# New Market Access in Fresh Fruit and Vegetable Imports to the United States

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**ABSTRACT**

Imports of fresh fruits and vegetables to the United States have grown by more than 350 percent since 1989. Factors such as rising consumer incomes, the desire for greater variety and availability of fresh produce throughout the year, and a reduction in trade barriers through multi-lateral and bi-lateral trade agreements have contributed to this growth in imports. In addition, since the implementation of the Agreement on Agriculture and the Agreement on the Application of Sanitary and Phytosanitary Measures from the Uruguay Round of the World Trade Organization negotiations, there have been numerous requests to export fresh fruits and vegetables to the United States. From 1996 to 2008, the United States has granted new market access to 204 exporter/commodity combinations. Given this large increase in new market access, this thesis assesses the success of the new entrants in terms of contributing to the increase in fresh fruit and vegetable imports and whether they exported on a continual basis after gaining import eligibility. In addition, this thesis estimates a gravity model to assess the differences in fresh fruit and vegetable exports from new entrants subject to phytosanitary measures relative to those with no such restrictions in place and to determine whether these effects vary by commodity sector and exporter's size.

The major finding of this thesis is that in general, new entrants have contributed little to the growth in U.S. fresh fruit and vegetable imports. For most commodities, new entrants do not provide a significant proportion of imports potentially because new entrants are not able to compete with existing suppliers. This study finds differences in fresh fruit and vegetable exports from new entrants subject to specific phytosanitary treatments relative to entrants with no such restrictions in place.

*Dedicated to*

*Mrs. Aliki Perroti*

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# Chapter 1: International Trade in Fruits and Vegetables

International trade in fruits and vegetables has been growing faster than any other agricultural commodity since 1980, averaging 14.4 percent[1] annually (ERS, USDA, 2004). Efforts from international organizations to liberalize agricultural trade, improved transportation and rising consumer incomes have been some of the most cited factors that have increased trade of these commodities (ERS, USDA, 2004; Diop and Jaffee, 2005). The leading destinations for fresh fruit and vegetable (FF&V) exports have been the European Union (EU) and members of the North American Free Trade Agreement (NAFTA), particularly the United States (U.S.) (ERS, USDA, 2004).

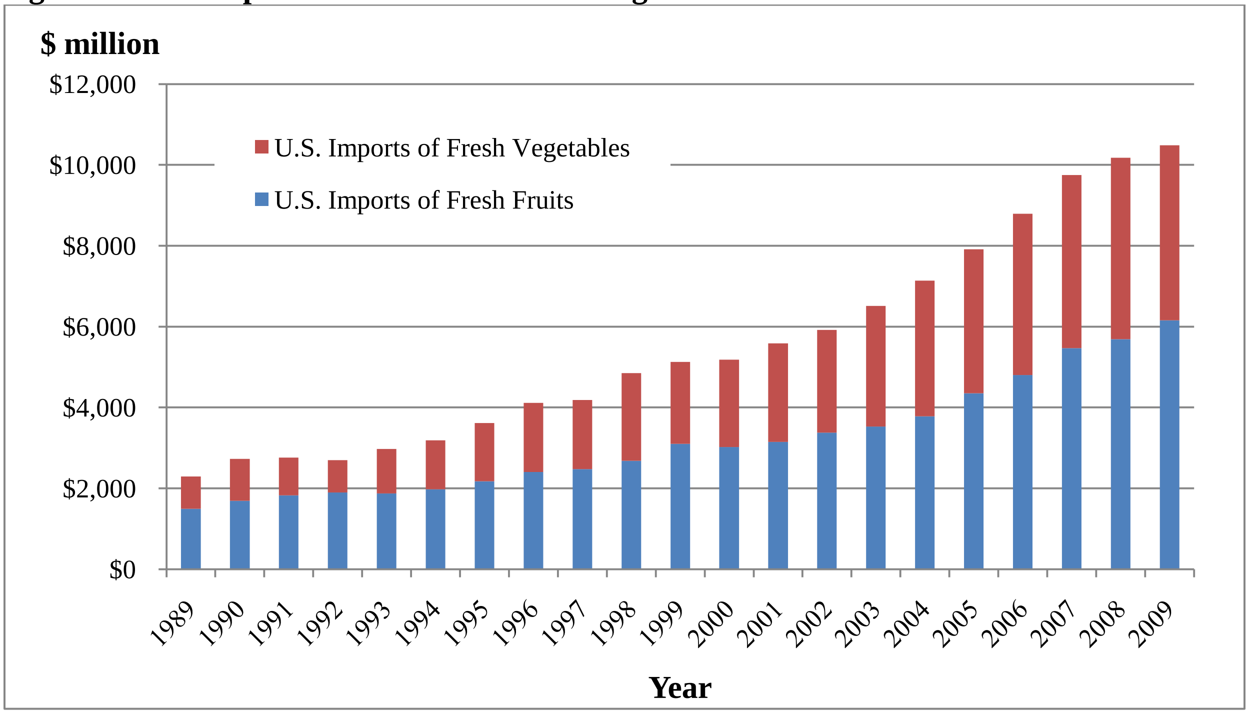
## 1.1 United States Fresh Fruit and Vegetable Imports

As shown in Figure 1.1, U.S. FF&V imports have steadily grown in the past two decades from approximately $2.3 billion in 1989 to $10.5 billion in 2009[2]. Fresh fruit imports grew at an annual rate of 7 percent, increasing from a nominal value of $1.5 billion in 1989 to $6.2 billion in 2009. In 2009, fresh fruit imports accounted for 8.6 percent of U.S. agricultural imports, up from 6.8 percent in 1989. In comparison, fresh vegetable imports grew at an annual rate of 8.3 percent, increasing from $801 million in 1989 to $4.3 billion in 2009. In 2009, fresh vegetable imports accounted for 6 percent of U.S. total agricultural import value, up from 3.7 percent in 1989.

[1] The annual average growth rate was calculated using the following period averages: 1977-1981 (11.7%), 1987-1991 (15.1%) and 1997-2001 (16.5%).

[2] The values of fresh fruit and fresh vegetable imports statistics were compiled from data in the United States Department of Agriculture (USDA) – Foreign Agricultural Service (FAS') Global Agricultural Trade System (GATS) database. Drawn from the Intermediate and Consumer Oriented (BICO) reports, fresh fruit and vegetable imports is the sum of other fresh fruits and bananas/plantains, and fresh vegetables.

**Figure 1.1U.S. Imports of Fresh Fruits and Vegetables 1989-2009**




Source: (USDA, FASonline, 2011)

### 1.2 Factors Driving Higher U.S. FF&V Imports

Previous studies (Huang and Huang, 2007; Lucier *et al.*, 2006) have identified two main groups of factors that have contributed to the increase in the imports of FF&V by the United States. The first group includes factors such as rising consumer incomes, changing U.S. consumer preferences, and government programs, such as the Food Guide Pyramid that promote healthier lifestyles (Clemens, 2004; Nzaku and Houston, 2009) have contributed to an increase in U.S. consumption.

This in turn has lead to consumer desire for year round supply of fresh produce, increasing imports, especially in the winter months when domestic supply of these products is low (Clemens, 2004; Lucier *et al.*, 2006; Johnson, 2010). In addition, the demand for greater variety of fresh fruits and vegetables, especially tropical products, has been growing since the late 1980s (Lucier *et al*., 2006). The greater demand for product variety may be a reflection of increased ethnic diversity in the U.S. population (Pollack, 2001).

A second set of factors are related to the reduction in trade barriers for fresh fruits and vegetables that has occurred through multi-lateral or bi-lateral trade agreements. The Agreement on Agriculture (AOA) in the World Trade Organization (WTO) Uruguay Round negotiations reduced tariff and non-tariff barriers as well as increased new market access. On average, the U.S. bound tariffs were reduced by 35 percent and 40 percent on simple average basis for fresh fruit and fresh vegetable imports. In 2001, 85 percent of the U.S. fresh fruit imports and 75 percent fresh vegetable imports had applied tariff rates of 10 percent or less (Aksoy and Beghin, 2005).

Establishment of Regional Trade Agreements (RTAs), such as the North American Free Trade Agreement (NAFTA), has played an important role in increasing agricultural trade (Grant and Lambert, 2008). By reducing or eliminating tariffs on U.S. FF&V imports, the NAFTA agreement lowered the costs of imports from Mexico and Canada (Krissoff and Wainio, 2007). For instance, tariffs on most horticultural crops between Mexico, Canada, and U.S. were eliminated in 2003(Huang, 2004). Between 2002 and 2004, imports from Canada and Mexico accounted for 27 percent and 83 percent of the total value of U.S. fresh fruit and fresh vegetable imports. In addition, the negotiation and implementation of NAFTA has also lead to new market access through the removal of trade bans.  For example, phytosanitary restrictions precluded the imports of fresh Hass avocados from Mexico until 1997. After a series of regulatory changes that have eliminated all seasonal and geographic restrictions, imports of Hass avocados from Mexico has increased to $497 million in 2008.

### 1.3 Market Access

Importation of fresh fruits and vegetables into the U.S. is regulated on a country/commodity basis. Each country must petition the Animal and Plant Health Inspection Service (APHIS) of the USDA before being permitted to export a specific product to the United States. Each petition is evaluated by APHIS personnel on the potential pest risks associated with importing the given product. The petition may be denied if the pest risks are deemed to be too high and no pest-risk mitigation practices are available. Alternatively, the petition may be granted subject to a set of pest-risk mitigation practices, such as methyl bromide fumigation treatments, inspections, or restrictions on geographic origin or destination, or granted without any pest-risk mitigation practices.

Between 1996 and 2008, APHIS has granted total of 204 new import permits. Table 1.1 lists the number of import permits by year and product sector. Nearly one-third of the import permits were issued in 1997 and 1998, just after the implementation of the AOA. This may reflect the use of new market access provisions in the AOA to gain access to the U.S. market. The large variation in number of permits issues across years likely reflects variations in the length of time required by APHIS to complete a pest-risk assessment and if necessary to develop a set of pest-risk mitigation practices, and variations in the number of countries petitioning for new market access. Since 1999, an average of four new import permits were granted annually, with three permits issued for fresh fruit commodities and one permit issued for fresh vegetable commodities.

**Table 1.1Distribution of United States Fresh Fruit and Vegetable Import Permits**

| | Number of Import Permits Granted | | | |
|---|---|---|---|---|
| Year | Fresh Fruits | Fresh Vegetables | **Total FF&V** | Plant Parts, Herbs and Nuts |
| 1997 | 7 | 2 | **9** | 9 |
| 1998 | 6 | 7 | **13** | 42 |
| 1999 | 0 | 0 | **0** | 0 |
| 2000 | 3 | 0 | **3** | 3 |
| 2001 | 8 | 2 | **10** | 1 |
| 2002 | 1 | 0 | **1** | 1 |
| 2003 | 0 | 3 | **3** | 22 |
| 2004 | 0 | 0 | **0** | 0 |
| 2005 | 4 | 0 | **4** | 14 |
| 2006 | 5 | 5 | **10** | 18 |
| 2007 | 7 | 2 | **9** | 25 |
| 2008 | 5 | 0 | **5** | 2 |
| Total 1996-2008 | 46 | 21 | **67** | 137 |

Source: (USDA/APHIS, 1996-2008); (USITC, 2008)

### 1.5 Thesis Objectives

The increase in the provision of new import permits for FF&V by the U.S. raises an empirical question whether countries that gain new market access (NMA) are able to capitalize on that new access. Are countries able to successfully enter the U.S. market, as evidence by continuous post-entry export shipments and provide a significant share of FF&V imports? Are new entrants able to increase their exports over time and can they achieve similar export volumes as existing suppliers?

To date, these empirical questions have not been explored for U.S. imports of FF&V. One barrier to research on this topic is the effort required to identify cases of NMA. The Fruit and Vegetable Import Requirements (FAVIR) database developed by APHIS, provides general information about eligibility and importation requirements for fruit and vegetable imports by country and commodity. However, this database does not chronologically list country/commodity cases where NMA was obtained; rather it provides a list of the most recent countries eligible to export a specific product (USDA, APHIS, 2011e). Instances of NMA are identified by either reviewing the *Federal Register* for posted regulatory changes or comparing the *Fresh Fruit and Vegetable Import Manual* in order to identify changes between two consecutive years.

This thesis extends the work of Karov *et al*. (2009) who found that exporters that received NMA during the 1996 through 2007 period had lower export values than did countries with market access throughout the period. However, NMA was modeled simply as an intercept shifter in their econometric model, which did not allow for the impact of NMA to vary over time. For example, it may take a new entrant time to build the necessary supply chains required to ship larger quantities of FF&V. This would suggest that while new entrants would likely ship less than established suppliers initially, this effect may decrease over time.

The potential for variation in U.S. FF&V imports from new and long standing exporters presents an opportunity to explore the effects of NMA on this sector. While considering this general objective, the following three specific objectives have been developed:

a) To provide a summary of NMA instances in the U.S. FF&V sector that occurred between 1996 and 2008.

b) To determine the success of new entrants at the U.S. FF&V market by providing an evidence of their export levels and market retention after they gained import eligibility.

c) To assess the differences in FF&V exports from new entrants subject to phytosanitary measures relative to those with no such restrictions in place and to determine whether these effects vary by commodity sector and exporter's size.

### 1.6 Thesis Organization

The organization of this thesis is as follows. Chapter 2 explains the procedures for obtaining U.S. FF&V import eligibility and provides a summary of NMA instances. Chapter 3 summarizes previous literature about the impacts of tariff barriers and NTBs, in particular SPS measures, and their role in determining market access. The empirical model used to assess the effects of NMA on U.S. imports will be presented in Chapter 4. Chapter 5 discusses the data and gives information about the data sources. Chapter 6 presents the results and offers economic interpretation of the magnitude and direction of the marginal effects of NMA. Finally, Chapter 7 sums up the findings and offers policy recommendations, as well as discusses potential concerns and limitations of this study.

## Chapter 2: New Market Access for Fresh Fruits and Vegetables

One of the goals of the AOA in the Uruguay Round was to increase access in agricultural markets along with reducing the levels of support for domestic policies and export subsidies that distort trade. Efforts to increase market access were mainly focused on replacing non-tariff barriers (NTB) with tariffs that provide an equivalent level of protection (e.g., tariffication), then reducing the level of all tariffs. In addition, minimum access tariff quotas are to be utilized when imports are less than 3% of domestic consumption, increasing to 5% of domestic consumption over the implementation period. Some argue that the tariffication process was a significant achievement; however, the revising of the agricultural trade rules (e.g. banning quantitative import restrictions, variable import levies and etc.) was the key factor in expanding market access in this sector (ERS, USDA, 1998).

The AOA also includes a separate agreement on the application of sanitary and phytosanitary (SPS) measures. This agreement offers an opportunity to expand market access since it provides a framework for implementation of SPS measures. While WTO Members can set their own national standards, they are encouraged to use international standards and guidelines where they exist. In addition, all SPS measures must be based on scientific evidence (e.g., risk assessment), equally applied to domestic and foreign producers, and be the least trade restrictive measure to achieve a given level of risk protection. While it is hoped that these measures will increase harmonization and transparency in SPS measures, concern exists that some countries implement these measures in order to protect domestic producers from international competition (Yue, *et al*., 2006).

### 2.1 Import Permits

APHIS employs the Plant Protection and Quarantine (PPQ) program in order to proactively protect U.S. natural resources from inadvertent introduction of foreign pests or diseases. Although invasive species can be introduced by natural phenomena (e.g. via winds, ocean currents) or by human interventions (e.g. via travelling, smuggling), imports remain the major potential source for this problem. For instance, the Mediterranean fruit fly is the world's most harmful pest and more than 400 plants have been identified as its host (USDA, APHIS, 2006). Due to the gravity of the pest problem, no import of fresh and/or frozen fruits and vegetables is allowed in the U.S. unless the exporter has been granted a market access permit by APHIS (APHIS, USDA, 2011)..

An exporter who has been granted an import permit for a specific commodity has the privilege to export to the U.S. providing all documentation requirements associated with the permit have been met. For example, imports of clementines from Spain are allowed if that shipment has been grown according to the Spanish Mediterranean Fruit Fly management program and has been cold treated before entering to the United States. In addition, all eligible FF&V imports are subject to further inspections and testing, and entry may be refused. For example, entry inspections in December 2001 revealed the presence of quarantine pests in shipments of clementines from Spain. This discovery results in APHIS revoking import permits of fresh clementines from Spain for almost a year (USDA, APHIS, 2002). This is a case of a country that temporarily lost its eligibility to export the respective commodity in question.

### 2.2 Procedure to Obtain an Import Permit

As outlined in Title 7, Chapter III, part 319 of the U.S. Code of Federal Regulations (7 CFR § 319.56-3(b)), fruits and vegetables can be imported only if a permit was issued by APHIS and all the conditions listed in the permit have been met (U.S. Government, 2011a). Obtaining import eligibility is a multi-step procedure that may last anytime between 18 months and 3 years. Figure 2.1 summarizes the steps for obtaining import eligibility.

In order for APHIS to consider a permit request, it must be submitted by the National Plant Protection Organization (NPPO) of the petitioning country (U.S. Government, 2006c). For example, the NPPO of Republic of Korea has recently submitted a petition to export tomatoes[3] (U.S. Government, 2011d). In the permit request, the exporter submits a description of the commodity and shipping information, any pests or diseases associated with the commodity and the current risk mitigation programs implemented. After the permit request has been submitted, APHIS conducts a pest risk assessment (PRA) on the commodity. If there are no pest risks identified in the PRA or if the designated phytosanitary measures used by the exporting country are sufficient to mitigate the pest-risk, the PRA is published in the Federal Register for public comment. After a 60-day public comment period, if the designated phytosanitary measures are still deemed sufficient to mitigate any pest-risk, a notice is published in the Federal Register indicating that APHIS will begin issuing import permits for that commodity from the exporting country. If the designated phytosanitary measures used by the exporting country are not sufficient to mitigate the pest-risk, then APHIS begins a rulemaking-based process that develops a set of phytosanitary measures that does mitigate any pest-risk. The proposed rule and PRA are both published in the Federal Register for a 60-day public comment period. After all public

[3] APHIS has conducted PRA and proposed NMA to be granted. Currently, APHIS has published the notice in the Federal Register and accepts public comments until May 16th, 2011.

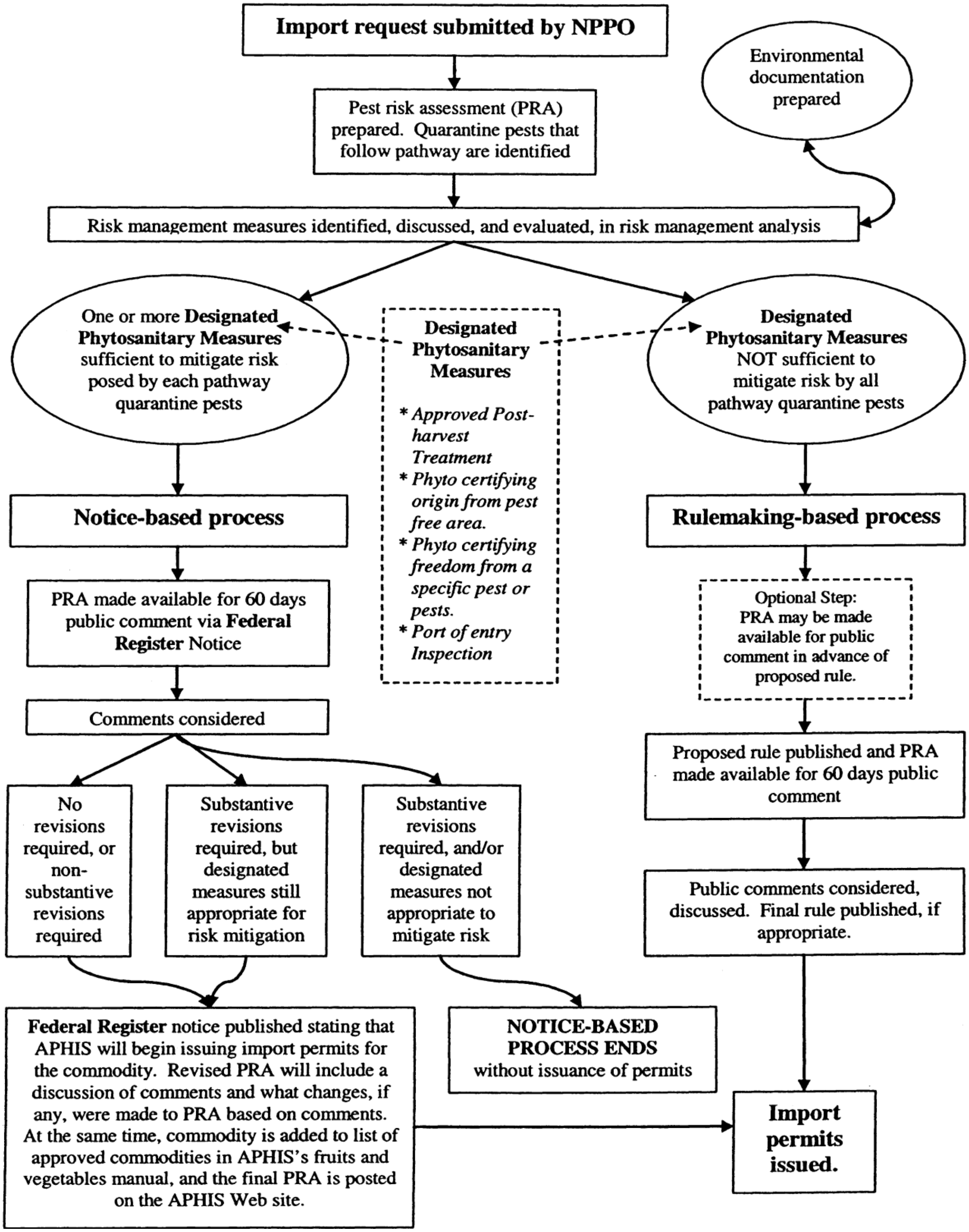
comments have been considered, the proposed rule may be amended and published as the final rule, or may be withdrawn. Once a final rule is published, APHIS may begin issuing import permits. At any time APHIS reserves the right to amend or cancel the granted permit if the exporter does not comply with the designated regulations or new risks are found afterwards (7 CFR 319.56-3(5)).

Once the country has been granted an import permit, APHIS publishes this information in the *Fresh Fruits and Vegetables Import Manual* and updates the FAVIR database. U.S. agents (e.g. retailers, manufacturers) wanting to import this commodity[4] must submit an application for Permit to Import Plants and Plant Products (PPQ 587) to the Plant Protection and Quarantine Office[5] either by mail, by fax or online via ePermits (USDA, APHIS, 2011). The PPQ 587 application (attached in Appendix C of this thesis) is a simple one page form which asks for importer's general information (name/company of importer and contact) and plant or plant product information (country of origin, scientific name, plant parts to be imported and port(s) of arrival). Once approved, the agent can start importing. However, it is important to note that all FF&V imports are still subject to port of entry inspections and must be accompanied by the required documentation in order for the shipment to be released. In case a shipment cannot be precleared at a port of entry due to inappropriate documentation or inspections show potential SPS issues, then a Federal Order for suspension is issued. For example, Federal Order DA-2011-21 issued April 19, 2011 prevents the entry or introduction of Anestrepha oblique (e.g. via imports of cherry) from Saint Vincent and the Grenadines.

[4] FF&V falls in the Imports of Plants and Plant Products category.

[5] There are three offices at APHIS that deal with different permits: 1) Biotechnology Regulatory Services, 2) Plant Protection & Quarantine and 3) Veterinary Services

**Figure 2.1 Import Request Evaluation Process**




Source: (U.S. Government, 2006c)

### 2.3 Instances of FF&V NMA since 1996

Information on the requirements for importing eligible FF&V in the U.S. is available in the *Fresh Fruits and Vegetables Import Manual* on a country and commodity basis. This manual is updated whenever a new regulation or requirement is promulgated (e.g. a country has been granted NMA for a commodity). For each country, the import manual lists all FF&V commodities that are eligible for export along with all conditions for entry. Entry conditions may include origin and/or destination restrictions. For example, papayas from Guatemala may be imported only from the Province of Petén or papayas from Brazil may not be exported to Hawaii. In addition, entry conditions may include phytosanitary treatments[6], such as fumigation with methyl bromide or cold treatment. For example, grapefruit exported from Guatemala must be cold treated.

Using the APHIS import manuals, 204 new import permits (see Table A.1 in Appendix A) for a specific commodity/exporter were issued from 1996 to 2008. However, many of these instances are for commodities other than a fresh fruit or vegetable. For example, all new permits for herbs or nuts are not considered in this thesis. In addition, specialty commodities, such as exotic fruits (e.g. Durians) are also excluded from this thesis. This is because specialty fruits or vegetables are generally included in the "other" or "not elsewhere classified" categories of the HS codes. As is discussed in Section 5.4, these categories generally contain a large degree of product heterogeneity and are thus not included in this analysis. In other instances, a country was granted new import permits for commodities that belong to the same HS category. For example, Nicaragua received new import permits for four different types of beans: broad bean, faba bean, green bean and mung bean. Finally, not all countries that obtained a new import permit are included in the sample (see Section 5.3). For example, in 2007 Kenya, which is not in the

[6] Please see Table 5.2 for a complete list of phytosanitary treatment options.

sample, obtains a new import permit for baby carrots. After these adjustments, as shown in Table 2.1, there are 67 occurrences of a country obtaining a new import permit for a fresh fruit or vegetable commodity. These 67 occurrences represent new permits issued to 29 different countries for 26 different commodities.

The first column of Table 2.2 lists the number of permits by commodity. New import permits were granted for 16 different fruit and 10 different vegetable commodities. New import permits for fresh fruits (46) were granted approximately twice as often as new import permits for fresh vegetables (21). Nearly 60 percent of the new fresh fruit import permits were for citrus (grapefruit, lemons, limes, mandarins and clementines, and oranges) or tropical fruits (mangoes, papayas, and pineapples). For fresh vegetables, peppers and eggplants had the largest number of new import permits. The second column of Table 2.2 lists how many years the new permits were effective during the period 1996 to 2008. By dividing the frequency by the number of permits, one is able to determine the average duration these permits were in effect during this period.

**Table 2.1 Import permits Granted for Import of FF&V, 1996-2008**

| Year | Country | Commodity | Sector |
|---|---|---|---|
| 1997 | Korea | Apples | Fruit |
| | Mexico | Avocados | Fruit |
| | Peru | Cranberries & Blueberries | Fruit |
| | Dominican Republic | Eggplants | Vegetable |
| | Nicaragua | Fresh Beans | Vegetable |
| | South Africa | Grapefruit | Fruit |
| | South Africa | Lemons | Fruit |
| | South Africa | Mandarins & Clementines | Fruit |
| | South Africa | Oranges | Fruit |
| 1998 | Ecuador | Broccoli | Vegetable |
| | Ecuador | Brussels Sprouts | Vegetable |
| | Ecuador | Cauliflower | Vegetable |
| | El Salvador | Eggplants | Vegetable |
| | Nicaragua | Eggplants | Vegetable |
| | Costa Rica | Mangoes | Fruit |
| | Venezuela | Melon | Fruit |
| | Brazil | Papayas | Fruit |
| | Spain | Peppers | Vegetable |
| | South Africa | Pineapples | Fruit |
| | Chile | Tomatoes | Vegetable |
| | Brazil | Watermelons | Fruit |
| | Venezuela | Watermelons | Fruit |
| 2000 | Argentina | Grapefruit | Fruit |
| | Argentina | Lemons | Fruit |
| | Argentina | Oranges | Fruit |
| 2001 | Spain | Eggplants | Vegetable |
| | Spain | Head Lettuce | Vegetable |
| | Argentina | Kiwifruit | Fruit |
| | Spain | Kiwifruit | Fruit |
| | Philippines | Mangoes | Fruit |
| | El Salvador | Papayas | Fruit |
| | Guatemala | Papayas | Fruit |
| | Honduras | Papayas | Fruit |
| | Nicaragua | Papayas | Fruit |
| | Panama | Papayas | Fruit |
| 2002 | Honduras | Mangoes | Fruit |
| 2003 | Honduras | Jicamas, Pumpkins, Breadfruit | Vegetable |
| | Nicaragua | Jicamas, Pumpkins, Breadfruit | Vegetable |
| | Chile | Peppers | Vegetable |
| 2005 | Chile | Mandarins & Clementines | Fruit |
| | Dominican Republic | Mangoes | Fruit |

**Table 2.1 Continued**

| Year | Country | Commodity | Sector |
|---|---|---|---|
| | Peru | Melon | Fruit |
| | Peru | Watermelons | Fruit |
| 2006 | Colombia | Cranberries & Blueberries | Fruit |
| | Peru | Grapefruit | Fruit |
| | Peru | Limes | Fruit |
| | Peru | Mandarins & Clementines | Fruit |
| | Peru | Oranges | Fruit |
| | Costa Rica | Peppers | Vegetable |
| | El Salvador | Peppers | Vegetable |
| | Guatemala | Peppers | Vegetable |
| | Honduras | Peppers | Vegetable |
| | Nicaragua | Peppers | Vegetable |
| 2007 | Uruguay | Cranberries & Blueberries | Fruit |
| | South Africa | Currants | Fruit |
| | Ghana | Eggplants | Vegetable |
| | New Zealand | Lemons | Fruit |
| | New Zealand | Mandarins & Clementines | Fruit |
| | India | Mangoes | Fruit |
| | Thailand | Mangoes | Fruit |
| | New Zealand | Oranges | Fruit |
| | Israel | Spinach | Vegetable |
| 2008 | Bolivia | Cranberries & Blueberries | Fruit |
| | Guatemala | Cranberries & Blueberries | Fruit |
| | Morocco | Peaches & Nectarines | Fruit |
| | Netherlands | Peaches & Nectarines | Fruit |
| | United Kingdom | Peaches & Nectarines | Fruit |

(USDA, APHIS, 2011g)

**Table 2.2 Frequency of U.S. FF&V NMA instances**

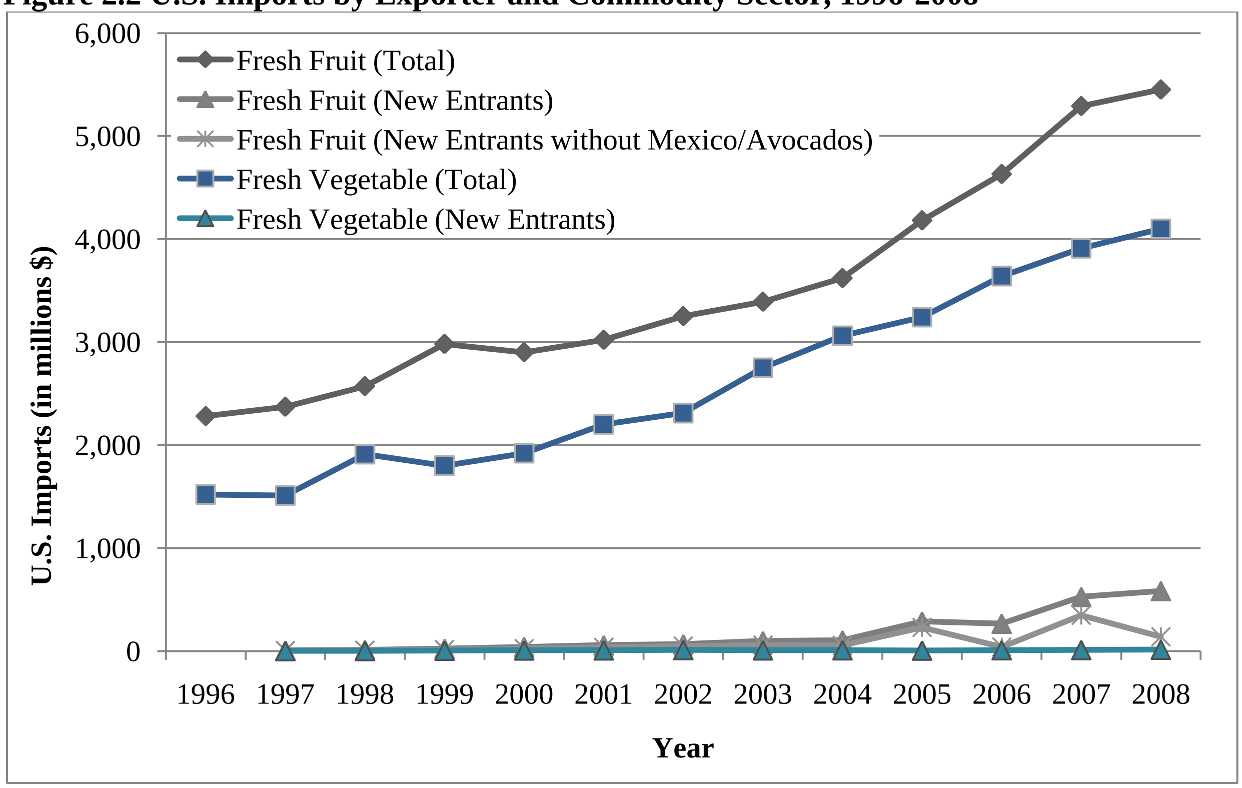
| Commodity | Number of Import permits | Frequency | Percent of NMA Obs. |
|---|---|---|---|
| | Fresh Fruits | | |
| Apples | 1 | 12 | 2.6% |
| Avocados | 1 | 13 | 2.9% |
| Cranberries & Blueberries | 5 | 19 | 4.2% |
| Currants | 1 | 2 | 0.4% |
| Grapefruits | 3 | 24 | 5.3% |
| Kiwifruit | 2 | 16 | 3.5% |
| Lemons | 3 | 22 | 4.9% |
| Limes | 1 | 3 | 0.7% |
| Mandarins & Clementines | 4 | 21 | 4.6% |
| Mangoes | 6 | 34 | 7.5% |
| Melon | 2 | 15 | 3.3% |
| Oranges | 4 | 27 | 6.0% |
| Papayas | 6 | 51 | 11.3% |
| Peaches & Nectarines | 3 | 3 | 0.7% |
| Pineapples | 1 | 11 | 2.4% |
| Watermelons | 3 | 26 | 5.7% |
| *Subtotal* | 46 | 299 | 66.0% |
| | Fresh Vegetables | | |
| Broccoli | 1 | 11 | 2.4% |
| Brussels Sprouts | 1 | 11 | 2.4% |
| Cauliflower | 1 | 11 | 2.4% |
| Eggplants | 5 | 44 | 9.7% |
| Fresh Beans | 1 | 12 | 2.6% |
| Head Lettuce | 1 | 8 | 1.8% |
| Jicamas, Pumpkins & Breadfruit | 2 | 12 | 2.6% |
| Peppers | 7 | 32 | 7.1% |
| Spinach | 1 | 2 | 0.4% |
| Tomatoes | 1 | 11 | 2.4% |
| *Subtotal* | 21 | 154 | 34.0% |
| ***Totals*** | **67** | **453** | **100.0%** |

Source: (USDA, APHIS, 2011g)

### 2.4 Exports of Countries that Obtained New Import Permits

This section analyzes FF&V export volumes of new entrants to the U.S., first relative to exports of existing suppliers and then relative to each other. Figure 2.2 graphically illustrates the annual imports from new entrants and existing suppliers of fresh fruits and fresh vegetables. Cumulatively, new entrants provided little of the total imports of fresh vegetables. After 2004, the amount of fresh fruit imports provided by new entrants increased, but most of this increase was the imports of fresh Hass avocados from Mexico. The large increase in fresh fruit imports from new entrants in 2005 was due to the removal of all geographical and seasonal restrictions on the imports of Hass avocados from Mexico.

