The Road Not Taken: Agricultural Trade without the GATT/WTO

Jason H. Grant, Virginia Tech

Kathryn A. Boys, North Carolina State university

December 2017

Abstract

The General Agreement on Tariffs and Trade (GATT), and its successor the World Trade Organization (WTO) are often heralded as the most successful multilateral institutions in the post-war era (Bagwell and Staiger 2002, Bhagwati 1992, Irwin 1995). For more than 60 years, the GATT/WTO set out to foster a rules-based trading system for mutually advantageous trade among member countries. While economic theory and the founding principles of the GATT/WTO stand in stark contrast to economic nationalism, it is not clear what international (agricultural) trade would look like in a world without the WTO. Building on the foundations of Grant and Boys (2012), this article provides a comprehensive assessment of the counterfactual case of international agri-food trade in an international economy where economic nationalism gains momentum or countries retreat from upholding their WTO commitments. Incorporating recent theoretical and empirical advances in estimation of the gravity equation explaining bilateral trade flows, and using both parametric and non-parametric approaches, we quantify what would have been the level of global agricultural trade had developed and developing countries not participated in the WTO essentially reversing decades of multilateral cooperation on market access. These results provide further evidence that participating in multilateral trade agreements has brought benefits in facilitating trade between signatories of those agreements through reducing the costs of trade, and providing market access benefits.

JEL: F1 and F6

Acknowledgements: The authors wish to thank Shuwen Duan for her contributions to portions of this study.

Introduction

The creation of the World Trade Organization succeeding the General Agreement on Tariffs and Trade (GATT) is often viewed as a high-water mark for agricultural trade diplomacy (Bagwell and Staiger 2002, Irwin 1995). The Uruguay Round Agreement on Agriculture (URAA), coinciding with the creation of the WTO, put in place a set of rules to improve the conditions for market access for agricultural goods. Bound *ad valorem* tariffs almost entirely replaced non-tariff import measures such as quotas and variable levies, export subsidies were curbed, and limits were placed on the amount of trade distorting domestic support countries could provide to producers. These accomplishments are often attributed to the multilateral organization's role in reducing barriers to trade on a non-discriminatory basis through successive rounds of negotiation and dispute settlement. While the URAA did not produce substantial cuts to applied tariffs exporters face on the shipments of their agricultural products, the process of tariffication meant that exporters now have a much more transparent view of the conditions for market access (Ingco and Hathaway, 1996; Josling, 1998). Moreover, having brought agricultural tariffs, export subsidies and disciplines on trade distorting domestic support under the auspices of the WTO, the time was ripe for future multilateral negotiating rounds to complete the job of improving market access conditions started by the URAA.

Despite these merits, since the turn of the century the WTO has suffered its deepest impasse in modern history (Baldwin 2006, 2010; Grant and Boys 2012). Gridlock in the Doha Development Agenda (DDA) has dragged on for nearly two decades and most commentators and policy makers have conceded that the multilateral negotiations are moribund (Baldwin 2016, Krishna 2011, Josling 2011, Bagwell and Staiger 2014, Tangermann 2016). Economic nationalism – the use of explicit policies to promote domestic industries rooted in the belief that free trade has led to a decline domestic manufacturing and job loss - has emerged front and center in the current political discourse. Britain's vote to withdraw from the European Union in June 2016, and the January 2017 decision by U.S. President Donald Trump to withdraw the U.S. from the Trans-Pacific Partnership (TPP) Agreement and the August 2017 initiation of talks to renegotiate the North American Free Trade Agreement (NAFTA) are recent outcomes of a growing movement in some countries to reestablish independent, and perhaps, protectionist economic policies. If more countries follow suit, especially industrialized nations, the global

economy faces the threat of potentially undermining more than 60 years of multilateral trade negotiations.

The GATT/WTO is often viewed as a large network whose hub lies with a few key countries, traditionally the EU and U.S. However, as highlighted in Bagwell and Staiger (2014) at least two incompatibilities may explain why the WTO as a multilateral agreement is under fire. First, the "latecomer's problem," refers to the unprecedented rate at which developing countries have joined the WTO and now want a voice at the negotiating table. Twenty new members have joined since 2001, bringing total WTO membership to 164. Here the situation is quite different when compared to the U.S. and EU because agricultural reforms in developing and least-developed economies have been modest, although more recent accessions such as China in 2001 resulted in more significant concessions. Second, "what you get is what you give"is based on the fact that developed nations have very little left to "give" because, as a result of participating in eight rounds of GATT/WTO negotiations, many of the most advanced economies now apply tariffs that on average are less than five percent (Grant and Lambert 2008). In 2014, EU agricultural and non-agricultural Most Favored Nation tariffs averaged 12.2 and 4.2 percent, respectively, and in the U.S. averaged 5.1 and 3.2 percent, respectively. While these numbers mask some tariff peaks in sensitive sectors such as agriculture, and constrained trade flows falling under tariff rate quotas, these simple averages highlight the fact that both superpowers have few tariff concessions left to offer in the multilateral arena (Bureau, Guimbard, and Jean 2016). If developed countries are content with the current level of trade openness, then multilateral negotiations may have run its course.

On the other hand, developing countries have a considerable stake in multilateral negotiations. Generally, the smaller the economy the more important agricultural trade is in providing food for consumers. Moreover, developing and least-developed economies commonly specialize in a limited set of commodities and export much of their production. Thus, trade becomes a critical means by which lower income economies can improve their standard of living relative to what could be achieved under autarchy. For small countries the cheapest and reliable source of food and agricultural products is often abroad.

The converse is true for most developed and advanced emerging economies. Although it would entail significant changes in production and consumption patterns, the EU, U.S., and to a lesser extent Canada, Japan, and emerging economies such as China, India, Brazil, and Russia

could provide the needed food to feed their population even under autarchy. However, for many of these countries achieving this would require counter-cyclical and out-of-season production to maintain sufficient consistent supplies throughout the year. Doing so would create a situation that reverses the many market access gains that have been achieved over the last sixty plus years – and the huge variety of internationally sourced products crisscrossing the globe through globalized supply chains would no longer exist. Thus underlying much of the current rhetoric is the fact that the largest economies are themselves the most profitable markets, and have the least at stake if the global economy were to revert to a situation of increased economic nationalism. Paradoxically then, the trade policies of those that could best survive without trade have the biggest impact on the smallest countries who rely on sales to export markets to be able to pay for imports but who are themselves insignificant in terms of their imports from these large countries.

Most economists extol the virtues of more open international markets. Consumers benefit from a greater variety of available goods at lower-prices and consistent supplies throughout the year. Producers gain access to foreign consumers and, if there are economies of scale, the enlarged market that now includes domestic and foreign consumers allows firms to move down their long-run average cost curves and expand firm sales (Krugman, 1980). While economic theory and the founding principles of many multilateral organizations stands in stark contrast to economic nationalism, it is not clear what international (agricultural) trade would look like in a world without multilateral agreements. The purpose of this article is to offer a comprehensive assessment of the counterfactual case of international agri-food trade in an international economy where economic nationalism gains momentum and results in countries retreating from upholding their international economic commitments. As the oldest and most widely adopted multilateral forum, primarily considers the case of a world without the World Trade Organization.

A three-pronged approach is used to examine this issue. First, building on the foundations of Grant and Boys (2012), we provide updated estimates of the GATT/WTO effect on trade using state-of-the-art methods to estimate gravity equations. Our methods allow us to examine not only how membership in the GATT/WTO affects members' bilateral trade relative to that of non-members, but also how trade is impacted along the intensive and extensive product margins for variety growth of trade. Second, we provide a novel assessment of international agricultural trade costs following the approach of Novy (2012). Finally, we proceed to a more

recent non-parametric approach known as the synthetic control method (SCM) to examine the counterfactual case of China's international agri-food trade in an international economy without the WTO. Incorporating recent theoretical and empirical advances in estimation of the gravity equation explaining bilateral trade flows, and using both parametric and non-parametric approaches, we quantify what would have been the level of global agricultural trade had developed and developing countries not participated in the WTO, essentially resulting in the reversal of decades of multilateral cooperation on market access.

Empirical Framework

In this section we introduce the three methods used to investigate the extent to which membership in the GATT/WTO has facilitated members' trade. First we begin with the most popular method - that is to compare members' trade using a gravity equation. The gravity equation continues to be the workhorse model used to evaluate the trade flow impacts of international economic integration.[1] The popularity of this model is due not only to its consistent results and compact specification, but also because a large class of quantitative trade models based on "structural gravity" yield isomorphic gravity equations (Arkolakis, Costinot and Rodriquez-Clare 2012; Head and Mayer 2014). This includes models based on Armington preferences (Anderson and van Wincoop 2003), Ricardian specialization (Eaton and Kortum 2002), monopolistic competition (Krugman 1980) and heterogeneous firms (Melitz 2003).

