AN EMPIRICAL ASSESSMENT OF PHYTOSANITARY REGULATIONS ON US FRESH FRUIT AND VEGETABLE IMPORTS

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PRELIMINARY RESULTS: PLEASE DO NOT QUOTE

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1. Introduction

US imports of fresh fruits and vegetables have grown substantially in recent decades and account for a steadily increasing share of domestic consumption. Since 1989, the value of US fresh vegetable imports has increased from $811.5 million to $4,680.4 million in 2008, or an annual growth rate of 9.7 percent (USDA/FAS)[1]. During this same period, the value of US fresh fruit imports increased from $1,958.4 million to $6,802.5 million, or an annual growth rate of 6.8 percent. The rate of growth in imports of fresh vegetables has exceeded the rate of growth in total agricultural imports, with the fresh vegetable share of total US agricultural imports increasing from 3.4 percent in 1989 to 5.5 percent in 2008. The rate of growth in imports of fresh fruits has been almost identical to rate of growth in total agricultural imports, with the import share of fresh fruits in total agricultural imports holding near 8 percent.

Several factors have been posited to explain the growth in US fresh fruit and vegetable imports, including increasing consumer incomes, dietary needs, consumer demand for year-round access to fresh fruits and vegetables, and the implementation of free trade agreements such as the North American Free Trade Agreement (NAFTA) (Huang and Huang, 2007).

With the growth in US imports of fresh fruits and vegetables comes increased concern for the introduction of pests and diseases into the United States via shipments of these products from abroad. Introductions can occur naturally, through migration, or passively via water or wind dispersion. However, most foreign pests and diseases are introduced via human-mediated pathways, either accidentally or intentionally through smuggling or introduction of biological controls. While the lack of data precludes ranking the relative importance of these pathways,

[1] The Harmonized coding system was first implemented in 1989.

trade and travel are believed to be important vectors (National Research Council 2002). Because of this concern, US imports of fresh fruits and vegetables are highly regulated by the Animal and Plant Health Inspection Service of the US Department of Agriculture (USDA/APHIS).

The most restrictive regulations prohibit the importation of specific fresh fruits or vegetables from countries that have identified pest risks and have not developed approved mitigation practices. For example, the US permits the importation of fresh apples and oranges from only a subset of countries that export these commodities, with approved countries only accounting for 39 and 68 percent of global exports of apples and oranges (USDA, Economic Research Service, 2009).

Alternatively, exporters may have access to the U.S. market subject to a set of regulations that often require the use of a specific treatment. For example, fumigation with methyl bromide, which is a common pest-risk mitigation strategy, is often a condition for product entry. Phytosanitary measures to mitigate pest-risk concerns are not required for all shipments of fresh fruits or vegetables into the United States, but vary by the country of origin and the fruit or vegetable being shipped.

Regional trade agreements, such as the North American Free Trade Agreement (NAFTA), in addition to the Uruguay Round Agreement on the Application of Sanitary and Phytosanitary (SPS) Measures, have provided countries opportunities to discuss and potentially challenge existing and proposed SPS regulations (Roberts and Orden, 1997). Both Agreements require measures to be based on scientific evidence and be minimally trade distorting, and have borne results in both high-profile and obscure cases (Josling, Roberts, and Orden, 2004). The World Trade Organization (WTO) reports that just under one half of the 53 complaints related to phytosanitary measures applied to fruits and vegetables have been resolved between trading partners, most before reaching formal dispute settlement (WTO, 2009).

Since the implementation of the Uruguay Round agreement, USDA/APHIS has granted 44 countries new access to ship 107 fresh fruit and vegetable categories into the United States. For example, in 2007 a new regulation was implemented that permitted the importation of fresh mangoes from India if a set of pest-risk mitigation practices, including the irradiation of all mangoes prior to export and the use of fungicides or orchard inspections, were implemented. Changes to phytosanitary rules that permit new market access have in some instances led to significant increases in trade, such as the ten-fold increase in the value of US avocado imports which now totals more than $500 million each year since the elimination of the 84 year-old ban on Mexican avocados in 1997. However, from an exporter's perspective, building capacity and meeting pest-risk mitigation and inspection procedures mandated by USDA/APHIS may take time. It is likely that the increase in imports of fruits and vegetables as a result of new market access occurs over time as exporters invest in production capacity to ensure conformity with USDA/APHIS requirements.

The objective of this paper is to investigate how existing phytosanitary regulations and new market access impact the importation of fresh fruits and vegetables into the United States. Specifically, this study will address two questions:

1. How and to what extent do differing single mitigation treatments, such as fumigation, irradiation, or cold treatment, affect the level and composition of US imports of fresh fruits and vegetables?
2. What portion of the observed increase in US imports of fresh fruits and vegetables can be attributed to new market access, particularly for developing countries?

In order to achieve these objectives, we construct a unique and comprehensive database on US phytosanitary measures pertaining to the importation of fresh fruits and vegetables which has been developed using current and archived versions of the USDA/APHIS Fresh Fruits and Vegetables Import Manual, the Code of Federal Regulations, Federal Register notices, and APHIS reports. We are able to track country eligibility, treatment requirements by type, origin and destination restrictions, systems approaches, and new market access provisions by exporter-and-commodity over the period 1996-2007.

2. Literature Review

While there is concern that developing and least-developed countries (LDCs) may not have the technical and financial resources necessary to meet the SPS requirements in major export markets in developed countries, *ex post empirical* assessments of SPS regulations have not received much attention in the literature and are generally limited to case studies (Peterson and Orden, 2008; Calvin, Krissoff and Foster 2008).

Recent studies employing the gravity model of international trade typically find a negative impact of SPS regulations on agricultural exports, especially exports from developing countries. Otsuki, Wilson, and Sewadeh (2001) and Gebrehiwet, Ngqangweni and Kirsten (2007) analyzed the impacts of stricter aflatoxin standards adopted by developed countries on the exports of food products from African countries. [2] Otsuki, *et al* consider the effects of 15 European Union Member States (EU-15) adopting a stricter Aflatoxin B1 standard (2 ppb) than the standard suggested by Codex Alimentarius Commission (9 ppb). They found that the stricter measures reduced exports of dried fruits, edible nuts, and cereals from nine African countries to the EU-15 countries by an estimated $670 million annually while leading to a decrease in 2.3

[2] The three international organizations which set international benchmark standards for SPS measures are: L'Office International des Epizooties (OIE), the International Plant Protection Convention (IPPC), and the Codex Alimentarius Commission (Codex) (Josling, Roberts, and Orden, 2004).

deaths per billion. Gebrehiwet, *et al* considers the impacts of the total aflatoxin standard adopted by the US, Germany, Italy, Sweden, and Ireland on food exports from South Africa. They found that if these countries would have adopted the total aflatoxin standard suggested by the Codex, it would have led to an additional $69 million in food exports annually from South Africa during the period 1995 to 1999.

Chen, Yang, and Findlay (2008) assess the trade effects of the use of the pesticide Chlorpyrifos MRL and the medicated fish feed Oxytetracycline MRL on Chinese exports of fresh vegetables and fish and aquatic products. Their findings suggest that food safety regulations adopted by importing developed countries negatively influence Chinese agricultural exports. In addition, changes in regulations governing food safety have a larger international trade impact as compared to a relative change in the import tariff. Jayasinghe, Beghin, and Moschini (2009) examine trade costs related to US exports of seed corn to 48 countries, and find that tariffs, distance, and SPS measures all have a statistically significant and negative impact on exports. The authors find that the effects of trade costs related to tariffs and distances outweigh the effects of phytosanitary measures, such as testing and field inspection. However, the authors used a simple count variable to identify the impact of SPS regulations affecting seed corn exports.

A more comprehensive study of the effects of technical measures on agri-food trade by Disdier, Fontaigné and Mimouni (2008) found that regulations employed by OECD countries negatively influence international trade in agricultural products, especially exports of developing and LDCs. Their findings also suggest that international trade in agricultural products among OECD countries isn’t significantly impacted because of these regulations. Moreover, the authors argue that agricultural imports of EU countries are more negatively influenced because of these regulations as compared to other OECD countries. In addition, the authors calculate coverage ratios for OECD countries and conclude that EU countries have some of the lowest coverage ratios among OECD countries.

One drawback of this analysis is the reliance on the Trade Analysis and Information Systems (TRAINS) dataset, which is based in large part on notification of measures to the WTO.[3] Researchers have noted that the TRAINS data are extremely fragmentary and subject to large measurement error with respect to SPS measures (Anderson and van Wincoop (2004); Roberts and Krissoff (2004)). One shortcoming of the data set is that WTO members have only been obliged to notify *changes* to SPS measures since the WTO came into force. As a consequence, a large number of the most trade-restrictive SPS measures adopted in the first decades of the 20th century have never been notified.