**Figure 2.2 U.S. Imports by Exporter and Commodity Sector, 1996-2008**

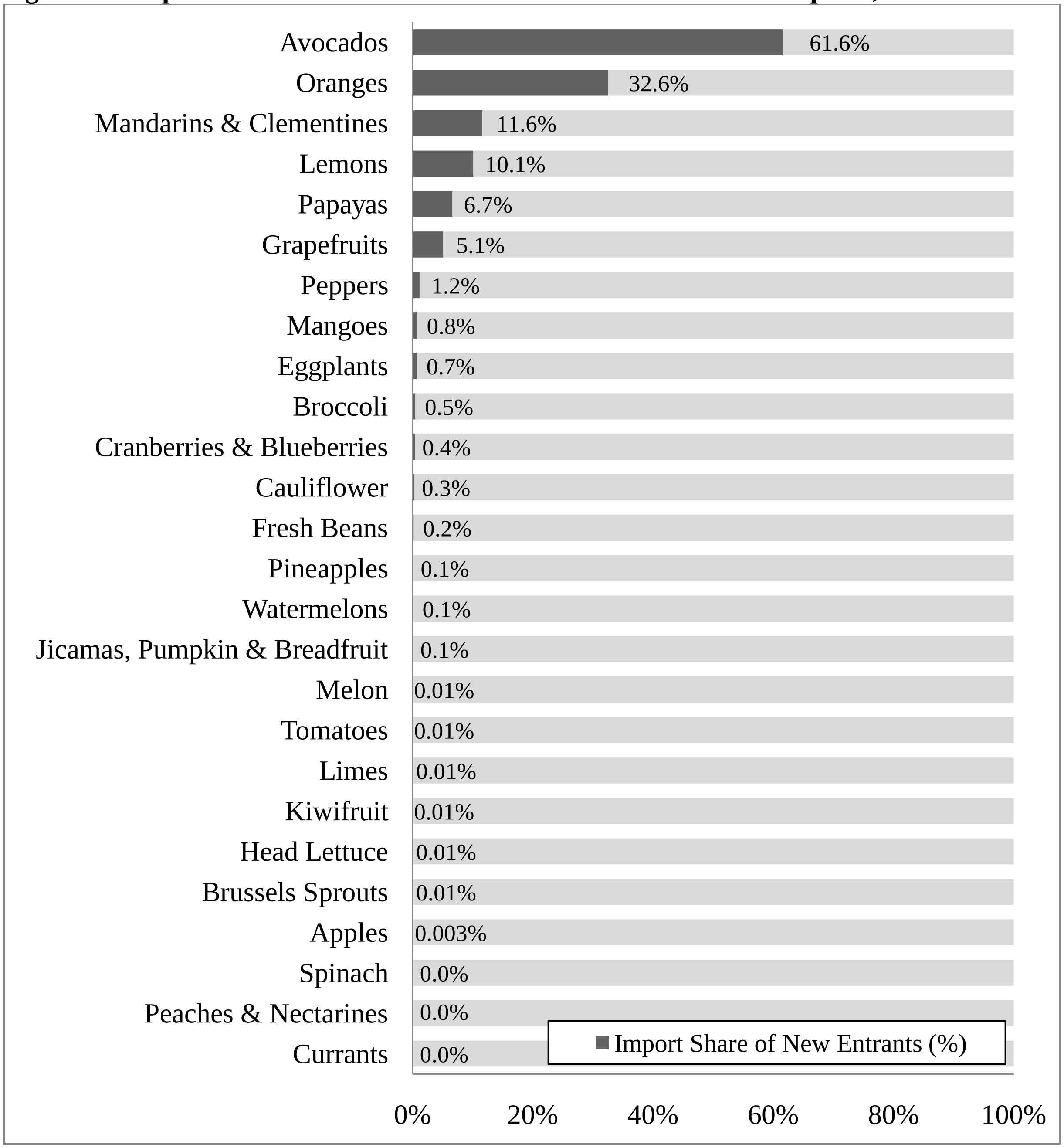



Source: (USITC, 2008b; USDA, APHIS, 2010)

While Figure 2.2 analyzes imports of FF&V from all new entrants as a group, it does not consider the impacts of new entrants on a commodity basis. Figure 2.3 shows the percentage of total value of U.S. imports by commodity that were accounted for by new entrants during the 1996 - 2008 period. For half of all commodities where NMA occurred (13), new entrants exported only 0.1 percent or less of total exports of the respective commodities. Only for avocados, oranges, mandarins and clementines, lemons, papayas, and grapefruit did new entrants provide at least 5 percent of U.S. imports. For peppers and eggplants, which had the highest number of NMA instances, the new entrants only provided about 1 percent of U.S. imports. Figure B.1 in Appendix B shows annual exports by entrant and commodity over the 13 year period.

Since for most commodities, new entrants do not provide a significant proportion of imports relative to existing suppliers, does this occur because the entrants cannot enter and remain in the market on a continual basis or because they export relatively small amounts? Table 2.3 shows how often new entrants were able to achieve an annual dollar value of exports of a given commodity as a percentage of the number of years the new entrants had access to the U.S. market. Annual export threshold levels of $0, $50,000, $100,000 and $200,000 were chosen because about 70 percent of observed exports by new entrants were less than $200,000. New entrants of citrus (except grapefruit) and tropical fruits have been the most successful in entering the U.S. market. For instance, South Africa's export of oranges and Mexico's export of avocados, reaching 33.5 million and $497 million in 2008, respectively, are great examples of successful entry. With the exception of peppers, tomatoes and broccoli, countries that gained new market access for a vegetable commodity did not achieve large export values on a continual basis. Finally, little or no entry occurred for apples, currants, peaches and nectarines, brussels sprouts, and spinach.

**Figure 2.3 Import Share of New Entrants from Total U.S. FF&V Imports, 1996 - 2008**




Source: (USDA, APHIS, 2011g)

**Table 2.3 Frequency and Value of Exports by New Entrants**

| | Percent of Years Where Exports By New Entrants Exceed Customs Value of | | | |
|---|---|---|---|---|
| **Commodity** | **$0** | **$50,000** | **$100,000** | **$200,000** |
| | | Fresh Fruits | | |
| Apples | 8 | 0 | 0 | 0 |
| Avocados | 100 | 100 | 100 | 100 |
| Cranberries & Blueberries | 32 | 16 | 11 | 11 |
| Currants | 0 | 0 | 0 | 0 |
| Grapefruits | 25 | 8 | 4 | 4 |
| Kiwifruit | 19 | 0 | 0 | 0 |
| Lemons | 45 | 32 | 32 | 32 |
| Limes | 100 | 67 | 0 | 0 |
| Mandarins & Clementines | 95 | 95 | 95 | 95 |
| Mangoes | 88 | 76 | 68 | 50 |
| Melon | 47 | 13 | 13 | 0 |
| Oranges | 70 | 59 | 59 | 48 |
| Papayas | 55 | 41 | 41 | 33 |
| Peaches & Nectarines | 0 | 0 | 0 | 0 |
| Pineapples | 82 | 73 | 64 | 64 |
| Watermelons | 27 | 15 | 8 | 8 |
| | | Fresh Vegetables | | |
| Broccoli | 55 | 36 | 36 | 27 |
| Brussels Sprouts | 9 | 0 | 0 | 0 |
| Cauliflower | 64 | 9 | 0 | 0 |
| Eggplants | 61 | 36 | 25 | 14 |
| Fresh Beans | 50 | 25 | 17 | 17 |
| Head Lettuce | 13 | 0 | 0 | 0 |
| Jicamas, Pumpkins & Breadfruit | 42 | 8 | 0 | 0 |
| Peppers | 88 | 75 | 69 | 69 |
| Spinach | 0 | 0 | 0 | 0 |
| Tomatoes | 82 | 82 | 36 | 27 |

(USDA, APHIS, 2011g; USITC, 2008b)

Note: Percent of instances with positive export flows was computed by dividing total years new entrants exported a commodity with value of more than $0, ($50,000; $100,000; $200,000) by total years new entrants were eligible to export that commodity.

While Table 2.3 identifies the commodities where new entrants as a group have been more successful as evidenced by the frequency and size of their export flows, it does not track individual entrants. Another question is whether new entrants are able to penetrate the U.S. market and export on a continual basis or do they enter and then exit the market? Table 2.4 provides information on the duration of new entrants' shipments by showing the distribution of the annual number of new entrants that actively participated in the U.S. market for at least two, three, four and five or more years after gaining market access. The duration of shipments by each entrant was determined by counting how many of the total export-eligible years an entrant exported to the U.S. (i.e. customs value>0). While nearly three-quarters of all new entrants exported for at least two years after gaining market access, less than half of them continued to export five years after gaining market access. Thus exporters in other countries may perceive an opportunity to sell their products in the U.S., however the low success rate suggests that gaining market access does not guarantee success.

As illustrated by Figure 2.3., except exporters of avocados and oranges, new entrants do not claim large shares from U.S. FF&V imports. This fact leads to another question: what is the relative size of new entrants on the global export market? Are new entrants also insignificant exporters to the rest of the world or are they globally large exporters? This question can be answered by analyzing the global export market share of new entrants. Looking at the data, 50 NMA instances of the 67 have an average global export share over the sample period of 13 years (1996-2008) of 2 percent or less. Moreover, only 8 country/commodity NMA instances have an average global export share of 20 percent or more.

**Table 2.4 Duration of New Entrants' Shipments, 1996-2008**

| | | **Number of New Entrants Exporting For at Least:** | | | |
|---|---|---|---|---|---|
| **Year of Import Permit** | **Number of NMA Instances** | ***Two or More Years*** | ***Three or More Years*** | ***Four or More Years*** | ***Five or More Years*** |
| 1997 | 9 | 8 | 7 | 7 | 6 |
| 1998 | 13 | 11 | 10 | 9 | 8 |
| 1999 | 0 | 0 | 0 | 0 | 0 |
| 2000 | 3 | 3 | 2 | 1 | 0 |
| 2001 | 10 | 7 | 4 | 4 | 3 |
| 2002 | 1 | 1 | 1 | 1 | 0 |
| 2003 | 3 | 2 | 2 | 1 | 0 |
| 2004 | 0 | 0 | 0 | 0 | 0 |
| 2005 | 4 | 3 | 3 | 3 | 0 |
| 2006 | 10 | 8 | 7 | 0 | 0 |
| 2007 | 9 | 3 | 0 | 0 | 0 |
| 2008 | 5 | 0 | 0 | 0 | 0 |
| **Total 1996-2008** | **67** | **46** | **36** | **26** | **17** |
| **Percent** | **100.00%** | **74.2%** | **67.9%** | **60.5%** | **43.6%** |

(USDA, APHIS, 2011g; USITC, 2008b)

Note: The number of new entrants exporting for at least two (three, four and five) years during their export-eligible years was computed by summing the number of years where new exporters exhibited positive export flows. The percent of new entrants that remained on the U.S. market was computed by dividing the total number of entrants that remained for at least two (thee, four and five) years on the U.S. market by the total new entrants minus the number of entrants in the last one (last two, last three, last four) years, respectively. For instance the percent of entrants that remained for at least two years on the U.S. market was computed as follows: 46/(67-5)=72.4%; the percent of entrants that remained for at least three years on the U.S. market: 36/(67-9-5)=67.9% and etc.

Because majority of the countries which have gained NMA in the period from 1996 through 2008 were not globally large exporters raises the following two questions. First, what portion of the U.S. FF&V imports is sourced from the large global exporters (e.g. top 10 exporters) of these commodities? Given that the U.S. historically has been a large importer of these commodities, it is possible that the large exporters have already been granted import permits before 1996. Moreover, if the above statement is true, then new (also small) exporters such as the new entrants may not be able to penetrate this market because they lack the capacity to compete with the existing suppliers. For instance, established exporters may have an advantage over new exporters in terms of experience and efficiency but also have established relationships with U.S. wholesalers and retailers. Second, what types of counties in terms of global export share are eligible to export FF&V to the United States? It is possible that many of the globally large exporters of these commodities are not even eligible to export to the U.S., in other words, such exporters have not gained NMA by 2008 - the last year of the data sample used in this study.

In order to answer these two questions, U.S. FF&V imports from globally large exporters are summarized in Table 2.5 (fresh fruits) and Table 2.6 (vegetables) below. As illustrated in Table 2.5, large eligible exporters comprised more than 76 percent of all U.S. fresh fruit imports by value in 2008, with an exception of pears and quinces (51 percent) and grapefruit (6 percent). Additionally, over 90 percent of all imports for13 out of the 20 fresh fruits is sourced from the large eligible exporters. Similarly, as shown in Table 2.6, large exporters comprised more than 70 percent of all fresh vegetable imports by value in 2008. Furthermore, over 90 percent of all imports for 12 out of the 17 of these commodities are sourced from the large eligible exporters. Within both groups, only few large new entrants can be found among the eligible countries. For instance, only 6 out of the 20 fresh fruits and only 4 out of the 17 fresh vegetables have at least one large new entrant within the group. There are total of 13 (9 fresh fruit and 4 fresh vegetable) large new entrants out of all 177 (94 fresh fruits and 83 fresh vegetables) eligible large exporters. However, looking at the data, 8 of those 13 new large exporters have a share of U.S. imports of less than 1 percent.

**Table 2.5 Number of Eligible Countries within Top Ten World Exporters of Fresh Fruits and Their Share from U.S. Imports**

| Commodity | Number of Eligible Countries within Top Ten Exporters[a] | Share of Top Eligible Exporters from U.S. Imports (%)[b] | Number of NMA Countries within Top Eligible Exporters |
|---|---|---|---|
| Apricots | 0 | 0.0 | 0 |
| Cherries | 0 | 0.0 | 0 |
| Grapefruit | 2 | 6.9 | 0 |
| Watermelons | 2 | 93.8 | 1 |
| Peaches | 3 | 96.4[c] | 0 |
| Pears | 3 | 51.1[d] | 0 |
| Plums | 3 | 99.5[e] | 0 |
| Apples | 4 | 80.5 | 0 |
| Tangerines | 4 | 76.3[f] | 1 |
| Avocado | 5 | 100.0 | 1 |
| Kiwi | 5 | 100.0 | 0 |
| Papayas | 5 | 95.4 | 1 |
| Bananas | 6 | 95.4 | 0 |
| Lemons and Limes | 6 | 97.4[g] | 0 |
| Oranges | 6 | 85.9 | 1 |
| Pineapple | 7 | 91.3 | 0 |
| Cantaloupe and Honeydew | 8 | 97.0[h] | 0 |
| Grapes | 8 | 97.0 | 0 |
| Strawberries | 8 | 98.9 | 0 |
| Mango | 9 | 95.3 | 4 |
| Cranberries and Blueberries | nd | | |
| Raspberries and Blackberries | nd | | |

Source: (USITC, 2008b) (USDA, ERS, 2010) (USDA, APHIS, 2011g)

[a] Information on the number of eligible countries within the top ten exporters was obtained from USDA, ERS Phytosanitary Regulation for the Entry of Fresh Fruits and Vegetables into the United States Data Sets. Only information on the commodities subject to interest of this thesis was extracted.

[b] The share of top eligible exporters from U.S. imports was calculated using the thesis database. First the top eligible exporters for each commodity, in terms of global export share, were extracted. Then their share of U.S. imports for the corresponding commodity was calculated.

[c] This share is calculated for peaches and nectarines since the thesis database puts these two commodities as a single commodity.

[d] This share is calculated for pears and quinces since the thesis database puts these two commodities as a single commodity.

[e] This share is calculated for plums and sloes since the thesis database puts these two commodities as a single commodity.

[f] This share is calculated for mandarins and clementines instead of tangerines, as given by the USDA, ERS.

[g] This share is calculated for limes only since the thesis database puts lemons and limes as two separate commodities. However, the U.S. import value is given for lemons and limes together.

[h] This share is calculated for melons instead of cantaloupe and honeydew, as given by the USDA, ERS.

**Table 2.6 Number of Eligible Countries within Top Ten World Exporters of Fresh Vegetables and Their Share from U.S. Imports**

| Commodity | Number of Eligible Countries within Top Ten Exporters[a] | Share of Top Eligible Exporters from U.S. Imports (%)[b] | Number of NMA Countries within top eligible exporters |
|---|---|---|---|
| Potato | 1 | 100.0 | 0 |
| Artichokes | 2 | 99.7 | 0 |
| Pumpkin and squash | 2 | 95.8[c] | 0 |
| Tomato | 2 | 80.0 | 0 |
| Asparagus | 3 | 98.1 | 0 |
| Spinach | 3 | 70.5 | 0 |
| Carrot | 4 | 76.8 | 0 |
| Eggplant | 4 | 91.3 | 1 |
| Bell pepper | 5 | 97.3 | 1 |
| Cucumber | 5 | 96.4 | 0 |
| Green bean | 5 | 96.6 | 0 |
| Lettuce | 5 | 99.5[d] | 1 |
| Cabbage and other brassicas | 7 | 98.2[e] | 0 |
| Broccoli and cauliflower | 8 | 100.0[f] | 1 |
| Garlic | 9 | 99.5 | 0 |
| Mushroom | 9 | 84.8[g] | 0 |
| Onion | 9 | 74.9 | 0 |
| Brussels sprouts | nd | | |
| Okra | nd | | |

Sources: (USITC, 2008b) (USDA, ERS, 2010) (USDA, APHIS, 2011g)

[a] Information on the number of eligible countries within the top ten exporters was obtained from USDA, ERS Phytosanitary Regulation for the Entry of Fresh Fruits and Vegetables into the United States Data Sets. Only information on the commodities subject to interest of this thesis was extracted.

[b] The share of top eligible exporters from U.S. imports was calculated using the thesis database. First the top eligible exporters for each commodity, in terms of global export share, were extracted. Then their share of U.S. imports for the corresponding commodity was calculated.

[c] This share is calculated for squash only since the thesis database puts pumpkins and squash as two separate commodities.

[d] This share is calculated for head lettuce only since the thesis database puts head lettuce and leaf lettuce as two separate commodities.

[e] This share is calculated for cabbage only.

[f] This share is calculated for broccoli only since the thesis database puts broccoli and cauliflower as two separate commodities.

[g] This share is calculated for mushrooms and truffles since the thesis database puts these two commodities as a single commodity.

### 2.5 Pest-risk Management Options

If pest-risk assessment conducted by APHIS identifies quarantine pests, a set of procedures will be specified in the import permit to mitigate the risk posed by the identified pests. Information on whether phytosanitary measures are required as a condition for entry for a specific commodity and exporter is provided in the APHIS *Fresh Fruits and Vegetables Import Manual*. The phytosanitary measures identified in the import manual can classified in five categories:

a) phytosanitary treatments (e.g. methyl bromide fumigation or cold treatment (see Table 2.7 for treatment options)),

b) geographical restrictions on origin (e.g. fresh avocados from Mexico must originate in the municipality of Michoacán),

c) geographical restrictions on destination (e.g. pineapples from South Africa cannot be shipped to Puerto Rico, Virgin Islands, Northern Mariana Islands, Hawaii, and Guam)

d) systems approach (e.g. Hass avocados from Mexico – pre-harvest, harvest, packing, transport, and shipping, measures designed to reduce pest risks)

e) preclearance procedures in exporting country (e.g. mangoes from India – must be precleared and approved by an APHIS officer in India before shipped to the U.S.)

Of these five pest-risk mitigation procedures, phytosanitary treatments were the most frequently required as a condition of entry, with at least one treatment being required in 43 percent of the instances of NMA. Origin and destination restrictions were required for 33 and 24 percent of all instances of new market access. Pre-clearance procedures and systems approaches were the least used options in about 20 percent of all cases of NMA

[22]. Only phytosanitary treatments and geographic restrictions on destination are included in the sample. Pre-clearance procedure, origin restrictions, and system approaches are not included the sample because these measures are commodity and exporter specific. Thus, the impacts of these measures will not be constant across different commodity/exporter combinations. With only 13 years of data, there would likely not be sufficient observations to econometrically identify the effects of these restrictions.

There are ten approved SPS treatments identified in the USDA/APHIS *Treatment Manual*. Following Karov *et al*., (2009), because some treatments use similar procedures and some regulatory regimes require the combination of two treatments, eleven different treatment groups, summarized in Table 2.7, are identified in the sample.

Table 2.8 summarizes the frequency of SPS treatment type by product sector. Just over 82 percent of all NMA instances subject to a treatment pertain to fresh fruit commodities, and almost half of these commodities are subject to a cold treatment. Eight of the eleven treatment types have been applied to at least one fresh fruit instance compared to only two treatment types to at least one fresh vegetable instance.

While phytosanitary treatments tend to be required more often for fresh fruits, compared with fresh vegetables, they need not be applied to all new exporters of a given commodity. Table 2.9 below provides a list of all 26 commodities with an import permit and whether they have a SPS treatment requirement or not. Furthermore, this table shows the percent of NMA observations of each commodity that is affected by a treatment.

[22] The percentages of phytosanitary measures applied to the 67 NMA instances have been calculated by the author of this thesis. Using the FAVIR database, each NMA instance was reviewed in order to determine whether each country/commodity is subject to any of the five phytosanitary measures discussed above. Then the percentages have been calculated by dividing the number of NMA instances affected by the relevant phytosanitary measure with the total number of NMA instances.

**Table 2.7 SPS Treatment Groups**

| Group | Definition | T100 Series Code |
|---|---|---|
| 1 | Methyl Bromide Fumigation | T101 |
| 2 | Water Treatment | T102 |
| 3 | Heat Treatment | T103; T106 |
| 4 | Pest Specific/Host Variable | T104 |
| 5 | Irradiation | T105 |
| 6 | Cold Treatment | T107; T110 |
| 7 | Fumigation Plus Refrigeration of Fruits | T108; T109 |
| 8 | Methyl Bromide Fumigation and Cold Treatment | T101 and T107; T110 |
| 9 | Cold Treatment or Fumigation Plus Refrigeration of Fruits | T07; T110 or T108; T109 |
| 10 | Water Treatment or Methyl Bromide Fumigation | T102 or T101 |
| 11 | Methyl Bromide Fumigation or Cold Treatment | T101 or T107; T110 |

Source: (Karov, 2009)

**Table 2.8 Frequency of SPS Treatments for New Entrants by Product Sector**

| | Product Sector | |
|---|---|---|
| **SPS Treatment** | **Fresh Fruit** | **Fresh Vegetable** |
| Methyl Bromide Fumigation | 4 | 3 |
| Cold Treatment | 12 | 0 |
| Water Treatment | 3 | 0 |
| Methyl Bromide Fumigation and Cold Treatment | 0 | 0 |
| Cold Treatment or Fumigation Plus Refrigeration of Fruits | 1 | 0 |
| Pest Specific/Host Variable | 0 | 0 |
| Fumigation Plus Refrigeration of Fruits | 1 | 0 |
| Heat Treatment | 1 | 0 |
| Water Treatment or Methyl Bromide Fumigation | 0 | 0 |
| Irradiation | 2 | 1 |
| Methyl Bromide Fumigation or Cold Treatment | 1 | 0 |
| **Total** | **25** | **4** |

(USDA, APHIS, 2008)

In terms of SPS treatment requirement, 9 out of the 16 fresh fruits and 4 out of the 10 fresh vegetables with an import permit have treatment applications. In general, 39 percent of all NMA observations are subject to at least one phytosanitary treatment. When considering fresh fruits, the percent of NMA observations affected by a treatment ranges from 33 percent (e.g. peaches & nectarines) to 100 percent (e.g. apples, kiwifruit, mangoes). When considering fresh vegetables, treatment applications range from 81 percent (e.g. tomatoes) to 100 percent (fresh beans and head lettuce), with an exception of eggplants which have only 4.5 percent affected NMA observations.

**Table 2.9 Percent of NMA Observations Subject to at Least One SPS Treatment**

| Commodity | SPS Treatment Required | Percent of NMA Observations Subject to at Least One Treatment |
|---|---|---|
| | Fresh Fruits | |
| Apples | Yes | 100.0% |
| Avocados | No | 0.0%[a] |
| Cranberries & Blueberries | Yes | 100.0% |
| Currants | No | 0.0% |
| Grapefruits | Yes | 70.8% |
| Kiwifruit | Yes | 100.0% |
| Lemons | Yes | 54.5% |
| Limes | No | 0.0% |
| Mandarins & Clementines | Yes | 85.7% |
| Mangoes | Yes | 100.0% |
| Melon | No | 0.0% |
| Oranges | Yes | 66.7% |
| Papayas | No | 0.0% |
| Peaches & Nectarines | Yes | 33.3% |
| Pineapples | No | 0.0% |
| Watermelons | No | 0.0% |
| | Fresh Vegetables | |
| Broccoli | No | 0.0% |
| Brussels Sprouts | No | 0.0% |
| Cauliflower | No | 0.0% |
| Eggplants | Yes | 4.5% |
| Fresh Beans | Yes | 100.0% |
| Head Lettuce | Yes | 100.0% |
| Jicamas, Pumpkins & Breadfruit | No | 0.0% |
| Peppers | No | 0.0% |
| Spinach | No | 0.0% |
| Tomatoes | Yes | 81.8% |

Source: (USDA, APHIS, 2011g)

Note: The percent of NMA observations subject to at least one phytosanitary treatment was calculated when the frequency of NMA observations subject to a treatment (e.g. cold treatment) is divided by the frequency of all NMA observations, by commodity, and then multiplied by 100.

[a] There are a set of pest risk mitigation practices (systems approach) required for avocados exports from Mexico.

## Chapter 3: Literature Review

The URAA laid the foundations for increased market access provisions worldwide, mainly via lowering tariff barriers on agricultural trade. Consequently, after 1995, a 'new' set of trade barriers – NTBs emerged as a result of this increase in trade liberalization (Henson and Caswell, 1999; Shafaeddin, 2007). Decrease of tariff barriers and proliferation of NTBs caused shift in emphasis from the former to the later (Beghin, 2006). As a consequence, there is a surge of studies analyzing the impacts on bilateral trade flows of NTBs such as technical barriers to trade[24]. Sanitary and Phytosanitary (SPS) measures are a particular type of technical regulations related to pest risk and food safety which can impede trade. There is evidence that these measures play a major role in shaping agricultural trade (Henson and Caswell, 1999; The Office of the U.S. Trade Representative, 2010). In fact, their importance in agricultural trade is such that it is a central factor that determines market access provisions (Unnevehr, 2000; Jongwanich, 2009).

The WTO in response to the need to set basic rules for food safety and animal and plant health standards in the world, in 1995 released the SPS Agreement. Given that this agreement grants the right of WTO members to set their own national standards as they deem necessary to prevent ecological and economic loses, there is a great potential for these measures to become restrictive to trade and determine import eligibility, i.e. market access. For instance, Yue, *et al*. (2006) claim that some countries implement SPS measures in order to protect domestic producers from international competition.

This chapter is mainly dedicated to summarizing the impacts of NTBs, in particular SPS measures and their role in determining market access. The rest of the literature review chapter is organized as follows. Section 3.1 discusses studies pertaining to agricultural trade barriers such

[24] In a working paper, Beghin (2006) provides a profound explanation of the taxonomy of non-tariff barriers.

as traditional tariffs and tariff-rate quotas (TRQs). It also summarizes findings from studies which specifically analyze the impacts of these barriers on market access. Section 3.2 provides a synopsis of studies which analyze the impacts of SPS measures on agricultural trade with a special emphasis on U.S. FF&V imports. Section 3.3 draws examples from the literature to explain the way food safety and SPS standards affect market access provisions. Finally, Section 3.4 presents the limitations of the current literature and contributions of this study.

### 3.1 Impact of Tariff Barriers on Market Access

Agricultural commodities, such as fresh fruits and vegetables are heavily regulated and face a range of trade barriers classified into two categories: tariff barriers and NTBs. These barriers restrict market access, however NTBs are considered to be more trade impeding due to lack of transparency and dissimilarity across countries. Unlike NTBs, also referred as "invisible barriers" (Elci, 2006), tariff barriers are easily identifiable, quantifiable, comparable across commodities and countries and do not establish maximum ceilings on import. Thus, the WTO URAA urged for 'tariffication', which is a process of converting NTBs (e.g. quotas) into their tariff equivalents in order to increase market access provisions. It is expected that the resulted tariffs will set the stage for future negotiations on improved market access among countries. In addition to tariffication and reduction of tariffs, minimum access commitments, usually fulfilled via application of TRQs, are also supposed to positively affect trade liberalization. TRQs are two-tier tariffs, where low tariffs are applied to in-quota imports and higher tariffs to over-quota imports. Since the beginning of the implementation of the URAA in 1995, many studies have analyzed the effects of these commitments on market access provisions.