Arkolakis et al. (2012) show that the gravity equation consistent with several underlying theoretical frameworks in a K-country world is as follows:

$$X_{ijt} = \frac{\chi_{ijt} N_{it} \left(w_{it} \tau_{ijt} \right)^{\varepsilon} Y_{jt}}{\sum_{k} \chi_{kjt} N_{kt} \left(w_{kt} \tau_{kjt} \right)^{\varepsilon}} \qquad (1)$$

where, X_{ijt} is the value of bilateral trade from exporter i to importer j in year t, N_{it} is a capacity measure of the number of goods that can be produced in exporter i and year t, w_{it} is the wage (i.e., price) in country i, τ_{ijt} is total variable trade costs to ship products from country i to country j, ε is the elasticity of trade with respect to variable trade costs with $\varepsilon < 0$, Y_{jt} is aggregate expenditure in importer j, and χ_{ijt} is a measure of all structural parameters other than variable

[1] See Cipollina and Salvatici (2010) for a comprehensive survey of this literature.

trade costs (τ_{ijt}) impacting trade between *i* and *j*, the most important of which are fixed export costs (f_{ij}) to serve market *j*.

Our approach to estimating the impacts on a country's trade of not being a member of the GATT/WTO is as follows:

$$X_{ijt}^{k} = \exp\left(\alpha_{it} + \eta_{jt} + \theta_{ij} + \gamma RTA_{ijt} + \lambda Nonein_{ijt}\right)\mu_{ijt} \quad (2)$$

where, α_{it} captures all time-varying characteristics of the exporting country including its production capacity and origin prices (N_{it} and w_{it} in equation 1) and outward multilateral resistance exporter *i* faces with its partners in the rest of the world (AvW 2003), η_{jt} captures all time-varying multilateral factors impacting importer *j's* trade with all its partners including total expenditure (Y_{jt}) and *j's* inward multilateral price index (denominator in equation 1). θ_{ij} captures all time-invariant factors which influence trade between countries *i* and *j* including "natural" effects associated with sharing a border, speaking the same language, cultural and institutional similarities, and many other factors unobservable to an econometrician that might be otherwise picked up by time-varying policy variables (Grant, 2013). In the context of equation (1), θ_{ij} also captures the influence of $\chi_{ijt.}$ However, as noted by Bergstrand, Larch and Yotov (2015) the influence of χ_{ijt} on bilateral trade between *i* and *j* could be changing over time due to, for example, improved access to information technology and efficiency gains from globalized supply chains. These cost changes could also affect international relative to domestic fixed trade costs and, if not accounted for, could contaminate measurements of the impact of multilateral agreements such as GATT/WTO or RTAs.[2]

To account for this we include an interaction of the logarithm of geographical distance with a time trend ($lnDIST*TT_{ijt}$) in the model. Because distance is a time-invariant variable unique to each country pair, its interaction with a time trend will partially mitigate the influence of declining international trade costs over time.[3] The remaining time-varying country-pair specific trade costs (τ_{ijt}) are captured by the policy variables of interest: RTA_{ijt} and $Nonein_{ijt}$. RTA_{ijt} equals one when *i* and *j* belong to the same mutual regional trade agreement in year *t*, and

[2] It could be argued that the θ_{ij} country-pair fixed effects should be time-varying (i.e., θ_{ijt}). However, this would perfectly predict bilateral trade as the number of unique time-varying bilateral pair fixed effects would be equal to the number of observations in the dataset.

[3] Bergstrand, Larch and Yotov (2015) further suggest the inclusion of intra-national trade flows in the dataset (i.e., a country's trade with itself or X_{iit}) in order to fully capture the influence of declining international relative to intra-national (fixed) trade costs.

zero otherwise; the variable $Nonein_{ijt}$ is equal to one if both *i* and *j* are not members of the GATT/WTO, and zero otherwise. The main coefficient of interest is λ, which estimates the impact on trade flows of not being a member of the GATT/WTO. Equation (2) is estimated by Poisson Pseudo-Maximum Likelihood (PPML) which is the estimation strategy recommended by a growing literature to address both sample-selection related to zero trade flows and heteroscedasticity issues (Helpman, Melitz and Rubinstein 2008; Head and Mayer 2014; Santos Silva and Tenreyro 2006, 2011).

Agricultural Trade Costs and the GATT/WTO

Impediments to the free flow of goods across national borders continue to exist and are known to be large but difficult to measure (Novy 2012; Obstfeld and Rogoff 2000). A number of empirical investigations have generally concluded that impediments to trade vary dramatically across space and are much larger than what we would expect them to be (Head and Ries 2001; Anderson and van Wincoop 2003, 2004; Olper and Raimondi 2009; Fontagne et al. 2008; Novy 2011).[4] Given the difficulties in constructing direct measures of trade costs and market access impediments, here we develop an indirect measure of trade costs. Based on the framework in Novy's (2012) novel derivation of the international relative to intra-national (domestic) boarder effects, we modify the theoretical gravity equation developed by Anderson & van Wincoop (2003) which assumes CES preferences and that products are differentiated by country of origin (Armington). In this framework trade costs are compared relative to domestic trade - the latter of which serves as the appropriate benchmark to define a seemingly well-integrated zone.

The popular Anderson and van Wincoop (2003) gravity equation is specified as follows:

$$X_{ij} = \frac{Y_i Y_j}{y^W}\left(\frac{\tau_{ij}}{\Pi_i P_j}\right)^{1-\sigma} \quad (3)$$

where, as before X_{ij} is the bilateral trade from *i* to *j*, Y_i and Y_j are the nominal incomes of countries *i* and *j*, respectively, y^W is aggregate world income, Π_i is the outward multilateral resistance country *i* faces with its trading partners in the rest of the world, P_j is the inward multilateral resistance of country *j*, and τ_{ij} denotes variable bilateral trade costs. Following Novy (2012) consider country *i's* intra-national trade:

[4] For example, Anderson and van Wincoop (2004) assert that non-agricultural trade costs are large and equal to a 170 percent ad-valorem equivalent barrier, even between economies that are seemingly well integrated.

$$\mathrm{X}_{ii} = \frac{\mathrm{Y}_i \mathrm{Y}_j}{\mathrm{y}^W} \left(\frac{\tau_{ii}}{\Pi_i \mathrm{P}_\mathrm{i}} \right)^{1-\sigma} \tag{4}$$

and rewrite it as:

$$\Pi_\mathrm{i} P_i = \left(\frac{X_{ii}/Y_i}{Y_i/y^W} \right)^{\frac{1}{\sigma-1}} \tau_{ii} \tag{5}$$

which solves for country *i's* multilateral resistance. Multiplying (5) by X_{ij} and X_{ji}, we obtain:

$$X_{ij} X_{ji} = \left(\frac{Y_i Y_j}{y^W} \right)^2 \left(\frac{\tau_{ij} \tau_{ji}}{\Pi_i P_i \Pi_j P_j} \right)^{1-\sigma} \tag{6}$$

Substituting (5) for country *i* and *j* into (4), we can derive the bilateral trade costs relative to domestic trade costs τ_{ij}:

$$\tau_{ij} = \left(\frac{t_{ij} t_{ji}}{t_{ii} t_{jj}} \right)^{\frac{1}{2}} - 1 = \left(\frac{\mathrm{x_{ii}} \mathrm{x_{jj}}}{\mathrm{x_{ij}} \mathrm{x_{ji}}} \right)^{\frac{1}{2(\sigma-1)}} - 1 \tag{7}$$

where, τ_{ij} is defined as the indirect measure of relative bilateral trade costs, expressed as an *ad-valorem* equivalent (by subtracting one), and σ is the elasticity of substitution between domestic and foreign goods. This trade cost (or boarder effect) measure is a scaled ratio of domestic relative to international trade costs weighted by the degree of product substitutability (i.e., the elasticity of substitution) between these markets. Using equation (7) all the data that is required to these relative trade costs is the product of *i* and *j's* bilateral trade with each other (denominator), the product of each of their respective intra-national trade (numerator), and reasonable estimates of σ.

We compute τ_{ij} for a panel of agricultural trade and domestic production data on a value basis for over 100 countries from 1965-2010 to answer two important policy questions:

1) To what extent have international agricultural trade costs fallen over the last several decades?
2) Do international agricultural trade costs differ between members and non-members of the GATT/WTO and RTAs?