A second drawback of the above mentioned empirical studies is their use of coverage ratios and frequency indices (Disdier, *et al* 2008; Jayasinghe, Beghin, and Moschini 2009). These count variables are often based on aggregate trade. Most SPS measures, particularly for OECD imports, are defined at a much greater level of product/commodity disaggregation. For example, the commodities identified in USDA/APHIS SPS regulations correspond to the HS-6 digit categories (e.g., strawberries), HS-8 digit level (e.g., carrots), and in some cases, commodities are identified at the HS-10 digit level (e.g., broccoli).

Finally, coverage ratios or frequency counts cannot capture the effect of differing *types* of treatments on bilateral trade. The TRAINS database fails to account for a large number of

[3] WTO members are required to submit notification of new measures under the Agreement on the Application of Sanitary and Phytosanitary Measures and the Agreement on Technical Barriers to Trade in order to provide an opportunity for trading partners to raise questions or objections to proposed measures before they are adopted. Each notification indicates, among other things, what the proposed measure is, which product or products it is applied to, if it is based on an international standard, and when it is expected to come into force.

economically significant bilateral restrictions, and reports measures that can either restrict or facilitate trade under single descriptors. For example, notification of a maximum residue level for use of a new pesticide on a fruit may in fact expand the production technology available to producers in exporting countries, thereby potentially increasing trade.

3. Regulating Imports of Fruits and Vegetables: USDA Phytosanitary Regulations

Federal efforts to prevent the entry of foreign pests and diseases date back to the early 20th century when Congress passed the Plant Quarantine Act of 1912 to address increasing concern over pest outbreaks in nursery stock (USDA, APHIS, 2005). Currently, USDA/APHIS has the authority to promulgate import regulations under the Plant Protection Act of 2000 to reduce risk the entry of plant pests into the United States and to implement domestic control programs in the event of outbreaks.[4] Agricultural products can be imported into the United States only after successfully completing USDA's approval process. After a country petitions USDA to allow importation of a specific commodity, APHIS conducts a risk assessment to identify the economic and environmental damage pests associated with the commodity might cause if they were to enter the United States. APHIS will recommend that the commodity be allowed to enter only if measures can be identified that will reduce pest risk to acceptable levels.

Figures 1a and 1b shows the percentage of global production eligible for entry into the United States in 2008 for the ten most important fresh fruits and vegetables in the American diet. The shares range from 6 percent (watermelons) to 83 percent (strawberries) of world fresh fruit production, and from 1 percent (potatoes) to 84 percent (onions) of global fresh vegetable production (USDA/ERS, 2008).

[4] Authority to administer port-of-entry inspections was transferred from USDA to the Department of Homeland Security in 2003, but these activities are still funded through inspection fees collected by the USDA.

All eligible imports are subject to inspection and must meet general documentation requirements upon arrival in the United States, but are also often required to comply with additional phytosanitary measures as a condition of entry. These measures fall into five categories, as described in 7 CFR § 319.56-4 in the US Code of Federal Regulations: origin restrictions; pre-clearance in the exporting country; treatments; destination restrictions; and systems approaches. Table 1 provides a brief description and example of each type of phytosanitary measure.

Information on country eligibility and treatment requirements for a given year is obtained from several sources. The main source is the *Fresh Fruits and Vegetables Import Manual* (USDA/APHIS) which contains information, by exporting country, on the fresh fruits and vegetables approved for importation in the US and the additional requirements, if any, for entry of each commodity.[5] Data on the values of fresh fruit and vegetable imports for the US are obtained from the United States International Trade Commission (USITC, 2009).

3.1 Required Treatments

For the years 1996 through 2007, there are 695 instances where a positive import flow from a specific country/commodity pair into the US is subject to a treatment, out of 5,415 total positive country/commodity pair import flows. Thus, approximately 12.8 percent of all

[5] Because most, but not all, changes in US phytosanitary regulations are initially published in the Federal Register and the Code of Federal Regulations, and because of time lag between the effective dates of a new regulation and its publication in the import manual, we use the last updated version of the import manual for a given year as our source for required phytosanitary treatments and lists of approved fresh fruit and vegetable commodities by exporting country. This ensures that we capture all changes in regulations within a given year without having to inspect each version of the import manual. Annual data is collected for the years 1996 through 2007 which represent the post-Uruguay Round time period when the WTO SPS agreement has been in effect. We develop a concordance between the commodity identifiers in the APHIS manuals and the corresponding HS 6, 8, or 10 digit code to analyze the effects of phytosanitary regulations on US imports of fresh fruits and vegetables. For example, avocados are defined at the 6-digit level, bananas at the 8-digit level, and broccoli at the 10-digit level. Other commodities, such as mangoes and carrots, are defined as the combination of a several 8-digit product lines. Overall, 23 fresh fruit and 23 fresh vegetable product lines are included in this study.

country/commodity pairs from eligible countries were subject to treatment. Table 2 lists the frequency for each specific treatment identified in the *Fresh Fruits and Vegetable Import Manual* for the 695 trade flows subject to a treatment. The three most common treatments are: cold treatment (41.6 percent), methyl bromide fumigation (31.2 percent), and water treatment (13.5 percent). Regulations that require a combination of treatments, groups 7 and 8 in Table 2, are not common, accounting for only 9.1 percent of all occurrences.

Because the frequency count in Table 2 is based on country/commodity/time triplets, there are only 108 unique country/commodity treatment pairs. These pairs are listed in Table 3. There are 30 different commodities and 36 different countries that are subject to required treatments. Fresh fruits are subject to treatments more than twice as often as fresh vegetables, with 74 occurrences for fruits compared with 34 occurrences for vegetables. The group of commodities with the most treatment requirements is citrus (grapefruit, lemon, limes, mandarins and clementines, and oranges) with 31 country occurrences. The individual commodities with the most required treatments are mangoes with 13 occurrences, garlic and mandarins and clementines with 9 occurrences, fresh beans with 8 occurrences, and apples with 6 occurrences. Of the countries subject to required treatments, 11 are in Asia, 9 are in Central America and the Caribbean, 7 are in South America, 5 are in Europe, 3 are in Africa, and 1 in North America.

The large number of countries from Central and South America is likely due to their proximity to the US and the ability to produce fruits or vegetables year round or during the winter season in the United States. The countries that face the largest number of required treatments are Argentina with 10 commodities, Israel with 9 commodities, South Africa with 7 commodities, Spain and Peru with 6 commodities, Chile and Mexico with 5 commodities, and

Australia, Italy, Honduras, and Morocco with 4 commodities. These 11 countries account for 64 of the 108 total country/commodity pairs.

3.2 New Market Access

Exporting countries that gained new market access for a specific commodity are identified by comparing the list of approved fruits and vegetables in the *Fresh Fruits and Vegetable Import Manual* across two consecutive years. For example, the list of approved fruits and vegetables for Argentina in 2007 were compared with the same list for 2006. Any commodities that appear in the approved list in 2007 that were not included in the approved list in 2006 are considered the result of new market access.[6]

Of the 44 countries that received new market access to export fresh fruits or vegetables to the US listed in Table 4, the top 10 countries, Argentina, Chile, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Peru, South Africa, and Spain, accounted for 57.2 percent of all the new access as measured by the number of commodity/country combinations (Table 4). Nicaragua was the largest recipient gaining access for 21 commodities, followed by Mexico with 18 commodities, and El Salvador and Peru with 15 commodities. The top 10 commodities that gained new market access were rambutan, garlic, and chicory with 9 occurrences, peppers with 8 new occurrences, blueberries, mangoes, and papaya with 6 new occurrences, and eggplant, endive, and mandarins and clementines with 5 new occurrences. These top 10 commodities accounted for about one-third of all the new market access opportunities.

Based on the information in Table 4, on average there have been 15.2 instances of new market access being granted by USDA/APHIS annually. However, there has been considerable

[6] All instances of new market access identified from the *Fresh Fruits and Vegetable Import Manual* were also cross-checked with notifications published in the Code of Federal Regulations, the Federal Register, and APHIS staff reports (USDA/APHIS, various years).

variation in the number of occurrences of new market access, with a standard deviation of 15.8 per year. The number of occurrences range from zero in 1996, 1999, and 2004 to 44 occurrences in 2003. Other years with large number of new market access were 39 occurrences in 1998 and 2007, and 25 in 1997.