As many negotiators of the Uruguay Round expected, the process of tariffication resulted in very high tariffs which challenged the AOA goals to improve members' market access (Gibson *et al*., 2001). This report argues that TRQs did not help market access provisions since the average agricultural in-quota tariff was 63 percent, which is even higher than the global average of 62 percent. Although TRQs facilitated some imports and helped some counties to meet the minimum access requirements, it discouraged larger imports due to the extremely high over-quota agricultural tariffs which averaged 128 percent globally. Nonetheless, the WTO reports that even minimum access requirements were not fully met during the implementation period of 1995-2002 as quotas were under-filled. More specifically, agricultural quota fill rates on the sample average fall from 66 percent in 1995 to 54 percent in 2001 (WTO, 2002). In fact, imports under TRQs were less than under quotas (Abbott, 2001). Judging from quota fill rates and import levels, TRQs were not a significant factor in expanding market access in the agricultural sector.

However, according to a report by the Organization for Economic Cooperation and Development (OECD), regardless of the fact that agricultural tariff levels remain high, the tariffication process is still considered a step forward in achieving the market access goals. This statement has been somewhat proven right in a study by Abbott and Morse (1999) who provide evidence that TRQs adoption by developing countries has increased imports above historical trends in 72 percent of the cases. Therefore, regardless of the amount, there is evidence of some increase in imports under TRQs.

Although in general implementation of TRQs may have increased member's trade, many studies have pointed out that almost all of this increase may come due to minimum market access (3-5% of imports) rather than current market access commitments (above 3-5% of imports)

(Abbott, 2001; Tangermann, 2001). However, it is impossible to separately assess the imports under these two commitments because no country, expect the U.S. Canada and Japan, distinguishes in-quota and over-quota imports in reporting trade (deGorter and Sheldon, 2001).

The fact that TRQs failed to substantially improve market access (e.g. Wainio *et al.*, 1998) drew attention among researchers in this field to indentify the factors under this instrument that impede market access and to provide recommendations for reforms. The most commonly cited problem is high in-quota and extremely trade prohibitive over-quota tariff rates (Li and Carter, 2009). Li & Carter (2009) provide evidence that reducing in-quota tariffs will result in considerable increase in imports. Furthermore, Jean *et al.* (2005) found that market access levels will be strongly positively affected by large tariff cuts. Other important TRQ factors that reduce market access are high transactions and administrative costs, such as costs associated with import licensing. These issues have been recognized by the WTO and are currently addressed in the Doha Round of negotiations. For instance, a report by OECD (2001) explains that market access can be affected by administration of tariff-quota licenses, a process which gives an opportunity for countries to determine quota rights (market access) and with that to engage in rent seeking activities. Li & Carter (2009) provide evidence that costs associated with TRQ administrative methods are relatively high and negatively affect quota fill rates and thus reduce market access. In two reports, Skully (1999) and Skully (2001) argue that reforms in TRQ administration and import licensing can improve market access and reduce discrimination in trade. According to deGroter & Sheldon (2001) and Abbott (2001), TRQ implementation and administration issues function as NTBs and have a negative effect on market access. Other mentioned factors under the TRQs that limit market access are issues with the so called "dirty tariffication[25]" and

[25] When converting non-tariff barriers to tariffs, many developed countries took on tariff levels that were much higher than their non-tariff equivalents.

"endogenous quotas[26]", which essentially are products of countries' flexibility to adjust tariff and quota levels, respectively.

The WTO implemented TRQs as the transitioning instrument in hope that eventually tariff-only protection will be achieved. As expected, converting TRQs into a single tariff (bound tariff) is considered to be one of the most effective instruments in increasing market access (OECD, 2001; Li and Carter, 2009). For example, in case of imperfect competition, Joerin (2009) graphically shows the improvements in market access as a result of replacing TRQs into tariff equivalents. Auctions are one of the proposed methods which can help this conversion and it will ensure that new tariff levels are equivalent protection as TRQs, but serve market access goals better (Skully, 2001; Joerin, 2009)

In conclusion, by converting NTBs into adequate tariff equivalents, the URAA was by far more successful in achieving greater transparency in agricultural trade than in increasing market access among WTO members. Due to the minimal success in agricultural market access improvements, the WTO (2002) referred to this subject as "unfinished business"; which will be a key topic to be addressed on the next negotiation rounds.

### 3.1.1 Impacts of Tariff Barriers on U.S. Market Access: The Case of FF&V Imports

The focus of this thesis, however, is U.S. market access; therefore this section provides evidence from the literature about the effects of tariff barriers on U.S. agricultural import liberalization, in particular U.S. market access as a result of the URAA accomplishments. It also sheds some light on U.S. market access for imports of fruits and vegetables.

In general, the U.S. has very low agricultural tariffs compared to other WTO members (Gibson *et al*., 2001). Although the sample average tariff rate is 11.8 percent, which is more than

[26] When the quota is above the minimum access commitments and it is managed by the country (for example to stabilize the domestic market), the regime is called endogenous quota.

five times smaller than the average global tariffs, the median tariff rate is 2.7 percent. In terms of the FF&V sector, U.S. average and median tariff rate is 7 and 4 percent, respectively for fresh vegetables; and U.S. average and median tariff rate is 4 and 1 percent, respectively for fresh fruits. U.S. market is fairly accessible since these rates are significantly lower than the global averages of the FF&V sector, where global tariff rate for fresh vegetables and fresh fruits average is 69 and 58 percent respectively.

As of 2002, the U.S. had a total of 54 tariff quota commitments as a result of the URAA tariffication requirements, which represents 3.8 percent of all individual tariff quotas (WTO, 2002). Out of these, the U.S. FF&V sector was represented in only 7 TRQs. The U.S. average in-quota tariff rate is 10 percent compared to the global average of 63 percent, while the average out-of quota is 52 percent compared to the global average of 128 percent. Over the period 1995-2002, U.S. sample average fill rates for FF&V TRQs was 69 percent, which indicates there was some growth in imports of this sector due to U.S. market access commitments under the URAA.

The U.S., which belongs to the developed countries tariff-reduction-group, consented to reduce agricultural tariff levels (both previous and those that resulted from the tariffication process) by 36 percent on sample average, over the period of 6 years with a minimum decrease of 15 percent for each tariff line. The U.S. average depth of the Uruguay Round tariff cut was 35 percent for fresh fruits and 40 percent for fresh vegetables, where both of these percentages are close to global tariff cuts of developed countries, but much larger than those of the developing countries. However this tariff cut approach has been widely criticized because it can produce limited market access (e.g. Wainio *et al*., 1998). Fortunately that has not been the case for the U.S. since Bureau *et al.* (2000) claim that different tariff cut approaches would have had similar effects on market access as the Uruguay Round tariff cut, mainly because the U.S. had low tariffs even before the cut.

Very few studies have analyzed the impacts of the URAA on U.S. market access pertaining to the FF&V sector. Wainio and Krissoff (2005) analyzed both fresh and processed fruits and vegetables and how tariff barriers and NTBs have affected U.S. and other countries' market access. "*High tariffs, particularly during certain times of the year, remain a major impediment for expansion of global trade in fruits and vegetables*" (Wainio and Krissoff, 2005). The U.S. along with Canada and several European countries are remarkable users of seasonal tariffs, which have a negative effect on market access since these tariffs limit efficient and price-competitive exporters to increase their market share. Furthermore, this paper concludes that fruit and vegetable import markets after the URAA are as open as before its implementation. This result indicates that even after the URAA tariff reduction and tariffication efforts, market access goals specific to the fruit and vegetable sector remain unmet; therefore there is a need for the WTO to readdress this issue in the ongoing Doha and future rounds of negotiations.

Johnson (2010) in a report for congress cites U.S. low import tariffs and "relatively open import regime" as two very important factors causing increase in the U.S. fruit and vegetable trade deficit. In other words, this report argues that the U.S. has a fairly accessible fruit and vegetable market in terms of tariff barriers, relative to the EU, Japan and some other countries from the emerging economies, which have drastically larger tariff rates established on imports of this sector.

A WTO report on world tariff profiles shows that a significant amount of U.S. imports of fruits, vegetables and plants are entering at zero tariff levels (e.g. in-quota duty-free imports) since the share of MFN duty-free imports of total imports falling under this product group was about 24 percent for the past six years (WTO, 2010). In addition, Canada and Mexico, the largest suppliers of fruits and vegetables to the U.S., export these products at zero or very low tariffs (Krissoff & Wainio, 2007).

In conclusion, judging from tariff reduction levels and TRQ fill rates, it is probably safe to say that as a result of the URAA, access to the U.S. fruit and vegetable market relative to other courtiers has notably improved. However, there is insufficient information to ascertain whether this market access has resulted in increased U.S. imports of FF&V.

### 3.2 Impact of Phytosanitary Regulations on Market Access

While tariff barriers significantly limit market access, other factors such as NTBs may also act as impediments to trade. As mentioned before, following a trend of declining tariff barriers, countries sought other protective measures, such as NTBs. Beghin (2006) states that during and after the Uruguay Round, the use of NTBs (other than quantity and price controls) increased from 55 percent in 1995 to 85 percent in 2004. During the same period, a similar trend also can be noticed in Technical Barriers to Trade (TBT), where their use increased from 32 percent 59 percent.

The emphasis of this thesis is, however, on SPS measures, a specific kind of technical barriers; therefore this section provides evidence from the literature about the impact of these measures on U.S. imports. More specifically, this section discusses the potential for SPS measures to determine U.S. market access.

There is an array of literature which found negative impacts of SPS measures on agricultural trade (e.g. Calvin and Krissoff, 1998; Henson and Loader, 2001; Elci, 2006; Disdier *et al*., 2007; Karov *et al*., 2009). Regardless whether implemented as tools to prevent the introduction of pests and diseases via imports or as means to protectionism, SPS measures can constrain market access. According to the rules of the Uruguay Round SPS Agreement, countries have the right to nationally establish SPS standards providing those are backed up by scientific evidence. However this rule also indirectly gives the right to countries to determine import eligibility privileges. For example, based on SPS standards, the U.S. (APHIS) determines access of all shipments of plants, animals and their products to the U.S. market.

Although the impacts of SPS measures on agricultural trade are well defined, there is limited literature which analyzes the effects of these measures on market access provisions. Unnevehr (2000) analyzes fresh food product exports from least developed countries and concludes that SPS measures imposed by developed countries play a significant role in determining market access. He suggests least developed countries could improve their eligibility to export to developed countries by learning how to meet their standards. However, by doing so, governments of least developed countries will face challenges in choosing the most effective actions to improve market access. Finally, this study raises an important question for future research concerning the impacts of prospective stricter standards on market access.

Jongwanich (2009) examines the impact of food safety standards, in particular SPS standards on processed food exports and finds that standards imposed by developed countries could impede developing countries exports of these products. Although this paper does not specifically address market access provisions, it points out that one of the key challenges to market access for developing countries is to meet the increasingly stricter standards of developed countries.

Jouanjean and Le Vernoy (2010) evaluate the robustness and intensity of FF&V exports from Central American countries to the U.S. following import detentions/refusals due to SPS issues. In particular, this paper discusses the capacity of these countries to retain market access to the U.S. by evaluating the resilience of the supply chains, which is expressed as the rate of survival and adaptation of the FF&V sector. Their findings suggest a negative relationship between the unit prices of fresh fruits and vegetables and import refusal instances, however they find mixed effects of these instances on export flows. Nevertheless, this preliminary result implies that issues with U.S. SPS standards may have negative consequences on the reputation of countries FF&V exports and potentially disruptions in access to this sector's market.

Judging from evidence provided in the literature, market access provisions may depend on SPS standards. The next step, however, is to explore imports from countries which have obtained import eligibility and were given green light to supply to the U.S. market. As discussed in Chapter 2, the U.S. provides import permits to new entrants either because their products do not pose substantial risks to natural resources or because pest risk mitigation practices could be applied to eradicate potential hazards.

To date, there is only one study that evaluates post-market-access-provision import flows of new exporters compared to established suppliers in the U.S. Karov *et al.* (2009) focuses on SPS treatment effects on U.S. FF&V imports, though this study also assesses the effects of new market access on this U.S. sector with an ex-post approach. They found a significant difference in import flows from new entrants relative to established suppliers. In fact, their gravity model estimate suggests that new entrants are shipping on average 65 percent less FF&V to the U.S. relative to long standing suppliers.

### 3.3 Contributions of This Study

Market access in the literature often is examined as an issue associated with prohibitive trade costs, mainly tariffs. The interest in analyzing this type of market access comes with the fact that tariff barriers along with TRQs are key factors that may limit market access, for example via large over-quota tariff rates. This type of market access does not set ceilings on imports; therefore, even if these trade costs may be high, an exporter is still eligible to export providing it is willing to pay the extra charges. However, market access in this study is associated with SPS standards and eligibility rather than costs. In other words, regardless of the monetary trade costs, the U.S. market may be accessed only if APHIS has preapproved imports of a commodity by issuing a permit to prospective suppliers. Thus, the first contribution of this study is to explore market access pertaining to SPS standards using the case of U.S. FF&V imports. As a result, this study will answer the following very central empirical question. Are countries that gain import eligibility able to successfully enter a market and capitalize on the new market access?

As mentioned before, to date there is only one study which sheds some light on U.S market access provisions and their effect on imports. Given that Karov *et al.* (2009) use an intercept shifter to estimate the differences in import flows between new and long standing suppliers, there is an opportunity to extend this research further. As a result, this study aims to examine new market access in greater detail and provide new evidence to the literature about the trade effects of increased eligibility of FF&V imports to the U.S.

Finally, an important contribution of this study originates in detailed information on new market access instances which vary by time, exporting country and commodity. Thus, this comprehensive approach does not only provide empirical assessment of import flows of new entrants in general, but also it allows for their trade effects to vary across product sectors, exporter's size and SPS restrictions.

# Chapter 4: Empirical Model

How much, what and why do countries trade are questions that can be answered by international trade theories and empirical studies. Anderson (2004) argues that most of the international trade theories predict gains from trade. For example the theory of comparative advantage, first analyzed by Robert Torrens in 1815, suggests that countries can gain if each specializes in what it does “best”, i.e. has lower opportunity cost than the other country. Because of potential gains, majority of economists are in favor of liberalization of trade between countries (Anderson, 2004).

This thesis estimates economic relationships using the gravity model of international trade. The use of the gravity equation originates in the studies of Tinbergen (1962) and Pöyhönen (1963) who proposed that Newton’s law of universal gravitation can be applied in international trade. Newton found that the attractive forces between two objects are increasing with their masses and decreasing with their distance. Similarly Tinbergen (1962) and Pöyhönen (1963) suggest that the trade flow between countries increases with their economic masses and decreases with distance.

This model has been applied to quantify the trade flow effects of distance (Disdier and Head, 2008; Melitz, 2007; Brun *et al*., 2005), economic masses of trade partners (Baier and Bergstrand, 2001), FTAs (Jayasinghe and Sarker, 2004), border differences such as currency, culture, colonial ties and language (Linders *et al*., 2005; Sousa and Lochard, 2005), regulations (Frahan and Vancauteren, 2006), tariff barriers and NTBs (Haveman and Thursby, 2000). The gravity model is not only extensively used to estimate trade flows, but also international migration (Karemera *et al*., 2000), travel patterns and volumes (Mayo *et al*., 1988), foreign direct investment (Bevan and Estrin, 2004), transportation (Alcaly, 1967; Grosche *et al*., 2007), consumer choice (Bucklin, 1971) and health planning (Lowe and Sen, 1996). This empirical study employs the gravity model to explain observed U.S. FF&V import flows and to identify how factors such as NMA affect these trade flows.

### 4.1 Conceptual Framework of the Gravity Equation

Although the gravity equation did not have a solid theoretical foundation, it was widely used to predict trade flow patterns for nearly fifty years. Anderson (1979) and Bergstrand (1985) were among the first to develop the theoretical foundation of the gravity equation. Although they mentioned the issue of multilateral prices, Anderson and van Wincoop (2003) improved the theoretical foundation to include international prices explicitly. As a result this has eliminated the problems of omitted variable bias due to exclusion of international prices.

Anderson (1979) derived the gravity equation based on constant elasticity of substitution (CES) utility function and goods that are differentiated by geographic entities. Following Anderson (2003), the demand for the $k^{th}$ fresh fruit or vegetable commodity from the $i^{th}$ supply region by consumers in the United States is derived from the following CES utility function:

$$C_j^k = \left( \sum_{i=1}^{I} (c_{ij}^k)^{\frac{\sigma_k}{\sigma_k - 1}} \right)^{\frac{\sigma_k}{\sigma_k - 1}} \qquad (1)$$

where $(c_{ij}^k)$ is the quantity consumed and $\sigma_k$ is the elasticity of substitution between the different varieties of commodity $k$ from different countries, and its value is assumed to be greater than one. The quantity of each variety consumed is derived by maximizing the utility function subject to the following budget constraint:

$$E_j^k = \sum_{i=1}^{I} p_{ij}^k c_{ij}^k \text{, where } p_{ij}^k = p_i^k t_{ij}^k \text{ and } t_{ij}^k \geq 1 \tag{2}$$

where $E^k$ is the total expenditure on the $k^{\text{th}}$ fresh fruit or vegetable and $p_{ij}^k$ is the price paid by U.S. consumers. Note that $p_{ij}^k$ is the price linkage equation defined as the exporter's shipping price ($p_i^k$) adjusted for the *ad valorem* trade cost ($t_{ij}^k$). Further discussion about the trade cost components is provided in the benchmark specification section below. Maximizing (1) subject to (2), the demand function for the $i^{\text{th}}$ variety of commodity $k$:

$$c_{ij}^k = \frac{\left(p_{ij}^k\right)^{-\sigma_k}}{\left(P_j^k\right)^{1-\sigma_k}} E_j^k \tag{3}$$

where $P_j^k$ is the consumer price index over all varieties from country $i$, which is defined as:

$$P_j^k = \left( \sum_{i=1}^{I} \left(p_{ij}^k\right)^{1-\sigma_k} \right)^{\frac{1}{1-\sigma_k}} \tag{4}$$

Multiplying the demand equation (3) by the price paid by U.S. consumers ($p_{ij}^k$) and the number of symmetric varieties ($n_i^k$) of the $k^{\text{th}}$ commodity, yields the total value of imports, symbolically expressed as:

$$V_{ij}^k = c_{ij}^k p_{ij}^k n_i^k \tag{5}$$

Substituting for the demand function (3) and the price paid by U.S. consumers (2) into equation (5), leads to the following expression:

$$V_{ij}^k = n_i^k \left(p_i^k t_{ij}^k\right)^{1-\sigma_k} \frac{E_j^k}{\left(P_j^k\right)^{1-\sigma_k}} \tag{6}$$

Equation (6) represents only the demand side of the gravity equation. The supply side of the equation is derived assuming that total production in the exporting country equals the sum of quantity demanded in all regions (e.g., market clearing condition). For this to occur, the wages and prices for exporter *i* must adjust to equalize supply and demand. The value of total output for exporter *i* ($Y_i^k$) is defined as its total sales to all markets (*j=1..J*), including domestic market in region *i*. Symbolically this can be expressed as:

$$Y_i^k = \sum_{j=1}^{J} V_{ij}^k \tag{7}$$

Substituting equation (6) into equation (7) yields the value of total production in the $i^{th}$ export region:

$$Y_i^k = (n_i^k p_i^k) \sum_{j=1}^{J} \left( \left(t_{ij}^k\right)^{1-\sigma_k} \frac{\left(p_{ij}^k\right)^{-\sigma_k}}{\left(P_j^k\right)^{1-\sigma_k}} \right) E_j^k \tag{8}$$

Rearranging and solving for $(n_i^k p_i^k)$ leads to:

$$\left(n_i^k p_i^k\right) = \frac{Y_i^k E_j^k}{\Omega_i^k} \quad \text{, where} \quad \Omega_i^k = \sum \left( \left(t_{ij}^k\right)^{1-\sigma_k} \frac{\left(p_{ij}^k\right)^{-\sigma_k}}{\left(P_j^k\right)^{1-\sigma_k}} \right) \tag{9}$$

Substituting equation (9) into equation (6):

$$V_{ij}^k = \left(t_{ij}^k\right)^{1-\sigma_k} \left( \frac{Y_i^k E_j^k}{\Omega_i^k \left(P_j^k\right)^{1-\sigma_k}} \right) \tag{10}$$

Using exporter's production of traded commodities ($Y_i^k$), importer's (U.S.) production (see Section 4.2.1) as proxy for total expenditure on traded commodities ($E_j^k$) and distance ($D_{ij}^k$) as proxy for trade cost, equation (10) may be rewritten as the physical gravity equation:

$$V_{ij}^{k} = G\frac{Y_i^k Y_j^k}{\left(D_{ij}^k\right)^{1-\sigma_k}} \quad \text{, where} \quad G = \frac{1}{\Omega_i^k}\frac{1}{\left(P_j^k\right)^{1-\sigma_k}} \qquad (11)$$

Using equation (11), the gravity equation in its most simple form is specified as:

$$V_{ijt} = \beta_0 \frac{Y_{it}^{\beta_1} Y_{jt}^{\beta_2}}{D_{ij}^{\beta_3}} \varepsilon_{ijt} \qquad (12)$$

where

$\beta_0, \beta_1, \beta_2, \beta_3$ are econometrically estimated parameters,

$V_{ij}$ is the trade flow from country (*i*) to country (*j*) in time (*t*),

$Y_i$ and $Y_j$ are the economic sizes of the two countries (*i*) and (*j*) in time (*t*),

$D_{ij}$ is the distance between the two countries (*i*) and (*j*) and

$\varepsilon_{ijt}$ is the error term.

The gravity equation is often estimated using the ordinary least squares (OLS) estimator. Since this estimator assumes equations are linear in the parameters, the gravity equation is often made linear in the parameters by taking the natural logarithm of equation (12):

$$\ln(V_{ijt}) = \beta_0 + \beta_1 \ln(Y_{it}) + \beta_2 \ln(Y_{jt}) + \beta_3 \ln(D_{ij}) + \varepsilon_{ijt} \qquad (13)$$

A simple gravity model specification typically includes two main factors determining bilateral trade flows. Countries' economic sizes, such as Gross Domestic Product (GDP) are often indicators of the "production and absorption" capacities of the trading partners, and bilateral distances are used as a proxy for transportation costs (Baier and Bergstrand, 2001). Baier and Bergstrand (2001) who analyzed the main determinants of the growth in world trade found that economic size (in this case, income growth) explained 67 percent of the growth, and distance (transportation costs) explained 8 percent of the growth. Although gravity equations explain relatively large percent of the variation in bilateral trade flows with just the two aforementioned factors, researchers generally augment the equation with other variables (e.g. FTAs) in hope to better explain trade. In this study the gravity equation is augmented in order to explain the variation in trade flows as a result of NMA as well as other factors, such as phytosanitary requirements.

### 4.2 Specification of the Gravity Model of This Study

This section will discuss the independent variables that will be used in the gravity model and is divided into two sub-sections. The first sub-section presents a common set of independent variables that are used in all specifications of the gravity model. The second sub-section presents alternative specifications to examine the effects of new market access and phytosanitary treatments on U.S. FF&V imports.

#### 4.2.1 Common Independent Variables

Using equation (13) as a starting point, this section will develop the augmented gravity model used in this thesis. Table 4.1 provides a list of all variables, grouped by type (e.g. basic independent variables, trade agreement variables, and trade resistance variables), as well as their definition and expected sign.

Because this analysis is conducted at the commodity level (e.g., at the HS-six, HS-eight, and in some cases HS-ten digit levels), U.S. and exporter production levels are utilized as the measure of exporter's "economic mass" (see equation 12) rather than the traditional measure of Gross Domestic Product (GDP). As shown in equation (11), U.S. production levels are utilized as proxy for U.S. total expenditures for traded commodities because expenditures is a function of production. U.S. expenditure for each commodity represents the product of the quantity consumed and its price. Summing all expenditures across traded commodities yields U.S. total

**Table 4.1 Definition of Gravity Model Specification Variables**

| Variable | Variable Definition | Exp. Sign |
|---|---|---|
| | Dependent Variable | |
| $cvalue_{ikt}$ | Value of U.S. FF&V commodity (*k*) imports from exporter (*i*) in year (*t*), expressed as the customs value excluding tariff and freight costs | |
| | Basic Independent Variables | |
| $lusprod_{jkt}$ | U.S. production of commodity (*k*) in year (*t*), expressed in metric tons | - |
| $lrowprod_{ikt}$ | Exporter (*i*)'s production of commodity (*k*) in year (*t*), expressed in metric tons | + |
| $trend_t$ | Trend variable | + |
| $fruit_t$ | Dummy variable equals to one if imported commodity (*k*) is a fresh fruit, and zero otherwise | + |
| $ler_{it}$ | Exchange rate expressed as the value of one U.S. dollar in terms of foreign currency | + |
| $usrowprice_{ikt}$ | Ratio of U.S. market price and world market price in a year (*t*) of commodity group as identified with the HS-four digit code | + |
| $lshriexp_{ikt}$ | Exporting country (*i*)'s exports of commodity (*k*) in year (*t*) as a share of the total global exports of commodity (*k*) in year (*t*) *100 (in terms of value) | + |
| | Trade Agreement Variables | |
| $nafta\_frt_{ik}$ | Dummy variable equal to one if exporter (*i*) in year (*t*) is Canada or Mexico and imported commodity (*k*) is a fresh fruit, and zero otherwise | + |
| $nafta\_veg_{ik}$ | Dummy variable equal to one if exporter (*i*) in year (*t*) is Canada or Mexico and imported commodity (*k*) is a fresh vegetable, and zero otherwise | + |
| $cafta\_dr_{it}$ | Dummy variable equal to one if exporter (*i*) in year (*t*) is the Dominican Republic, El Salvador, Guatemala, Honduras, or Nicaragua, and zero otherwise | + |
| $fta_{it}$ | Dummy variable equal to one for all other FTAs, and zero otherwise | + |
| | Trade Resistance Variables | |
| $ldist_i$ | Geographical distance between the U.S. and exporting country *(i)*, expressed in kilometers | - |
| $ltarahs_{ikt}$ | Tariff rate of commodity (*k*) imported in year (*t*) from exporter (*i*) | - |
| $treat_{ikt}$ | Dummy variable equal to one if commodity *(k)* imports from exporter *(i)* in year (*t*) are subject to at least one phytosanitary treatment requirement, and zero otherwise. | - |
| $treat\_lshriexp_{ikt}$ | Interaction term between $treat_{ikt}$ and $lshriexp_{ikt}$ | + |
| $mainland_{ikt}$ | Dummy variable equal to one if commodity *(k)* imports from exporter *(i)* in year (*t*) are eligible for shipping to the continental U.S., and zero otherwise | + |
| $nma\_all_{ikt}$ | Dummy variable equal to one if exporter (*i*) gained new market access for commodity (*k*) in year (*t*), and for each additional year (*t*) in which (*i*) retained the market access | +/- |

income or GDP. However, for a specific variety (*k*), commodity level production is likely a better measure of the economic mass of the importing and exporting regions compared to GDP.

Before describing each of the variables, it is important to mention that all continuous independent variables have been expressed in natural logarithm since their ranges are varying. Using a natural logarithmic transformation will compress the distribution and potentially solve the problem of skewed distributions of variables which have very large values. For instance comparing tariff rates and exporter production have skewed distributions and very different ranges which are brought together by transforming these variables into natural logarithm.

The variable $lusprod_{jkt}$, is the natural logarithm of the quantity of annual U.S. production and $lrowprod_{ikt}$, is exporter *i*'s annual production, both expressed in metric tons. Increased U.S. production is expected to reduce the level of U.S. imports, by providing a greater share of U.S. consumption. Conversely, larger exporter production is expected to increase the export supply of that country, and thus make it more likely that the U.S. will import more from that exporter.

The variable $ldist_i$ is the natural logarithm of geographical distance between the U.S. and exporter (*i*), expressed in kilometers. It is expected that countries that are geographically closer to each other will trade more due to lower transportation and logistics costs[27]. For instance, the U.S. is more likely to trade more with Canada or Mexico than with the EU due to proximity, faster delivery, fresher products, lower freight costs etc.

A time trend ($trend_t$) is included in the gravity model to account for the upward trend in the U.S. FF&V imports during the sample period. As a robustness check, alternative specifications use year dummy variables to account for the time fixed effects. Many studies support the inclusion of time fixed effects into gravity models (e.g. Egger and Pfaffermayr, 2003).

[27] See Deardoff (1998) for examples of distance effects on trade flows.

Inclusion of a $fruit_k$ dummy variable allows the intercept of the regression line to vary by commodity sector. The need to account for any level differences between commodity sectors comes with the fact that import flows of fresh fruits and fresh vegetables differ during the sample period. For instance, since U.S. imports of fresh fruits were nearly 50 percent larger than fresh vegetables in 2009, the intercept for the former may be larger than the later. As a robustness check, alternative specifications use commodity dummy variables to allow the intercept to differ by commodities.

To control for changes in price competitiveness between domestic and imported varieties and between imported varieties over time, exchange rates and a measure of the relative price of domestic versus imported varieties are included in the gravity model.[28] The variable $ler_{it}$ is the natural logarithm of the exchange rates between exporter (*i*) and the U.S. expressed in U.S. dollars. Exchange rates are determined by macroeconomic variables such as monetary and fiscal policies, therefore it is likely that the determination of exchange rates is decoupled from the determination of the price of that commodity (*k*), which depends on market forces. Inclusion of exchange rates in the model is important since exporters' competitiveness decreases for all commodities when their currency appreciates. Finally, the ratio of U.S. to world prices, expressed in natural logarithm terms ($lusrowprice_{ikt}$) measures the relative price changes between domestic and imported varieties. It represents the ratio between the U.S. producer's price of commodity (*k*) in year (*t*) and the world price of the same commodity in year (*t*). The U.S. and the world prices are specified to vary by commodity and time. The world price is generated by dividing global export value of commodity (*k*) in time (*t*) with the global export quantity of the same (*k*) in time (*t*). Both, the exchange rates and the price ratio variables are expected to yield a

[28] Bergstrand (1985) was the first to incorporate exchange rates as a proxy for price competitiveness in a gravity model. (Thursby and Thursby, 2987; Mátyás *et al*., 1997; Zarzoz and Lehmann, 2003; Anders and Caswell, 2009) have also included exchanges rates in their analyses.

positive sign. A stronger U.S. dollar attracts imports due to the increased purchasing power of U.S. consumers. For instance when the dollar appreciates against another currency, the goods denominated in that currency become inexpensive. Similarly, higher price ratio (due to higher domestic prices, lower world prices or both) is expected to stimulate U.S. FF&V imports.

The last basic independent variable is $lshriexp_{ikt}$ which is the natural logarithm of exporter (*i*)'s global market share. It is posited that larger exporters, with well established marketing channels and potential economies of scale, may have a competitive advantage over smaller exporters. The variable is computed by dividing exporter (*i*)'s export value of commodity (*k*) in time (*t*) by the total global export value of that commodity in (*t*), then multiplied by 100. A positive relationship is expected between this variable and U.S. FF&V imports.

The second group of variables is trade agreements. There is evidence in the existing literature that RTAs increase agricultural trade between members. Kepaptsoglou *et al*. (2010) reviewed last ten years of empirical studies exploiting the gravity model and found that most of the papers analyzing trade policies were concerned with the effects of trade agreements. Moreover, Grant and Lambert (2008) found that trade agreements have a positive and significant effect on agricultural trade. Thus, this study incorporates four dummies to account for the effects of NAFTA, CAFTA-DR and other FTAs on U.S. FF&V imports. NAFTA, a regional trade agreement between the U.S., Canada and Mexico has been disaggregated into two dummy variables: one denoting the effect of NAFTA for fresh vegetables ($nafta\_veg_{ik}$) and the other denoting NAFTA fresh fruit trade ($nafta\_frt_{ik}$) since the data indicates larger import flows of the former than the later. CAFTA-DR trade agreement (U.S., Dominican Republic, El Salvador, Guatemala, Honduras and Nicaragua), represented with the $cafta\_dr_{it}$ variable, is also expected to positively affect U.S. FF&V imports, especially fresh fruit imports since the member countries of this agreement are the main sources for U.S. banana imports. Finally, a separate dummy variable, $fta_{ik}$, is included to account for all other trade agreements between the U.S. and the exporters in the data sample, as indicated by the WTO[29]. For instance, this dummy variable equals unity for Australia, Chile, Israel, Morocco and Singapore.