While equation (7) provides a convenient and theoretically sound representation of aggregate international relative to domestic trade costs, several caveats are worth noting. First, τ_{ij} in equation (7) is not directional; that is, τ_{ij} measures the barrier between country *i* and *j* as a two-way trade cost which is the same for both trading partners. Second, equation (7) is undefined (trade costs are infinite) when countries *i* and *j* have zero trade. Third, the degree of

substitutability, σ, plays a fundamental role since international trade costs are decreasing in the degree of substitutability. Chen & Novy (2011) estimate σ at the industry level and confirm that the elasticity of substitution is heterogeneous across industries. Similar evidence is presented in Hertel et al. (2007); Head and Ries (2001), Haveman et al. (2003). Here we assume $\sigma = 10$ for agricultural trade, but also report ad-valorem trade costs when sigma is assumed equal to a lower value of eight. On the other hand, equation (7) captures the barriers of international relative to intra-nation trade without assuming frictionless trade in the former or symmetric trade costs between the latter (Novy 2012). An additional advantage is that it allows τ_{ij} to be computed in a panel framework allowing for time-varying measures of bilateral trade barriers.

China and the GATT/WTO – An Investigation Using Synthetic Control Methods

China's accession to the WTO was notable in many respects. By the time of its accession in 2001, China was the among the economically largest countries which were not yet a member of organization, and it became by far the largest economic power among developing country members. China was home to a fifth of the world's population and was already a major player in world trade. It was thought that China's accession would increase the WTO's share of world trade by about five percent (Martin and Ianchovichina, 2001)

China's path to WTO membership was long and far from direct. China was one of the original signatories of the General Agreement on Tariffs and Trade (GATT; 1948) but shortly thereafter announced that they would leave the GATT system. In 1986 China communicated that it would like to enter into negotiations to resume its status as a party to the GATT. This process proved to be slow and far from simple. The complexities of improving WTO rules applied to formally centrally planned economies, China's economic size and assertion that it be granted developing country status, and WTO member concerns about competition from China and enforcement of intellectual property rights in China became some of the many notable challenges in these negotiations (Anderson, 1997). Also, as time passed and the GATT transitioned into the WTO, and then held subsequent rounds of negotiations to further the scope of the agreement, the "goal posts" that China must reach were periodically moved (Anderson, 1997). Finally in 2001, more than 15 years after submitting its GATT application, China was accepted as a WTO member.

A large literature has examined various aspects of the trade impacts of China's accession to the WTO. To assess the impact of this policy, a key question is how China's trade would have evolved after 2001 should it not have finally been successful in joining the WTO. This question is considered using a synthetic control method. The Synthetic Control Method (SCM) provides a systematic way to choose comparison units in comparative case studies. Using this approach the economic evolution of a "treated" unit (in this case China's accession to the WTO) is a weighted averate of untreated units (other countries). The weights are chosen such that both the outcome measure of interest such as imports, and its key determinants match with the treated unit before the treatment. The different between the actual evolution of the treated unit in the post-treatment period and the outcome of the synthetic unit is interpreted as the treatment effect and in this case will allow us to assess the impact of China joining the WTO.

Since its introduction, synthetic control methods have been applied to a variety of economic studies including those evaluating policies and outcomes relevant to international economics. The economic performance of open verses closed economies (Nannicini and Billmeier, 2011; Billmeier and Nannicini, 2013) offered a few early examples of SCM application to this field. Subsequent analyses have used SCM to examine the impact of policies as varied as the 2007 Legal Arizona Workers Act on that state's unauthorized immigrant population (Bohn et al., 2014), the effectiveness of trade boycotts (Heilmann, 2015), the impact of trade liberalization on child mortality (Olper et al., 2015) and the impact of the US specific safeguard case regarding Chinese tires on American workers (Chung et al., 2016).

Relatively few studies, however, have used a synthetic control approach to examine the impact of international trade agreements. Hosny (2012) used SCM to examine Algeria's trade with countries in the Greater Arab Free Trade Area (GAFTA). Hannan (2016) and Hannan (2017) examined the impact on the trade between country pairs who were both signatories of a given major trade agreement, and both parties to a Latin America trade agreement, respectively. Demko and Jaenicke (2017) used a synthetic control method in their study of the impact of trade impact of an agreement establishing bilateral equivalence of organic standards in the U.S. and the EU. To our knowledge, however, SCM has not been used in an assessment of the WTO.

Synthetic Control Method

The synthetic control method was introduced and expanded upon by Abadie and Gadeazabal (2003), and Abadie et al. (2010, 2015). Briefly, adopted from these sources, this method can be described as follows. Suppose there is a sample of J + 1 units (e.g. countries) indexed by j, in which the unit of interest (the "treated unit") is defined when j=1, and other units of possible comparison units (the "donor pool") are represented by j=2 to j = J+1. The comparison units are meant to approximate the counterfactual of the case of interest without the treatment; as such, the donor pool should include units with outcomes thought to be driven by the same structural process as the unit of interest, but which are not subject to structural shocks during the same period of study. Further, it is assumed that the sample includes a number of pre-treatment (T_0) and post-treatment (T_1) periods, with $T = T_0 + T_1$. The treatment is assumed to have no effect during the pre-treatment periods $1, \dots, T_0$, but that Unit 1 (only) is treated during periods $T_0 + 1, \dots, T$.

During the pretreatment period, the characteristics of the unit of interest can be most accurately approximated by a weighted average of the units in the donor pool. The synthetic control can thus be represented by a $(J + 1)$ vector of weights $W = \left(w_2, \dots, w_{J+1}\right)'$, with $0 \leq w_j \leq 1$ for $j = 2, \dots, J$ and $w_2 + \cdots + w_{J+1} = 1$. The difference between the pre-treatment characteristics of the unit of interest and the synthetic control group is given by a vector $X_1 - X_0 W$, where $X_1$is a $k \times 1$ vector of pre-treatment characteristics of the unit of interest, X_0 is a $k \times J$ matrix collecting the same variables for the unit in the donor pool. Subject to the constraints noted above, the optimal synthetic control weights W^* approximate:

$$W^* = argmin_w \parallel X_1 - X_0 W \parallel = argmin_w \sqrt{(X_1 - X_0 W)' V (X_1 - X_0 W)} \qquad (9)$$

where $V$is a positive semidefinite $k \times k$matix of weights. The optimal Vassigns weights that minimize the root mean squared prediction error that the synthetic control approximates the pre-treatment path of the outcome variable.

The SCM method offers several key advantages relative to other parametric and semi-parametric estimators (Olper et al., 2015). First, it is transparent as the countries are identified through the weights W* assigned to them to construct the counterfactual outcome (the control). Second, as the pool of countries used to construct the counterfactual can be restricted to make the country comparisons more appropriate. Finally, it is based on the assumptions which are weaker than those often used by standard estimators because it allows for the effect of unobservable

confounding factors to vary by time. As such, endogeneity bias due to omitted time-varying variables is accounted for.

The SCM, however, is not without drawbacks. Among the most significant of these are the inability to assess the significance of results due to the small number of observations, the lack of randomization, and the inability use a probabilistic sampling strategy to construct the sample units (Abadie et al., 2015). The ability to use standard approaches to statistical inference is also complicated by these features (Abadie et al., 2015). To partially address this problem Abadie et al., (2010) recommended using placebo tests which compare the magnitude of the estimated effect on the treated case with the size of the effect which is obtained by randomly assigning the treatment to any country in the donor pool. These tests are included in this analysis.

Data

To conduct these analyses we develop a new dataset of total agri-food trade flows covering 46 years (1965-2010), 185 countries, and 206 bilateral and regional trade agreements. The trade data are based on countries' reported import statistics to the United Nations' Commodity Trade Statistics (Comtrade) using 4-digit Standard Industrial Trade Classification (SITC, revision 1) product codes. Reported import statistics are used whenever they are available. Following Feenstra et al. (2005), mirrored trade flows, defined as the exporters' reported exports, are employed if the reporting countries' imports are missing and the exporter's statistics are non-zero. The WTO's Multilateral Trade Negotiation (MTN) categories are used to classify agricultural goods.[5]

Distance data are taken from the *Centre d'Etudes Prospectives et d'Informations Internationales* (CEPII) geo-distance dataset developed by Mayer and Zignago (2006).[6] GDP data are taken from two sources: the World Bank's (WB) World Development Indicators (WDI) and the United Nation's National Accounts Main Aggregates Database.[7] Information on regional

[5] The WTO's MTN categories for agriculture are: (1) animal and meat products; (2) dairy; (3) fruits, vegetables and plants; (4) coffee, tea, and spices; (5) cereals and preparations; (6) oilseeds, fats and oils; (7) sugar; (8) beverages and tobacco; (9) cotton; and (10) other agriculture (confectionary products, hides and skins, etc.). See http://www.wto.org/english/res_e/booksp_e/tariff_profiles06_e.pdf (pgs. 24-25) for more details.