4. Empirical Model

To investigate the impacts of existing phytosanitary regulations and granting of new market access on the on the importation of fresh fruits and vegetables into the US, we employ a product-level gravity equation applied to the imports of US fruit and vegetables. The gravity equation has become the workhorse for empirical international trade studies (Eichengreen and Irwin 1998). Originally developed by Tinbergen (1962), the gravity model is akin to Newton's law of universal gravitation, whereby larger and closer countries trade more with one another than smaller and more distant countries. In its basic form, the model predicts that trade flows from country *i* to country *j* in year *t* are proportional to the multiplicative interaction (in levels) of each country's size, often measured by GDP, and inversely proportional to the distance between them.

$$(1) \qquad V_{ijt} = \alpha_0 Y_{it}^{\alpha_1} Y_{jt}^{\alpha_2} D_{ij}^{\alpha_3} \varepsilon_{ijt}$$

where, α_0, α_1, α_2, and α_3 are unknown parameters and ε_{ijt} is a multiplicative, stochastic error term. Taking logs of both sides yields a traditional, linear in parameters, gravity equation that can be easily estimated:

$$(2) \qquad \ln(V_{ijt}) = \alpha_0 + \alpha_1 \ln(Y_{it}) + \alpha_2 \ln(Y_{jt}) + \alpha_3 \ln(D_{ij}) + \gamma Z_{ij(t)} + \varepsilon_{ijt} ,$$

where, Z_{ij} is a vector of additional controls of interest. Common variables include whether the countries share a common language, a common currency, or if both countries are members of a particular trade agreement.

In the present study, we modify the traditional gravity equation in several respects. First, our dataset contains product line variation denoted as k ($k \in$ fruit & vegetable products). Second, whereas typical gravity equations are estimated for all ij pairs in world trade, our dataset focuses on U.S. product line imports (i.e., j = U.S.). Thus, a trade flow observation in our dataset includes an exporter (i) shipping a particular fruit and vegetable commodity (k), in time period (t). Finally, we replace traditional GDP and distance proxies for country size and transport costs in the gravity equation with more appropriate exporter production levels of product k in year t, and transport and tariff costs, respectively.

Our benchmark specification is:

$$\text{(3)} \qquad \ln V_{itk} = \alpha_0 + \alpha_t + \alpha_1 \ln PR_{itk} + \alpha_2 \ln Trs_{itk} + \alpha_3 \ln Tar_{itk}$$
$$+ \alpha_4 FTA_{it} + \alpha_5 MAIN_{itk} + \lambda_1 TREAT_{itk} + \lambda_2 NMA_{itk} + \varepsilon_{itk}$$

where, V_{itk} is the value of imports of product k ($k \in$ fruit & vegetable products) from exporter i into the US at time t, α_t is a comprehensive set of time fixed effects, PR_{ikt} is the production capacity of exporter i in year t calculated as total fruit or vegetable production; Trs_{itk} (Tar_{itk}) is the transportation (tariff) cost faced by exporter i on product k in year t; FTA_{it} is a dummy variable equal to one if country i is in a free trade agreement with the US in year t, and $MAIN_{itk}$ is a dummy variable equal to one if country i is permitted to ship fruit or vegetable products to the continental U.S. (some exporters face destination/port restrictions to ship product k in year t).

The coefficients of interest are λ_1 and λ_2 measuring the impact of exports that are subject to treatment (see table 2) and exports that have received new market access (*NMA*), respectively. $TREAT_{ikt}$ is a dummy variable equal to one if exporter-and-commodity pair (ik) was subject to any one treatment in year t listed in table 2. NMA_{itk} is a dummy variable equal to one if exporter i received new market access to ship product k in year t.

Equation (3) alone is rather restrictive for at least two reasons. First, there may be considerable country and commodity variation in the data that is not captured by the standard right-hand-side variables in equation (3). To control for potential country and commodity specific variation in the data, we specify a comprehensive set of country and commodity fixed effects. Second, equation (3) only tells us how treatments and new market access impact trade flows more generally. Yet, policy makers and exporters may be more interested in how treatments and new market access affect fruit or vegetable product trade or whether new market access is beneficial for developing or developed countries. To shed light on these questions we augment equation (3) by disaggregating the treatment and new market access dummy variables to capture the trade flow impacts for: (i) fruit and vegetable categories; and (ii) developed or developing countries.

Finally, equation (3) is a linear in parameters, logarithmic, product-line gravity equation that assumes zero trade flows do not exist. However, this is typically not the case, particularly when considering HS6- or HS8-digit trade flows. It is common for researchers to either drop zero trade flow observations, add one to all zero trade flows so the logarithmic function is well defined, or to estimate the model using a threshold-Tobit estimator (Pham and Martin 2008). In the current paper, we drop zero trade flow observations. However, in subsequent analysis, we will return to the issue of zero trade flows in order to properly address the identification of new market access where an exporter does not export to the US in time t, but begins to export in year $t+1$ and all subsequent years after receiving new market access.

5. Other Data

Data on fresh fruit and vegetable import values, trade costs and tariffs for the US are obtained from the United States International Trade Commission (USITC, 2009). To avoid problems associated with explaining "low" trade values when estimating the empirical model, only countries that exported at least $100,000 annually of at least one fruit or vegetable commodity for at least three years were included in the sample. However, six countries that fulfilled this criterion, Tunisia, Samoa, Malawi, Kenya, Algeria and Albania, were not included in our sample because they exported only dried, frozen, or preserved products. In addition, Serbia and Montenegro are treated as a single country because the trade data for the separate countries were only available beginning in 2007. Overall, 89 exporting countries are included in our sample.

To control for market size of the exporting country, data on production and producer prices for fresh fruits and vegetables was obtained from the Food and Agricultural Organization of the United Nations (FAOSTAT, 2009; FAO, 2009b).[7] Because data on producer prices is not available for many low-income exporting countries, we consider total fruit and vegetable production for each exporter and time-period as a proxy for production capacity.

U.S. free trade agreements are taken from the WTO's Regional Trade Agreements dataset (available at: http://www.wto.org/english/tratop_e/region_e/region_e.htm). Thirteen exporters in the sample have a free trade agreement with the U.S. These exporting countries are Australia, Canada, Chile, Costa Rica, the Dominican Republic, El Salvador, Guatemala, Honduras, Israel, Mexico, Nicaragua, Morocco, and Singapore.

Because of destination restrictions in existing phytosanitary regulations, some fruits and vegetables are not eligible to be shipped to continental United States. There are thirteen different ports of entry identified in the *Fresh Fruits and Vegetable Import Manual*. We assume that the following ports of entry are not part of the continental United States: the State of Alaska

[7] Since no data is available for leeks in the FAO data, but leeks is one of the traded vegetable products, we use green onion (including shallots) data as a proxy for leeks in the summation to get total vegetable production for each exporter.

(ALASKA), Puerto Rico (PR), US Virgin Islands (USVI), the State of Hawaii (HAWAII), Guam (GUAM), the Northern Mariana Islands (CNMI), and any ports specified as (SoP) or (LTD). Roughly two percent of our sample observations were not eligible to be exported to the continental United States.

Treatment types and new market access information is obtained principally from the *Fresh Fruits and Vegetable Import Manuals* and cross-checked with the Federal Registrar and with notifications published in the Code of Federal Regulations, the Federal Register, and APHIS staff reports (USDA/APHIS, various years). As shown in Table 2, there are 213 instances where USDA/APHIS granted new market access (NMA) for a specific country/commodity combination. However, only 88 of these instances are included in our sample. There are two reasons for this. First, some countries do not export to the U.S. even though they may have new market access for a particular commodity and time period. Second, the data trimming process described earlier excludes observations where exporters shipped fruits and vegetables less than three years in the sample period (1996-2007) and those shipments that totaled less than $100,000 in value.

Finally, in the empirical specifications we test whether treatments and new market access impact trade flows originating in developed and developing countries. To map exporters into developed or developing countries we use the World Bank classification of low, middle, or high income economies. High income economies which we classify as developed countries are defined by the World Bank as countries with a Gross National Income per capita of $11,456 or more. Low and middle income economies which we classify as developing countries are defined by the World Bank as countries with a Gross National Income per capita in the range ($0, $11,455).[8]

Table 5 provides summary statistics for our data. The average trade flow is $12.1 million. However, the standard deviation around this is $53.6 million. *Ad valorem* tariff rates are low for fruits and vegetable imports in the US with an average tariff rate of 1.8 percent ((1-1.018)*100). The average transportation cost on an *ad valorem* equivalent basis averaged 31.4 percent. 21.1 percent of all observations involve an FTA between the exporter and the U.S.