The last group of independent variables includes factors which account for the trade resistance between the U.S. and exporter (*i*). Trade resistance includes different barriers to trade, such as tariff barriers and NTBs. The first variable used in this study to account for trade costs is tariffs. Oguledo and Macphee (1994) noticed that most of the previous studies they reviewed did not include tariff rates as determinants of trade flows. However, with the Uruguay Round efforts to reduce and eliminate tariffs, this variable caught the attention of many researchers who assessed the effects of tariff rate changes on trade flows. Kapaptsoglou *et al.* (2010) list seven studies that incorporate tariff rates into the gravity equation and four of those considered tariffs explicitly. Baier and Bergstrand (1999) provide empirical evidence that 25 percent of the world trade growth is a result of tariff rate reductions. In light of this literature, a tariff variable, $ltarahs_{ikt}$ is included the gravity model of this study. This variable is the natural logarithm of the effectively applied tariffs (AHS) which returns preferential tariffs if any, otherwise takes the most-favored-nation tariff. The expected sign is negative since a higher tariff rate discourages trade.

An important non-tariff barrier to trade in fresh fruits and vegetables is the requirement of phytosanitary treatments by the importing country. To capture this effect, a dummy variable $treat_{ikt}$, is included in this study to represents phytosanitary treatments applied to country (*i*)'s exports of commodity (*k*) in time (*t*). Alternative specification disaggregates the generic

[29] All other trade agreements have been aggregated together because low number of observations precludes the possibility of identifying the effects of each agreement separately.

treatment variable in order to account for the differences between specific treatment types. Multiple studies have analyzed the effects of these NTBs on trade flows (e.g. Disdier *et al*., 2007) and most of them found trade reducing effects. Following recent empirical studies, the expected sign of the generic phytosanitary treatment variable is negative. However, some studies (e.g. Anders and Caswell, 2009) suggest that globally large and developed exporter countries may have the capacity to meet phytosanitary treatment requirements. Therefore the trade flow effects of phytosanitary treatments may not be negative. Following the findings of Anders and Caswell (2009) and Karov *et al*. (2009), this study includes an interaction term between treatment and global export market share, $treat\_lshriexp_{ikt}$, which allows for joint effects of phytosanitary treatments and exporter size on U.S. FF&V import flows. The sign of this variable is expected to be positive due to the potential for globally large exporters to reach this level of safety easier than other smaller exporters because of their financial strength, market power and resource availability (e.g. technology, technical labor).

Along the same lines, the gravity model in this study accounts for another SPS measure pertaining to geographical restriction on destination. The variable $mainland_{ikt}$, takes in consideration the ability of exporter ($i$) to deliver commodity ($k$) in time ($t$) through ports that are part of the mainland U.S., i.e. the 48 U.S. contiguous states. Majority of the U.S. FF&V import flows enter through the mainland U.S., therefore this coefficient is expected to be positive and significant.

### 4.2.2 Modeling the Effects of New Market Access and Phytosanitary Treatments

A trade resistance factor that may positively affect trade flows is NMA ($nma\_all_{ikt}$) which is the independent variable of interest in this study. This dummy variable is used to control for the differences in trade flows from new exporters (since 1997) and established exporters (before 1996). It equals unity if exporter (*i*) gained NMA to export commodity (*k*) to the U.S. in year (*t*) and for each additional year it retained an import permit. A negative relationship is expected between $nma\_all_{ikt}$ and U.S. FF&V imports because new suppliers need time to set up marketing channels and also they may encounter large sunk costs in setting up exporting facilities and dealing with logistics.

However, as mentioned in the thesis objectives section, there is a need to model the effects of NMA not only as an intercept shifter, but also to account for other factors that may jointly affect U.S. FF&V imports. This section explains the different model specifications used to explore ways in which NMA instances may affect U.S. FF&V imports. Besides the generic impact on imports, this study hypothesizes that NMA instances may have lagged effects or may vary with the exporter global market power, commodity sectors (fresh fruits; fresh vegetables) and phytosanitary treatment requirements. Keeping in mind the thesis objectives provided in Chapter 1, the effects of NMA are modeled using six main econometric specifications organized as cases (C1-C6). All specifications stem out from the generic model (C1), where NMA is modeled simply as a dummy variable, and then each additional specification analyze these effects in greater details. The model specifications address the following empirical questions.

*Case 1 and Case 2:* do countries that obtain new market access export less than existing suppliers and will that effect diminish over time?

*Case 3:* does the level of exports by countries that gain new market access vary with the size of the exporter measured by its global export market share?

*Case 4*: does the difference in exports to the U.S. between new and existing suppliers vary by commodity sector, while accounting for the size of the exporter?

*Case 5 and Case 6*: does the level of exports by countries that gain new market access vary with SPS treatment requirements, while allowing for the effects of new market access to vary with time, size of exporter, and commodity sector?

Each of these models is econometrically estimated to provide empirical evidence for the direction and magnitude of the generic as well as of the potential varying effects of NMA influenced by changes in related factors. To estimate these effects, six gravity equations, based on cases one through six (C1-C6), are specified. The marginal effects of NMA have been computed by assigning values of interest (e.g. means) to corresponding factors in each of the six gravity equations.

For Case 1 (C1), the gravity equation is specified in equations (14) and (15):

$$V_{ikt} = A + \lambda_1 nma\_all_{ikt} + \varepsilon_{ikt} \tag{14}$$

where *A* is the set of common independent variables (Table 4.1) defined as:

$$\begin{aligned} A = {} & \beta_0 + \beta_1 ldist_i + \beta_2 lusprod_{jkt} + \beta_3 lrowprod_{ikt} + \beta_4 trend_t + \beta_5 fruit_k + \beta_6 ler_{it} + \\ & + \beta_7 usrowprice_{ikt} + \beta_8 lshriexp_{ikt} + \gamma_1 nafta\_frt_{ikt} + \gamma_2 nafta\_veg_{it} + \gamma_3 cafta\_dr_{it} + \\ & + \gamma_{41} fta_{it} + \delta_1 tariff_{ikt} + \delta_2 treat_{ikt} + \delta_3 treat\_lshri\exp_{ikt} + \delta_4 mainland_{ikt} \end{aligned} \tag{15}$$

The hypothesis that *overall, NMA instances have no effect on U.S. FF&V imports* is tested by determining whether $\lambda_1$ is statistically different than zero.

In Case two (C2), the effect of new market access is allowed to vary over time. As discussed in Chapter 2, new exporters may not be able to capture large U.S. market share right after they have been granted an import permit due to various reasons (e.g. time needed to build export marketing channels). To incorporate the potential for lagged effects in the gravity model in equation (14), two new dummy variables are included: NMA lagged one (*nma_1*) and two periods (*nma_2*).[30] The gravity model for Case 2 is:

$$V_{ikt} = A + \lambda_1 nma\_all_{ikt} + \sum_{v=1}^{2} \delta_v nma_{ikt}^{v} + \varepsilon_{ikt} \quad (16)$$

where *v* are the first and second one-year lags of the NMA variable. If the difference in exports between new and existing suppliers is constant over time, then $\delta_1 = \delta_2 = 0$.

If a country that gains new market access is a relatively large exporter of the given commodity, then exporters from that country may be able to penetrate the U.S. market more easily that other new entrants, due to established export supply channels in that country and better knowledge of export requirements and procedures. To allow for the effect of new market access on export to vary by size of the new entrant, an interaction term between the new market access dummy variable and the size of the exporter, measured by its global market share, is added to the gravity model in equation (16):

$$V_{ikt} = A + \lambda_1 nma\_all_{ikt} + \sum_{v=1}^{2} \delta_v nma_{ikt}^{v} + \varphi_1 nma\_lshriexp_{ikt} + \varepsilon_{ikt} \quad (17)$$

If the estimated coefficient $\varphi_1$ is not statistically different than zero, then the effect of new market access on U.S. imports does not vary by size of the entrant.

In the first three cases, the effect of new market access on U.S. imports has been assumed to be the same for fruits and vegetables. Case four addresses the fact that the effects of NMA on imports may vary across commodity sectors. This case tests the hypothesis that *taking in consideration the size of their global market share, new exporters of fresh fruits on average export equally as new exporters of fresh vegetables* (C4: $\gamma_1 = \gamma_2$). As discussed in Chapter 2, the U.S. has granted almost double the number of import permits for fresh fruits (46) than for fresh

[30] Alternative specification will consider a higher-order lag structure. A potential drawback of using a higher-order lag structure is the short sample period of 13 years.

vegetables (21). Consequently, there are almost twice as many NMA instances[31] of fresh fruits (299) compared with fresh vegetables (154) which may potentially lead to different intercepts between sectors. Case four will relax this assumption by allowing the average effect of new market access, $\lambda_1$, to vary by commodity sector by incorporating an interaction term between the independent variables *nma_all* and *fruit* into the gravity equation listed in equation (17). The following equation is estimated:

$$V_{ikt} = A + \lambda_1 nma\_all_{ikt} + \sum_{v=1}^{2} \delta_v nma_{ikt}^{v} + \varphi_1 nma\_lshriexp_{ikt} + \gamma_1 nma\_fruit_{ikt} + \varepsilon_{ikt} \qquad (18)$$

If the estimated coefficient $\gamma_1$ is not statistically different than zero, then the effect of new market access does not vary by sector.

The final gravity model specifications incorporate the potential effects of phytosanitary treatments. As discussed in Chapter 2, about 39 percent of all observations with new market access are subject to at least one phytosanitary treatment. Because the SPS treatment requirements may be costly, countries that gain new market access that are required to perform SPS treatments may export less to the U.S. than countries that gain new market access that are not required to perform SPS treatments. To test this hypothesis, the gravity model for Case five adds an interaction between *nma_all* and *treat* to the gravity model in equation (18):

$$V_{ikt} = A + \lambda_1 nma\_all_{ikt} + \sum_{v=1}^{2} \delta_v nma_{ikt}^{v} + \varphi_1 nma\_lshriexp_{ikt} + \gamma_1 nma\_fruit_{ikt} +$$

$$+ \mu_1 nma\_treat_{ikt} + \varepsilon_{ikt} \qquad (19)$$

If phytosanitary treatment requirements do not affect exports from new entrants, then the estimated coefficient $\mu_1$ will not be statistically different than zero.

[31] Exporter/commodity/year is considered a single instance (observation).

Because some SPS treatments may be more costly than others, for example the cost of fumigating with methyl bromide may be different than the cost of cold treatment, the effects of a SPS treatment on the exports of countries with new market access may differ by treatment type. To test this possibility, the variable *nma_all* is interacted with three SPS treatments and included in the gravity model in equation (19). The three SPS treatments, methyl bromide fumigation (MBF), water treatment (WTR) and cold treatment (CLD), are the only specific treatment types with sufficient observations to identify its effect on exports of new entrants. Case six tests the null hypothesis that *the way in which NMA affect U.S. FF&V imports does not depend on the specific treatment type* (C6: $\eta_1 = \eta_2 = \eta_3 = \eta_4$). Case six estimates the following equation:

$$V_{ikt} = A + \lambda_1 nma\_all_{ikt} + \sum_{v=1}^{2} \delta_v nma_{ikt}^{v} + \varphi_1 nma\_lshriexp_{ikt} + \gamma_1 nma\_fruit_{ikt} +$$

$$+ \sum_{\psi=1}^{4} \eta_\psi nma\_treat_{ikt}^{\psi} + \varepsilon_{ikt} \qquad (20)$$

where $\psi$ is one of the three phytosanitary treatments listed above.

### 4.3 Econometric Estimation of the Gravity Equation

This study estimates an augmented gravity equation using the PPML estimator proposed by Santos Silva and Tenreyro (2006). This section provides discussion about the preferences for using the PPML over other estimation techniques (e.g. OLS, non-linear least squares (NLLS), Tobit, Heckman).

As a result of a great popularity and extensive use of the gravity equation, the question of the ‘correct’ estimation technique for this equation has arisen. Raimondi and Olper (2009) analyzed the estimator selection and found that trade substitution elasticities are not robust across different estimation techniques due to problems with heteroskedasticity, presence of zero bilateral trade flows and limited-dependent variable issues.

The gravity equation is most frequently estimated in a log-linear form using the OLS estimator. However, logarithmic transformations of variables with zeros produce undefined values which results in sample truncation. Hurd (1979) pointed out that such sample truncation yields severe bias in the estimates under the presence of heteroskedasticity. Flowerdew and Aitkin (1982) provide an in-depth discussion of problems with the log-normal gravity model. Some studies (e.g. Disdier *et al*., 2007; Linders and de Groot, 2006) have dealt with the zero issue by taking the natural logarithm of a small positive coefficient plus the value of the dependent variable (e.g. $ln(0.0001+V_{ij})$ or $ln(1+V_{ij})$). However, this approach has been criticized for the lack of its theoretical evidence and deceptive estimation results due to downward bias (Linders and de Groot, 2006; Westerlund and Wilhelmsson, 2006).

Another way to avoid the issue of taking the natural logarithm of zero flows is to estimate the non-linear form of the gravity equation (equation 13) using the NLLS estimator. However, as described by Shepherd (2008), the NLLS estimator allocates greater weight to larger-value observations, in this case large-value pairs of U.S. imports from country (*i*). The advantage of the PPML estimator comes with the fact that it assigns equal weight to all observations in the sample.

The efficiency of the log-linearized models (e.g. OLS) depends on the assumption that the error terms have the same variance (homoskedasticity) for all pairs of bilateral flows. Given there are large number of cases with small or zero flows, logarithmic transformation will lead to large differences in the log-linearized estimation coefficients (Flowerdew and Aitkin, 1982). Under the Jensen's inequality ($E(\ln y) \neq \ln E(y)$), presence of heteroskedasticity in log-linearized models (e.g. OLS) affects the variances of the estimates and requires those to be 'corrected' in order to conduct accurate hypothesis testing (Santos Silva and Tenreyro, 2006).

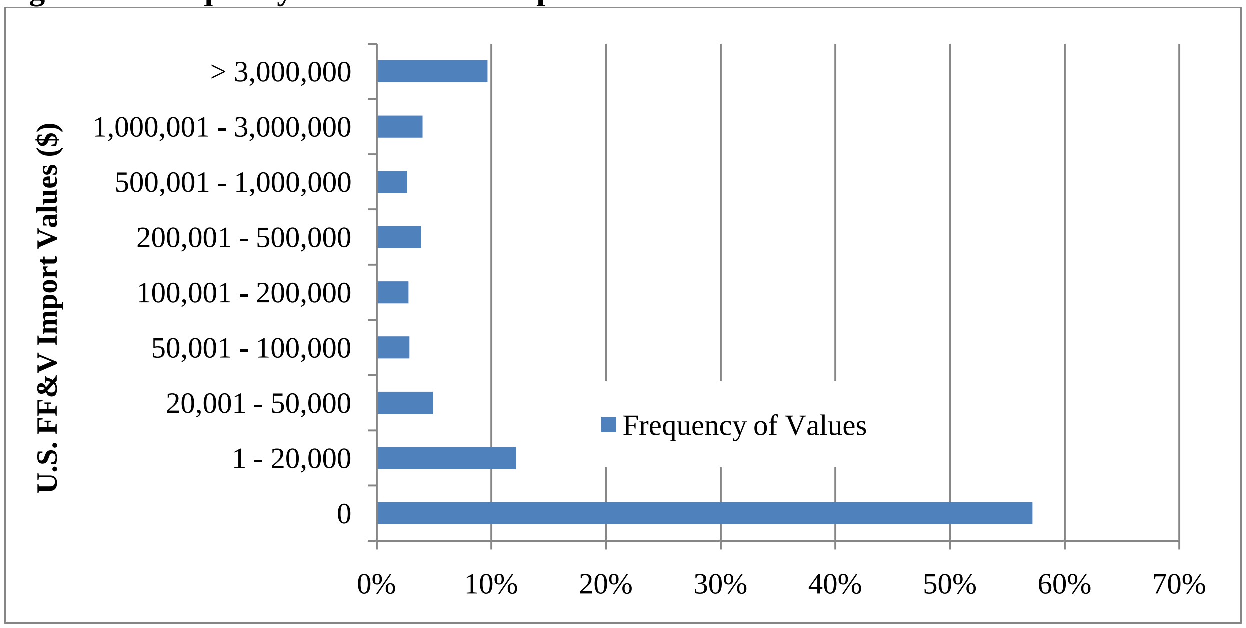
The nature of the dependent variable of this study, U.S. FF&V import flows, requires special attention in selection of the estimation technique due to potential problems with sample selection bias and heteroskedasticity. This non-negative variable contains a large number of zero values, which is common in product level analyses. In other words, not every country exports and exports all 47 commodities, which creates an array of zero bilateral flows. If the observed zero trade flow is due to high trade costs, high tariffs or existing non-tariff barriers (such as SPS treatments), then these observations contain valuable information and it should not be excluded from the sample (Martin and Pham, 2008; Helpman *et al*., 2008). As illustrated in Figure 4.1 below, the dataset of this study contains 57.2 percent of the sample in this study has zero import flows and 69.3 percent import flows of $20,000 or less. In addition, the histogram shows that the data is strongly skewed towards low or zero import values which suggest OLS estimation that excludes these values may not provide unbiased estimates.

Because the dependent variable in this study is left-censored, the Tobit model may be a suitable estimator for the gravity equation. This estimator is a good candidate since the natural logarithm of zero is undefined and this estimator has the capacity to estimate the log-linearized gravity equation (e.g. Rose, 2004). In light of this property of limited dependent variable and high frequency of zero import flows, Martin and Pham (2008) demonstrated that the standard threshold-Tobit estimator[32] performs better than the PPML estimator, providing the issue of heteroskedasticity is properly addressed. However the Tobit model requires correct specification

[32] The threshold-Tobit model is a special case of the Heckman model. While not the case in the Heckman model, the Tobit model requires that the latent variable is distinguished from the realized variable.

of the error variance, which creates strong preference for using the PPML estimator since it is robust to heteroskedasticity of an unknown form.

**Figure 4.1 Frequency of U.S. FF&V Import Values**




Source: (USITC, 2008b)

Finally, in order to deal with the sample selection bias due to zero trade flows, in particular when there is a large fraction of zero values, researchers have suggested the two-stage Heckman (1979) procedure (Linders and de Groot, 2006; Martin and Pham, 2008). The Heckman model estimates a Probit selection equation that provides predictions of whether a trade flow will be zero or not and then estimates a gravity equation using only the positive trade flows and a sample selection variable, such as the inverse-Mills ratio, obtained from the estimates of the Probit equation. Although this approach is less frequently used to deal with zero trade flows (e.g. Bikker and De Vos, 1992), the Heckman sample selection model performs well if there are suitable dependent variables that determine the absence of trade but are unrelated to trade flows (e.g., exclusion restrictions). However, Burger *et al.* (2009) argue that such exclusion restrictions are almost impossible to find and offer better estimation techniques: zero-inflated

Poisson and negative-binomial models, both of which are very similar to the Heckman selection procedure and do not require exclusion restrictions.

Studies by Martinez-Zarzoso, Nowak-Lehmann and Vollmer (2007) and Martin and Pham (2008) criticized the PPML estimator (Santos Silva and Tenreyro (2006)) for its poor performance when zero trade flows are frequent in the sample. Santos Silva and Tenreyro (2009) reviewed this issue and provided simulation evidence that the PPML is generally well behaved providing the data is generated by CES models. In addition, the aforementioned studies cannot provide any information for the performance of the PPML estimator due to the fact that their data is not generated by CES models (Santos Silva and Tenreyro, 2009). In the light of this argument, PPML estimation of the gravity equation of this study is the preferred method since the underlying gravity model is defined on a CES utility function.

### 4.4 Definition of the PPML Estimator

As mentioned before this study uses the PPML estimation technique proposed by Santos Silva and Tenreyro (2006) because it is capable of dealing with the "zeros" issue and it is robust to heteroskedasticity of an unknown form. This section defines the PPML estimator.

Since trade flows are non-negative, the functional relationship between the dependent variable and the independent variables must always yield positive predicted values. One functional form that meets this requirement is the exponential function where:

$$E(y_i|x_i) = \exp(\beta_0 + \beta_1 x_1 + ...\beta_i x_i)\text{, where } x_i = 1,2,3\ldots I \qquad (21)$$

where $y_i$ is the dependent variable (e.g. U.S. FF&V imports), $x_i$ represents all of the explanatory variables (e.g. U.S. production) in the regression and $\beta_i$ are econometrically estimable parameters.

Following Santos Silva and Tenreyro (2006, 2009), the Poisson regression model is defined as the following:

$$P(y_i = h|x_i) = \frac{\exp\left[-\exp(\beta_0 + \beta_1 x_1 + \beta_i x_i)\right]\left[\exp(\beta_0 + \beta_1 x_1 + \beta_i x_i)\right]^h}{h!}\text{, where h = 0,1,2...} \quad (22)$$

The Poisson distribution specified above yields the probability that $y_i$ equals the value of $h$ for a given set of explanatory variables $x_i$. It assumes equidispersion, meaning if $y_i$ has a Poisson-like distribution, then the conditional variance of the dependent variable equals the conditional mean[33]. All of the $\beta_i$'s can be estimated by maximizing the log-likelihood function specified as the following:

$$\ln L(\beta_i) = \sum_{i=1}^{n} l_i(\beta_i) = \sum_{i=1}^{n}\left[-\exp(\beta_i x_i + (\beta_i x_i) y_i - \ln(y_i!)\right] \quad (23)$$

After dropping the term ln ($y_i$!) because it does not depend on $\beta_i$, the log-likelihood function can be specified as the following:

$$\ln L(\beta_i) = \sum_{i=1}^{n} l_i(\beta_i) = \sum_{i=1}^{n}\left[-\exp(\beta_i x_i + (\beta_i x_i) y_i\right] \quad (24)$$

Under the assumption that the conditional mean equals the conditional variance of the dependent variable, $\beta_i$ can be estimated by solving the following set of first order conditions:

$$\sum_{i=1}^{n}\left[y_i - \exp(\beta_i x_i)\right]x_i = 0 \quad (25)$$

Equation (25) represents the PPML estimator used to estimate the gravity equation of this study. In order for this estimator to be consistent all it needs is the correct specification of the conditional mean:

$$E\left[y_i|x_i\right] = \exp(\beta_i x_i) \quad (26)$$

[33] The negative binomial model relaxes this restriction and allows for over- or under-dispersion in the conditional variance and mean (Burger *et al*., 2009)

The data does not have to be Poisson distributed and the dependent variable does not have to be an integer in order for the PPML estimator based on the log-likelihood function (equation 24) to be consistent. This property of the PPML estimator allows the dependent variable to enter the regression in levels form. Therefore the estimated parameters can be interpreted as elasticities.

### 4.5 PPML Model Specification

This study estimates various specifications of the gravity model in order to assess the impacts of U.S. FF&V NMA instances on import flows. Applying the PPML approach by Santos Silva and Tenreyro (2006), the model specification takes the following basic form:

$$V_{ikt} = \exp(A) + \varepsilon_{ikt} \tag{27}$$

where $V_{ikt}$ represents U.S. FF&V imports and it is a non-negative integer, $A$ is a vector of independent variables defined in equation (15), $\beta$ is a vector of econometrically estimable parameters and $\varepsilon_{ikt}$ is the error term which has an expected value of zero, given any value of the explanatory variable.

In particular, the augmented gravity model estimated in this study is specified in the following generic form:

$$\begin{aligned} cvalue_{ikt} = \exp(&\beta_0 + \beta_1 ldist_i + \beta_2 lusprod_{jkt} + \beta_3 lrowprod_{ikt} + \beta_4 trend_t + \beta_5 fruit_k + \beta_6 ler_{it} + \\ &+ \beta_7 usrowprice_{ikt} + \beta_8 lshri\exp_{ikt} + \gamma_1 nafta\_frt_{ikt} + \gamma_2 nafta\_veg_{it} + \gamma_3 cafta\_dr_{it} + \\ &+ \gamma_{41} fta_{it} + \delta_1 tariff_{ikt} + \delta_2 treat_{ikt} + \delta_3 treat\_lshri\exp_{ikt} + \delta_4 mainland_{ikt} + \\ &+ \delta_5 nma\_all_{ikt}) + \varepsilon_{ikt} \end{aligned} \tag{28}$$

## Chapter 5: Data and Methodology

The purpose of this study is to empirically assess the effects of NMA on U.S. FF&V imports. This study updates the data used in *Karov et al*. (2009) by adding an additional year of data. The dataset spans 13 years (1996-2008), and thus the data reflects U.S. imports of fresh fruits and vegetables after the completion of Uruguay Round of trade negotiations and the implementation of the SPS Agreement. The data are organized as a panel with an observation consisting of U.S. bilateral imports of commodity ($k$) from exporter ($i$) and in year ($t$).

Information on when a new import permit is issued is obtained from two main sources: the USDA/APHIS *Fresh Fruits and Vegetables Import Manual*[34] and the Federal Register. The import manual is updated after a regulatory change, including the issuing of a new import permit. This allows the issuance of a new import permit to be identified by comparing the list of approved commodities for country across two consecutive issues. Because of the frequent updating and the use of annual trade data, the last issue[35] of the import manual is used to make the cross year comparisons. For example, the list of approved commodities from Mexico in the last issue of 2006 (September) was compared with the one for Mexico in the last issue of 2007 (November). Commodities that appear in the list of the 2007 issue and are not included in the same list of the 2006 issue are regarded as NMA instances.

In order to verify the accuracy of the APHIS import manuals, the Federal Register (U.S. Government, 2011d) and the U.S. Code of Federal Regulations (U.S. Government, 2011a) were used as secondary data sources. As noted in Figure 2.1, any change in import regulations that result in the issuance of a new import permit must be published in the Federal Register. These

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[34] Copies of all the USDA/APHIS *Fresh Fruits and Vegetables Import Manual* were obtained from the USDA/APHIS Manuals Unit Branch, Fredrick, MD.

[35] The last issue of the *Fresh Fruits and Vegetables Import Manual* is not necessarily published in the month of December, rather it is the latest publication in a particular year. For example, the last issue of the manual for 2006 is published in the month of September.

sources also provide information on amendments of FF&V import regulations and NMA cases, but the changes are not as easy to track as using the manuals due to their release form as notices. The drawbacks of using this data source are that it is difficult to search for regulatory changes specifically related to the imports of fresh fruits and vegetables and the time difference between the notice of new regulations and their effective date.

### 5.1 Sample Countries

Following Karov *et al*., (2009), countries that exported at least $100,000 of at least one HS 6-digit fresh fruit or vegetable product category to the U.S. for at least three years between 1996 and 2008 were included in the sample. This selection process eliminates countries that infrequently export small values of fresh fruits and vegetables. Because the economic reasons for infrequently exporting small values of product are varied, including these countries, would likely increase the variance of the estimated model parameters unnecessarily. Serbia and Montenegro, Belgium and Luxembourg and South Africa and the South African Customs Union are treated as single countries because trade data for each individual country/region are not available for the entire sample period. Following this selection process, total of 89 countries are chosen to be included in the data sample. The list of these 89 countries is provided in Table 5.1.

### 5.2 Sample Commodities

The fresh fruit and vegetable commodities in the sample are defined to correspond to the commodity identifiers in the APHIS import manual and their six, eight, or ten-digit HS category. This provides a link between import permits and phytosanitary measures listed in the import manual by commodity and trade data on U.S. imports of fresh fruits and vegetables. Because the

**Table 5.1 Sample Countries**

| # | Country | ISO3 | # | Country | ISO3 | # | Country | ISO3 |
|---|---|---|---|---|---|---|---|---|
| 1 | Afghanistan | AFG | 31 | Ghana | GHA | 61 | Peru | PER |
| 2 | Argentina | ARG | 32 | Greece | GRC | 62 | Philippines | PHL |
| 3 | Australia | AUS | 33 | Grenada Is | GRD | 63 | Poland | POL |
| 4 | Bahamas | BHS | 34 | Guatemala | GTM | 64 | Portugal | PRT |
| 5 | Bangladesh | BGD | 35 | Haiti | HTI | 65 | Romania | ROU |
| 6 | Belgium | BEL | 36 | Honduras | HND | 66 | Russia | RUS |
| 7 | Belize | BLZ | 37 | Hong Kong | HKG | 67 | Saudi Arabia | SAU |
| 8 | Bolivia | BOL | 38 | Hungary | HUN | 68 | Serbia/Montenegro | SCG |
| 9 | Bosnia-Hercegov. | BIH | 39 | India | IND | 69 | Singapore | SGP |
| 10 | Brazil | BRA | 40 | Indonesia | IDN | 70 | South Africa | ZAF |
| 11 | Bulgaria | BGR | 41 | Iran | IRN | 71 | Spain | ESP |
| 12 | Cambodia | KHM | 42 | Ireland | IRL | 72 | Sri Lanka | LKA |
| 13 | Cameroon | CMR | 43 | Israel | ISR | 73 | St Lucia Is | LCA |
| 14 | Canada | CAN | 44 | Italy | ITA | 74 | St Vinc. & Gren. | VCT |
| 15 | Chile | CHL | 45 | Jamaica | JAM | 75 | Sweden | SWE |
| 16 | China | CHN | 46 | Japan | JPN | 76 | Switzerland | CHE |
| 17 | Colombia | COL | 47 | Korea | KOR | 77 | Syria | SYR |
| 18 | Costa Rica | CRI | 48 | Lebanon | LBN | 78 | Taiwan | TWN |
| 19 | Cote d`Ivoire | CIV | 49 | Macedonia | MKD | 79 | Tanzania | TZA |
| 20 | Croatia | HRV | 50 | Madagascar | MDG | 80 | Thailand | THA |
| 21 | Denmark | DNK | 51 | Malaysia | MYS | 81 | Tonga | TON |
| 22 | Dominican Rep. | DOM | 52 | Mexico | MEX | 82 | Trin. & Tobago | TTO |
| 23 | Ecuador | ECU | 53 | Morocco | MAR | 83 | Turkey | TUR |
| 24 | Egypt | EGY | 54 | Mozambique | MOZ | 84 | United Arab Em. | ARE |
| 25 | El Salvador | SLV | 55 | Netherlands | NLD | 85 | United Kingdom | GBR |
| 26 | Estonia | EST | 56 | New Zealand | NZL | 86 | Uruguay | URY |
| 27 | Ethiopia | ETH | 57 | Nicaragua | NIC | 87 | Venezuela | VEN |
| 28 | Fiji | FJI | 58 | Nigeria | NGA | 88 | Vietnam | VNM |
| 29 | France | FRA | 59 | Pakistan | PAK | 89 | Zimbabwe | ZWE |
| 30 | Germany | DEU | 60 | Panama | PAN | | | |

Source: (Karov, 2009)

focus of this study is on fresh fruits and vegetables, all processed, dried, or frozen products are excluded. As shown in Table 5.2, most commodities are defined as the HS six-digit level, such as apples and cucumbers. For products such as lemons and limes, which are combined at the HS 6-digit level, the appropriate HS eight or ten-digit codes are utilized. All fresh fruits and vegetables that are classified in the “not elsewhere specified”, or nes, categories in HS chapters 07 and 08 are excluded from the sample due to the large degree of product heterogeneity in those “nes” categories. Finally, commodities where data on other variables in the gravity model could not be obtained are also excluded. For example, no production data for celery was available. Overall, there are 24 fresh fruit and 23 fresh vegetable commodities in the sample.

### 5.3 Data Sources and Independent Variables

Data for the dependent variable, annual value of U.S. imports, is obtained from the U.S. International Trade Commission (USITC, 2008b). Data on other relevant independent variables is collected in order to explain the variation in the dependent variable: distance (km), U.S. production (mt), exporter production (mt), FTAs (NAFTA, CAFTA-DR), exchange rates, exporter’s global market share (%), U.S.-World Price Ratio (ratio), tariff rates (%) and regulatory APHIS variables (SPS Treatment, NMA, Mainland). The explanatory variables come from various sources as described here below. The distance between the U.S. and each exporting country is obtained from the Centre d'Etudes Prospectives et d'Informations Internationales (CEPII) and measures the distances between capitols or “economic centers” of countries. Values of annual FF&V production of both, U.S. and exporting countries is obtained primarily from the Food and Agriculture Organization (FAO) of the United Nation (FAO, 2009).