[6] CEPII is an independent European research institute on the international economy stationed in Paris, France. CEPII's research program and datasets can be accessed at www.cepii.com. CEPII uses the great circle formula to calculate the geographic distance between countries, referenced by latitudes and longitudes of the largest urban agglomerations in terms of population.

[7] In some cases (i.e., Taiwan), we use GDP data from the Penn World Tables (6.3) to supplement WB and UN data when it is incomplete or missing. WB Development Indicators can be accessed at:

trade agreements is taken from the WTO's enhanced Regional Trade Agreements Information System (RTA-IS).[8] However, because RTAs covering trade in services are also required to be notified to the WTO, many agreements are double counted – once when the RTA is notified under Article XXIV covering trade in goods, and again under Article V covering trade in services. Removing 80 duplicate agreements leaves a total of 206 agreements coded in the database. GATT/WTO membership is coded based on the notifications of members' official dates of accession which are available from the WTO's website.[9]

The completed (unbalanced) dataset spans the period 1965-2010 at five year intervals (1965, 1970, 1975, . . . , 2010) and contains a total of 303,457 observations. Of this total, 27 (73) percent, or 81,475 (221,982) are zero (positive) trade flows. Forty-five percent of bilateral trade occurs between two GATT/WTO members, 42 percent between country pairs in which only one of the countries is a GATT/WTO member and 13 percent of trade flow observations takes place between non-members.

Data to Construct Agricultural Trade Costs

In the context of equation (7) an important consideration is we define a nation's trade with itself (X_{ii}, X_{jj}). Here intra-national trade is constructed using the approach described by Novy (2011) and Shang-Jin Wei (1996). It is assumed intra-national trade can be expressed as total production minus total exports in tradable goods categories on a gross value basis:

$$X_{iit} = y_{it} - X_{it} \tag{8}$$

where, X_{iit} is the value of country i's trade with itself, y_{it} is the value of country *i*'s gross agricultural production, and X_{it} is the aggregate value of country *i*'s agricultural exports.

We focus on agricultural trade costs for countries with readily available agricultural production and export value information. The Food and Agricultural Organization (FAO) tabulates statistics on agricultural production quantities and values, in real and nominal terms. . We use constant

http://databank.worldbank.org/data/home.aspx, and UN GDP data can be retrieved at: http://unstats.un.org/unsd/snaama/dnllist.asp.

[8] Available at: http://rtais.wto.org/UI/PublicMaintainRTAHome.aspx

[9] Our definition of GATT/WTO membership is akin to Rose (2004). We do not control for *de facto* or provisional membership as in TGR (2007) in the current version of this paper. A list of members prior to and after the formation of the WTO can be found at: http://www.wto.org/English/thewto_e/gattmem_e.htm.

production values which are available in a much longer time series from 1960-2010. Export values are then converted to real values using the exporters' GDP deflator. With real production and export values in constant values, we then estimated each of the 121 countries' intra-national trade using equation (8) and merge this with the bilateral trade dataset described above.

Synthetic Control Methods – Data and Implementation

This analysis assesses the impact of China's WTO membership by examining changes in its aggregate imports prior and subsequent to gaining membership in this organization. In the context of our analysis, the "treated unit" is the China's aggregate imports or agricultural products. The synthetic China is constructed as a weighted average imports of other countries in the donor pool with weights chosen so that the resulting synthetic China best reproduces a set of predictors of China's trade before its accession to the WTO.

Chinese exports are well known to have expanded considerably in the period since China joined the WTO. Concurrently, China has been accused of retaining protectionist policies against imports, and has undertaken domestic initiatives to foster technology development in sectors which would permit import substitution. Of these two flows, those concerned with economic nationalism might question whether or not China is pursuing their own nationalist trade policies and whether the WTO offered any benefits in improving access to China's market. For this reason, this analysis focusses on aggregate Chinese imports of agri-food products.

As a starting point we limit the countries included in this analysis to those who are among the 75 agricultural importers. As the synthetic China is meant to reproduce China's trade that would have been observed in the absence of the WTO, we discard from the donor pool countries that had a change in their WTO membership status during the study period. Also, as RTAs can affect trade through similar channels as the WTO, counties that are signatories to RTAs with China whose members or scope changed during the study period are discarded. In the baseline specification, the synthetic control unit is composed as a weighted average of ROW which, in this case are countries who are among the top 75 agri-food product importers and who were not discarded from the country set due to WTO or RTA status changes. Alternative model specification compare China's import performance to OECD countries, high income countries, and middle and lower income countries.

To estimate of the impact of WTO membership on China's aggregate imports, $M_{CHN,t}$of agricultural products we rely on standard trade predictors: the gross domestic product of China in year t, $GDP_{CHN,t}$, and the average number of RTAs that China's trading partners are signatories of, RTA_t. Many other standard gravity model covariates reflect characteristics of the trading partner or partnership; as the outcome of interest reflects the value of trade aggregated across trading partners, these variables are not included among the considered pre-treatment characteristics. Instead, a measure of China's remoteness from its trading partners for agricultural products, $Remote_t$, is included. This measure serves as a proxy for the multilateral resistance faced by China in period t and is calculated as the country's average distance from its trading partners weighted by the partner country's share of world GDP.

The study period for this analysis spans from 1997 – 2010 and makes use of annual panel data. As the WTO was formed in 1995 and as a notable number of countries joined in 1996, to preserve the size of the donor pool, the pre-treatment period is started in 1997. Given China joined the WTO in 2001, this analysis thus includes four pre-treatment and ten post-treatment periods. The trade flow dataset used in this analysis is constructed using the same sources as that previously described for the gravity model analysis. The International Monetary Fund's development classification is used to categorize countries as being high, middle or low income. LICs include the WTO's list of least-developed countries (LDCs) as well as nonmembers classified by the International Monetary Fund as low-income economies. This analysis was implemented using the "synth" package in Stata.

To infer significance the treatment effect, we make use of "in-space placebo" tests recommended by (Abadie et al., 2015). These tests are performed by selecting one of the members of the donor pool (e.g. $j = 2$) to be the treated unit and all other countries (including China) as untreated countries; the effects of the treatment are then reestimated. This process is then iteratively repeated for all *J* countries with replacement. As there are no other countries in *J* which joined the WTO during the sample period, it would be expected that the treatment effects on these countries would be zero. Thus if China's trade is affected by joining the WTO, a difference between $M_{CHN,t}$ and $M_{j\neq CHN,t}$ should be observed.

Results

The results are organized in three sub-sections. Sub-section one contains our main gravity equation estimates of the impact of not being a member of the GATT/WTO (equation 2). In sub-

section two we graphically present the computed trade costs from equation (7) for GATT/WTO members and nonmembers, and their *ad valorem* equivalents. Finally, sub-section three turns to a data drive non-parametric approach using synthetic controls to understand what China's agricultural trade might have looked like in a world without the WTO.

Agricultural Trade Costs and GATT/WTO Membership

Figure 1 presents the multilateral agricultural trade costs over the sample period 1965-2010, for elasticity of substitution values of eight ($\sigma = 8$) and ten ($\sigma = 10$). Plotted are the mean (solid line) and median (dashed line) ad-valorem equivalent trade cost values covering 121 countries after computing equation (7). The reduction of global agricultural trade costs through lower transportation costs, regional integration and successive rounds of multilateral negotiations is evident. In 1965, the height of agricultural trade costs was 304 percent on an ad-valorem equivalent (AVE) basis ($\sigma = 10$), roughly double the 170 percent AVE value reported by AvW (2004) using a smaller sample period (1989-2000). After 1970, international relative to domestic agricultural trade costs have fallen remarkably to their current level of 125 percent AVE which translates to a reduction of nearly 60 percent. Also plotted in Figure 1 are the AVE trade costs for an elasticity of substitution of eight. While agricultural trade costs are sensitive to changes in the degree of substitutability between varieties from different countries, the declining trend in trade costs is evident independent of this parameter.

