effective multilateral trade agreement, indeed reduces trade barriers among GATT/WTO members, and thus promotes international trade flows. We argue that Rose's mysterious findings that run counter to our findings can be explained by the fact that his specification gravity model omitted multilateral resistance terms and failed to capture unobserved bilateral heterogeneity. However, we find that even if economists use an accurate specification gravity model by controlling multilateral resistance, unobserved bilateral heterogeneity, and individual regional trade agreement effect to evaluate the GATT/WTO trade effects, one still cannot fully account for Rose's mysterious and counter-intuitive findings on GATT/WTO trade effects.

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