**Table 5.2 Commodities Definition by Commodity Sector and HS Code**

| # | Commodity | HS Code |
|---|---|---|
| | Fresh Fruits | |
| 1 | Apples | 80810 |
| 2 | Apricots | 80910 |
| 3 | Avocados | 80440 |
| 4 | Bananas | 8030020 |
| 5 | Cherries | 80920 |
| 6 | Cranberries & Blueberries | 81040 |
| 7 | Currants | 81030 |
| 8 | Grapefruit | 80540 |
| 9 | Grapes | 80610 |
| 10 | Kiwifruit | 81050 |
| 11 | Lemons | 8053020+ 8055020 |
| 12 | Limes | 8053040 + 8055030 + 8055040 |
| 13 | Mandarins & Clementines | 80520 |
| 14 | Mangoes | 8045040+8045060 |
| 15 | Melon | 80719 |
| 16 | Oranges | 80510 |
| 17 | Papayas | 80720 |
| 18 | Peaches & Nectarines | 80930 |
| 19 | Pears & Quinces | 80820 |
| 20 | Pineapples | 80430 |
| 21 | Plums & Sloes | 80940 |
| 22 | Raspberries & Blackberries | 81020 |
| 23 | Strawberries | 81010 |
| 24 | Watermelons | 80711 |
| | Fresh Vegetables | |
| 25 | Asparagus | 70920 |
| 26 | Broccoli | 704904020 |
| 27 | Brussels Sprouts | 70420 |
| 28 | Cabbage | 7049020 |
| 29 | Carrots | 7061005+7061010+7061020 |
| 30 | Cauliflower | 70410 |
| 31 | Cucumbers | 70700 |
| 32 | Eggplants | 70930 |
| 33 | Fresh Beans | 7082090 |
| 34 | Garlic | 70320 |
| 35 | Globe Artichoke | 70910+7099065 |
| 36 | Head Lettuce | 70511 |
| 37 | Jicamas, Pumpkins, Breadfruit | 7099005 |

**Table 5.2 Continued**

| # | Commodity | HS Code |
|---|---|---|
| 38 | Leaf Lettuce | 70519 |
| 39 | Leeks | 70390 |
| 40 | Mushrooms And Truffles | 70951 + 70959 + 70952 |
| 41 | Okra | 7099014 |
| 42 | Onions | 70310 |
| 43 | Peppers | 70960 |
| 44 | Potatoes | 70190 |
| 45 | Spinach | 70970 |
| 46 | Squash | 7099020 |
| 47 | Tomatoes | 70200 |

Source: (Karov, 2009)

The FAO production data were supplemented with data from the Economic Research Service (ERS) of the USDA when available (ERS, 2011). Because the commodity classifications in the FAO data are not always as disaggregate as the commodity definitions used in this thesis, there are several instances where the more aggregate FAO data is applied to two commodities: Brussels sprouts and cabbage, cauliflower and broccoli, head lettuce and leaf lettuce, lemons and limes, and jicamas, pumpkins, breadfruit and squash. Data for the U.S. producer's price, which is used in the U.S.-World Price ratio, is also collected from FAO. Data for the world price was computed using COMTRADE's reported global import value and quantity of a commodity.

Data on free trade and regional trade agreements, FTA, NAFTA and CAFTA–DR, are obtained from the WTO (WTO, 2009). The exporter's global market share was computed utilizing data for exporting country's global exports and world exports of a commodity. Both of these data sets are obtained from UN Comtrade (UN, 2009). Exchange rates are obtained from the ERS (USDA, ERS, 2009). Tariff rates (effectively applied tariffs - AHS tariffs) were extracted from the World Bank's website using the World Integrated Trade Solution (WITS) software (The World Bank, WITS, 2011). Finally, data on SPS treatments, mainland and NMA is coded in the database using the APHIS *Fresh Fruit and Vegetable Import Manual* (USDA, APHIS, 2011g).

### 5.4 Sample Size and Summary Statistics

A balanced panel with 89 countries, 47 products, and 13 years would contain 54,379 observations. However, many of these observations have zero exports to the U.S. either because the country is not eligible to export the given commodity to the U.S. or because that country does not produce that commodity (e.g., Canada does not produce citrus fruits). Because these observed zero trade-flows are not the result of high trade costs, due to distance or tariffs, or to the imposition of SPS treatment requirements, these observations are excluded from the sample. Thus, only observations for commodity/exporter pairs that are identified as being eligible to export to the U.S. in the *Fresh Fruit and Vegetable Import Manual* and those with positive production are included in the sample. This leaves a sample size of 7,129 observations, after adjustment for observations with missing values for other independent variables. Finally, because the gravity models for Cases 2 through 6 use a two-period lag of the new market access binary variable *nma_all*, this leads to a loss of 1,047 observations. Appendix D provides a more detailed discussion of the sample size for the Case 1 gravity model.

The summary statistics for Case 1 are not substantially different than for Cases 2 through 6 and thus Table 5.3 provides summary statistics for the sample used in Cases 2 through 6. In 2008, the top three fresh vegetable import flows by value were tomatoes ($1.14 billion), peppers ($566.5 million) and cucumbers & gherkins ($247.9 million). For the same year, other important vegetable commodities were squash ($201.1 million), onions ($185.5 million), potatoes ($155 million) and asparagus ($153 million). The top sources of fresh vegetable imports in 2008 were mostly the member countries of NAFTA, mainly Mexico. Other significant exporters were Peru, China and the Netherlands. Within the fresh fruits, in 2008, the top three import flows by value were grapes ($679.1 million), avocados ($497.3 million) and pineapples ($389.4 million). In the same year, bananas ($358.4 million), watermelons ($176.3 million) and limes (161.3 million) were other important fresh fruit imports by value. In terms of exporters in this sector, Chile, Mexico and the CAFTA-DR countries were the largest suppliers.

For the policy-related variables, approximately one-third of all observations are between the U.S. and a partner in a regional trade agreement. Nearly two-thirds of the observations are not subject to an import tariff. Tariff rates on the remaining observations ranged from 0.02 percent (New Zealand/peaches and nectarines) to 27.1 percent (United Kingdom/mushrooms and truffles). Almost 20 percent of all observations have a required phytosanitary treatment while 3 percent of all observations have a geographic restriction on destination (not able to ship to mainland U.S.). Finally, 41 percent of all observations for new entrants are subject to at least one phytosanitary treatment. The most commonly required SPS treatments for new entrants are cold treatment (44 percent of all required treatments for new entrants), methyl bromide fumigation (27 percent) and water treatment (12 percent). Since cold treatment is only used for fruits, more required SPS treatments for new entrants are for fruits than vegetables.

**Table 5.3 Sample Summary Statistics**

| Variable | Obs. | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| Import Flow ($ millions) | 6,082 | 11.80 | 54.10 | 0.00 | 1140.00 |
| Distance (km) | 6,082 | 6270.51 | 3757.85 | 548.39 | 16180.32 |
| U.S. Production (mmt) | 6,082 | 2.01 | 3.19 | 0.00 | 23.30 |
| Exporter Production (mmt) | 6,082 | 0.41 | 1.13 | 0.00 | 13.90 |
| NAFTA_Fruit | 6,082 | 0.06 | 0.24 | 0 | 1 |
| NAFTA_Vegetable | 6,082 | 0.07 | 0.26 | 0 | 1 |
| CAFTA-DR | 6,082 | 0.04 | 0.18 | 0 | 1 |
| Other FTAs | 6,082 | 0.07 | 0.25 | 0 | 1 |
| Fruit | 6,082 | 0.48 | 0.50 | 0 | 1 |
| Trend | 6,082 | 8.05 | 3.16 | 3 | 13 |
| Exchange Rate | 6,081 | 249.48 | 1524.18 | 0.02 | 25000.00 |
| Global Export Share - HS6 (percent) | 6,082 | 6.44 | 12.18 | 0.00 | 80.56 |
| Mainland | 6,082 | 0.97 | 0.17 | 0 | 1 |
| Treatment | 6,082 | 0.18 | 0.39 | 0 | 1 |
| Treatment_Exporter Share (log) | 6,082 | 0.08 | 1.10 | -12.64 | 4.32 |
| US-World Price Ratio | 6,082 | 0.89 | 0.88 | 0.10 | 5.40 |
| Tariff (AHS) | 6,082 | 1.77 | 4.47 | 0.00 | 22.50 |
| New Market Access (NMA) | 6,082 | 0.05 | 0.23 | 0 | 1 |
| NMA (1st lag) | 6,082 | 0.05 | 0.21 | 0 | 1 |
| NMA (2nd lag) | 6,082 | 0.04 | 0.20 | 0 | 1 |
| NMA_Exporter Share (log) | 6,082 | -0.03 | 0.76 | -8.67 | 4.18 |
| NMA_Fruit | 6,082 | 0.04 | 0.19 | 0 | 1 |
| NMA_Treat | 6,082 | 0.02 | 0.14 | 0 | 1 |
| MBF | 6,082 | 0.05 | 0.22 | 0 | 1 |
| WTR | 6,082 | 0.02 | 0.12 | 0 | 1 |
| PS/HV | 6,082 | 0.01 | 0.07 | 0 | 1 |
| CLD | 6,082 | 0.08 | 0.26 | 0 | 1 |
| FPRF | 6,082 | 0.00 | 0.07 | 0 | 1 |
| MBF&CLD | 6,082 | 0.01 | 0.11 | 0 | 1 |
| CLDorFPRF | 6,082 | 0.01 | 0.09 | 0 | 1 |
| Residual Treatments | 6,082 | 0.01 | 0.08 | 0 | 1 |
| Exporter Share_MBF (log) | 6,082 | 0.01 | 0.71 | -12.64 | 4.32 |
| Exporter Share_WTR (log) | 6,082 | 0.01 | 0.22 | -4.04 | 3.70 |
| Exporter Share_PS/HV (log) | 6,082 | -0.01 | 0.29 | -5.55 | 2.85 |
| Exporter Share_CLD (log) | 6,082 | 0.06 | 0.65 | -6.49 | 4.26 |
| Exporter Share_FPRF (log) | 6,082 | -0.01 | 0.20 | -7.74 | 0.77 |
| Exporter Share_MBF&CLD (log) | 6,082 | 0.00 | 0.24 | -5.22 | 3.26 |
| Exporter Share_CLDorFPRF (log) | 6,082 | 0.01 | 0.17 | -2.55 | 3.40 |
| Exporter Share_RESD (log) | 6,082 | 0.01 | 0.17 | -4.70 | 3.00 |
| NMA_MBF | 6,082 | 0.00 | 0.05 | 0 | 1 |
| NMA_WTR | 6,082 | 0.00 | 0.06 | 0 | 1 |

**Table 5.3 Continued**

| Variable | Obs. | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| NMA_CLD | 6,082 | 0.01 | 0.10 | 0 | 1 |
| NMA_RESD | 6,082 | 0.00 | 0.06 | 0 | 1 |

Sources: (Karov *et al*., 2009; USITC, 2008b; FAO, 2009; USDA, APHIS, 2011g; CEPII, 2011; The World Bank, WITS, 2011; UN, 2009; UN Comtrade, 2010; USDA, ERS, 2009; USDA, ERS, 2010; ERS, 2011)

Note: Import flow is defined as customs value (excluding tariffs and trade costs); Distance is expressed in kilometers; U.S. and Exporter Production are expressed in metric tons; NAFTA, CAFTA-DR and Other FTAs are dummy variables which equal to 1 if the U.S. has a trade agreement with an exporter (*i*) in time (*t*) under the corresponding agreements; The exchange rate is expressed as the value of one dollar in terms of foreign currency; Global Export Share is the percent of exporter (*i*)'s exports of commodity (*k*) in time (*t*) from total global exports of that commodity (*k*) in time (*t*); Exporter Share denotes the natural logarithm of Global Export Share and the table denotes this by adding "(log)" after the variables; Mainland is a dummy variable equals unity if exporters is eligible to access the continental U.S. ports; Treatment is a dummy variable equals unity if exporter faces at least one phytosanitary treatment; U.S.–World Price is the ratio of U.S. domestic prices for a commodity (*k*) in time (*t*) and world price of that same commodity (*k*) in time (*t*); Tariff is the applied bound tariff rates; NMA is a dummy variable equals unity if exporter gained import permit over the period of 1997-2008 and for each additional year it remained eligible; MBF, WTR, PS/HV, CLD, FPRF, MBF&CLD, CLDorFPRF and RESD represent Methyl Bromide Fumigation, Water Treatment, Pest-specific/Host Variable, Cold Treatment, Fumigation plus Refrigeration of Fruits; Methyl Bromide Fumigation and Cold Treatment, Cold Treatment or Fumigation plus Refrigeration of Fruits and Residual Treatments (Heat Treatment (HEAT), Irradiation (IRD), Water Treatment or Methyl Bromide Fumigation (WTRorMBF) and Methyl Bromide Fumigation or Cold Treatment (MBForCLD), respectively.

# Chapter 6: Results

This study seeks to assess the differences in U.S. imports of FF&Vs between new entrants and existing suppliers. It provides empirical evidence of the ability of new entrants to achieve similar export levels compared to existing suppliers. The results are organized into two main sections. Section 6.1 presents the estimated coefficients of the gravity models developed in Chapter 4. Section 6.2 is dedicated to robustness checks of the gravity model specifications (e.g. endogeneity issues) and the estimation technique (e.g. OLS) in order to examine the consistency of the parameter estimates as well as the reliability of the computed marginal effect of NMA on U.S. FF&V imports.

## 6.1 Gravity Model Estimation Results

As described in Chapter 4, the gravity equation is estimated with the PPML estimator, to avoid potential problems with endogenous sample selection if the non-zero trade flows are excluded from the sample. All regressions discussed below are estimated using the PPML specification described in equation (25) and include heteroskedastic-robust standard errors.

### 6.1.1 Results for Common Independent Variables

As shown in Table 6.1, except for distance and U.S. production, all of the coefficients for the common independent variables are statistically different from zero and have the expected sign for all cases. Additionally, the coefficient estimates remain constant across Cases 1 through 6 implying that the results of the common independent variables are robust across all gravity model specifications.

Although it was expected that distance and U.S. production would have a negative relationship with imports, these two variables are not statistically different from zero. Distance may not be significant because this variable does not vary over time or commodity (it is constant across exporters) and thus resulting in a very low variance which inflates the standard errors of the coefficient. Inclusion of the U.S.–World price ratio may have an impact on the parameter estimate of U.S. production since the price ratio may account for the variation in the production levels. For instance as a result of lower production levels (e.g. drought), U.S. price of domestic varieties increases. However, the estimated correlation between these variables of -0.22 does not suggest problems with multicollinearity.

As expected, increased exporter production, is associated with larger exports to the United States. Imports are also higher from members of regional trade agreements, NAFTA, CAFTA-DR and FTAs. Exchange rates and the U.S.-World price ratio both measure changes in relative prices between domestic and imported commodities. As the domestic price of a commodity increases relative to the price of imports, either through an appreciate in the U.S. dollar or through an increase in the domestic market price, leads consumers to substitute away from the domestic variety to imports. The positive relationship between the exporter's size on the global market and imports and, as discussed in Chapter 4, suggests the larger exporters may have a competitive advantage relative to smaller exporters. An exporter that can ship to the lower 48 states will export more than an exporter that is not allowed to ship to the lower 48 states. Finally, as shown in Figure 1.1, given the larger values of U.S. fruit imports relative to vegetable imports, the intercept of the gravity model for all fruit commodities is larger than for all vegetable commodities.

Exporters that must utilize at least one SPS treatment for a given commodity exported to the U.S. have lower exports than those exporters that are not required to use a SPS treatment. The intercept of the gravity model is approximately 25% lower for exporters that are subject to at least one SPS treatment. However, because the interaction term between the treatment dummy variable and the natural logarithm of the global export share is positive and significantly different than zero, this difference in average exports between exporters subject to a SPS treatment and those that are not diminishes as a country's export share increases. Evaluated at the sample mean of 0.40 for global export share, exporters that are required to use at least one SPS treatment have 81 percent[36] lower exports, ceteris paribus, than exporters not required to use a SPS treatment. This estimate is consistent with the work of Karov *et al*. (2009), who found that the imposition of a treatment reduces imports of FF&V by 88 percent[37], ceteris paribus. However, the marginal effect of a SPS treatment diminishes to a 48 percent reduction in exports for a 10 percent global export share and to a 27 percent reduction in exports for a 20 percent global export share.

Santos Silva and Tenreyro (2011) show that the R-squared statistic[38] reported by commonly used statistical software (e.g. Stata) does not represent the true goodness of fit of the model. Using their procedure, the gravity model performed quite well, explaining 54 percent (Case 6) of the variation in U.S. FF&V imports. However, compared to other product-level gravity models, the estimated R-squared statistics is low. For instance, Garcia-Alvarez-Coque and Selva (2007) who assessed the influence of Association Agreements on the fresh fruit and vegetable trade between Southern Mediterranean Countries and the European Union, estimated an explanatory power of the gravity model of 70 percent.

#### 6.1.2 Case 1 and Case 2 Results

As discussed in Chapter 4, the first two specifications of the gravity model, Cases 1 and 2, utilize a generic specification of new market access. In Case 1, a dummy variable is used to

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[36] The marginal effect of Treatment on U.S. FF&V imports has been calculated as (exp(β[Treatment] + β[Treat_Ex. Share]*Mean of Ex. Share)-1)*100).
[37] Evaluated at the sample mean of -0.72 for global export share,
[38] See Sanso, Cuairan and Sanz (1993) for an examination of the goodness of fit of various specifications of gravity models.

**Table 6.1 Estimation Results for Common Independent Variables**

| Variable | Case 1 | Case 2 | Case 3 | Case 4 | Case 5 | Case 6 |
|---|---|---|---|---|---|---|
| *Distance* | -0.09 | -0.11 | -0.11 | -0.11 | -0.11 | -0.07 |
| | (0.19) | (0.16) | (0.16) | (0.16) | (0.16) | (0.39) |
| *US Production* | -0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 |
| | (0.73) | (0.84) | (0.85) | (0.85) | (0.85) | (0.60) |
| *Exporter Production* | 0.48*** | 0.46*** | 0.46*** | 0.46*** | 0.46*** | 0.48*** |
| | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) |
| *NAFTA_Fruit* | 0.84*** | 0.84*** | 0.83*** | 0.83*** | 0.83*** | 0.72*** |
| | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) |
| *NAFTA_Vegetable* | 2.90*** | 2.86*** | 2.86*** | 2.85*** | 2.85*** | 2.88*** |
| | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) |
| *CAFTA-DR* | 0.99*** | 1.00*** | 1.00*** | 1.00*** | 1.00*** | 0.96*** |
| | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) |
| *Other FTAs* | 0.55*** | 0.54*** | 0.54*** | 0.54*** | 0.53*** | 0.37** |
| | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) | (0.02) |
| *Fruit* | 1.44*** | 1.41*** | 1.42*** | 1.41*** | 1.41*** | 1.59*** |
| | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) |
| *Trend* | 0.03*** | 0.04*** | 0.04*** | 0.04*** | 0.04** | 0.04*** |
| | (0.01) | (0.01) | (0.01) | (0.01) | (0.01) | (0.01) |
| *Exchange Rate* | 0.19*** | 0.19*** | 0.19*** | 0.19*** | 0.19*** | 0.15*** |
| | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) |
| *Global Export Share* | 0.57*** | 0.58*** | 0.58*** | 0.58*** | 0.58*** | 0.57*** |
| | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) |
| *Mainland* | 1.87*** | 1.75*** | 1.77*** | 1.77*** | 1.77*** | 1.84*** |
| | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) |
| *Treatment* | -1.87*** | -1.77*** | -1.75*** | -1.75*** | -1.75*** | ___ |
| | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) | ___ |
| *Treatment_Ex. Share* | 0.50*** | 0.48*** | 0.48*** | 0.48*** | 0.48*** | ___ |
| | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) | ___ |
| *US-World Price Ratio* | 0.32*** | 0.34*** | 0.34*** | 0.33*** | 0.33*** | 0.32*** |
| | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) |
| *Tariff (AHS)* | -11.62*** | -12.62*** | -12.54*** | -12.54*** | -12.54*** | -13.41*** |
| | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) |
| *Constant* | 6.40*** | 6.67*** | 6.66*** | 6.68*** | 6.68*** | 5.89*** |
| | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) |
| *N* | 7129 | 6082 | 6082 | 6082 | 6082 | 6082 |
| $R^2$ | 0.51 | 0.51 | 0.51 | 0.51 | 0.51 | 0.54 |

Note: The dependent variable U.S. annual customs value of fresh fruits and vegetables is expressed as the FOB (free on-board price). The significance of the coefficients is expressed with *, ** and *** which represent statistical significance of ten, five and one percent level. P-values>|z| are presented below the coefficients in parenthesis. All cases are estimated with heteroskedastic-robust standard errors. The reported $R^2$ is computed using the procedure proposed by Santos Silva and Tenreyro (2011). All of the continuous variables are expressed in natural logarithmic terms. Exporter Share denotes Global Export Share. NAFTA-FRT, NAFTA-VEG, CAFTA-DR, Other FTAs, Fruit, Mainland and Treatment are dummy variables. The sample contains 89 countries, 13 years (1996-2008) and 47 commodities (24 fresh fruits and 23 fresh vegetables).

**Table 6.2 Estimation Results for New Market Access and SPS Treatment Variables**

| Variable | Case 1 | Case 2 | Case 3 | Case 4 | Case 5 | Case 6 |
|---|---|---|---|---|---|---|
| *New Market Access (NMA)* | -0.78*** | -2.62*** | -3.41*** | -3.65*** | -3.61*** | -2.99** |
| | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) | (0.03) |
| *NMA (1st lag)* | ___ | 0.76 | 0.77 | 0.76 | 0.76 | 0.87 |
| | ___ | (0.25) | (0.26) | (0.27) | (0.26) | (0.22) |
| *NMA (2nd lag)* | ___ | 1.17** | 0.96** | 0.94* | 0.92* | 0.43 |
| | ___ | (0.02) | (0.04) | (0.05) | (0.06) | (0.38) |
| *NMA_Exporter Share* | ___ | ___ | 0.28 | 0.29 | 0.28 | 0.41 |
| | ___ | ___ | (0.31) | (0.31) | (0.28) | (0.26) |
| *NMA_Fruit* | ___ | ___ | ___ | 0.27 | 0.25 | -0.55* |
| | ___ | ___ | ___ | (0.54) | (0.54) | (0.08) |
| *NMA_Treatment* | ___ | ___ | ___ | ___ | -0.03 | |
| | ___ | ___ | ___ | ___ | (0.91) | |
| *MBF* | ___ | ___ | ___ | ___ | ___ | -1.09*** |
| | ___ | ___ | ___ | ___ | ___ | (0.01) |
| *WTR* | ___ | ___ | ___ | ___ | ___ | -0.09 |
| | ___ | ___ | ___ | ___ | ___ | (0.68) |
| *PS/HV* | ___ | ___ | ___ | ___ | ___ | -0.02 |
| | ___ | ___ | ___ | ___ | ___ | (0.89) |
| *CLD* | ___ | ___ | ___ | ___ | ___ | -1.61*** |
| | ___ | ___ | ___ | ___ | ___ | (0.00) |
| *FPRF* | ___ | ___ | ___ | ___ | ___ | -1.51*** |
| | ___ | ___ | ___ | ___ | ___ | (0.00) |
| *MBF&CLD* | ___ | ___ | ___ | ___ | ___ | -3.31*** |
| | ___ | ___ | ___ | ___ | ___ | (0.00) |
| *CLDorFPRF* | ___ | ___ | ___ | ___ | ___ | -2.79*** |
| | ___ | ___ | ___ | ___ | ___ | (0.00) |
| *Residual Treatments* | ___ | ___ | ___ | ___ | ___ | -3.04*** |
| | ___ | ___ | ___ | ___ | ___ | (0.01) |
| *Exporter Share_MBF* | ___ | ___ | ___ | ___ | ___ | 0.40*** |
| | ___ | ___ | ___ | ___ | ___ | (0.00) |
| *Exporter Share_WTR* | ___ | ___ | ___ | ___ | ___ | -0.03 |
| | ___ | ___ | ___ | ___ | ___ | (0.63) |
| *Exporter Share_PS/HV* | ___ | ___ | ___ | ___ | ___ | -0.31*** |
| | ___ | ___ | ___ | ___ | ___ | (0.00) |
| *Exporter Share_CLD* | ___ | ___ | ___ | ___ | ___ | 0.23** |
| | ___ | ___ | ___ | ___ | ___ | (0.04) |
| *Exporter Share_FPRF* | ___ | ___ | ___ | ___ | ___ | 0.91*** |
| | ___ | ___ | ___ | ___ | ___ | (0.00) |
| *Exporter Share_MBF&CLD* | ___ | ___ | ___ | ___ | ___ | -0.27 |
| | ___ | ___ | ___ | ___ | ___ | (0.21) |
| *Exporter Share_CLDorFPRF* | ___ | ___ | ___ | ___ | ___ | 0.47*** |
| | ___ | ___ | ___ | ___ | ___ | (0.00) |
| *Exporter Share_RESD* | ___ | ___ | ___ | ___ | ___ | 0.79* |
| | ___ | ___ | ___ | ___ | ___ | (0.07) |
| *NMA_MBF* | ___ | ___ | ___ | ___ | ___ | -4.63*** |
| | ___ | ___ | ___ | ___ | ___ | (0.00) |
| *NMA_WTR* | ___ | ___ | ___ | ___ | ___ | 0.23 |
| | ___ | ___ | ___ | ___ | ___ | (0.85) |

**Table 6.2 Continued**

| **Variable** | **Case 1** | **Case 2** | **Case 3** | **Case 4** | **Case 5** | **Case 6** |
|---|---|---|---|---|---|---|
| *NMA_CLD* | ___ | ___ | ___ | ___ | ___ | 0.85*** |
| | ___ | ___ | ___ | ___ | ___ | (0.01) |
| *NMA_RESD* | ___ | ___ | ___ | ___ | ___ | -2.00*** |
| | ___ | ___ | ___ | ___ | ___ | (0.00) |

Note: The dependent variable U.S. annual customs value of fresh fruits and vegetables is expressed as the FOB (free on-board price). The significance of the coefficients is expressed with *, ** and *** which represent statistical significance of ten, five and one percent level. P-values>|z| are presented below the coefficients in parenthesis. NMA is the New Market Access dummy variable which equals one if a country has gained new market access in the period from 1997 to 2008 and for each additional year it retained its import eligibility, otherwise zero. MBF, WTR, PS/HV, CLD, FPRF, MBF&CLD, CLDorFPRF and RESD represent Methyl Bromide Fumigation, Water Treatment, Pest-specific/Host Variable, Cold Treatment, Fumigation plus Refrigeration of Fruits; Methyl Bromide Fumigation and Cold Treatment, Cold Treatment or Fumigation plus Refrigeration of Fruits and Residual Treatments (Heat Treatment (HEAT), Irradiation (IRD), Water Treatment or Methyl Bromide Fumigation (WTRorMBF) and Methyl Bromide Fumigation or Cold Treatment (MBForCLD)), respectively.

allow the intercept of the gravity model to differ between new entrants and existing suppliers to determine on average if new entrants export less than existing suppliers. As shown in the first column of Table 6.2, the estimated coefficient for the new market access dummy variable is negative and statistically significant at the one percent level. This result implies that new entrants export on average export 54.2 percent[39] less than existing suppliers, ceteris paribus. Thus, one can reject the hypothesis that new entrants can achieve the same level of exports as existing suppliers (C1). This marginal effect is similar to findings of Karov *et al*. (2009), who predict that new entrants export 65 percent less than existing suppliers.

Using an intercept shifter to model the effect of new market access assumes that this effect is constant over time. However, as discussed in the empirical chapter, new exporters potentially need time to build production capacities, take care of logistics and establish export marketing channels. As a result, these new trading partners are not immediately able to compete with existing suppliers. Case 2 explores the possibility that any competitive disadvantage

[39] The marginal effect of NMA on U.S. FF&V imports has been calculated as (exp(β[nma_all])-1)*100.

experienced by new entrants will diminish over time by including a one- and two-year lag of the new market access dummy variable in the gravity model. As shown in the second column of Table 6.4, the immediate effect of gaining new market access is negative, but diminishes over time, as the coefficient for the two-year lagged variable is positive and statistically significant. Given that the coefficient for the one-year lag is not statistically different than zero, there is no difference between the immediate effects of new market access and one year after obtaining an import permit. However, after two years, the model estimates a lower difference in export levels of 49.8 percent[40], ceteris paribus, implying rejection of the hypothesis that NMA has no lagged effects on import levels (C2). A paired t-test[41] is conducted to test whether the mean difference of Case 1 and Case 2 is different than zero. A p-value of zero[42] indicates that the initial NMA marginal effect of 54.2 percent is statistically different than the lagged NMA marginal effect of 48.9 percent.

While not shown in Table 6.2, higher-order lag structures were also considered for Case 2. In all instances, the estimated coefficients on lags greater than two-years were not statistically significant, implying that the negative effects of new market access do not continue to diminish two years after new access is granted. A drawback of using higher-order lag structures is the greater loss of observations and therefore degrees of freedom. For example, going from a two-period lag to a three-period lag results in a loss of additional 534 observations.

[40] The marginal effect of NMA after the lapse of two years on U.S. FF&V imports has been calculated as: (exp(β[New Market Access] + β[New Market Access (1st lag)] + β[New Market Access (2nd lag)])-1)*100).

[41] The paired t-test was conducted in Stata. The null hypothesis $H_0$ = mean(difference) = 0, where mean(difference) = mean (NMA – NMA(2nd lag). The alternative hypotheses are $H_{a1}$ = mean(difference) < 0; $H_{a2}$ = mean(difference) ≠ 0; and $H_{a3}$ = mean(difference) > 0.

[42] P-value of $H_{a1}$ = 1.000, P-value of $H_{a2}$ = 0.000; P-value of $H_{a3}$ = 1.000

### 6.1.3 Case 3 Results

Are countries that are relatively large exporters better able to penetrate the U.S. market if they gain new market access? In order to answer this question, Case 3 contains an interaction between the NMA dummy variable and Global Export Share (*NMA_ Export Share*) in addition to the intercept shifter and lagged new market access dummy variables. Similar to Case 2, the estimated coefficient for the new market access dummy variable in Case 3 (Table 6.2) is negative and statistically significant at the zero percent level. Moreover, while the coefficient of the one-year lag is not statistically significant, the model again suggests that the difference in exports by new and existing suppliers declines two years after an exporter gained market access.

While the coefficient for the interaction term *NMA_Export Share* is positive, it is not statistically different than zero. This implies that one would fail to reject the null hypothesis that the effects of NMA do not depend on the size of the exporter (C3). Thus, larger exporters do not have a competitive advantage over new entrants. One explanation for this result could be that regardless of whether new entrants have existing export supply channels established, they still must develop supply relationships with U.S. distributers and retailers. Another possible explanation is that, as discussed in Chapter 2, the majority of new entrants are smaller exporters, implying that there is a relatively little variation in the interaction term, which would tend to inflate the variance of the estimated coefficient. In addition, the predominance of small exporters that are given new market access may indicate preferential treatment in the regulatory process to help these countries develop their fresh fruit or vegetable industries. If so, this would imply that the export share of new entrants may not truly be exogenous.

### 6.1.4 Case 4 Results

In the first three cases considered, it has been assumed that the effects of new market access are the same whether a country gains new market access for a fruit or vegetable. However, as shown in Figure 2.3, countries that gained new market access for citrus and tropical fruits were more successful than countries that gain new market access for most vegetables. Case 4 relaxes this assumption to allow the average effect of new market access to vary by commodity sector by including an interaction term between the new market access dummy variable and a commodity sector dummy for fruits. As shown in the fourth column of Table 6.2, while the estimated coefficient for the sector interaction variable is positive, it is not statistically different than zero. This implies one would fail to reject the null hypothesis that NMA effects do not vary across commodity sectors (C4).