The proliferation of regional trade agreements and the increasing size of WTO membership has been one of the great international economic developments since the post-war era. In contrast to Figure 1 which displays multilateral trade costs for 121 countries, Figure 2 compares agricultural trade costs for WTO Members and non-members, and those country pairs belonging to a mutual RTA. Multilateral and regional integration share at least one thing in common – the reduction of trade barriers among member nations. At first glance, regional integration clearly dominates multilateral efforts. The average ad-valorem agricultural trade cost within RTAs was 84 percent in 2010, compared to an average of 121 percent for all WTO members. However, it is difficult to identify the cause of this since many countries were members of the WTO before joining an RTA and vice versa. Moreover, trade costs are everywhere lower for country-pairs that participate in RTAs but show a much weaker downward trend compared to country-pairs belonging to the WTO. To gain some insight, Figure 2 also

traces out the level of agricultural trade costs for country-pairs that not members of the WTO. Again there is a clear downward trend in agricultural trade costs and by 2010 WTO members and non-members' agricultural trade costs nearly converge. Comparatively, GATT/WTO non-members' ad valorem equivalent trade costs were 64 percentage points higher than WTO members – more than 1.3 times that of the average GATT/WTO member. In practice, trade costs can vary considerably across goods and readers may be aware of specific product lines where the import tariffs exceed the ad valorem equivalent average reported in 2010. However, it is important to remember that this analysis represents average trade costs for all agricultural trade and all international frictions that affect the production and shipment of agricultural products to final destinations in the global market place. As such, these measures likely include a host of other trade costs including important non-tariff measures.

China and the GATT/WTO – An Investigation Using Synthetic Control Methods

Table 3 shows the weights of each country in the synthetic version of China's agricultural imports. In the case of the comparison between China and the rest of the world (panel A), the synthetic China is a weighted average of Turkey, Japan and Russia with weights decreasing in this order. All other counties in the donor pool are assigned weights of zero. In developing a synthetic control for China among OECD countries, only Turkey and Japan prove to be relevant, and among high income countries, Israel, Canada, and the Netherlands form the best synthetic control. Table 4 presents results of how the pre-treatment characteristics of China compare with the weighted average of those countries selected from the donor poll; the outcome of this experiment indicates that the synthetic control group members can be selected and combined in such a way as to provide a suitable control

Placebo tests are also conducted to provide further confidence in these results. If we find estimated effects that are similar or larger in magnitude than those estimated for China, our confidence that the effect of the China's WTO accession would greatly diminish. In examining the placebo test results (Appendix 1) we find a very large effect for the 2001 accession of China joining the WTO, but no effect at all when we artificially reassign the intervention to members of the donor pool. These result provide further assurance that the large synthetic control estimates are, indeed attributable to China joining the WTO.

Although China had committed to a number of regional and bi-lateral trade agreements prior to joining the WTO, these results suggest that this organization still has offered

considerable befits in-terms of facilitating trade of the world's exported agri-food products to China. In response to a nation pursing a nationalist trade policy, trading partners may opt to do the same. Market access to countries who may already protectionist trade and domestic policies would be reduced thus potentially adversely impacting the very firms that the protectionist policies had intended to shelter.

Conclusions

The protracted negotiations of the WTO's Doha Development Agenda has fallen short of the initially high expectations for significant new trade liberalization leading many to question whether the multilateral institution faces a legitimacy crisis (Bagwell and Staiger 2014; Josling 2012). However, even while there is little prospect for the conclusion of a successful multilateral round and a single undertaking by now 164 WTO Members, global trade liberalization is by no means stagnant. If anything, policy-makers have simply allocated what used to be multilateral negotiating resources to the regional level.

The first and most frequently cited reason for the latest surge in preferential and mega-regional trading blocs is the slow progress being made in multilateral trade talks. As Krugman (p.73, 1993) puts it (see also Bergsten 1996):

"This comes down to asking why nations may feel that they are able to negotiate more at a regional than at a global level. Or to put it more pessimistically, what are the problems of the GATT that lead countries to turn to their neighborhood instead?"

This paper revisited the benefits of membership in the multilateral organization using state of the art methods to estimate gravity equations of bilateral trade flows but also new methods to examine international trade costs through border effects as well as non-parametric data driven methods to examine what China's agricultural trade might have been in the absence of its accession to the WTO in 2001. Through each of these approaches, it has been demonstrated that participating in multilateral trade agreements has brought benefits in facilitating trade between signatories of those agreements, reducing the costs of trade, and providing market access benefits.

By all indications, multilateralism ought to stay and the world economy is likely to further benefit from its existence. While countries will likely find it more appealing to write their own rules for 21st century trade on a regional and bilateral basis through regional trade agreements to relying on a single undertaking, consensus-based approach with a group of 164 countries that vary considerably in terms of the agricultural trade openness they have achieved through the WTO process. Or it may not. Much remains to be seen on the specific provisions agreed upon in the mega-regionals and the type of preference structures they create for the more than 140 countries sitting on the sidelines while these trade deals unfold.

References

Abadie, A., A. Diamond, and J. Hainmueller. 2015. Comparative Politics and the Synthetic Control Method. *American Journal of Political Science* 59 (2): 495–510.

Abadie, A., A. Diamond, and J. Hainmueller. 2010. Synthetic Control Methods for Comparative Case Studies: Estimating the Effect of California's Tobacco Control Program. *Journal of the American Statistical Association* 105(490): 493–505.

Abadie, A., and J. Gardeazabal. 2003. Economic Costs of Conflict: A Case Study of the Basque Country. *American Economic Review*. 93(1): 113–32.

Anderson, K. 1997. On the Complexities of China's WTO Accession. *The World Economy*. 20(6): 749-772.

Anderson, J.E., and E. van Wincoop. 2003. "Gravity with Gravitas: A Solution to the Border Puzzle." *American Economic Review,* 93(1): 170-92.

Anderson J, van Wincoop E. 2004. Do National Borders Really Matter? Canada-US Regional trade Reconsidered. *Journal of Economic Literature,* 42(3): 691-751.

Arkolakis, C., A. Costinot and A. Rodriguez-Clare. 2012. New Trade Models, Same Old Gains? *American Economic Review*. 102(1): 94-130.

Bagwell, K., and R.W. Staiger. 2002. *The Economics of the World Trading System*. MIT Press, Cambridge, Massachusetts and London, England.

Bagwell, K. and R.W. Staiger. 2014. "Can the Doha Round Be a Development Round? Setting a Place at the Table," IN: *Globalization in an Age of Crisis* (edited by Feenstra and Taylor), University of Chicago Press, Chicago IL, January.

Baldwin, R.E. 2006. Multilateralising regionalism: Spaghetti bowls as building blocs on the path to global free trade. *World Economy*. 29, 1451–1518.

Baldwin, R. 2010. "Understanding the GATT's Wins and the WTO's Woes," CEPR Policy Insight No. 49, Geneva, June

Baldwin, R. 2016. The World Trade Organization and the Future of Multilateralism. *Journal of Economic Perspectives*. 30(1): 95-116.

Bergstrand, J.H., M. Larch, Y.V Yotov. 2015. Economic integration agreements, boarder effects and distance elasticities in the gravity equation. European Economic Review. 78: 307-327.

Bergstren, C.F. 1996. "Competitive Liberalization and Global Free Trade: A Vision for the Early 21st Century." Washington, DC: Institute for International Economics, Working Paper 96-15.

Bhagwati, J. 1992. Regionalism versus Multilateralism. *The World Economy*. 15(5): 535-555.

Bhagwati, J. 1995. U.S. Trade Policy: The Infatuation with Free Trade Areas. IN: Bhagwati, J. and Krueger, A. (Eds.) *The Dangerous Drift to Preferential Trade Agreements*, Washington, D.C., American Enterprise Institute for Public Policy Research.

Billmeier, A., and T. Nannicini. 2013. Assessing Economic Liberalization Episodes: A Synthetic Control Approach. *The Review of Economics and Statistics.* 95 (3): 983–1001.

Bohn, S., M. Lofstrom, and S. Raphael. 2014. Did the 2007 Legal Arizona Workers Act Reduced the State's Unauthorized Immigrant Population? *The Review of Economics and Statistics*. 96 (2): 258–69.

Chen N, and D. Novy. 2011. Gravity, trade integration, and heterogeneity across industries. *Journal of International Economics*. 85(2): 206-221.

Chung, S., J. Lee, and T. Osang. 2016. Did China tire safeguard save U.S. workers? *European Economic Review*. 85:23-38

Cipollina, M. and L. Salvatici. 2010. Reciprocal Trade Agreements in Gravity Models: A Meta-Analysis. *Review of International Economics*. 18(1): 63-80.