As noted previously, required phytosanitary treatments occur in 12.8 percent of all observations. However, middle income countries account 7.5 percent of these treatments, followed by high-income countries at five percent, and low-income countries making up only 0.2 percent of the observations (Haiti being the only low-income country subject to treatments).

NMA occurs in 3.7 percent of all observations again with middle-income countries making up the lion's share (3.3 percent). Looking at the commodity breakdown, fruits account for almost 60 percent and vegetables nearly 40 percent of this 3.7 percent share.

The mean U.S. production quantity (by individual product lines) is 1.71 million metric tons (mmt), with a standard deviation of 3.18 mmt. The average fruit and vegetable production quantity across all exporters and time periods is 13.3 mmt, with a standard deviation of 51.1 mmt. However, there are differences in exporter production of fruits and vegetables. Fruit production averaged 7.7 mmt while vegetables production averaged 18.5 mmt. China dominates both fruit and vegetable world production totaling 94 and 448 mmt, respectively, followed by India. Apples and Peaches and Nectarines are China's largest fruit production commodities and cabbage, peppers, and garlic are China's largest vegetable production commodities.

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[8] It should be noted that some relatively high income countries may be classified as developing countries under this definition.

6. Empirical Results

The econometric results are organized in two sections. Section one presents the results after estimating equation 3 using a generic treatment and new market access (henceforth NMA) dummy variable. Table 6 contains the econometric results. Section two estimates equation (3) only this time, allowing for separate treatment and NMA effects by development status of the exporter. These results are reported in table 7. In tables 6 and 7, each regression scenario is estimated twice – once using year fixed effects, and once using year, country, and commodity fixed effects. All estimations are performed using a panel of annual US bilateral imports over the period 1997-2007.

6.1 Treatments and NMA by Sector

The gravity equation applied to product line US imports of fruits and vegetables performed quite well, particularly when we specify exporter, commodity and time specific fixed effects (columns 2 and 4, table 6). Here, the gravity model explained 49 percent of the variation in fruit and vegetable import flows. The elasticity of economic size of the exporting country as measured by exporter production is consistently positive and relatively inelastic. Tariffs and transport costs negatively affect bilateral imports of fruits and vegetables as expected.[9] Moreover, the coefficient on the tariff rate (which can be interpreted as an elasticity of substitution among imports), particularly in columns 2 and 4, is consistent with previous findings in the literature (see Hertel et. al 2007; Grant, Hertel and Rutherford 2009) related to other sectors.

[9] However, one will note that the coefficient on transport costs is marginally significant in only one of the estimations (column 1). This is due to the accuracy with which this variable is measured. We are currently investigating possible measurement error with respect to this variable. One alternative is to replace transport costs with distance between the US and its partners. We have run this regression and found distance to be negative and statistically significant.

NAFTA has a large and statistically significant effect on fruit and vegetable imports, especially when compared to *All Other FTAs*. Moreover, the trade flow difference between NAFTA and other RTAs is statistically significant and the result is robust to the inclusion of year fixed effects (columns 1 and 3) and year, exporter, and commodity fixed effects (columns 2 and 4). Using column 2 in table 6, the formation and implementation of NAFTA has resulted in a nine-fold increase (exp(2.20)) in US imports of fruits and vegetables compared to non-NAFTA countries. What's even more interesting is the fact that all other US FTAs that have been signed and entered into force since 1996 have resulted in an insignificant (*and even negative*) trade flow effect with respect to fruits and vegetables. However, the insignificance of the *All Other FTAs* coefficient may not come as a big surprise. The US sources a lot of its fruit and vegetable imports from countries like China, India, and Central and South American countries where very few FTAs exist.

As expected the ability to ship to the continental US has a large and significantly positive effect on US imports. Using the results from column 2 in table 6, US imports to the mainland were 2.8 times larger (exp(1.02)) compared to exporters that faced destination restrictions (i.e., shipments that were only allowed to enter Hawaii, Guam or Puerto Rico). This result is also robust to differing specifications using alternative fixed effects estimators.

The generic impact of treatments such as fumigation with methyl bromide, irradiation, cold treatment, and others (see table 2) on US imports appears to have actually stimulated fruit and vegetable imports. Moreover, this 'treatment effect' is significant at the 5 percent level in column 2 with the inclusion of year, exporter, and commodity fixed effects. SPS treatments in general appear to increase US imports of fruits and vegetables by 28 percent ((exp(0.25)-1)*100) on average, compared to fruit and vegetable shipments that do not face SPS regulations.

However, we can gain additional insight by disaggregating the treatment dummy variable into treatments for fruits ($TREAT^{FRT}$) and treatments applied to vegetable products ($TREAT^{VEG}$). The results are presented in columns 3 and 4 of table 2. In this case we see that the increase in trade was due almost entirely to an increase in fruit imports subject to SPS regulations. For example, the results in column 4 suggest that imports of fruits that are subject to a SPS treatments for pest mitigation increased by 77 percent ((exp(0.57)-1)*100) on average. SPS regulations appear to have no effect on vegetable product imports. The difference in the trade flow effects of fruit and vegetable imports subject to treatment is also statistically significant (with an *F-test* statistic of 4.66 and a *p-value* of 0.03).

Finally, we consider the effects of NMA for exporting countries that were previously not eligible to supply the US market. Interestingly, the NMA coefficient is negative and statistically significant across all regression scenarios (columns 1-4, table 6). However, is this result due to the fact that exporters are indeed shipping smaller quantities of fruits and vegetable products or is it due to the fact that exporters (particularly developing countries) need time to invest in capacity and pest mitigation production and export strategies required by USDA/APHIS? We are currently investigating this question and will incorporate the results in a future version of the paper. It is also plausible that NMA effects could differ depending on the development status of the exporter. However, it is likely that developed country exporters are more capable of overcoming USDA/APHIS standards when NMA is granted. We shed light on this question below.

6.2 Treatments and NMA by Development Status

Do SPS treatments and NMA affect developed and developing exporters differently? In this scenario, we allow the effect of SPS treatments and NMA provisions to vary by sector (i.e., fruits or vegetables) and the development status of the exporting nation (developed (DC) or developing (DGC)). As described in the data section, developed exporters are those countries with GDP per capita greater than $11,456 as defined by the World Bank classification of high income countries. Developing country exporters are defined as those countries with less than $11,456 in per capita GDP.[10] Table 7 reports the econometric results. In the first two estimations (columns 1 and 2), we consider treatment and NMA effects by development status but do not consider any differential effects across fruits and vegetable sectors. Columns 3 and 4 considers treatments and NMA effects by development and fruit and vegetable sectors.

Exporter size as measured by its production capacity positively impact, while transport costs and tariffs negatively impact US imports of fruits and vegetables. NAFTA has had a sizeable impact on US fruits and vegetable imports compared to other FTAs (*All Other FTAs*, table 7) and exporter's that can ship fruits and vegetables to the mainland trade more with the US as expected. All three sets of coefficients are virtually unchanged from the previous section.

SPS treatments applied to imports from developed and developing countries are associated with higher trade flows whereas NMA applied to imports from developed and developing countries are associated with negative trade flows. Using the results in column 2 with year, country, and commodity fixed effects, developed (developing) country trade flows with SPS treatments were 27 (31) percent higher than the average trade flow not subject to SPS regulations.[11] However, testing for differences in SPS treatements affecting trade flows between developed and developing countries was insignificant.

[10] Least-developed countries (LDC), or low-income economies as defined by the World Bank, are not included as a separate category because there is only one LDC (Haiti) that received NMA or was subject to treatment. Thus we were unable to identify with any precision the NMA and treatment effects of US imports from LDC countries.

[11] Calculated as (exp(0.24)-1)*100 and (exp(0.27)-1)*100, respectively, in table 7 (column 2).

In column 4 we let the coefficient for SPS treatments (*TREAT*) vary by fruit and vegetable sectors and development status. Consistent with the results in table 6, SPS regulations applied to fruit imports results in larger import flows for developing and developed countries (column 4, table 7). However, developed countries appear to be more capable of meeting SPS regulations. The results in column 4 (table 7) suggest that developed country exporters of fruit products traded a remarkable 146 percent ((exp(0.90)-1)*100) more with the US compared to developing countries that traded just 35 percent more ((exp(0.30)-1)*100) with the US (although the latter only marginally significant). Testing the equality between the trade flow effects of developed and developing country fruit exports is rejected at the five percent level.