The results from the model contradict the information in Figures 2.2 and 2.3, which illustrate that new entrants exporting fresh fruits (especially citrus and tropical fruit exporters) are more successful relative to those of fresh vegetables. One possible explanation for this contradiction is that coefficient for the fruit sector dummy variable represents an "average effect" across all fruit commodities. Since Figures 2.2 and 2.3 show very small exports by new entrants for several fruit commodities, this will drive the average effect towards zero. In addition, it was also shown that new entrants exporting citrus and tropical fruits were more successful than most of the vegetable commodities therefore it is hypothesized that the effects of NMA may vary across specific commodities. Therefore, Case 4 is re-estimated to allow the effect of NMA to vary by commodity. Table 6.3 presents the results of Case 4 modified to include interaction terms between the NMA variable and specific commodities. Of the 26 commodities for which the U.S. has granted import permits (see Table 2.2), only 12 were individually interacted with the

NMA variable (e.g. *NMA_Apples*). Due to low number of observations, the residual commodities were interacted as a group (*NMA_Residual Commodities*). As shown in Table 6.3, the coefficients for the interactions of NMA with 10 individual commodities and NMA with the residual commodities are positive and strongly significant. This implies confirmation of the assumption that the effect of NMA varies across specific commodities where new entrants for some commodities have been more successful at the U.S. FF&V market compared to other entrants. For instance, the model results suggest that new entrants exporting mandarins and clementines, lemons and oranges from fresh fruits and tomatoes from fresh vegetables have contributed significantly more to the growth of U.S. FF&V imports relative to other new entrants. More specifically, in the cases of mandarins & clementines and tomatoes the model suggests that new entrants exporting these commodities are slightly more successful relative to existing suppliers. However, this result contradicts the trade data which shows that the U.S. predominantly imports mandarins & clementines from Spain, and tomatoes from the NAFTA countries, all of which are listed as existing suppliers to the United States.

### 6.1.5 Case 5 and Case 6 Results

Because 29 of the 67 new import permits granted by the U.S. face at least one phytosanitary treatment (see Chapter 2), it may be the case that new entrants facing a phytosanitary treatment export less than entrants that do not face such a restriction. In addition, it is conceivable that some SPS treatments are more costly to undertake than others, thereby raising the possibility that the effect of SPS treatments on the exports of new entrants could vary by treatment type.

Case 5 contains an interaction between the NMA and the generic treatment variable (*NMA_Treatment*) in order to explore whether an imposition of a phytosanitary treatment has an

**Table 6.3 Gravity Model Results for Modified Case 4**

| Variable | Modified Case 4 |
|---|---|
| *NMA* | -7.98*** |
| | (0.01) |
| *NMA (1st lag)* | 0.68 |
| | (0.24) |
| *NMA (2nd lag)* | -0.24 |
| | (0.58) |
| *NMA _Ex Share* | 0.62 |
| | (0.40) |
| *NMA_ Fruit* | ____ |
| | ____ |
| *NMA_Apples* | 6.80 |
| | (0.12) |
| *NMA_Avocados* | 4.45*** |
| | (0.00) |
| *NMA_Eggplants* | 3.22*** |
| | (0.00) |
| *NMA_Lemons* | 6.35*** |
| | (0.00) |
| *NMA_Mandarins & Clementines* | 7.98*** |
| | (0.00) |
| *NMA_Mangoes* | 4.20*** |
| | (0.00) |
| *NMA_Melons* | 5.88 |
| | (0.19) |
| *NMA_Oranges* | 6.19*** |
| | (0.00) |
| *NMA_Papayas* | 4.53*** |
| | (0.00) |
| *NMA_Peppers* | 4.29*** |
| | (0.00) |
| *NMA_Tomatoes* | 10.53** |
| | (0.03) |
| *NMA_Watermelons* | 4.16** |
| | (0.02) |
| *NMA_Residual Commodities* | 3.10*** |
| | (0.00) |
| *Commodity Fixed Effects* | see note |
| *N* | 6,082 |
| $R^2$ | 0.91 |

Note: All commodity dummy variables, except one are included instead of the *Fruit* variable.

impact on the export levels of new entrants. As shown in the fifth column of Table 6.2, although the coefficient for *NMA_Treatment* is negative, it is not statistically significant. Thus, one would fail to reject the null hypothesis that the effect of NMA on U.S. FF&V imports does not depend on whether an SPS treatment is required (C5). However, if some SPS treatments have substantial negative impacts on trade while other treatments have no or positive effects on trade, this could cause the estimated coefficient for *NMA_Treatment* to be statistically insignificant. This possibility is investigated in Case 6.

As shown in Table 2.8, cold treatment (CLD), methyl bromide fumigation (MBF), and water treatment (WTR) are the predominant SPS treatments required for new entrants. In Case 6, these treatments are interacted with the new market access dummy variable. All other SPS treatments required for new entrants are aggregated together to form a residual treatment group (RESD) that is also interacted with the new market access dummy variable. This is done because the low number of observations where a new entrant is required to use residual treatment prevents one from identifying the effects of these residual treatments individually. The residual treatments include fumigation plus refrigeration of fruits (FPRF), heat treatment (HEAT), irradiation (IRD), cold treatment or fumigation plus refrigeration of fruits (CLDorFPRF), and methyl bromide fumigation or cold treatment (MBForCLD).

As shown in the last column of Table 6.2, only MBF, CLD and Residual Treatments have a significant impact on exports by new entrants. Using the mean of natural logarithm of global export share of 0.18, fresh vegetable entrants subject to MBF on average export 99.8 percent[43] less than fresh vegetable entrants without this type of treatment restriction. This marginal effect

[43] The effects of new entrants facing a MBF requirement is calculated as follows: (exp(β[NMA] + β[NMA (1st lag)] +β[NMA (2nd lag)] + β[NMA_Ex. Share] * Mean of Nat. Log of Ex. Share + β[NMA_MBF])-1)*100). The mean value of exporter share of 0.18 is calculated including only new entrants exporting fresh vegetables subject to MBF.

suggests that MBF acts as a great barrier to exports of new entrants, potentially because there are fixed costs associated with MBF requirement since exporters need to set up treating facilities.

Similarly, using the mean of natural logarithm of global export share of 1.55, new entrants required to cold treat their fresh fruit shipments on average export 52.9 percent[44] less than those with no such requirement. Karov *et al*., (2009) estimate that imposition of a CLD reduces FF&V exports across all exporters by 84 percent. Although the overall effect of NMA subject to a CLD requirement is negative, the interaction between NMA_CLD is positive and statistically different than zero. Although this implies that CLD requirement have positive effects on new entrants subject to this requirement, it may not be the case. For instance the positive interaction coefficient may be driven by new entrants exporting citrus fruits (e.g. South Africa/oranges, Peru/mandarins & clementines, and etc.) since these entrants have been previously identified as overall successful instances of NMA (Figure 2.3) and export more than entrants without cold treatment requirement.

Finally, as expected, new entrants subject to any of the residual treatments (FPRF, HEAT, IRD, CLDorFPRF, and MBForCLD) export significantly less than entrants not facing these treatments. The model estimates an average reduction of approximately 98 percent[45] in FF&V imports by new entrants facing any of the residual treatment types compared to new

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[44] The effects of new entrants facing a CLD requirement is calculated as follows: (exp(β[NMA] + β[NMA (1st lag)] + β[NMA (2nd lag)] + β[NMA_Ex.Share]* Mean of Nat. Log of Ex. Share + β[NMA_Fruit]+ β[NMA_CLD])-1)*100). The mean value of exporter share of 1.55 is calculated including only new entrants exporting fresh fruits subject to CLD.

[45] There is a very small difference in the effects of new entrants (subject to RESD) exporting fresh fruits and fresh vegetables. The difference between exports of fruits by entrants subject to RESD and entrants without this requirement is 98.9 percent, while the difference between exports of fresh vegetables by entrants subject to RESD and entrants not subject to RESD is 98.1 percent. The effects of new entrants exporting fresh fruits and facing any of the RESD requirements is calculated as follows: (exp(β[NMA] + β[NMA (1st lag)] +β[NMA (2nd lag)] + β[NMA_Ex.Share]* Mean of Nat. Log of Ex. Share + β[NMA_Fruit] + β[NMA_RESD])-1)*100). The mean value of exporter share of -0.72 is calculated including only new entrants exporting fresh fruits which are subject to RESD. The effects of new entrants exporting fresh vegetables and facing any of the RESD requirement is calculated with the same formula and the same mean value of exporter share as for fresh fruits, expect the coefficient of the NMA_Fruit was not included.

entrants not facing these restrictions. Karov *et al*., (2009) estimated the individual effects of three (FPRF, IRD and MBForCLD) out of the five treatment requirements across all countries (regardless whether a supplier is new or existing). According to their results, HEAT had a positive but insignificant impact and FPRF and CLDorFPRF had a negative and significant impact on U.S. FF&V imports. More specifically, countries facing an FPRF requirement on average export 97 percent, while countries facing an MBForCLD requirement on average export 95 percent.

### 6.2 Robustness Checks

In this section, several model specification and data issues are explored in order to assess the robustness of the parameters of the gravity models estimated in Section 6.1. Section 6.2.1 considers three separate issues on the effect of new market access: the role of increased market access for Mexican Hass avocados; the inclusion of country, commodity and year specific fixed effects; and a check for potential endogeneity bias from the use of exporter share of global exports. Section 6.2.2 compares the results from the gravity model estimated using OLS and excluding the observations with zero-trade flows to the results from the gravity model estimated using the PPML estimator. This comparison will provide some insight on the importance of including all observations in the sample in the estimation process.

#### 6.2.1 Exclusion of Mexican Hass Avocados

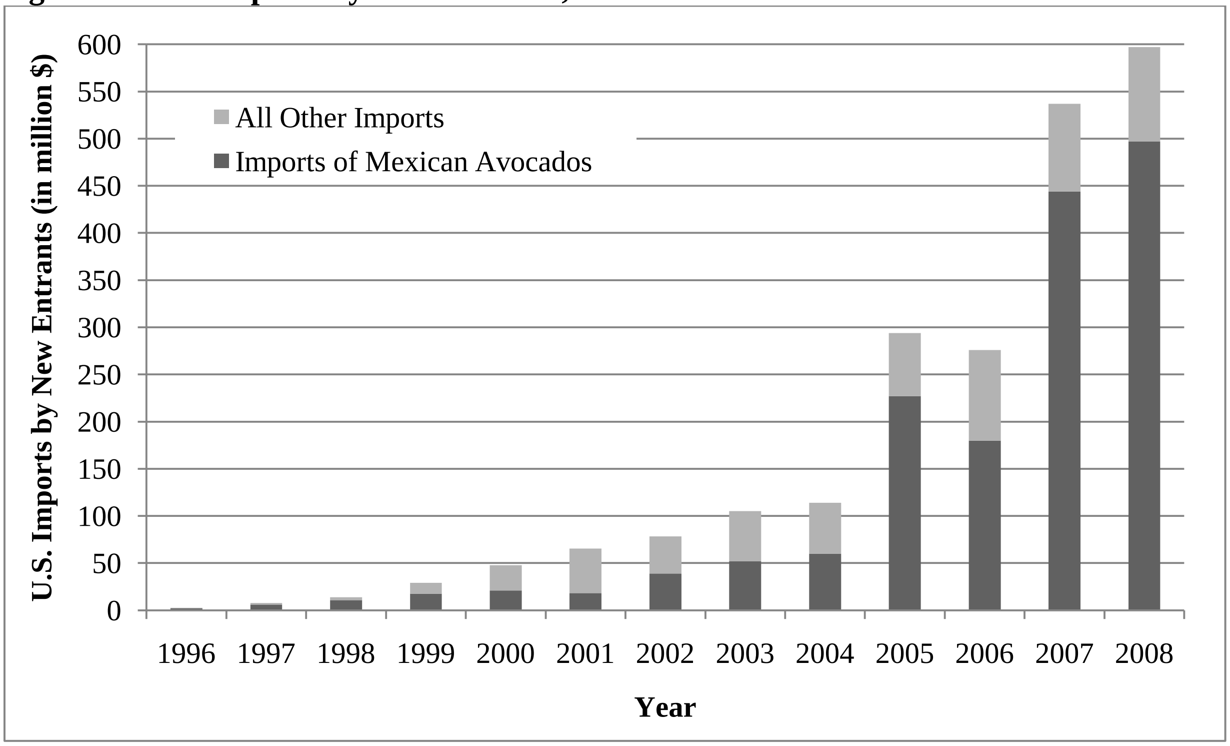
As discussed in Chapter 2, exporters of Hass avocados from Mexico have been the most successful in terms of increasing their sales in the U.S. market after gaining import eligibility. As shown in Figure 6.1, exports to the U.S. have increased from $1.84 million in 1996 to $497 million in 2008. In addition, the degree of new market access for Mexican avocados has evolved over time. In November 1997, fresh Mexican Hass avocados were allowed to be sold in 19 northeastern states and the District of Columbia during the months of November through February. In 2001, market access was extended to 12 additional states and for a six month time period (October 15 to April 15). In November 2004, all remaining geographic and seasonal restrictions were eliminated.

Exclusion of Mexican Hass Avocados from the sample significantly affects the magnitudes and the standard errors of the estimated coefficients in the gravity model. In Case 1, new entrants export 78 percent[46] less than existing suppliers (Table 6.4). This is 24 percentage points higher (in absolute terms) than the effect of NMA estimated using the full sample. In Case 2, while the coefficients for both lags are positive, they are not statistically different than zero implying that the immediate effect of gaining new market access does not diminish over time, which is contradicting to the results of Case 2 in Section 6.1.2. Since exporters of Mexican avocados have been relatively the most successful in increasing export volumes over time, it is possible that this instance has been driving the diminishing negative NMA effect over time computed in Section 6.1.2.

In Cases 3 and 5, there are coefficients that change sign and significance level if the exports of Mexican Hass avocados are excluded from the sample. In Case 3, the coefficient for the interaction term between the new market access dummy and exporter share becomes negative and statistically different than zero at the one-percent level. This implies that larger new entrants export less to the U.S. than smaller new entrants. However this may not be the case since the negative coefficient on the interaction may be accounting for the effects of large new entrants that do not export much to the United States. For instance, new entrants such as Spain, which is a

[46] The marginal effect of NMA on U.S. FF&V imports has been calculated as (exp(β[New Market Access without Mexico/Avocadosl])-1)*100

**Figure 6.1 U.S. Imports by New Entrants, 1996 – 2008**




Source: (USITC, 2008b)

globally large exporter of eggplants[47] and head lettuce[48] and South Africa which is a globally large exporter of grapefruits[49] account for less than 1 percent of U.S. imports of these commodities. In Case 6, the coefficient on the interaction term between the generic treatment and new market access dummy variables becomes positive and statistically significant at the one-percent level. However, in Case 6, the signs of the interaction terms between the new market access and specific SPS treatment variables do not changes signs or significance. The negative impacts of requiring a new entrant to treat with methyl bromide fumigation or the residual treatments is smaller while the positive impact of cold treatment is larger. These changes in the marginal effects of the individual treatments show why the generic treatment effect is positive in Case 5.

[47] Spain claims 39 percent of the global export share for eggplants.
[48] Spain claims 64 percent of the global export share of head lettuce.
[49] South Africa claims 40 percent of the global export share of grapefruit.

**Table 6.4 Robustness Checks for Gravity Models**

| Variable | Gravity Model Results | Mexico Avocados | Endogeneity Bias | Specific Fixed Effects |
|---|---|---|---|---|
| **Case 1** | | | | |
| *New Market Access (NMA)* | -0.78*** | -1.50*** | -0.53* | -0.63*** |
| | (0.00) | (0.00) | (0.06) | (0.00) |
| **Case 2** | | | | |
| *NMA* | -2.62*** | -2.66*** | -2.32*** | -2.02*** |
| | (0.00) | (0.00) | (0.00) | (0.00) |
| *NMA (1st lag)* | 0.76 | 0.78 | 0.95 | 1.07 |
| | (0.25) | (0.23) | (0.14) | (0.11) |
| *NMA (2nd lag)* | 1.17** | 0.52 | 0.90* | 0.39 |
| | (0.02) | (0.30) | (0.06) | (0.32) |
| **Case 3** | | | | |
| *NMA* | -3.41*** | -2.16*** | -2.39*** | -2.31*** |
| | (0.00) | (0.00) | (0.00) | (0.00) |
| *NMA (1st lag)* | 0.77 | 0.80 | 0.95 | 1.04 |
| | (0.26) | (0.22) | (0.15) | (0.12) |
| *NMA (2nd lag)* | 0.96** | 0.58 | 0.85* | 0.14 |
| | (0.04) | (0.23) | (0.06) | (0.75) |
| *NMA _Ex Share* | 0.28 | -0.21*** | 0.08 | 0.17 |
| | (0.31) | (0.00) | (0.54) | (0.21) |
| **Case 4** | | | | |
| *NMA* | -3.65*** | -1.70*** | -2.98*** | -1.64*** |
| | (0.00) | (0.00) | (0.00) | (0.01) |
| *NMA (1st lag)* | 0.76 | 0.81 | 0.94 | 1.04 |
| | (0.27) | (0.21) | (0.15) | (0.11) |
| *NMA (2nd lag)* | 0.94* | 0.57 | 0.75* | 0.17 |
| | (0.05) | (0.23) | (0.08) | (0.67) |
| *NMA _Ex Share* | 0.29 | -0.21*** | 0.13 | 0.19 |
| | (0.31) | (0.00) | (0.48) | (0.14) |
| *NMA Fruit* | 0.27 | -0.52 | 0.65 | -0.83*** |
| | (0.54) | (0.15) | (0.29) | (0.00) |
| **Case 5** | | | | |
| *NMA* | -3.61*** | -2.23*** | -2.38*** | -2.54*** |
| | (0.00) | (0.00) | (0.00) | (0.00) |
| *NMA (1st lag)* | 0.76 | 0.67 | 0.98 | 1.05 |
| | (0.26) | (0.39) | (0.12) | (0.15) |
| *NMA (2nd lag)* | 0.92* | 0.86 | 0.53 | 0.34 |
| | (0.06) | (0.13) | (0.21) | (0.47) |
| *NMA _Ex Share* | 0.28 | -0.32*** | 0.15 | 0.32** |
| | (0.28) | (0.00) | (0.39) | (0.04) |
| *NMA Fruit* | 0.25 | -0.64 | 0.36 | -0.72** |
| | (0.54) | (0.11) | (0.43) | (0.02) |
| *NMA _Treatment* | -0.03 | 1.33*** | -0.80* | 0.80*** |
| | (0.91) | (0.00) | (0.08) | (0.01) |
| **Case 6** | | | | |
| *NMA* | -2.99** | -0.20 | -1.81** | -1.69** |
| | (0.03) | (0.68) | (0.04) | (0.04) |
| *NMA (1st lag)* | 0.87 | 0.60 | 0.79 | 0.95 |

**Table 6.4 Continued**

| Variable | Gravity Model Results | Mexico Avocados | Endogeneity Bias | Specific Fixed Effects |
|---|---|---|---|---|
| | (0.22) | (0.32) | (0.25) | (0.16) |
| *NMA (2nd lag)* | 0.43 | -0.15 | 0.12 | -0.04 |
| | (0.38) | (0.74) | (0.77) | (0.93) |
| *NMA _Ex Share* | 0.41 | -0.31*** | 0.88 | 0.50** |
| | (0.26) | (0.00) | (0.18) | (0.02) |
| *NMA Fruit* | -0.55* | -2.37*** | -0.97*** | -1.80*** |
| | (0.08) | (0.00) | (0.00) | (0.00) |
| *NMA _Treatment* | ___ | ___ | ____ | ____ |
| | ___ | ___ | ____ | ____ |
| *MBF* | -1.09*** | -1.15*** | -0.28 | 0.49** |
| | (0.01) | (0.00) | (0.42) | (0.04) |
| *WTR* | -0.09 | -0.19 | 0.06 | 0.40* |
| | (0.68) | (0.37) | (0.71) | (0.07) |
| *PS/HV* | -0.02 | -0.06 | -0.26 | 1.28*** |
| | (0.89) | (0.75) | (0.11) | (0.00) |
| *CLD* | -1.61*** | -1.82*** | -0.98*** | -1.06*** |
| | (0.00) | (0.00) | (0.00) | (0.00) |
| *FPRF* | -1.51*** | -1.48*** | -3.92*** | -0.92*** |
| | (0.00) | (0.00) | (0.00) | (0.00) |
| *MBF&CLD* | -3.31*** | -3.38*** | -3.66*** | -1.71*** |
| | (0.00) | (0.00) | (0.00) | (0.01) |
| *CLDorFPRF* | -2.79*** | -2.86*** | -1.51*** | -1.53*** |
| | (0.00) | (0.00) | (0.00) | (0.01) |
| *Residual Treatments* | -3.04*** | -3.21*** | -0.86* | -2.28 |
| | (0.01) | (0.01) | (0.07) | (0.11) |
| *Exporter Share_MBF* | 0.40*** | 0.42*** | 0.30*** | -0.18** |
| | (0.00) | (0.00) | (0.01) | (0.01) |
| *Exporter Share_WTR* | -0.03 | 0.00 | -0.10* | -0.10 |
| | (0.63) | (0.96) | (0.09) | (0.13) |
| *Exporter Share_PS/HV* | -0.31*** | -0.30*** | -0.19** | -0.21*** |
| | (0.00) | (0.00) | (0.04) | (0.00) |
| *Exporter Share_CLD* | 0.23** | 0.28*** | 0.16 | 0.43*** |
| | (0.04) | (0.01) | (0.14) | (0.00) |
| *Exporter Share_FPRF* | 0.91*** | 0.97*** | -0.66** | -0.46*** |
| | (0.00) | (0.00) | (0.04) | (0.00) |
| *Exporter Share_MBF&CLD* | -0.27 | -0.27 | -0.21 | 0.15 |
| | (0.21) | (0.22) | (0.23) | (0.61) |
| *Exporter Share_CLDorFPRF* | 0.47*** | 0.47*** | 0.51*** | 1.50*** |
| | (0.00) | (0.00) | (0.00) | (0.00) |
| *Exporter Share_RESD* | 0.79* | 0.88** | -0.09 | 0.90* |
| | (0.07) | (0.05) | (0.72) | (0.10) |
| *NMA_MBF* | -4.63*** | -3.75*** | -7.40*** | -2.98*** |
| | (0.00) | (0.00) | (0.00) | (0.00) |
| *NMA_WTR* | 0.23 | 0.09 | -3.43*** | 1.41* |
| | (0.85) | (0.84) | (0.00) | (0.06) |
| *NMA_CLD* | 0.85*** | 2.95*** | 0.92*** | 1.63*** |
| | (0.01) | (0.00) | (0.00) | (0.00) |

**Table 6.4 Continued**

| Variable | Gravity Model Results | Mexico Avocados | Endogeneity Bias | Specific Fixed Effects |
|---|---|---|---|---|
| *NMA_RESD* | -2.00*** | -0.92* | -2.06*** | -0.97 |
| | (0.00) | (0.07) | (0.01) | (0.19) |
| **Case 1** | | | | |
| *N* | 7,129 | 7,129 | 7,129 | 7,129 |
| $R^2$ | 0.51 | 0.51 | 0.56 | 0.97 |
| **Case 2** | | | | |
| *N* | 6,082 | 6,082 | 6,082 | 6,082 |
| $R^2$ | 0.51 | 0.51 | 0.56 | 0.97 |
| **Case 3** | | | | |
| *N* | 6,082 | 6,082 | 6,082 | 6,082 |
| $R^2$ | 0.51 | 0.51 | 0.56 | 0.97 |
| **Case 4** | | | | |
| *N* | 6,082 | 6,082 | 6,082 | 6,082 |
| $R^2$ | 0.51 | 0.51 | 0.56 | 0.97 |
| **Case 5** | | | | |
| *N* | 6,082 | 6,082 | 6,082 | 6,082 |
| $R^2$ | 0.51 | 0.51 | 0.56 | 0.97 |
| **Case 6** | | | | |
| *N* | 6,082 | 6,082 | 6,082 | 6,082 |
| $R^2$ | 0.54 | 0.55 | 0.61 | 0.97 |

Note: The dependent variable is U.S. annual customs value of fresh fruits and vegetables. The significance of the coefficients is expressed with *, ** and *** which represent statistical significance of ten, five and one percent level. P-values>|z| are presented in parenthesis. Exporter Share in the 'Endogeneity Bias' model is specified on the HS-four level and in all of the other models on the HS-six level (as it was in the model in Section 6.1) for all cases.

### 6.2.2 Endogeneity of Global Export Share

In all specifications of the gravity model in Section 6.1, the share of global exports of the *k*th commodity by the *i*th exporter is used as an independent variable individually, and interacted with the new market access dummy variable in Cases 3 through 6. However, it may be possible that suppliers have a large global export share because they have relatively large exports to the United States. Thus, it may be possible that value of exports to the U.S., which is the dependent variable in the gravity model, and the global export share are jointly determined, raising a potential endogeneity problem. There are few observations in the sample that might raise concerns about endogeneity bias. Table 6.5 summarizes country/commodity instances which claimed an average share of 80 percent or more of the U.S. market and an average share of 20 percent or more of the global market for a commodity over the 13 year period (1996-2008). These instances are potential sources of endogeneity bias since their large global export shares are reflected in their exports to the United States. One possible solution is to compute the global export share at the HS four-digit level, rather than the HS six-digit level. This would measure the exporting country's share of a broader commodity category. For example, HS 0706 contains edible roots such as carrots, turnips, beets, and radishes. Thus, a high global export share of a given commodity within a HS four-digit category, as a result of large exports to the U.S., need not result in a high global export for the entire HS four-digit category. For example, Mexican exports of papayas accounted for 93 percent of the total U.S. imports and 35 percent of the total world imports of papayas (HS 080720 code), but only 75 percent of the total U.S. imports of the papayas, melons and watermelons (HS 0807 code) and 7 percent of the total world imports of these commodities. In order to check for variation in the marginal effects of NMA as a result of a potential problem with endogeneity of the global export share variable, cases 1 through 6 are re-estimated utilizing the HS-four instead of the product line global export share.

**Table 6.5 Exporter's Average Share to the U.S. and Global Share, 1996-2008**

| Country | Commodity | Exporter's Average Share to the U.S. | Exporter's Average Global Share |
|---|---|---|---|
| Mexico | Cranberries and Blueberries | 90.8% | 36.3% |
| Chile | Avocados | 80.5% | 32.8% |
| Canada | Cranberries and Blueberries | 96.0% | 44.1% |
| Mexico | Cucumbers | 85.9% | 24.6% |
| Mexico | Eggplants | 83.5% | 23.1% |
| Mexico | Fresh Beans | 82.0% | 22.2% |
| Mexico | Papayas | 93.5% | 35.1% |
| Mexico | Peppers | 90.0% | 22.0% |
| Canada | Potatoes | 84.0% | 22.7% |
| Mexico | Raspberries and Blackberries | 85.9% | 37.7% |
| Canada | Spinach | 98.8% | 21.6% |
| Mexico | Tomatoes | 89.3% | 21.4% |
| Mexico | Watermelons | 81.6% | 67.2% |

(USITC, 2008b; UN Comtrade, 2010)

For Cases 1 through 4, the marginal effects of new market access are smaller, but similar when the global export share is measured at the HS four-digit level compared to the six-digit level. In Case 1, new entrants export on average export 41 percent[50] less than existing suppliers using HS four-digit export shares compared with a 54.2 percent reduction using HS six-digit shares. Regardless of the measure of global export share, the difference between new and existing suppliers only diminishes by 4 percentage points[51] after two years of market access. Using HS four-digit export shares did not result in similar marginal effects of new market access in Cases 5 and 6, which potentially indicates the presence of some endogeneity bias due to the changes in the estimated coefficients of these cases. Case 5 now estimates negative and significant impact of treatment requirements on exports by new entrants, which was not the case when using HS six-digit shares. Furthermore, in Case 6, the negative effects of MBF and WTR treatments on exports by new entrants are now much higher (in absolute terms) compared to the effects estimated under HS six-digit level export share. Given that overall the marginal effects of NMA are not severely affected for Cases 1 through 4, the potential endogeneity concerns are minor and may be disregarded. However, the computed marginal effects of NMA using HS six-digit exporter share in Cases 5 and 6 may be affected by endogeneity bias since the estimates of these cases were different when utilizing the global export share at the HS four-digit level.

### 6.2.3 Incorporating Commodity, Country and Time Fixed Effects

Several studies have suggested that the country heterogeneity issue should be addressed to avoid bias in the estimates. Mátyás (1997) and Egger (2000) argued that the three-way-model which accounts for exporter, importer and time fixed effects is the proper specification of gravity equations using a panel dataset. Furthermore, Cheng and Wall (1999) performed an analysis

[50] The effects of New Market Access: (exp(β[New Market Access])-1)*100).

[51] The effects of New Market Access: (exp(β[New Market Access] + β[New Market Access (1st lag) + β[New Market Access (2nd lag))-1)*100).

about omission of fixed effects in gravity models, in particular bilateral country-pair dummies, and found that it leads to a pattern of overestimates in the effects of regional integration (the variable of interest) on trade volume. Because of the dataset used in this study is a panel, it is possible to control for unobserved heterogeneity between exporter/commodity pairs using a fixed effects model. One specification of a fixed effects model is to include dummy variables for all but one exporter/commodity pairs. Given, the sample size, this would require 4,183 dummy variables, which would substantially decrease the degrees of freedom. A second specification demeans the data by subtracting out the average of each variable over time for each exporter/commodity pair. However this adjustment of the data would lead to dropping all of the time-invariant variables. For instance, two out of the four interactions between NMA and specific treatment drops out since these treatment requirements do not vary over time. Instead the gravity model is estimated to include exporter commodity and time specific fixed effects in order to control for variation across the 89 exporters, the 47 commodities and the 13 years.

As shown in the last column of Table 6.4, inclusion of exporter, commodity and year dummy variables result in lower estimates of the marginal effects of new market access. In Case 1, new entrants, on average, export approximately 47 percent less than existing suppliers, which is about 7 percentage points smaller difference than in Case 1 of Section 6.1.2. While both lags in Case 2 have positive coefficients, neither is statistically significant at the 10 percent level. Although the coefficient for the one-period lag is marginally significant with a *p*-value of 0.11, suggesting the negative effects of new entry are diminished in the first year after entry, rather than in the second year after entry. In Cases 5 and 6, the coefficient on the interaction between the new market access dummy variable and the global export share is positive and statistically significant, implying that new entrants that are large exporters are more able to overcome the difficulties of entry than are smaller exporters. In addition, the effects of SPS treatments on new entrants are positive overall in Case 5 and are less negative or more positive for the individual treatments in Case 6. For example, the negative effect of requiring methyl bromide fumigation by new entrants is smaller in absolute terms when the country, commodity, and year fixed effects are included than when they are not included in the gravity model.

Overall the computed estimates of NMA across the different robustness checks are not robust in sign and magnitude, except for Case 1 where the effects of NMA are always negative and statistically significant ranging from 41 percent (Endogeneity check) to 78 percent (exclusion of Mexican avocados). In addition across all robustness check models, the effect of MBF remained negative and statistically significant. The gravity model specified in Cases 1 through 6 may not be the preferred model to use since the robustness checks seem to indicate that the model results are sensitive to the use of country, commodity and time specific fixed effects, to potential endogeneity problems, and to the exclusion of Mexican avocados from the sample.

The robustness check models excluding Mexico/avocados NMA instance and the models with inclusion of specific fixed effects significantly changed the results of Cases 2 through 6 implying the gravity models estimated in Section 6.1 are not robust across these changes. The results of the models checking for potential endogeneity bias overall produced similar results as the models estimated in Section 6.1 which means if existing, this issue is minor and could be ignored.

### 6.2.4 Ordinary Least Squares Estimation Results

As discussed in the empirical model chapter, estimating the gravity equation with the OLS model will result in sample truncation due to the exclusion of the "zeros" and thereby lead to biased estimates. Estimating cases 1 through 6 using the OLS model will provide evidence on the potential selectivity bias.