Demko, I. and E.C. Jaenicke. Impact of the European Union-U.S. Organic Equivalency Agreement on U.S. Exports. *Applied Economic Perspectives and Policy. Forthcoming.*

Eaton, J. and S. Kortum. 2002. Technology, Geography, and Trade. *Econometrica*. 70(5): 1741-1779.

Feenstra, R., R.E. Lipsey, H. Deng, A.C. Ma, and H. Mo. 2005. "World Trade Flows: 1962-2000". NBER Working Paper No. 11040.

Fontagné L., Laborde D., Mitaritonna C. 2008. "An Impact Study of the EU-ACP Economic Partnership Agreements (EPAs) in the Six ACP Regions." CEPII Working paper #2008-04.

Grant, J.H. and K.A. Boys. 2012. Agricultural Trade and the GATT/WTO: Does Membership Make a Difference? *American Journal of Agricultural Economics*. 94(1): 1-24

Grant, J.H. and D.M. Lambert. 2008. Do Regional Trade Agreements Increase Members' Agricultural Trade? *American Journal of Agricultural Economics*. 90(3): 765-782

Hannan, S.A. 2016. "The Impact of Trade Agreements: New Approach, New Insights." IMF Working Paper WP/16/117.

Hannan, S.A. 2017. "The Impact of Trade Agreements in Latin America using the Synthetic Control Method." IMF Working Paper WP/17/45.

Haq, Z. and K. D. Meilke. 2010. Do the BRICs and Emerging Markets Differ in their Agrifood Imports? *Journal of Agricultural Economics*. 61(1):1-14.

Haveman J.D., U. Nair-Reichert, and J.G. Thursby. 2003. How Effective are Trade Barriers? An Empirical Analysis of Trade Reduction, Diversion, and Compression. *The Review of Economics and Statistics.* 85(2): 480-485.

Head, K. and T. Mayer. 2000. Non-Europe: The Magnitude and Causes of Market Fragmentation in the EU. *Weltwirtschaftliches Archiv.* 136(2):285-314.

Head K, and J. Ries. 2001. Increasing Returns vs. National Product Differentiation as an Explanation for the Pattern of U.S.-Canada Trade. *Canadian Journal of Economics*. 91(4): 858-876.

Heilmann, K. 2016. Does political conflict hurt trade? Evidence from consumer boycotts. *Journal of International Economics.* 99:179-191.

Helpman, E. M. Melitz and Y. Rubinstein. 2008. Estimating Trade Flows: Trading Partners and Trading Volumes. The Quarterly Journal of Economics. 123(2): 441-487.

Hertel T., D. Hummels, M. Ivanic, and R. Keeney. 2007. How confident can we be of CGE-based assessments of Free Trade Agreements? *Economic Modeling*. 24(4):611-635.

Hosny, A.S. 2012. Algeria's Trade with GAFTA Counties: A Synthetic Control Approach. *Transition Studies Review.* 19: 35–42.

Ingco, M. and D. Hathaway. 1998. "Implementation of Uruguay Round Commitments in Agriculture: Issues and Practice." IN: Serageldian, I and D. Steeds. (Eds) *Rural Well-Being: From Vision to Action* (Proceedings of the Fourth Annual World Bank Conference on Environmentally Sustainable Development) World Bank Publications. Washington, DC.

Irwin, D.A. 1995. The GATT in Historical Perspective. *American Economic Review*. 85(2): 323-328.

Josling, T. 1998. "The Uruguay Round Agreement on Agriculture: A Forward-Looking Assessment." OECD Workshop on Emerging Trade Issues in Agriculture, Paris, October 26-28.

Josling, T. 2012. "New Trade Issues in Food, Agriculture and Natural Resources", IN: A. Narlikar, M. Daunton, and R.M. Stern (Eds.) *The Oxford Handbook on the World Trade Organization*. Oxford University Press, New York.

Josling, T. 2011. "Regional Integration and Agricultural Trade Policy", Chapter 7 in J.-P. Chauffour and J.-C. Maur, (Eds.) *Preferential Trade Agreement Policies for Development: A Handbook*. The World Bank, Washington, DC.

Krishna, P. 2011. "Preferential Trade Agreements and the World Trade System: A Multilateralist View," NBER Working Paper No. 17840, National Bureau of Economic Research, Cambridge MA.

Krugman, P. 1980. Scale economies, product differentiation, and the pattern of trade. *American Economic Review*. 70(5): 950-959.

Krugman, P. l993. "Regionalism versus Multilateralism: Analytic Notes," IN J. De Mello and A. Panagaria (Eds.) *New Dimensions in Regional Integration,* Cambridge University Press and CEPR, London.

Martin, W. and E. Ianchovichina. 2001. Implications of China's Accession to the World Trade Organisation for China and the WTO. *The World Economy*. 24(9): 1205-1219.

Mayer T, and S. Zignago. 2011. "Market Access in Global and Regional Trade". Banque de France Working Paper n°258

Melitz, M. 2003. The Impact of Trade on Intra-Industry Reallocation and Aggregate Industry Productivity. *Econometrica.* 71(6): 1695-1725.

Nannicini T. and A. Billmeier. 2011. Economies in transition: How important is trade openness for growth? *Oxford Bulletin of Economics and Statistics*. 73(3), 287–314.

Novy D. 2012. Gravity Redux : Measuring International Trade Costs with Panel Data. *Economic Inquiry*. 51(1):101-121.

Olper A. and V. Raimondi. 2009. Patterns and Determinants of International Trade Costs in the Food Industry. *Journal of Agricultural Economics*.60:273-297.

Olper, A., D. Curzi, and J. Swinnen. 2015. *Trade Liberalization and Child Mortality: A Synthetic Control Method*. Presentation to the International Conference of Agricultural Economists, Milan, Italy, August 8-14, 2015.

Rose, A. 2004. Do We Really Know That the WTO Increases Trade? *American Economic Review* 94(1): 8-114.

Santos Silva, J.M.C. and S. Tenreyro. 2006. "The Log of Gravity," *Review of Economics and Statistics.* 88(4): 641-658.

Santos Silva, J.M.C. and S. Tenreyro. 2011. Further simulation evidence on the performance of the Poisson pseudo-maximum likelihood estimator. *Economic Letters*. 112(2): 220-222.

Tangermann, S. 2016, "Multilateral Rules for Agriculture: From GATT to WTO", IN: T. Josling and K. D. Meilke, (Eds.) *Handbook of International Food and Agricultural Policies, Volume III: International Trade Rules for Food and Agricultural Products.* World Scientific, pp 63-89.

Tomz, M., J.L. Goldstein, and D. Rivers. 2007. Do We Really Know that the WTO Increases Trade? Comment, *American Economic Review.* 97(5): 2005-2018.

Wei S. 1996. "Intra-national Versus International Trade: How Stubborn Are Nations in Global Integration?" NBER Working Paper no. 5531.

Table 1. Econometric Estimates of the GATT/WTO Trade Effect, 1965-2010

Variable	PPML -No Zeros	PPML - With Zeros	PPML With Dist*TT	OLS
RTA	0.35***	0.35***	0.35***	0.41***
	(0.03)	(0.04)	(0.03)	(0.02)
Nonein	-0.17***	-0.33***	-0.31***	-0.05*
	(0.07)	(0.07)	(0.07)	(0.03)
n	211,937	299,605	299,605	211,937

Table 2. NAFTA, EU, and U.S. Bilateral Agricultural Trade Costs

Country/Region	Partner	1965	2005	% Change
NAFTA	NAFTA	1.57	0.21	-0.86
EU-15	EU-15	2.07	0.45	-0.78
---------- U.S. Bilateral Trade Costs----------				
U.S.	Canada	0.98	0.16	-0.84
U.S.	Australia	1.38	0.53	-0.62
U.S.	Germany	1.28	0.50	-0.61
U.S.	China	1.78	0.71	-0.60
U.S.	Japan	1.37	0.57	-0.59
U.S.	Chile	1.29	0.54	-0.58
U.S.	Brazil	0.91	0.77	-0.16
Mean of U.S. Bilateral Trade Costs		1.28	0.54	-0.57

Note: All agricultural trade cost values are reported as ad-valorem equivalent rates. Trade data are not available for China prior to 1970. Thus, the trade cost measure for China in 1965 is representative of 1975.