Conversely, whereas developing country exports of vegetable products subject to SPS regulations increased, developed country vegetable exports subject to SPS treatments decreases. This interesting result suggests that fruit and vegetable SPS barriers do not lead to lower developing country trade flows (on average) in fruit and vegetable sectors. Yet for developed countries, SPS treatments stimulated fruit imports by an average of 146 percent but reduce vegetable imports by an average of 80 percent ((exp(|-0.52|)-1)*100). A simple test of the equality of the SPS treatment variables between developed and developing countries for both fruits and vegetables (i.e., $TREAT^{DC\&FRT} = TREAT^{DGC\&FRT}$ and $TREAT^{DC\&VEG} = TREAT^{DGC\&VEG}$) is easily rejected at conventional levels.

Finally, we consider new market access for developed and developing countries. A causal glance at the NMA coefficient results in table 7 reveals that developed and developing countries tend to trade a lot less after being granted NMA relative to longer-standing partners already trading with the U.S. Examples of NMA for high-income developed countries include Spain exporting eggplants (since 2001), lettuce (since 2003), kiwi fruit (since 2002), and peppers (since 1998); Korea shipping apples (since 2003); and New Zealand shipping lemons, mandarins, and clementines (since 2007).

In column 1, NMA is negative for developing countries and statistically insignificant for developed countries. However, when we add country and commodity fixed effects along with year fixed effects the trade flow effect of NMA is negative for both developed and developing exporters. That is, developed (developing) countries exported 2.5 (3.8) times less after receiving NMA compared to the average fruit and vegetable trade flow of those countries that did not receive NMA.[12] Disentangling the NMA effects across fruit and vegetable sectors (column 4, table 7) we see that developed countries (namely Spain and New Zealand) traded a lot less fruit products relative to vegetable products whereas developing countries traded relatively less of both fruits and vegetables after being granted NMA. However, the $NMA^{DC\&FRT}$ and $NMA^{DC\&VEG}$ coefficients are somewhat unstable across econometric specifications suggesting that further analysis and specification testing is needed with respect to these variables.

7. Conclusions

The growth in US imports of fresh fruits and vegetables has been impressive over the last two decades. However, trade is thought to be one of the main pathways for pest and disease transmission. Thus, while increased imports of fresh produce provides consistent supplies year-round and increases the number of varieties available to consumers, it also increases the risk of pest and disease outbreaks when products enter the domestic market. As a result, imports of fresh produce into the U.S. are highly regulated by APHIS.

What are the nature, size, and scope of SPS regulations affecting trade? What types of SPS measures do countries enforce? How and to what extent do SPS measures affect trade flows? Surprisingly, there is very little empirical evidence that has attempted to answer these

[12] Calculated as exp(|-0.94|) and exp(|-1.35|), respectively.

questions. One reason for this is the lack of data documenting the implementation and application of SPS regulations in world trade. In this study, we provide an important first step in answering these questions. Using very detailed fruit and vegetable import manuals obtained from USDA/APHIS, we constructed a novel dataset for empirical work that matches product line SPS applications with US import flows.

While this work is still ongoing, our initial results suggest that NAFTA has played a prominent role in stimulating fresh fruit and vegetable trade with the US. US imports from its NAFTA partners were nine times greater than imports from nonmembers. In terms of SPS measures, the results suggest that SPS treatments actually increased US imports of fruits and vegetable products. Finally, although the USDA/APHIS has granted new market access to 42 countries since 1996, our results suggest that this new access has not increased trade. However, in the current paper, we used a dummy variable to measure new market access that equals one the year the country received new access. It is likely that exporters need time to build capacity and invest in procedures to conform to USDA/APHIS standards such that the cumulative effect of new market access occurs over time. We address the dynamics of new market access in a future version of the paper.

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Figure 1A. U.S. Market Access for Fruits and Vegetables

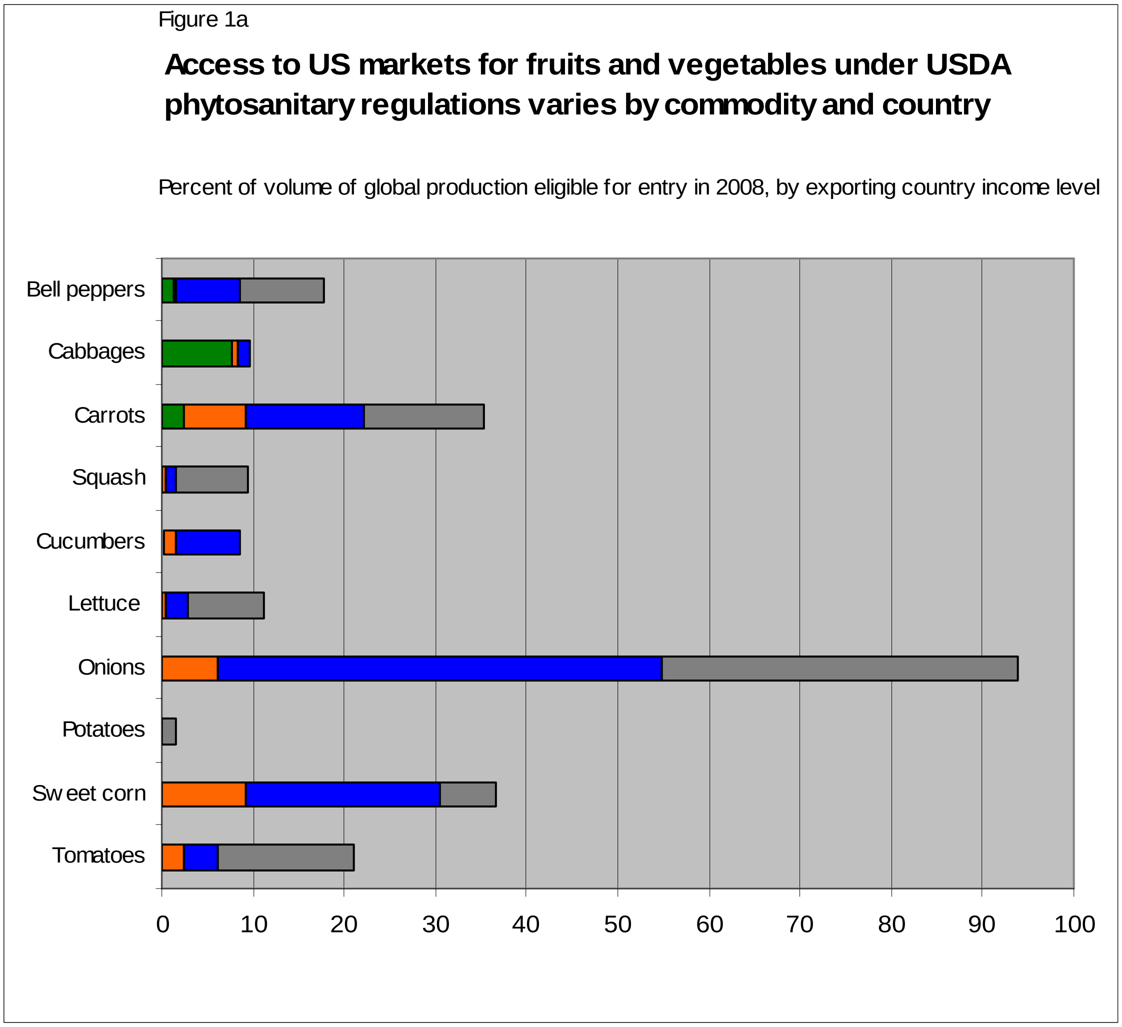
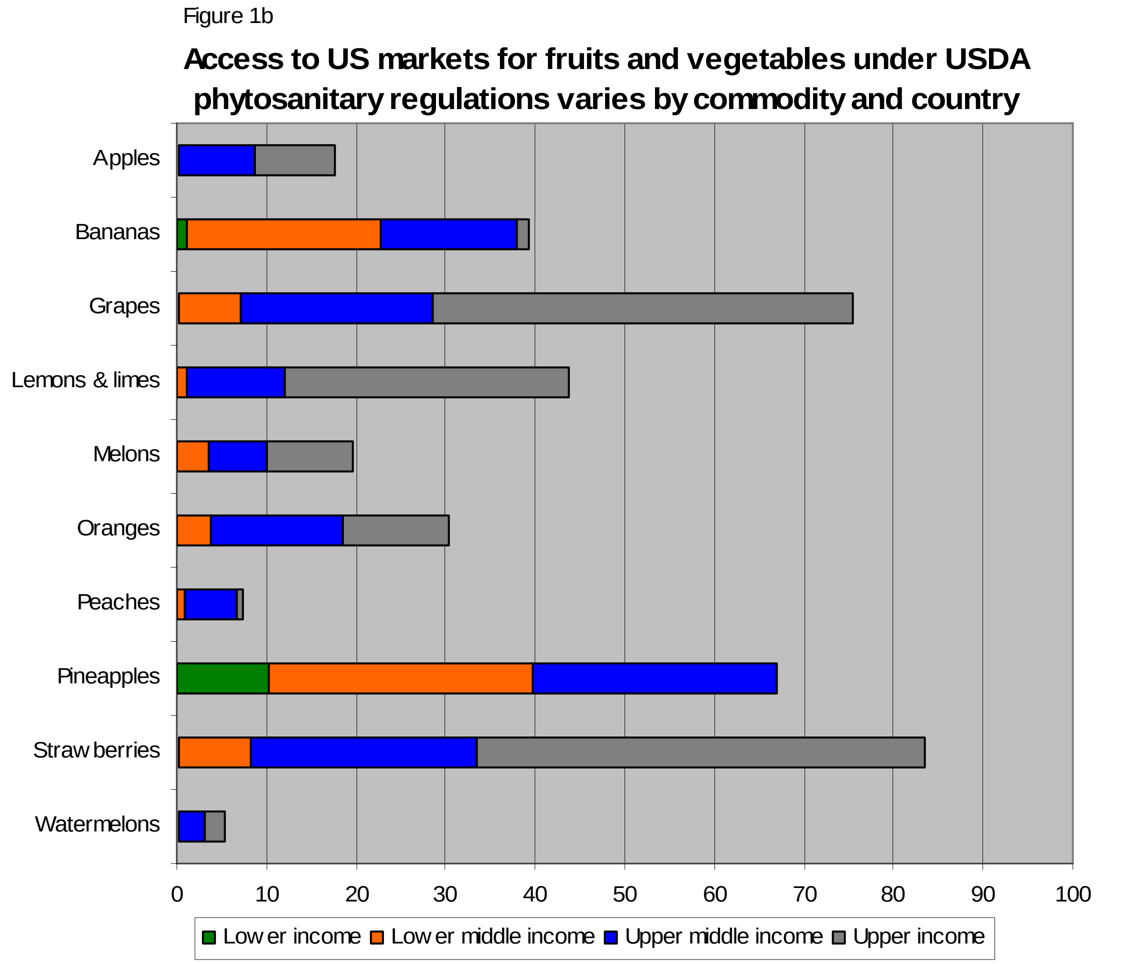