While the independent variables are the same as were used in Cases 1 through 6, the dependent variable of the OLS model is specified as the natural logarithm of the U.S. FF&V customs value, which automatically excludes all "zeros" since the log of zero is undefined. Although Karov *et al*., (2009) have excluded U.S. FF&V imports less than $20,000 to avoid problems of explaining "low" values, this analysis is not possible since majority of the exports from new entrants are small. For instance, exclusion of zero import flows eliminates 41 percent of the total NMA observations, and an additional 10 percent of these observations would be eliminated as a result of low values. As in the PPML model, all cases have been estimated with heteroskedasticity-robust standard errors.

After dropping ineligible import flows, zero U.S and exporter production values and missing values, the OLS model is run on a total of 4,446 observations in Case 1 and a total 3,812 observations in Cases 2 through 6. Table 6.6 presents the estimated coefficients for the new market access independent variables for Cases 1 through 6.

Estimating the gravity model specifications of Cases 1 through 6 with OLS resulted in significant changes in the sign, magnitude and statistical significance of the parameters relative to the gravity models that incorporate zero trade flows. Given that in most of the cases, the OLS produced conflicting results implies that there is a potential sample selection bias due to exclusion of the zero trade flows. Additionally, under OLS the number of NMA observations dropped significantly since about 41 percent of the observations had a zero value. Thus, one may argue that the contradicting results produced by OLS are due to the inability of the model to econometrically estimate the effects of NMA.

**Table 6.6 Ordinary Least Squares Results**

| Variable | Case 1 | Case 2 | Case 3 | Case 4 | Case 5 | Case 6 |
|---|---|---|---|---|---|---|
| *New Market Access (NMA)* | -0.53*** | -0.68* | -0.76** | -0.38 | -0.35 | -0.13 |
| | (0.00) | (0.07) | (0.03) | (0.36) | (0.41) | (0.76) |
| *NMA (1st lag)* | ___ | 0.35 | 0.40 | 0.39 | 0.40 | 0.33 |
| | ___ | (0.49) | (0.41) | (0.41) | (0.40) | (0.47) |
| *NMA (2nd lag)* | ___ | -0.20 | -0.12 | -0.15 | -0.17 | -0.29 |
| | ___ | (0.60) | (0.75) | (0.69) | (0.66) | (0.42) |
| *NMA_Exporter Share* | ___ | ___ | -0.12** | -0.09* | -0.09* | -0.10** |
| | ___ | ___ | (0.02) | (0.08) | (0.08) | (0.05) |
| *NMA_FRT* | ___ | ___ | ___ | -0.55* | -0.47 | -0.58* |
| | ___ | ___ | ___ | (0.08) | (0.13) | (0.08) |
| *NMA_TREAT* | ___ | ___ | ___ | ___ | -0.20 | |
| | ___ | ___ | ___ | ___ | (0.53) | |
| *MBF* | ___ | ___ | ___ | ___ | ___ | 0.08 |
| | ___ | ___ | ___ | ___ | ___ | (0.62) |
| *WTR* | ___ | ___ | ___ | ___ | ___ | 0.67* |
| | ___ | ___ | ___ | ___ | ___ | (0.06) |
| *PS/HV* | ___ | ___ | ___ | ___ | ___ | 0.81*** |
| | ___ | ___ | ___ | ___ | ___ | (0.00) |
| *CLD* | ___ | ___ | ___ | ___ | ___ | -0.52*** |
| | ___ | ___ | ___ | ___ | ___ | (0.01) |
| *FPRF* | ___ | ___ | ___ | ___ | ___ | -1.48*** |
| | ___ | ___ | ___ | ___ | ___ | (0.00) |
| *MBF&CLD* | ___ | ___ | ___ | ___ | ___ | -1.32*** |
| | ___ | ___ | ___ | ___ | ___ | (0.00) |
| *CLDorFPRF* | ___ | ___ | ___ | ___ | ___ | -1.74*** |
| | ___ | ___ | ___ | ___ | ___ | (0.00) |
| *Residual Treatments* | ___ | ___ | ___ | ___ | ___ | 0.80 |
| | ___ | ___ | ___ | ___ | ___ | (0.20) |
| *Exporter Share_MBF* | ___ | ___ | ___ | ___ | ___ | 0.09 |
| | ___ | ___ | ___ | ___ | ___ | (0.13) |
| *Exporter Share_WTR* | ___ | ___ | ___ | ___ | ___ | 0.37*** |
| | ___ | ___ | ___ | ___ | ___ | (0.01) |
| *Exporter Share_PS/HV* | ___ | ___ | ___ | ___ | ___ | -0.13*** |
| | ___ | ___ | ___ | ___ | ___ | (0.00) |
| *Exporter Share_CLD* | ___ | ___ | ___ | ___ | ___ | 0.04 |
| | ___ | ___ | ___ | ___ | ___ | (0.62) |
| *Exporter Share_FPRF* | ___ | ___ | ___ | ___ | ___ | -0.53** |
| | ___ | ___ | ___ | ___ | ___ | (0.02) |
| *Exporter Share_MBF&CLD* | ___ | ___ | ___ | ___ | ___ | 0.12 |
| | ___ | ___ | ___ | ___ | ___ | (0.30) |
| *Exporter Share_CLDorFPRF* | ___ | ___ | ___ | ___ | ___ | 0.67*** |
| | ___ | ___ | ___ | ___ | ___ | (0.00) |
| *Exporter Share_RESD* | ___ | ___ | ___ | ___ | ___ | -0.56*** |
| | ___ | ___ | ___ | ___ | ___ | (0.00) |
| *NMA_MBF* | ___ | ___ | ___ | ___ | ___ | -0.27 |
| | ___ | ___ | ___ | ___ | ___ | (0.74) |
| *NMA_WTR* | ___ | ___ | ___ | ___ | ___ | -1.17** |
| | ___ | ___ | ___ | ___ | ___ | (0.01) |

**Table 6.6 Continued**

| Variable | Case 1 | Case 2 | Case 3 | Case 4 | Case 5 | Case 6 |
|---|---|---|---|---|---|---|
| *NMA_CLD* | ___ | ___ | ___ | ___ | ___ | 1.17** |
| | ___ | ___ | ___ | ___ | ___ | (0.01) |
| *NMA_RESD* | ___ | ___ | ___ | ___ | ___ | -2.35** |
| | ___ | ___ | ___ | ___ | ___ | (0.02) |
| *N* | 4,446 | 3,812 | 3,812 | 3,812 | 3,812 | 3,812 |
| $R^2$ | 0.54 | 0.54 | 0.54 | 0.54 | 0.54 | 0.55 |

Note: The dependent variable the natural logarithm of the U.S. annual customs value of fresh fruits and vegetables is expressed as the FOB (free on-board price). The significance of the coefficients is expressed with *, ** and *** which represent statistical significance of ten, five and one percent level. P-values>|z| are presented below the coefficients in parenthesis. NMA is the *New Market Access* dummy variable which equals one if a country has gained new market access in the period from 1997 to 2008 and for each additional year it retained its import eligibility, otherwise zero. MBF, WTR, PS/HV, CLD, FPRF, MBF&CLD, CLDorFPRF and RESD represent Methyl Bromide Fumigation, Water Treatment, Pest-specific/Host Variable, Cold Treatment, Fumigation plus Refrigeration of Fruits; Methyl Bromide Fumigation and Cold Treatment, Cold Treatment or Fumigation plus Refrigeration of Fruits and Residual Treatments (Irradiation, Water Treatment or Methyl Bromide Fumigation and Methyl Bromide Fumigation or Cold Treatment), respectively

The coefficient on the generic NMA dummy variable is always negative and statistically significant in all of the gravity models estimated with the PPML. However under OLS, the coefficient for NMA is not statistically significant for Cases 4 through 6 implying that the estimates might be biased. Furthermore, the OLS estimates contradict the results of the gravity models which include ‘zeros’ since the lagged new market access variables are statistically insignificant in all of the cases implying that the effects of NMA do not vary over time.

While in the gravity models that include ‘zeros’ it was found that the volume of exports by new entrants does not depend on the size of the entrant, the results of the OLS model in Case 3 contradict this finding since the coefficient for the *NMA_Exporter Share* variable is negative and statistically different than zero. This implies that larger new entrants export less FF&V to the U.S. than smaller entrants.

Estimates in Case 5 are robust across the two estimation techniques since the coefficient for the *NMA_Treatment* variable under the gravity model that includes ‘zeros’ and OLS is negative and statistically insignificant. Finally in Case 6 presented in Table 6.6, the estimates are somewhat consistent in sign and magnitude with the gravity model that includes zero trade flows, with exception of the interaction between *NMA_MBF* and *NMA_WTR.* It is important to note that while the coefficient for the *NMA_MBF* is always negative and statistically significant in all of the gravity models that include 'zeros', under the OLS this variable is negative but not statistically different than zero. This contradiction again implies a potential bias in the estimates of the OLS model.

## Chapter 7: Summary and Conclusions

U.S. FF&V imports have increased by more than 350 percent since 1989. Demand side factors such as increased consumer incomes and changed consumer preferences, as well as supply side factors such as lower trade barriers, have been identified as major contributors of the increase. NTBs and TBTs, most often cited as trade restrictive rather than stimulating, have also played a key role in shaping U.S. FF&V imports.

Due to commitments to increase market access made in the Agreement on Agriculture in the Uruguay Round of WTO negotiations as well as in regional trade agreements, such as NAFTA, the U.S. granted a total of 204 new import permits from 1996 to 2008. These new permits provided new market access to exporters of a specific fresh fruit or vegetable commodity that were previously not allowed to export to the United States. Given this large number of new permit, this thesis assesses the success of the new entrants in terms of contributing to the growing level of fresh fruit and vegetable imports and whether they exported on a continual basis after gaining import eligibility. In addition, this thesis assesses the differences in FF&V exports from new entrants subject to phytosanitary measures relative to those with no such restrictions in place and to determine whether these effects vary by commodity sector and exporter's size.

The major finding of this thesis is that in general, new entrants have contributed little to the growth in U.S. imports of fresh fruits and vegetables. For most commodities, new entrants do not provide a significant proportion of imports potentially because new entrants are not able to compete with existing suppliers. Moreover, it was found that new entrants did not export FF&V to the U.S. on a continual basis since only 44 percent of the entrants exported five years after gaining market access. Of course, there have been several exceptions to this generalization. Imports of Mexican Hass avocados have grown significantly from $1.84 million in 1996 to $497 million in 2008. Other examples of successful entries are the cases of South African oranges and mandarins and clementines where exports of these commodities increased from $0.32 million and $0.26 million in 1997 to $33.5 million and $16.4 million in 2008, respectively. However, these have been exceptions rather than the rule.

A gravity model was used to quantify the differences in exports between new entrants and existing suppliers. The results of the model suggest that new entrants to the U.S. FF&V market are far behind established suppliers in terms of export volumes. The imports flow gap between exporters, ceteris paribus, is 54.2 percent on average initially, however the empirical estimates imply lagged effects where new entrants two years after gaining new market access export 49.8 percent less than rest of the suppliers. The gravity model results indicate that the global export market size of new entrants do not play a role in determining the level of exports by new entrants therefore larger new entrants are equally successful at the U.S FF&V market as smaller entrants. However, an analysis of the size of new entrants reveals that majority of these exporters are relatively small on the global export market. According to the results of the gravity model there are no differences in import flows by new entrants between the two commodity sectors. However there is a significant variation in the effects of NMA across specific commodities.

Finally the results from the gravity model show that the effect of phytosanitary treatments on new entrants varies by treatment type. The requirement to fumigate with methyl bromide has a negative effect on new entrants while requiring cold treatment has a positive effect on new entrants. However the estimated positive effect of cold treatment may be driven by the trade data. For instance, new entrants subject to a cold treatment are the exporters of citrus fruits (e.g. South Africa/oranges, Peru/mandarins & clementines, and etc.) and as shown in Figure 2.3, their exports are greater than those of entrants without a cold treatment requirement. A water treatment requirement had no effect on the exports of new entrants compared to the entrants not subject to that treatment. Finally, new entrants subject to any of the residual treatments (FPRF, HEAT, IRD, CLDorFPRF, and MBForCLD) export significantly less than entrants not facing these treatments.

### 7.1 Limitations

There are few limitations of the model in this study. The first and most important is the concern for the sample size of the NMA instances. As mentioned before, since only 67 of the 204 import permits were accounted for, NMA instances are observed in only 5 percent of the entire sample. This low observations issue could be addressed by expanding the sample products, countries and years. For instance, many of the import permits were granted to countries for exports of herbs or plant parts, therefore the data sample could be enlarged to incorporate these instances.

Another limitation is the nature and volume of the import flows by new entrants. As illustrated in Figure B.1 of Appendix B, over the 13 year period, there is a great variation in imports by new entrants and as a result their flows do not exhibit a particular trend, implying that it is difficult to fit the regression line. A potential solution for this problem is to include only entrants that have exported FF&V on a continual basis. Furthermore, there is another concern pertaining to the import flows of Mexican Hass Avocados, since this instance accounted for more than 50 percent of all annul imports by new entrants in 9 out of the 13 sample years.

Finally, the effects of NMA have been evaluated subject to only one out of the five types of SPS measures: phytosanitary treatments. However, it may be the case that the other four SPS measures play a significant role in determining export flow volumes by new entrants. For example, geographical restrictions on origin and destination were imposed on 33 and 24 percent, while pre-clearance procedures and system approaches in about 20 percent of all NMA instances. Since the model does not include these four factors, there might be a potential omitted variable bias if an excluded SPS measure is correlated with any of the independent variables in the model (e.g. SPS treatment). This limitation could be addressed if all five types of SPS measures are accounted for in the data sample. However the inclusion of pre-clearance procedures, geographic restrictions and system approaches might be difficult since these measures vary by exporter and commodity. With only 13 years of data, there would likely not be sufficient observations to econometrically estimate the effects of these measures.

### 7.2 Future Research

One possible extension of this research would be to consider alternative model specifications of new market access. Modeling new market access with an intercept and slope shifters only identifies difference in exports from new entrants compared to existing suppliers. Thus, the question of whether U.S. granting import permits in number of instance over the 13 year period has been one of the factors to increased U.S. FF&V imports cannot be answered by the model. A potential solution for this is to specify the NMA variable as a continuous variable, for instance by counting the number of years each new entrant has been eligible to export to the U.S. market.

This study touched on the ability of new entrants to enter and sustain a presence in the U.S. FF&V market. Since many of the new entrants were not able to achieve large sales on a continual basis, they may not able to compete with the existing suppliers. A future research might consider the following additional question: if new entrants are able to penetrate the U.S. FF&V market, what is their survival period and what are the factors that determine their survival function (e.g. comparative advantage, efficiency, U.S. – exporter loyalty relationships, etc.). Another interesting question is whether exporters will petition for an import permit to the U.S. for use as a quality signal to other countries. In other words, if regulators in other countries observe that APHIS believes that a country's exporters can minimize any pest-related risks, then they may also allow exports from that country as well. If so, it may be possible that a country that gains new market access has no intentions of exporting to the U.S., but use its U.S. eligibility to gain access to markets in other countries.

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## Appendix A: New Market Access Instances for Fresh Fruits and Vegetables

**Table A.1 Import Permits Granted for Import of FF&V (1996-2008), by Year**

| Year | Country | Commodity | Sector |
|---|---|---|---|
| 1997 | Chile | Babaco | Fruit |
| | Dominican Republic | Eggplant | Vegetable |
| | Honduras | Hyacinth bean | Vegetable |
| | Honduras | Yard long Bean | Vegetable |
| | Korea | Apple, Fuji only | Fruit |
| | Morocco | Strawberry | Fruit |
| | Nicaragua | Broad Bean | Vegetable |
| | Nicaragua | Faba Bean | Vegetable |
| | Nicaragua | Green Bean | Vegetable |
| | Nicaragua | Mung Bean | Vegetable |
| | Peru | Blueberry | Fruit |
| | South Africa | Globe Artichokes | Vegetable |
| | South Africa | Grapefruit | Fruit |
| | South Africa | Lemons | Fruit |
| | South Africa | Lime | Fruit |
| | South Africa | Mandarins, clementines, satsumas | Fruit |
| | South Africa | Orange | Fruit |
| | Uruguay | Plum | Fruit |
| 1998 | Anguilla | Singhara nut | Vegetable |
| | Antigua and Barbuda | Singhara nut | Vegetable |
| | Bahamas | Singhara nut | Vegetable |
| | Barbados | Singhara nut | Vegetable |
| | Belgium | Leeks | Vegetable |
| | Brazil | Papaya | Fruit |
| | Brazil | Watermelon | Fruit |
| | Cayman Islands | Singhara nut | Vegetable |
| | Chile | Tomatoes | Vegetable |
| | Costa Rica | Mango | Fruit |
| | Dominica | Singhara nut | Vegetable |
| | Dominican Republic | Singhara nut | Vegetable |
| | Dominican Republic | Yard long Bean | Vegetable |
| | Ecuador | Broccoli | Vegetable |
| | Ecuador | Brussels sprouts | Vegetable |
| | Ecuador | Cauliflower | Vegetable |
| | Ecuador | Chicory | Vegetable |
| | Ecuador | Radicchio | Vegetable |
| | El Salvador | Eggplant | Vegetable |
| | France | Tomato (other than green) | Vegetable |
| 1998 | Grenada Is | Singhara nut | Vegetable |
| | Guadaloupe | Singhara nut | Vegetable |
| | Guatemala | Rhubarb | Fruit |
| | Haiti | Singhara nut | Vegetable |
| | Jamaica | Singhara nut | Vegetable |
| | Martinique | Singhara nut | Vegetable |
| | Mexico | Avocado, Hass | Fruit |
| | Mexico | Cherry | Fruit |

**Table A.1 Continued**

| Year | Country | Commodity | Sector |
|---|---|---|---|
| 1998 | Mexico | Ethrog | Fruit |
| | Mexico | Plum | Fruit |
| | Montserrat | Singhara nut | Vegetable |
| | Morocco | Tomato (other than green) | Vegetable |
| | Netherlands | Leeks | Vegetable |
| | Nicaragua | Chicory | Vegetable |
| | Nicaragua | Eggplant | Vegetable |
| | Nicaragua | Radicchio | Vegetable |
| | Panama | Belgian Endive | Vegetable |
| | Panama | Chicory | Vegetable |
| | Panama | Endive | Vegetable |
| | Peru | Swiss chard | Vegetable |
| | Romania | Garlic | Vegetable |
| | Saint Kitts and Nevis | Singhara nut | Vegetable |
| | Saint Lucia | Singhara nut | Vegetable |
| | Saint Vincent and the Grenadines | Singhara nut | Vegetable |
| | South Africa | Pineapple | Fruit |
| | Spain | Ortanique | Fruit |
| | Spain | Pepper | Vegetable |
| | St. Eustatius | Singhara nut | Vegetable |
| | St. Martin | Singhara nut | Vegetable |
| | Turks and Caicos Islands | Singhara nut | Vegetable |
| | Venezuela | Cantaloupe | Fruit |
| | Venezuela | Honeydew Melon | Fruit |
| | Venezuela | Watermelon | Fruit |
| | Virgin Islands, British | Singhara nut | Vegetable |
| | Western Sahara | Tomatoes | Vegetable |
| 2000 | Argentina | Grapefruit | Fruit |
| | Argentina | Lemons | Fruit |
| | Argentina | Orange | Fruit |
| | Bulgaria | Garlic | Vegetable |
| | Peru | Radicchio | Vegetable |
| | Argentina | Kiwi | Fruit |
| 2001 | El Salvador | Papaya | Fruit |
| | Guatemala | Papaya | Fruit |
| | Honduras | Papaya | Fruit |
| | Mexico | Carambola | Fruit |
| | Nicaragua | Papaya | Fruit |
| | Panama | Papaya | Fruit |
| | Philippines | Mango | Fruit |
| | Spain | Eggplant | Vegetable |
| | Spain | Kiwi | Fruit |
| | Spain | Lettuce | Vegetable |
| | Spain | Watermelon | Fruit |
| 2002 | Chile | Passion Fruit | Fruit |
| | Honduras | Mango | Fruit |
| 2003 | Belize | Rambutan | Fruit |

**Table A.1 Continued**

| Year | Country | Commodity | Sector |
|---|---|---|---|
| | Bulgaria | Strawberry | Fruit |
| 2003 | Bulgaria | Vaccinium spp. (Cranberries&Blueberries) | Fruit |
| | Chile | Pepper | Vegetable |
| | China | Longan | Fruit |
| | Colombia | Cape gooseberry | Fruit |
| | Colombia | Pitahaya, yellow | Fruit |
| | Costa Rica | Rambutan | Fruit |
| | El Salvador | Blackberry | Fruit |
| | El Salvador | Fennel | Vegetable |
| | El Salvador | Jicama Root | Vegetable |
| | El Salvador | Rambutan | Fruit |
| | Guatemala | Fennel | Vegetable |
| | Guatemala | Rambutan | Fruit |
| | Honduras | Jicama Root | Vegetable |
| | Honduras | Rambutan | Fruit |
| | Mexico | Rambutan | Fruit |
| | Nicaragua | Fennel | Vegetable |
| | Nicaragua | Jicama Root | Vegetable |
| | Nicaragua | Naranjilla | Fruit |
| | Nicaragua | Rambutan | Fruit |
| | Nicaragua | Tomato (green only) | Vegetable |
| | Nicaragua | Yam Been Root | Vegetable |
| | Panama | Rambutan | Fruit |
| | Spain | Persimmons | Fruit |
| 2005 | Chile | Clementine | Fruit |
| | Chile | Kiwanos Melon | Vegetable |
| | Chile | Mandarin | Fruit |
| | Chile | Tangerine | Fruit |
| | Dominican Republic | Mango | Fruit |
| | Grenada Is | Atemoya | Fruit |
| | Grenada Is | Cherimoya | Fruit |
| | Grenada Is | Custard Apple | Fruit |
| | Grenada Is | Soursop | Fruit |
| | Grenada Is | Sugar Apple | Fruit |
| | Korea | Cucumber | Vegetable |
| | Korea | Oriental melon | Fruit |
| | Korea | Squash | Vegetable |
| | Korea | Watermelon | Fruit |
| | Mexico | Pitaya | Fruit |
| | Peru | Melon (cantaloupe, honeydew, netted) | Fruit |
| | Peru | Watermelon | Fruit |
| | Peru | Winter melon | Vegetable |
| 2006 | Belgium | Endive | Vegetable |
| | China | Fragrant Pear | Fruit |
| | China | Ya Pear | Fruit |
| | Colombia | Blueberry | Fruit |
| | Costa Rica | Pepper | Vegetable |
| | Costa Rica | Tomato (red or pink) | Vegetable |

**Table A.1 Continued**

| Year | Country | Commodity | Sector |
|---|---|---|---|
| 2006 | El Salvador | Pepper | Vegetable |
| | El Salvador | Tomato (red or pink) | Vegetable |
| | Guatemala | Endive | Vegetable |
| | Guatemala | Pepper | Vegetable |
| | Guatemala | Tomato (red or pink) | Vegetable |
| | Honduras | Pepper | Vegetable |
| | Honduras | Tomato (red or pink) | Vegetable |
| | Namibia | Grapes | Fruit |
| | Netherlands | Endive | Vegetable |
| | Nicaragua | Pepper | Vegetable |
| | Nicaragua | Tomato (red or pink) | Vegetable |
| | Panama | Tomato (red or pink) | Vegetable |
| | Peru | Grapefruit | Fruit |
| | Peru | Lime | Fruit |
| | Peru | Mandarin | Fruit |
| | Peru | Orange, sweet | Fruit |
| | Peru | Tangelo | Fruit |
| | Peru | Tangerine | Fruit |
| | Spain | Clementine | Fruit |
| | Spain | Squash | Vegetable |
| | Zambia | Baby Carrots | Vegetable |
| | Zambia | Baby Corn | Vegetable |
| 2007 | Argentina | Chicory | Vegetable |
| | Belgium | Belgian Endive | Vegetable |
| | Bolivia | Chicory | Vegetable |
| | Brazil | Chicory | Vegetable |
| | Dominican Republic | Jackfruit | Fruit |
| | El Salvador | Chicory | Vegetable |
| | Ghana | Eggplant | Vegetable |
| | Ghana | Okra | Vegetable |
| | Ghana | Pepper | Vegetable |
| | India | Mango | Fruit |
| | Israel | New Zealand Spinach | Vegetable |
| | Kenya | Baby Carrots | Vegetable |
| | Kenya | Baby Corn | Vegetable |
| | Kenya | Garden Pea | Vegetable |
| | Mexico | Endive | Vegetable |
| | Mexico | Persian Lime | Fruit |
| | Mexico | Yard long Bean | Vegetable |
| | New Zealand | Grapefruit | Fruit |
| | New Zealand | Lemons | Fruit |
| | New Zealand | Lime | Fruit |
| | New Zealand | Mandarins and clementines | Fruit |
| | New Zealand | Orange | Fruit |
| | South Africa | Blueberry | Fruit |
| | South Africa | Currant | Fruit |
| | South Africa | Gooseberry | Fruit |
| | Thailand | Litchi | Fruit |

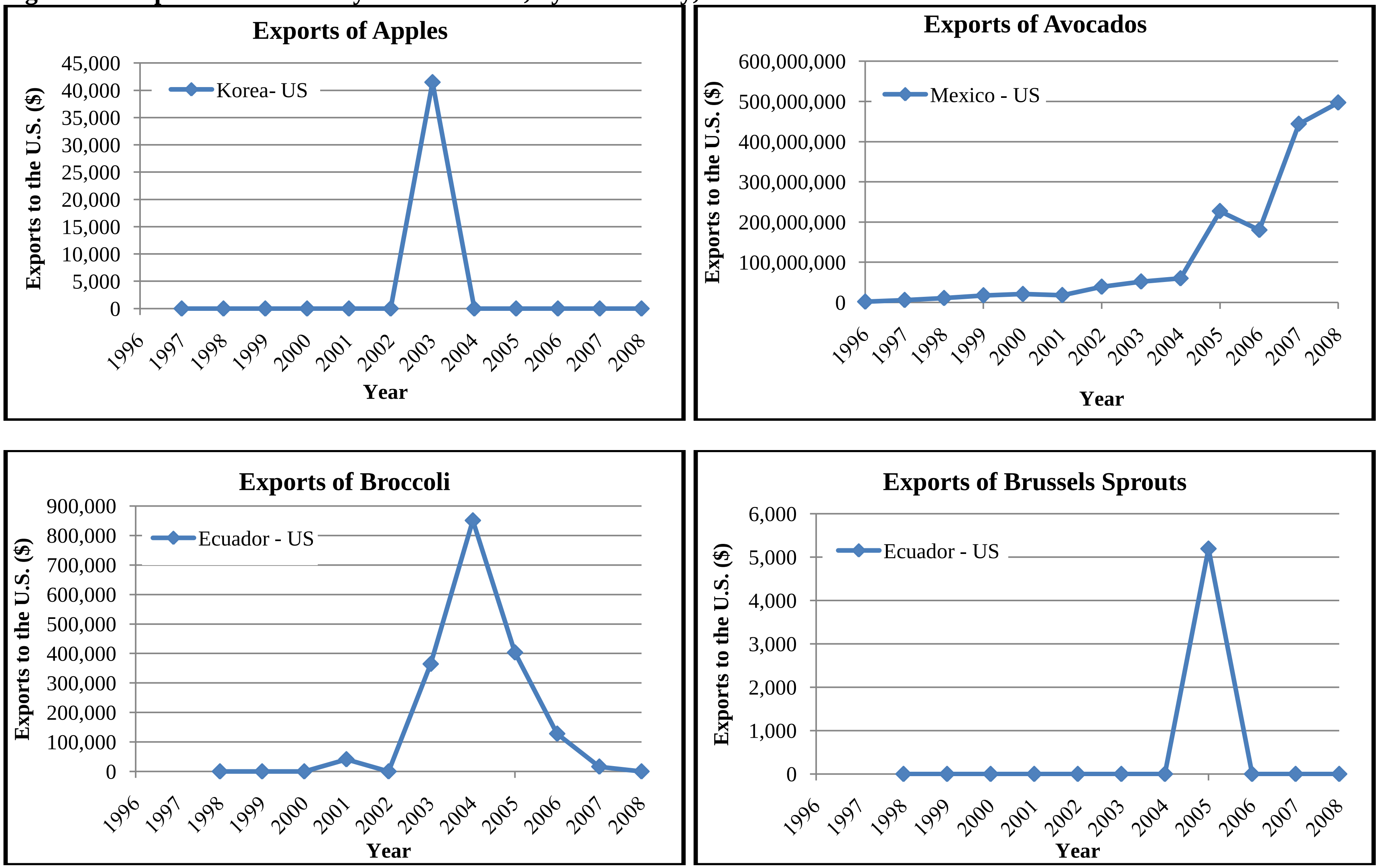
**Table A.1 Continued**

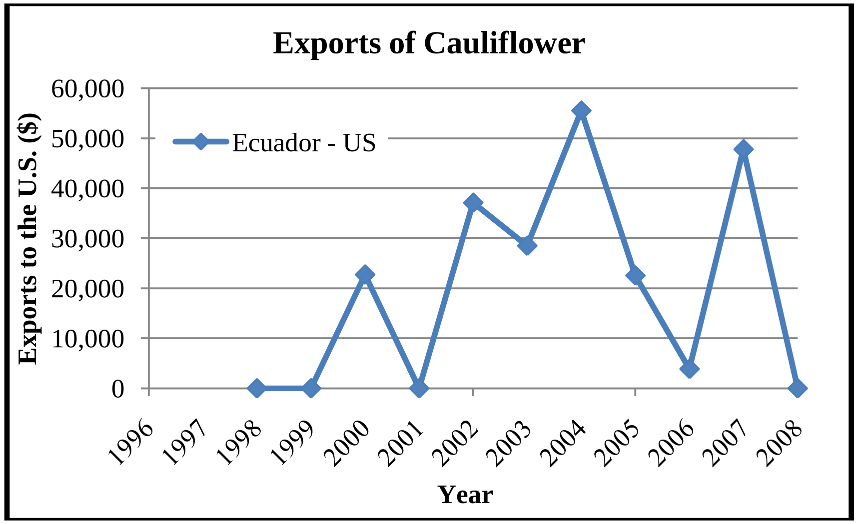
| Year | Country | Commodity | Sector |
|---|---|---|---|
| 2007 | Thailand | Longan | Fruit |
| | Thailand | Mango | Fruit |
| | Thailand | Mangosteen | Fruit |
| | Thailand | Pineapple | Fruit |
| | Thailand | Rambutan | Fruit |
| | Uruguay | Blueberry | Fruit |
| | Uruguay | Chicory | Vegetable |
| | Venezuela | Chicory | Vegetable |
| 2008 | Guatemala | Blueberry | Fruit |
| | Korea | Plantain | Fruit |
| | Morocco | Nectarine | Fruit |
| | Netherlands | Nectarine | Fruit |
| | Panama | Arugula | Vegetable |
| | United Kingdom | Nectarine | Fruit |
| | VietNam | Dragon Fruit | Fruit |

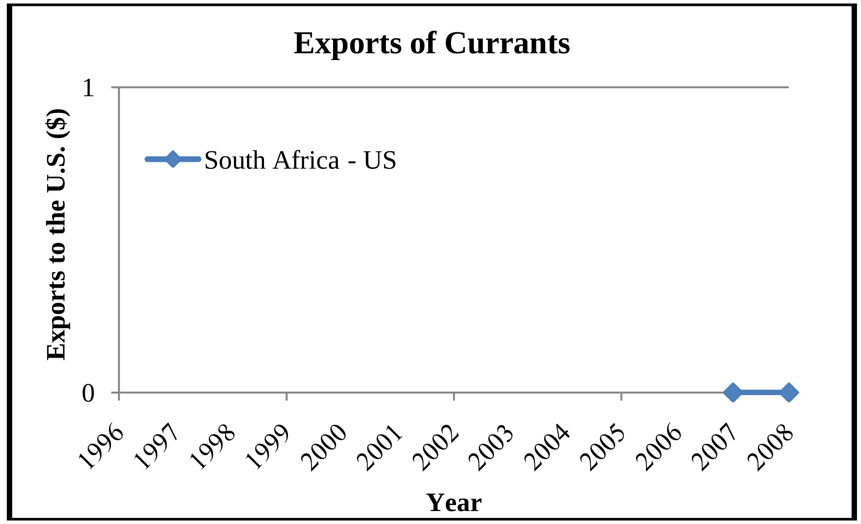
Source: Karov *et al*., (2009)