Table 3. Country Weights in the Synthetic Control Groups

Country Name	World	OECD Countries	High Income Countries
Algeria	0	-	-
Argentina	0	-	-
Australia	0	0	0
Austria	0	0	0
Belgium-Luxembourg	0	-	-
Brazil	0	-	-
Cameroon	0	-	-
Canada	0	0	0.347
Colombia	0	-	-
Costa Rica	0	-	-
Cote D'Ivoire	0	-	-
Denmark	0	0	0
Dominican Republic	0	-	-
Egypt	0	-	-
El Salvador	0	-	-
Finland	0	0	0
France	0	0	0
Germany	0	0	0
Ghana	0	-	-
Greece	0	0	0
Guatemala	0	-	-
Honduras	0	-	-
Hungary	0	0	0
Ireland	0	0	0
Israel	0	-	0.388
Italy	0	0	0
Jamaica	0	-	-
Japan	0.242	0.264	-
Kenya	0	-	-
Mexico	0	0	-
Morocco	0	-	-
Netherlands	0	0	0.266
Nicaragua	0	-	-
Nigeria	0	-	-
Norway	0	0	0
Paraguay	0	-	-
Poland	0	0	0
Portugal	0	0	0
Romania	0	-	-
Russia	0.116	-	-
Senegal	0	-	-
South Africa	0	-	-
Spain	0	0	0
Sweden	0	0	0
Trinidad and Tobago	0	-	0
Tunisia	0	-	-
Turkey	0.642	0.736	-
United Arab Emirates	0	-	0
United Kingdom	0	0	0
United States	0	-	0
Uruguay	0	-	-
Venezuela	0	-	-
Zambia	0	-	-
Number of Control Countries	54	23	23

Notes: - Indicates that the country was not included in the specification.

Table 4. Matching Variables for Construction of the Synthetic Control Group

Matching Variables		World	OECD Countries	High Income Countries
	Treated	Synthetic	Synthetic	Synthetic
GDP_i	512,165.2	521,838.9	520,612.5	509,276.4
Remote	8,261.7	7,100.2	7,216.2	6,191.3
RTA	0.0	0.3	0.4	0.2
Total Imports, 1997	13.4	12.9	12.5	12.2
Total Imports, 1998	11.2	11.5	11.4	11.7
Total Imports, 1999	9.5	10.7	10.9	11.3
Total Imports, 2000	12.2	11.1	11.5	10.9
RMSE		0.8494	0.8973	1.2771

Notes: GDP is measured in nominal USD. Total imports are denoted in millions of nominal USD.