Figure 1B. Market Access for Fruits and Vegetables by Development Status



Source: USDA, ERS, *Phytosanitary Regulation of the Entry of Fresh Fruits and Vegetables into the United States*

Table 1: Phytosanitary Measures Applied to US Imports of Fruits and Vegetables from Eligible Countries

Type	Description	Example
Origin restrictions	Fruits and vegetables must be grown in areas that are recognized as free of quarantine pests by APHIS or in greenhouses.	Tomatoes from Israel must be grown in registered greenhouses in the Arava Valley.
Pre-clearance requirements	A quarantine pest is associated with the commodity in the country or region of origin, but the commodity is subject to inspection in the country of origin, and the commodity is to be accompanied by a phytosanitary certificate that the commodity has been inspected and found free of such pests in the country or region of origin.	Mangoes from Peru must be pre-cleared at an approved facility by APHIS in the country of origin.
Destination restrictions	Allowable ports of entry are designated which may include or exclude regions in the continental United States, Alaska, Hawaii, or U.S. territories.	Pineapples from Thailand are allowed importation into Guam and the Commonwealth of the Northern Mariana Islands only.
Treatments	Chemical and non-chemical treatments authorized for use under provisions of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), as amended, for the prevention of the movement of agricultural pests into or within the United States. The five main post-harvest treatment types are fumigation with methyl bromide, water treatment, heat treatment, cold treatment, and irradiation.	Grapes from Chile must be fumigated with methyl bromide according to a specified time/temperature regime.
Systems approaches	The integration of different pest risk management measures, at least two of which act independently, and which cumulatively achieve the desiresd level of phytosanitary protection.	Avocados from Mexico must be grown in the state of Michoacan and are subject to a number of pre- and post-harvest safeguards in production areas as well as at numerous points in the international supply chain.

Sources: *U.S. Code of Federal Regulations 7 CFR 319.56-13, Revised as of January 1, 2008* (US Government).

Table 2 Observed Treatment Requirement Frequency

Treatment Description	**Frequency**	**Percent**
Group 1: Methyl bromide	**217**	**31.2**
Fumigation	113	16.2
Optional fumigation	104	15.0
Group 2: Water	**94**	**13.5**
Group 3: Heat	**6**	**0.9**
High temperature forced air	0	0.0
Vapor heat	6	0.9
Group 4: Specific pest/host	**23**	**3.3**
Pest specific/host variable	3	0.4
Optional pest specific/host variable	20	2.9
Group 5: Irradiation	**3**	**0.4**
Group 6: Cold	**289**	**41.6**
Cold treatment/quick freeze	224	32.2
Optional cold treatment/quick freeze	65	9.3
Group 7: Fumigation/cold	**20**	**2.9**
Methyl bromide fumigation plus refrigeration	7	1.0
Cold treatment plus methyl bromide fumigation	13	1.9
Group 8: Combination of groups 1-7	**43**	**6.2**
Methyl bromide or refrigeration or methyl bromide plus cold	2	0.3
Cold treatment or methyl bromide or refrigeration	39	5.6
Water or methyl bromide	2	0.3
Totals	**695**	**100.0**

Sources: US Department of Agriculture, APHIS *Fresh Fruit and Vegetable Import Manual* and US Department of Agriculture, FAS *US Trade Internet System*.

Table 3 Country/Commodity Treatment Pairs

Country	Commodity	Treatment
Argentina	Apples	Cold
Argentina	Apricots	Cold
Argentina	Cherries	Cold
Argentina	Grapefruit	Cold
Argentina	Peaches & Nectarines	Cold
Argentina	Pears & Quinces	Cold
Argentina	Plums & Sloes	Cold
Argentina	Kiwifruit	Cold (optional)
Argentina	Oranges	Cold (optional)
Argentina	Cranberries & Blueberries	Methyl bromide
Australia	Lemons	Cold (optional)
Australia	Mandarins & Clementines	Cold (optional)
Australia	Oranges	Cold (optional)
Australia	Asparagus	Methyl bromide (optional)
Brazil	Apples	Cold
Brazil	Mangoes	Water
Canada	Cherries	Fumigation plus Refrigeration
Canada	Cranberries & Blueberries	Methyl bromide
Chile	Lemons	Methyl bromide
Chile	Tomatoes	Methyl bromide
Chile	Mandarins & Clementines	Methyl bromide (optional)
Chile	Apricots	MB plus Cold or Fumigate plus Refrig[a]
Chile	Limes	Water or Methyl bromide
China	Pears & Quinces	Cold
Costa Rica	Oranges	Cold
Costa Rica	Fresh Beans	Methyl bromide
Costa Rica	Mangoes	Water
Dominican Republic	Fresh Beans	Pest Specific/Host Variable (optional)
Dominican Republic	Mangoes	Water
Ecuador	Mandarins & Clementines	Cold
Ecuador	Fresh Beans	Methyl bromide (optional)
Ecuador	Mangoes	Water
Egypt	Garlic	Methyl bromide
El Salvador	Fresh Beans	Methyl bromide
France	Kiwifruit	Cold or Fumigation plus Refrigeration
France	Garlic	Methyl bromide
Germany	Garlic	Methyl bromide
Greece	Kiwifruit	Cold or Fumigation plus Refrigeration
Guatemala	Plums & Sloes	Cold
Guatemala	Mangoes	Water
Haiti	Mangoes	Water
Honduras	Grapefruit	Cold
Honduras	Oranges	Cold

Table 3 Continued

Country	Commodity	Treatment
Honduras	Fresh Beans	Methyl bromide
Honduras	Mangoes	Water
India	Mangoes	Irradiation
Israel	Grapefruit	Cold
Israel	Mandarins & Clementines	Cold
Israel	Oranges	Cold
Israel	Plums & Sloes	Cold or Fumigation plus Refrigeration
Israel	Avocados	Methyl bromide
Israel	Cabbage	Methyl bromide
Israel	Garlic	Methyl bromide
Israel	Head Lettuce	Methyl bromide
Israel	Leaf Lettuce	Methyl bromide
Italy	Mandarins & Clementines	Cold
Italy	Oranges	Cold
Italy	Kiwifruit	Cold or Fumigation plus Refrigeration
Italy	Garlic	Methyl bromide (optional)
Jamaica	Fresh Beans	Methyl bromide (optional)
Jamaica	Peppers	Pest Specific/Host Variable
Japan	Apples	Cold Treatment plus Fumigation
Japan	Cabbage	Methyl bromide
Korea	Apples	Cold Treatment plus Fumigation
Mexico	Okra	Methyl bromide
Mexico	Broccoli	Methyl bromide (optional)
Mexico	Brussels Sprouts	Methyl bromide (optional)
Mexico	Cabbage	Methyl bromide (optional)
Mexico	Cauliflower	Methyl bromide (optional)
Morocco	Mandarins & Clementines	Cold
Morocco	Oranges	Cold
Morocco	Apricots	Cold or Fumigation plus Refrigeration
Morocco	Garlic	Methyl bromide
New Zealand	Asparagus	Methyl bromide (optional)
New Zealand	Cucumbers	Methyl bromide (optional)
New Zealand	Squash	Methyl bromide (optional)
Nicaragua	Fresh Beans	Methyl bromide
Nicaragua	Mangoes	Water
Peru	Grapefruit	Cold
Peru	Mandarins & Clementines	Cold
Peru	Oranges	Cold
Peru	Asparagus	Methyl bromide
Peru	Cranberries & Blueberries	Methyl bromide
Peru	Mangoes	Water
Philippines	Mangoes	Heat

Table 3 Continued

Country	Commodity	Treatment
South Africa	Apples	Cold
South Africa	Grapefruit	Cold
South Africa	Lemons	Cold
South Africa	Mandarins & Clementines	Cold
South Africa	Oranges	Cold
South Africa	Pears & Quinces	Cold
South Africa	Plums & Sloes	Cold
Spain	Kiwifruit	Cold
Spain	Mandarins & Clementines	Cold
Spain	Oranges	Cold
Spain	Lemons	Cold (optional)
Spain	Head Lettuce	Methyl bromide
Spain	Garlic	Methyl bromide (optional)
Thailand	Mangoes	Irradiation
Thailand	Pineapples	Irradiation
Turkey	Oranges	Cold
Turkey	Garlic	Methyl bromide
Uruguay	Apples	Cold
Uruguay	Pears & Quinces	Cold
Venezuela	Oranges	Cold
Venezuela	Fresh Beans	Methyl bromide (optional)
Venezuela	Mangoes	Water

[a] Methyl bromide plus Cold treatment or Fumigation plus Refrigeration

Sources: US Department of Agriculture, APHIS *Fresh Fruit and Vegetable Import Manual* and US Department of Agriculture, FAS *US Trade Internet System*.

Table 4 New Market Access Granted for Fresh Fruits and Vegetables by the United States

Year	Country	Commodity
1995	Zimbabwe	Apricot
	Zimbabwe	Nectarine
	Zimbabwe	Peach
	Zimbabwe	Plum
1997	Argentina	Basil
	Bahamas	Garlic cloves, free of their papery skin
	Chile	Babaco
	Dominican Republic	Eggplant
	Dominican Republic	Garlic cloves, free of their papery skin
	Grenada Island	Garlic cloves, free of their papery skin
	Haiti	Garlic cloves, free of their papery skin
	Jamaica	Garlic cloves, free of their papery skin
	Korea	Angelica
	Korea	Apple, Fuji only
	Mexico	Coconut
	Morocco	Strawberry
	Nicaragua	Faba Bean
	Nicaragua	Green Bean
	Nicaragua	Mung Bean
	Peru	Blueberry
	South Africa	Globe Artichokes
	South Africa	grapefruit
	South Africa	lemons
	South Africa	limes
	South Africa	mandarins and clementines
	South Africa	oranges
	St Lucia Island	Garlic cloves, free of their papery skin
	St Vincent & Grenadines	Garlic cloves, free of their papery skin
	Uruguay	Plum
1998	Brazil	Papaya
	Brazil	Watermelon
	Chile	Tomato
	Costa Rica	Coconut
	Costa Rica	Mango
	Ecuador	Broccoli
	Ecuador	Brussels sprouts
	Ecuador	Cauliflower
	Ecuador	Chicory
	Ecuador	Radicchio
	El Salvador	Eggplant
	France	Tomato (other than green)
	Guatemala	Basil
	Guatemala	Dill

Table 4 Continued

Year	Country	Commodity
1998	Guatemala	Rhubarb
	Israel	Parsley
	Jamaica	Coconut
	Japan	Ginger Bracts
	Mexico	Avocado, Hass
	Mexico	Chenopodium Spp.
	Mexico	Ethrog
	Mexico	Salicornia
	Nicaragua	Chicory
	Nicaragua	Eggplant
	Nicaragua	Mint
	Nicaragua	Parsley
	Nicaragua	Radicchio
	Nicaragua	Rosemary
	Panama	Belgian endive
	Panama	Chicory
	Panama	Endive
	Peru	Swiss chard
	Romania	Garlic
	South Africa	Pineapple
	Spain	Ortanique
	Spain	Pepper
	Venezuela	Cantaloupe
	Venezuela	Honeydew Melon
	Venezuela	Watermelon
2000	Argentina	Grapefruit
	Argentina	Lemons
	Argentina	Orange
	Bulgaria	Garlic
	Peru	Radicchio
2001	Argentina	Kiwi
	Argentina	Marjoram
	Argentina	Oregano
	El Salvador	Papaya
	Guatemala	Papaya
	Honduras	Papaya
	Mexico	Carambola
	Nicaragua	Papaya
	Panama	Papaya
	Peru	Marjoram
	Philippines	Mango
	Spain	Eggplant
	Spain	Kiwi

Table 4 Continued

Year	Country	Commodity
2001	Spain	Lettuce
	Spain	Watermelon
2002	Belize	False coriander
	Chile	Passion Fruit
	Honduras	Mango
2003	Belize	Rambutan
	Bulgaria	Blueberry
	Bulgaria	Cranberry
	Bulgaria	Strawberry
	Chile	Pepper
	China	Longan
	Colombia	Cape gooseberry
	Colombia	Pitahaya, yellow
	Costa Rica	Rambutan
	El Salvador	Blackberry
	El Salvador	Fennel
	El Salvador	German Chamomile
	El Salvador	Jicama Root
	El Salvador	Loroco
	El Salvador	Lotus Root
	El Salvador	Oregano
	El Salvador	Parsley
	El Salvador	Rambutan
	El Salvador	Rosemary
	El Salvador	Sweet Marjoram
	Guatemala	Fennel
	Guatemala	German Chamomile
	Guatemala	Rambutan
	Honduras	Basil
	Honduras	German Chamomile
	Honduras	Jicama Root
	Honduras	Loroco
	Honduras	Lotus Root
	Honduras	Oregano
	Honduras	Rambutan
	Honduras	Sweet Marjoram
	Mexico	Fig
	Mexico	Rambutan
	Nicaragua	Fennel
	Nicaragua	German Chamomile
	Nicaragua	Jicama Root
	Nicaragua	Loroco
	Nicaragua	Lotus Root

Table 4 Continued

Year	Country	Commodity
2003	Nicaragua	Naranjilla
	Nicaragua	Rambutan
	Nicaragua	Tomato (green only)
	Nicaragua	Waterlily root
	Nicaragua	Yam Been Root
	Panama	Rambutan
2005	Chile	Clementine
	Chile	Mandarin
	Chile	Tangerine
	Dominican Republic	Mango
	Grenada Is	Atemoya
	Grenada Is	Cherimoya
	Grenada Is	Custard Apple
	Grenada Is	Soursop
	Grenada Is	Sugar Apple
	Mexico	Pitaya
	Peru	Cantaloupe
	Peru	Honeydew Melon
	Peru	Netted Melon
	Peru	Watermelon
	Peru	Winter melon
2006	Belgium	Endive
	China	Fragrant Pear
	China	Ya Pear
	Colombia	Blueberry
	Costa Rica	Pepper
	El Salvador	Pepper
	Guatemala	Endive
	Guatemala	Pepper
	Honduras	Pepper
	Mexico	Ambrosia Mexicana
	Netherlands	Endive
	Nicaragua	Pepper
	Peru	Grapefruit
	Peru	Lime
	Peru	Mandarin
	Peru	Orange, sweet
	Peru	Tangelo
	Peru	Tangerine
	Spain	Squash
2007	Argentina	Chicory
	Belgium	Belgium Endive
	Bolivia	Chicory