Figure 1. Multilateral Agricultural Trade Costs, 1965-2010

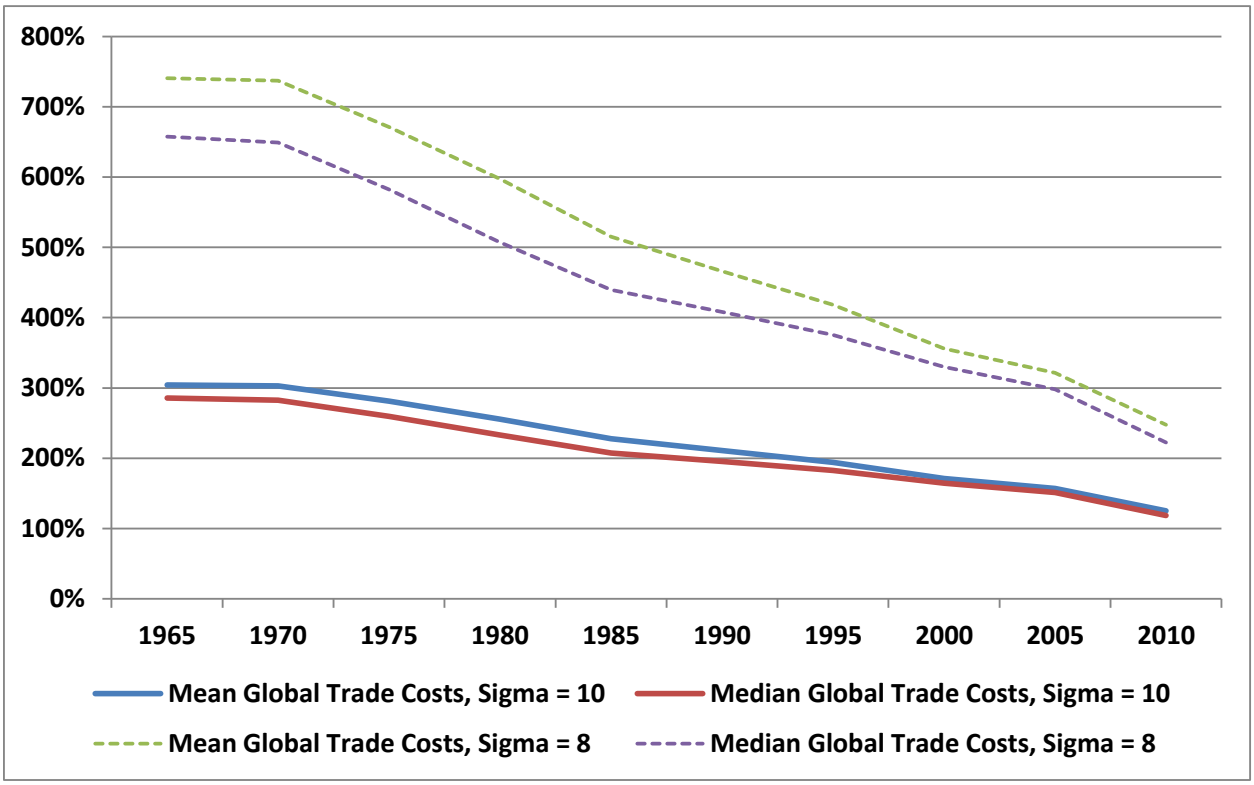


Figure 2. Multilateral Agricultural Trade Costs, WTO and RTA Members, 1965-2010

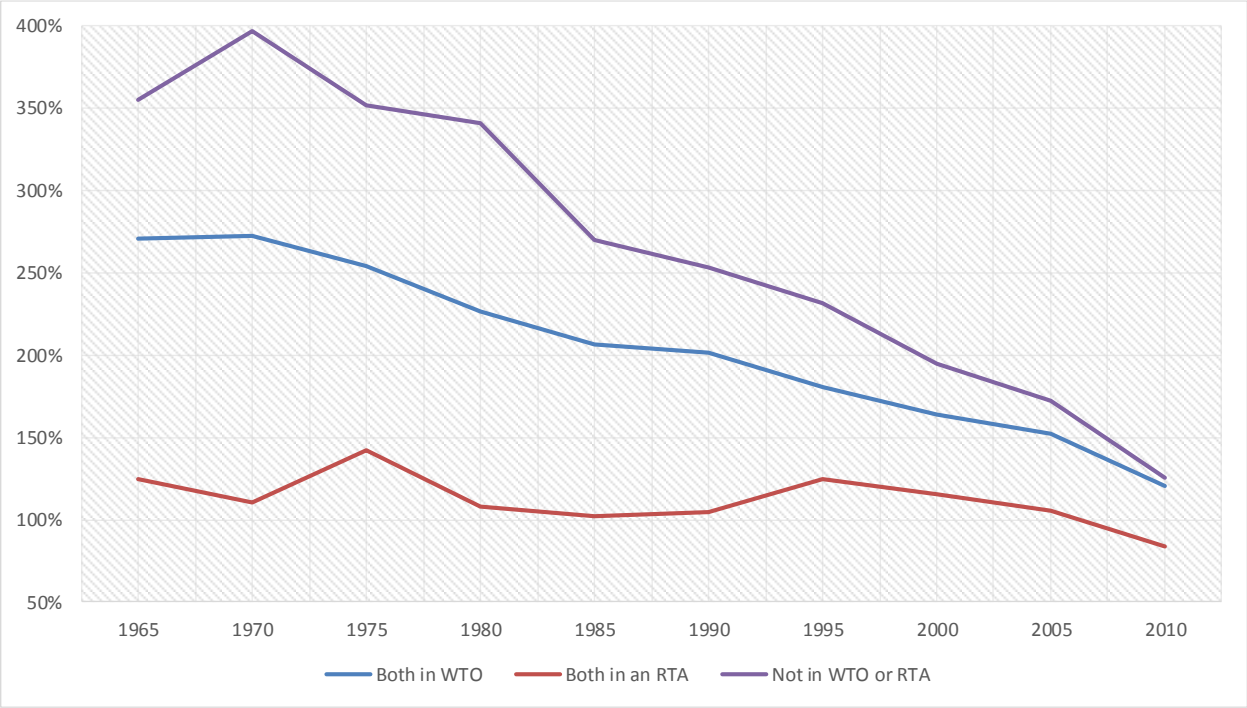
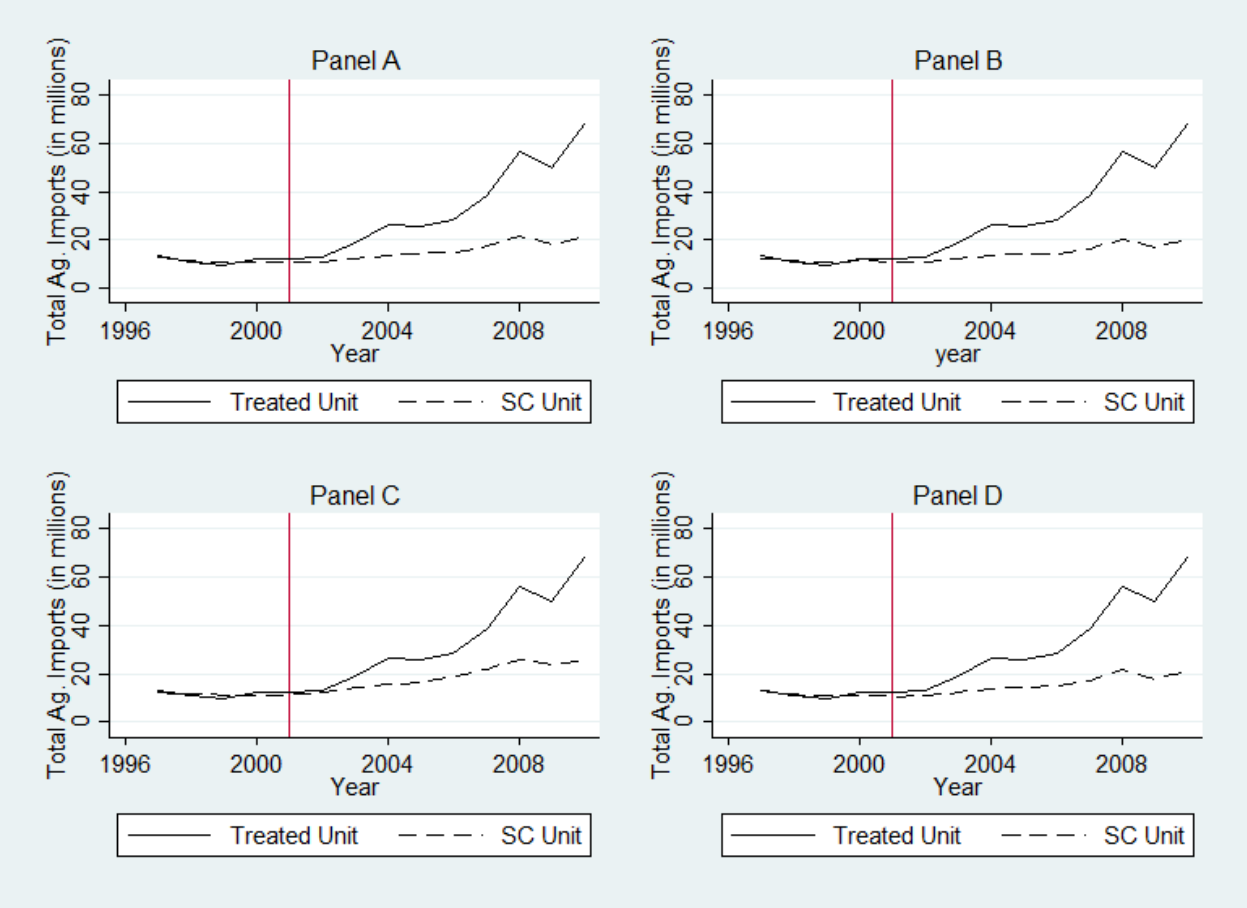


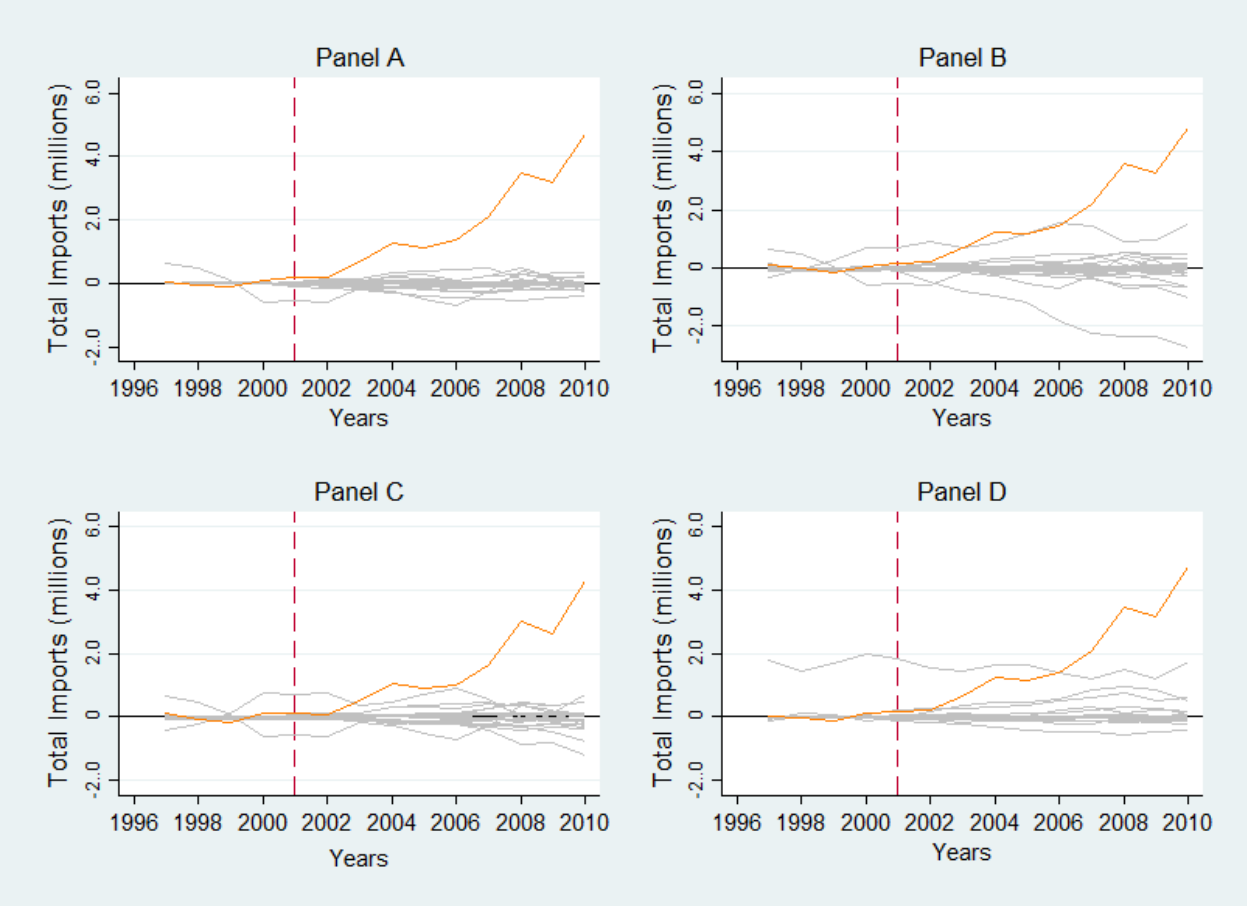
Figure 3: Synthetic Control Method Results for China's Accession to the WTO



Notes: The Figure reports examples of the SCM placebo tests for synthetic controls drawn from a donor pool of the world (Panel A), OCED countries (Panel B), High-Income Countries (Panel C), and Medium- and Low-Income Countries (Panel D). For each SCM experiment, the vertical line indicates the year that China joined the WTO (2001), the outcome variable for the treated unit (solid line), and the synthetic control unit (dashed line).

Appendix 1.

Figure A1. Synthetic Control Method Placebo Tests for WTO Accession Effects



Notes: The Figure reports examples of the SCM placebo tests for synthetic controls drawn from a donor pool of the world (Panel A), OCED countries (Panel B), High-Income Countries (Panel C), and Medium- and Low-Income Countries (Panel D). In each panel, the vertical dashed line indicates the year of the trade reform, and the orange line reports the difference between the treated unit and the synthetic control. The grey lines report the outcome difference between each (false) treated country from the donor pool and their synthetic control in the placebo tests.