Table 4 Continued

Year	Country	Commodity
2007	Brazil	Chicory
	Dominican Republic	Jackfruit
	El Salvador	Chicory
	Ghana	Eggplant
	Ghana	Okra
	Ghana	Pepper
	India	Mango
	Israel	New Zealand Spinach
	Kenya	Baby Carrot
	Kenya	Baby Corn
	Kenya	Garden Pea
	Mexico	Endive
	Mexico	Epazote
	Mexico	Huazontle
	Mexico	Mexican Tea
	Mexico	Pecan
	Mexico	Quinua
	Mexico	Strawberry-spinach
	Mexico	Wild spinach
	New Zealand	grapefruit
	New Zealand	lemons
	New Zealand	limes
	New Zealand	mandarins and clementines
	New Zealand	oranges
	South Africa	Blueberry
	South Africa	Currant
	South Africa	Gooseberry
	Thailand	Litchi
	Thailand	Longan
	Thailand	Mango
	Thailand	Mangosteen
	Thailand	Pineapple
	Thailand	Rambutan
	Uruguay	Blueberry
	Uruguay	Chicory
	Venezuela	Chicory
2008	Guatemala	Blueberry
	Korea	Plantain
	Korea	Water dropwort
	Panama	Arugula
	Vietnam	Dragon Fruit

Sources: *Fresh Fruits and Vegetables Import Manual* (USDA/APHIS) and Federal Register.

Table 5: Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Trade Flows ($ mil)	5432	12.1	53.6	0.01	1,010
Transportation (1 + rate)	5432	1.314	0.425	1.000	11.293
Tariff (1+rate)	5432	1.018	0.057	1.000	1.857
FTA (count)	5432	0.211	0.408	0	1
Mainland US (count)	4372	0.981	0.138	0	1
Treatment	5432	0.128	0.334	0	1
Treatment low-income	5432	0.002	0.047	0	1
Treatment middle-income	5432	0.075	0.264	0	1
Treatment high-income	5432	0.050	0.219	0	1
New Market Access (NMA)	5432	0.037	0.189	0	1
NMA –low-income	5432	0.000	0.000	0	0
NMA – middle-income	5432	0.033	0.179	0	1
NMA – high-income	5432	0.004	0.065	0	1
NMA-fruit	5432	0.022	0.147	0	1
NMA-vegetable	5432	0.015	0.122	0	1
US Production (mmt)	5432	1.7	3.2	0	23.3
Exporter Production (mmt)	5254	13.3	51.1	10	449
Exporter Production – Fruits (mmt)	2498	7.7	13.9	10	94.4
Exporter Production – Vegetables (mmt)	2748	18.5	68.9	940	449

Sources: *Fresh Fruits and Vegetables Import Manual* (USDA/APHIS); Federal Register; USITC, 2009; FAOSTAT, 2009; FAO, 2009b; WTO, n.d.; The World Bank, 2008;

Table 6. Treatment and New Market Access Results, 1996-2007

Variable	*(1)* *Year FE*	*(2)* *Year, Country & Commodity FE*	*(3)* *Year FE*	*(4)* *Year, Country & Commodity FE*
Exporter Production	0.28***	0.97***	0.26***	0.97***
	(0.00)	(0.00)	(0.00)	(0.00)
Transport Cost	-0.41*	-0.11	-0.35	-0.13
	(0.09)	(0.67)	(0.14)	(0.61)
Tariff Rate	-9.15***	-3.21***	-8.08***	-3.25***
	(0.00)	(0.00)	(0.00)	(0.00)
NAFTA	2.52***	2.20***	2.64***	2.21***
	(0.00)	(0.00)	(0.00)	(0.00)
All Other FTAs	0.02	-0.11	0.03	-0.13
	(0.90)	(0.57)	(0.84)	(0.53)
Mainland US	1.21***	1.02***	0.89***	0.92***
	(0.00)	(0.00)	(0.00)	(0.01)
TREAT	0.48	0.25**	-----	-----
	(0.00)	(0.05)	-----	-----
$TREAT^{FRT}$	-----	-----	1.02***	0.57***
	-----	-----	(0.00)	(0.00)
$TREAT^{VEG}$	-----	-----	-0.73***	-0.01
	-----	-----	(0.00)	(0.94)
NMA	-0.51**	-1.30***	-----	-----
	(0.01)	(0.00)	-----	-----
NMA^{FRT}	-----	-----	-0.55**	-1.42***
	-----	-----	(0.03)	(0.00)
NMA^{VEG}	-----	-----	-0.72**	-1.15***
	-----	-----	(0.02)	(0.00)
N	4,266	4,266	4,266	4,266
R^2	0.17	0.49	0.18	0.49
F-Statistic	46.74***	31.46***	92.96***	30.83***

Note: The dependent variable is the natural logarithm of the U.S. imports of fresh fruits and vegetables expressed as the Landed Duty Paid Value (LDPV). P-values are in parentheses. *FE* denotes fixed effects and *FRT* (*VEG*) denotes fruits (vegetables). *FTA* is a dummy variable denoting free trade agreements and *Mainland US* is a dummy variable denoting shipments that may enter the continental US. *TREAT* is a dummy variable if the export shipment was subject to any kind of treatment (listed in table 2). *NMA* is a dummy variable denoting new market access. The sample contains 95 countries, 12 years, and 46 fresh fruit and vegetable product lines.

Table 7. Treatment and New Market Access Results by Development Status, 1996-2007

Variable	(1) Year FE	(2) Year, Country & Commodity FE	(3) Year FE	(4) Year, Country & Commodity FE
Exporter Production	0.29***	0.97***	0.26***	0.98***
	(0.00)	(0.00)	(0.00)	(0.00)
Transport Cost	-0.34	-0.17	-0.29	-0.16
	(0.16)	(0.51)	(0.23)	(0.52)
Tariff Rate	-9.07***	-3.19***	-8.71***	-3.14***
	(0.00)	(0.00)	(0.00)	(0.00)
NAFTA	2.52***	2.20***	2.62***	2.16***
	(0.00)	(0.00)	(0.00)	(0.00)
All Other FTAs	0.18	-0.11	0.18	-0.11
	(0.30)	(0.59)	(0.30)	(0.57)
Mainland US	1.07***	1.02***	0.74**	0.69**
	(0.00)	(0.00)	(0.02)	(0.04)
$TREAT^{DC}$	-0.14	0.24	-----	-----
	(0.42)	(0.20)	-----	-----
$TREAT^{DC\&FRT}$	-----	-----	0.61***	0.90***
	-----	-----	(0.00)	(0.00)
$TREAT^{DC\&VEG}$	-----	-----	-1.43***	-0.52*
	-----	-----	(0.00)	(0.06)
$TREAT^{DGC}$	0.90***	0.27	-----	-----
	(0.00)	(0.12)	-----	-----
$TREAT^{DGC\&FRT}$	-----	-----	1.26***	0.30
	-----	-----	(0.00)	(0.22)
$TREAT^{DGC\&VEG}$	-----	-----	-0.11	0.43*
	-----	-----	(0.68)	(0.08)
NMA^{DC}	0.38	-0.94*	-----	-----
	(0.50)	(0.06)	-----	-----
$NMA^{DC\&FRT}$	-----	-----	-1.89	-3.22***
	-----	-----	(0.12)	(0.00)
$NMA^{DC\&VEG}$	-----	-----	1.02*	-0.21
	-----	-----	(0.10)	(0.72)
NMA^{DGC}	-0.78***	-1.35***	-----	-----
	(0.00)	(0.00)	-----	-----
$NMA^{DGC\&FRT}$	-----	-----	-0.62**	-1.21***
	-----	-----	(0.02)	(0.00)
$NMA^{DGC\&VEG}$	-----	-----	-1.30***	-1.42***
	-----	-----	(0.00)	(0.00)
N	4,266	4,266	4,266	4,266
R^2	0.18	0.49	0.19	0.49
F-Statistic	88.92***	30.75***	68.83***	29.80***

Note: The dependent variable is the natural logarithm of the U.S. imports of fresh fruits and vegetables expressed as the Landed Duty Paid Value (LDPV). P-values are in parentheses. *FE* denotes fixed effects; *DC* (*DGC*) denotes a developed (developing) country; and *FRT* (*VEG*) denotes fruits (vegetables). *FTA* is a dummy variable denoting free trade agreements and *Mainland US* is a dummy variable denoting shipments that may enter the continental US. *TREAT* is a dummy variable if the export shipment was subject to any kind of treatment (see table 2). *NMA* is a dummy variable for new market access. The sample contains 95 countries, 12 years, and 46 fresh fruit and vegetable product lines.