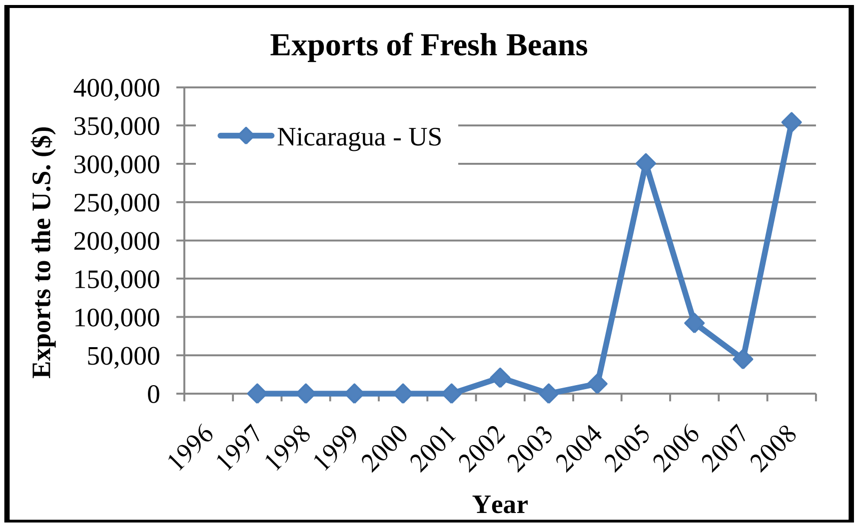
**Appendix B: Exports to the U.S. by New Entrants**

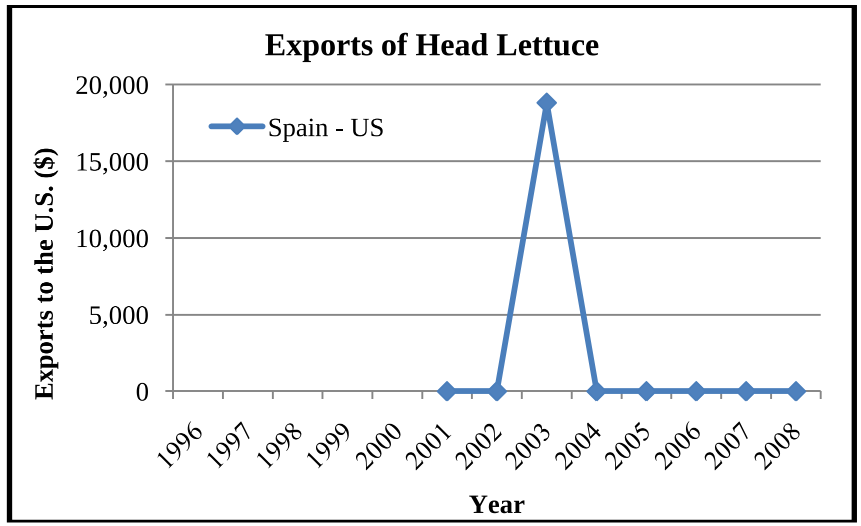
**Figure B.1 Exports to the U.S. by New Entrants, by commodity, 1996-2008**

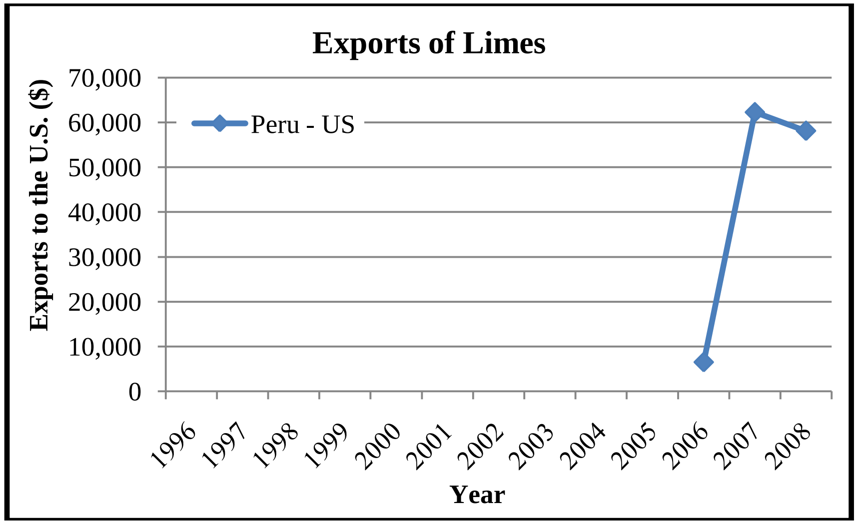


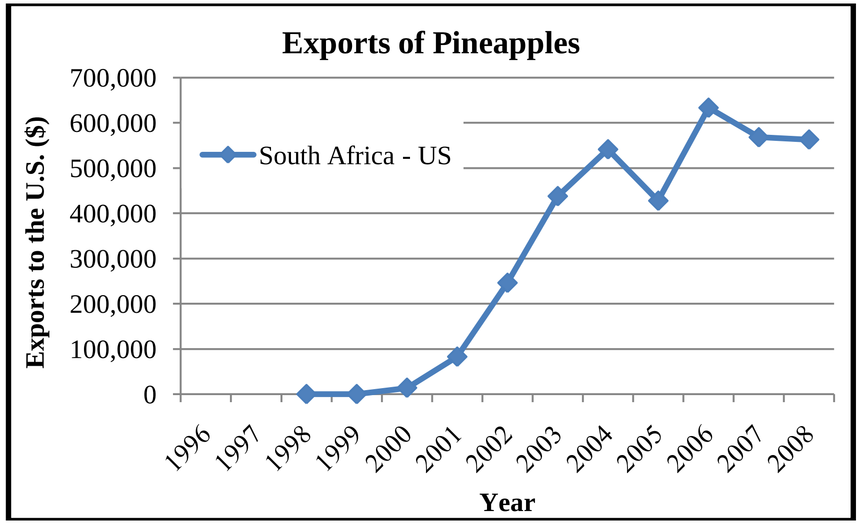

Exports of Cauliflower
Ecuador - US
Exports to the U.S. ($)
60,000
50,000
40,000
30,000
20,000
10,000
0
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
Year

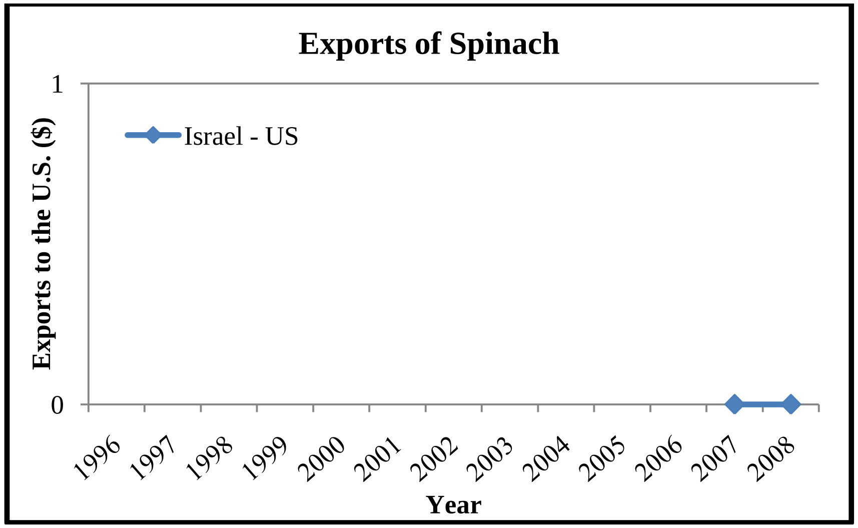

Exports of Currants
South Africa - US
Exports to the U.S. ($)
1
0
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
Year

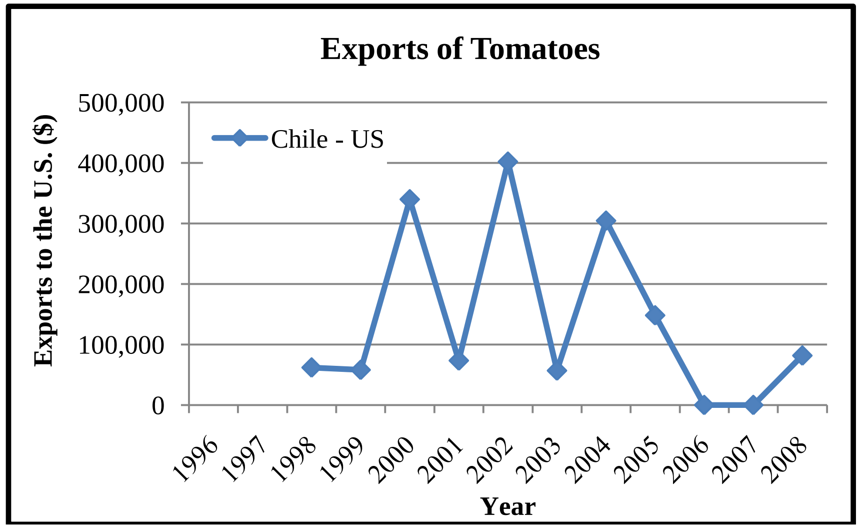

Exports of Fresh Beans
Nicaragua - US
Exports to the U.S. ($)
400,000
350,000
300,000
250,000
200,000
150,000
100,000
50,000
0
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
Year

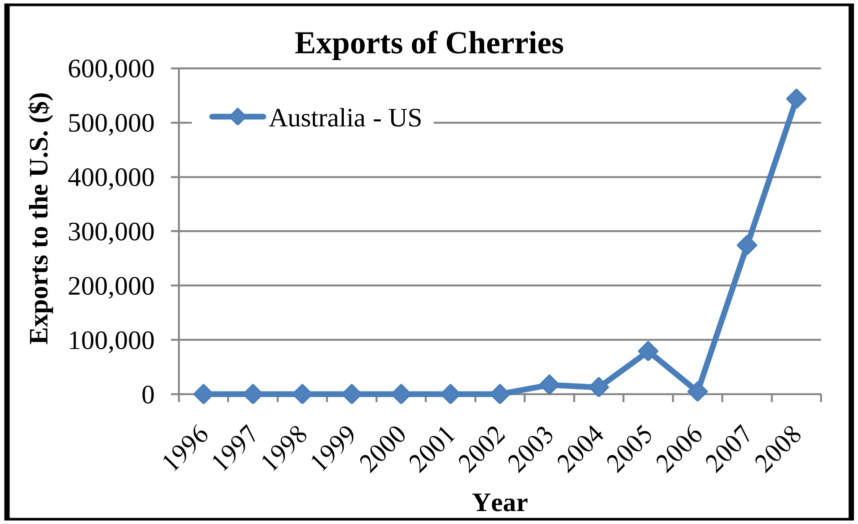

Exports of Head Lettuce
Spain - US
Exports to the U.S. ($)
20,000
15,000
10,000
5,000
0
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
Year

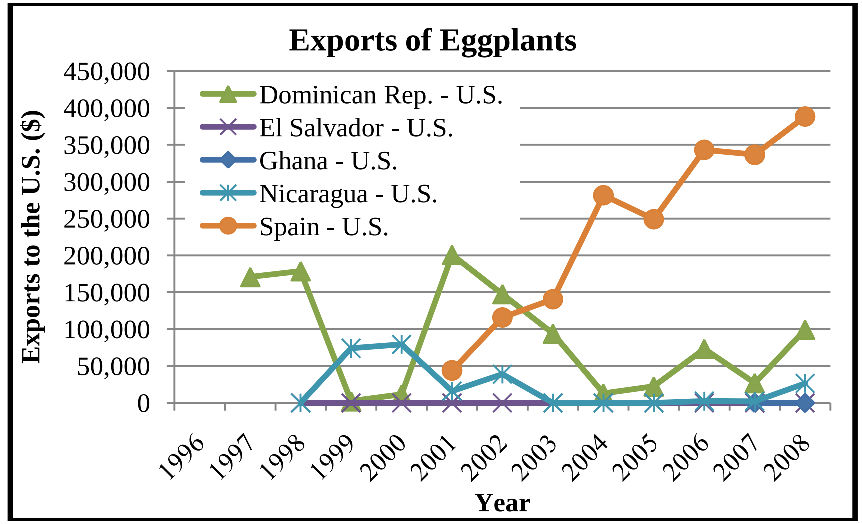

Exports of Limes
Exports to the U.S. ($)
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
Peru - US
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
Year

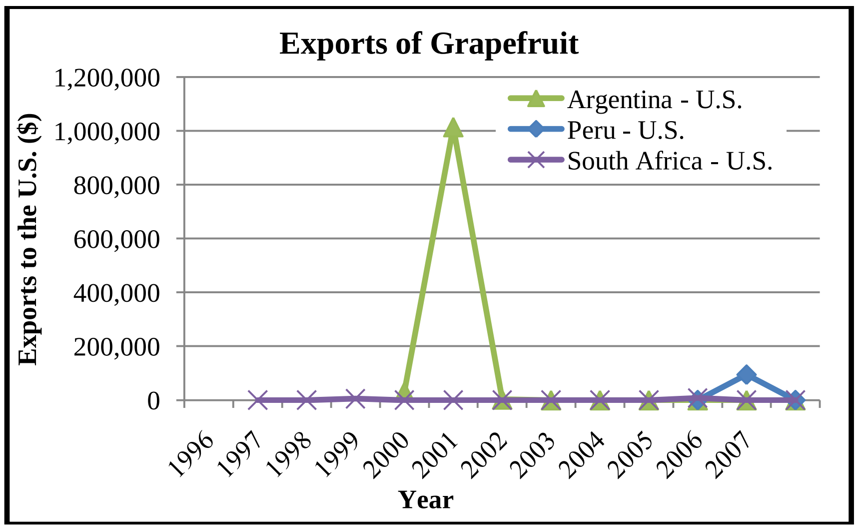

Exports of Pineapples
Exports to the U.S. ($)
700,000
600,000
500,000
400,000
300,000
200,000
100,000
0
South Africa - US
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
Year

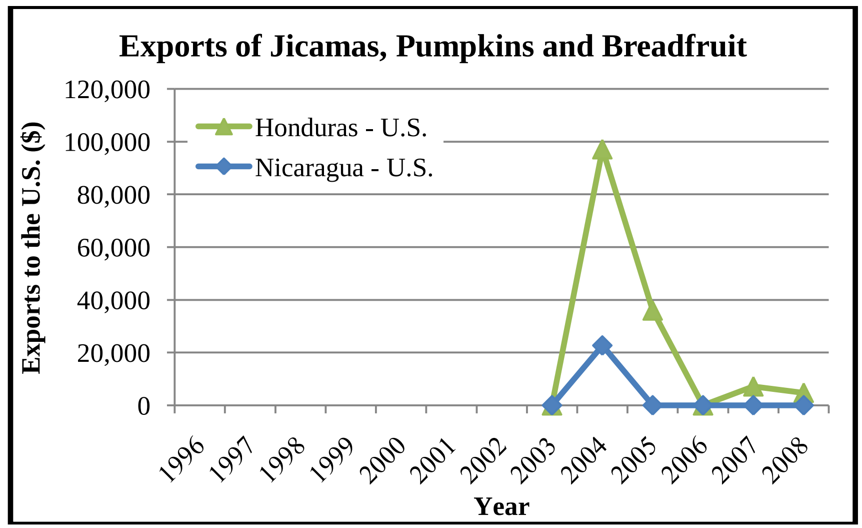

Exports of Spinach
Exports to the U.S. ($)
1
0
Israel - US
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
Year

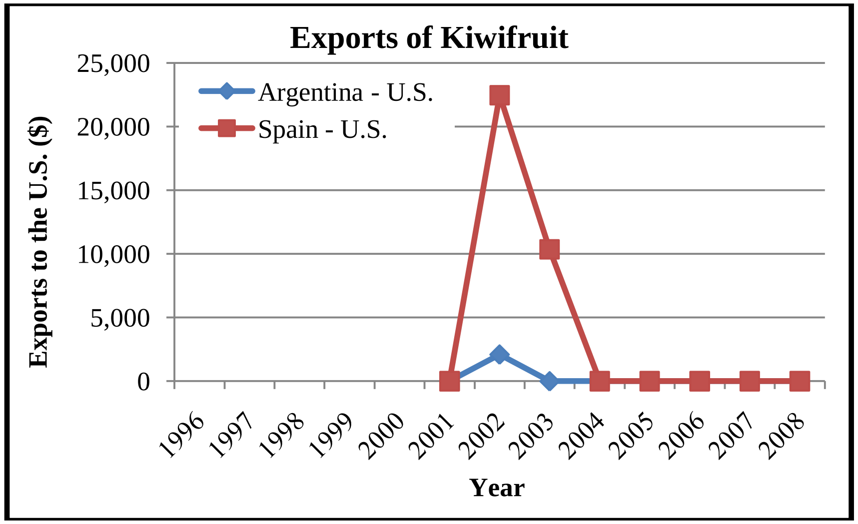

Exports of Tomatoes
Exports to the U.S. ($)
500,000
400,000
300,000
200,000
100,000
0
Chile - US
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
Year

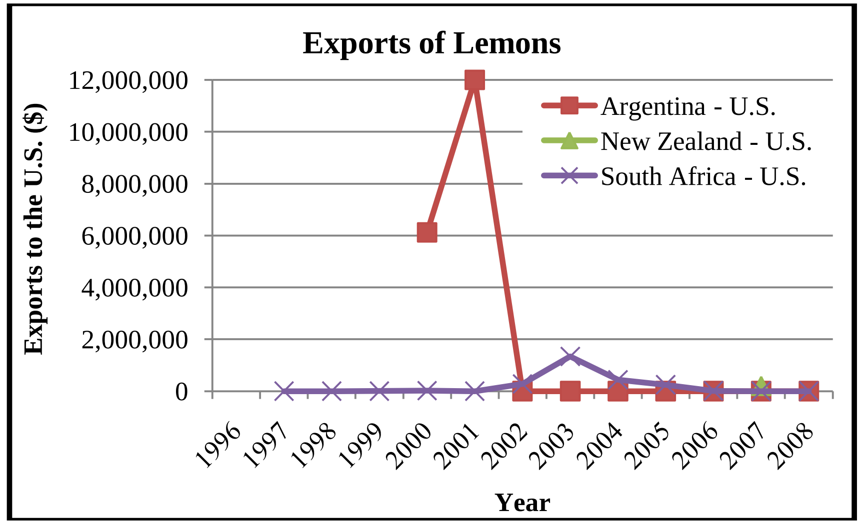

Exports of Cherries
Exports to the U.S. ($)
600,000
500,000
400,000
300,000
200,000
100,000
0
Australia - US
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
Year

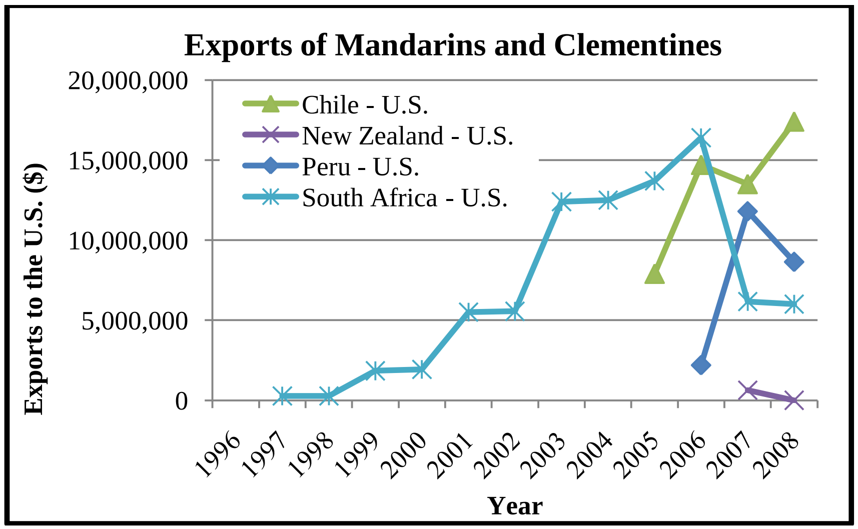

Exports of Eggplants
Exports to the U.S. ($)
450,000
400,000
350,000
300,000
250,000
200,000
150,000
100,000
50,000
0
Dominican Rep. - U.S.
El Salvador - U.S.
Ghana - U.S.
Nicaragua - U.S.
Spain - U.S.
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
Year

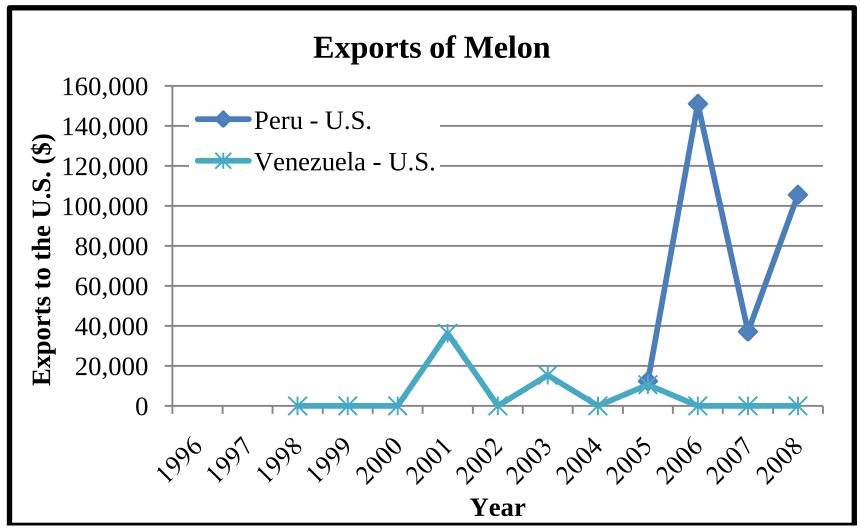

Exports of Grapefruit
Exports to the U.S. ($)
1,200,000
1,000,000
800,000
600,000
400,000
200,000
0
Argentina - U.S.
Peru - U.S.
South Africa - U.S.
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
Year

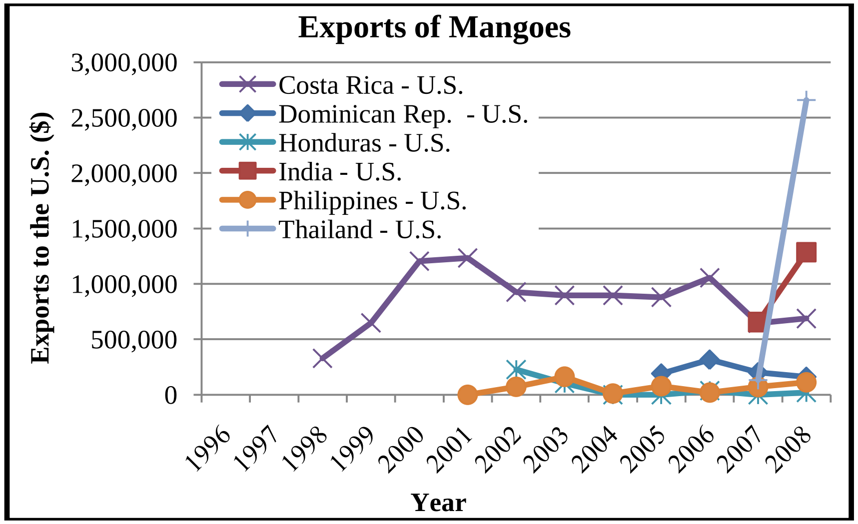

Exports of Jicamas, Pumpkins and Breadfruit
Exports to the U.S. ($)
120,000
100,000
80,000
60,000
40,000
20,000
0
Honduras - U.S.
Nicaragua - U.S.
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
Year

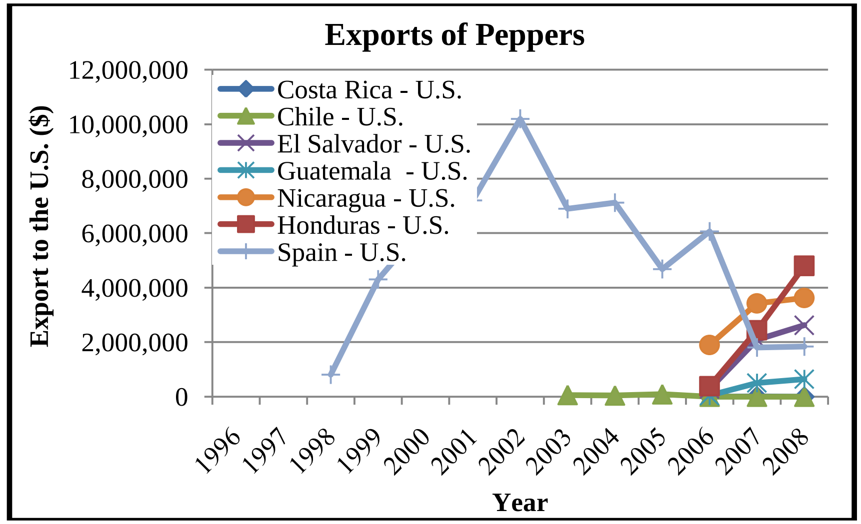

Exports of Kiwifruit
Exports to the U.S. ($)
25,000
20,000
15,000
10,000
5,000
0
Argentina - U.S.
Spain - U.S.
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
Year

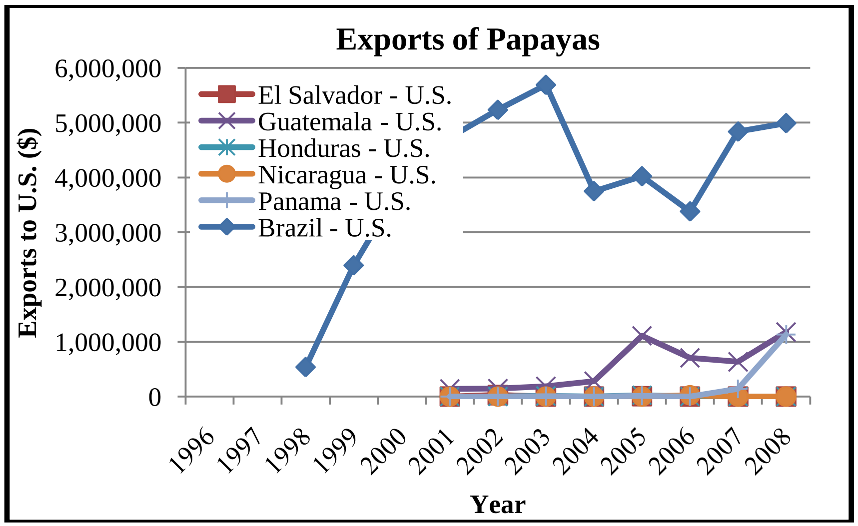

Exports of Lemons
Exports to the U.S. ($)
12,000,000
10,000,000
8,000,000
6,000,000
4,000,000
2,000,000
0
Argentina - U.S.
New Zealand - U.S.
South Africa - U.S.
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
Year

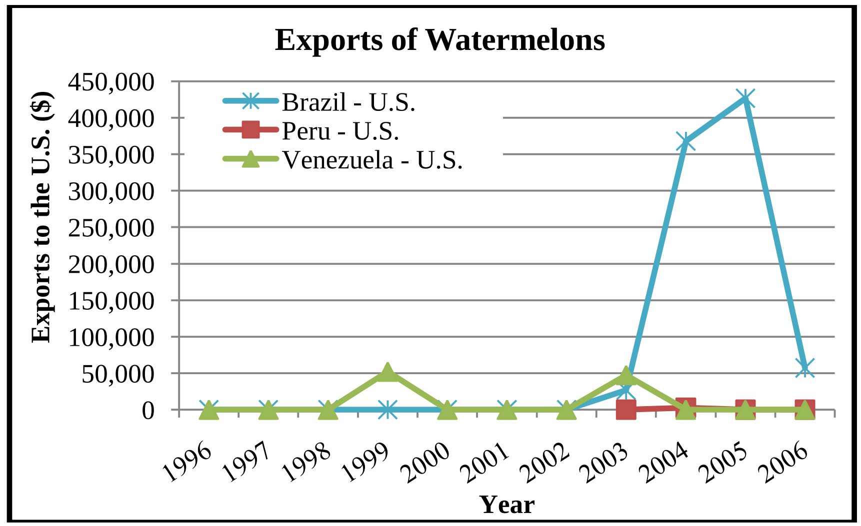

Exports of Mandarins and Clementines
Exports to the U.S. ($)
20,000,000
15,000,000
10,000,000
5,000,000
0
Chile - U.S.
New Zealand - U.S.
Peru - U.S.
South Africa - U.S.
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
Year

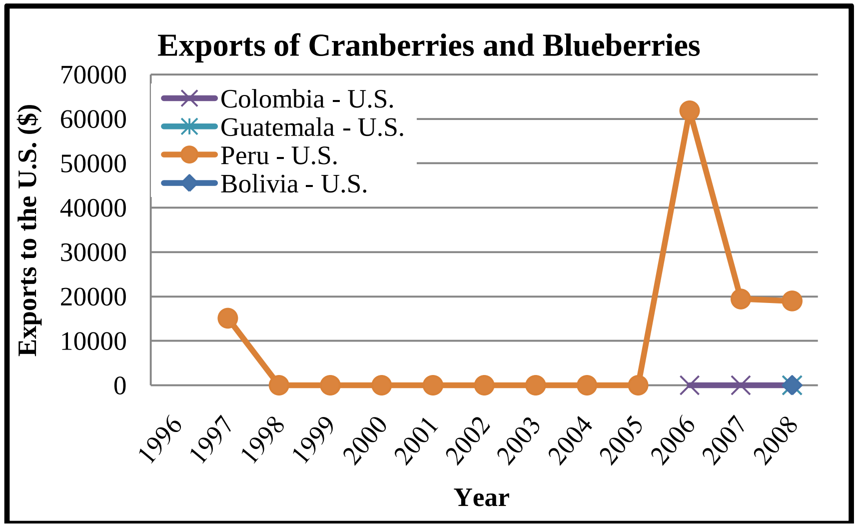

Exports of Melon
Exports to the U.S. ($)
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
Peru - U.S.
Venezuela - U.S.
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
Year

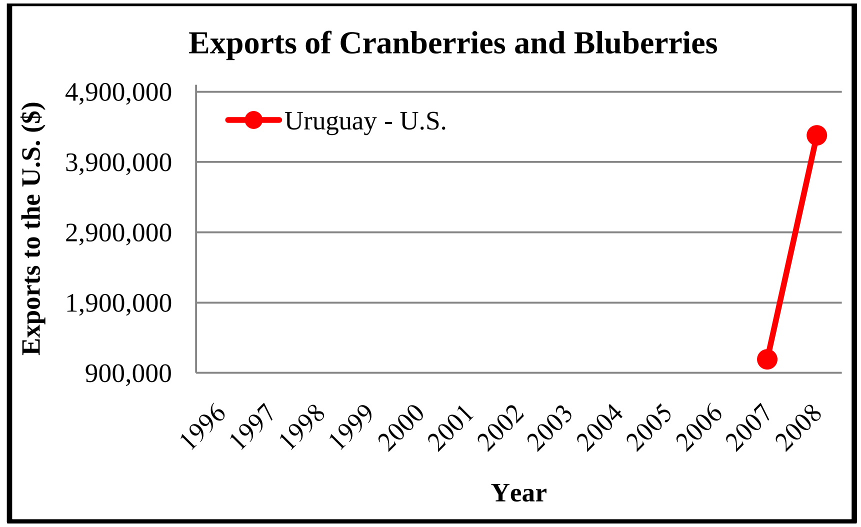

Exports of Mangoes
Exports to the U.S. ($)
3,000,000
2,500,000
2,000,000
1,500,000
1,000,000
500,000
0
Costa Rica - U.S.
Dominican Rep. - U.S.
Honduras - U.S.
India - U.S.
Philippines - U.S.
Thailand - U.S.
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
Year

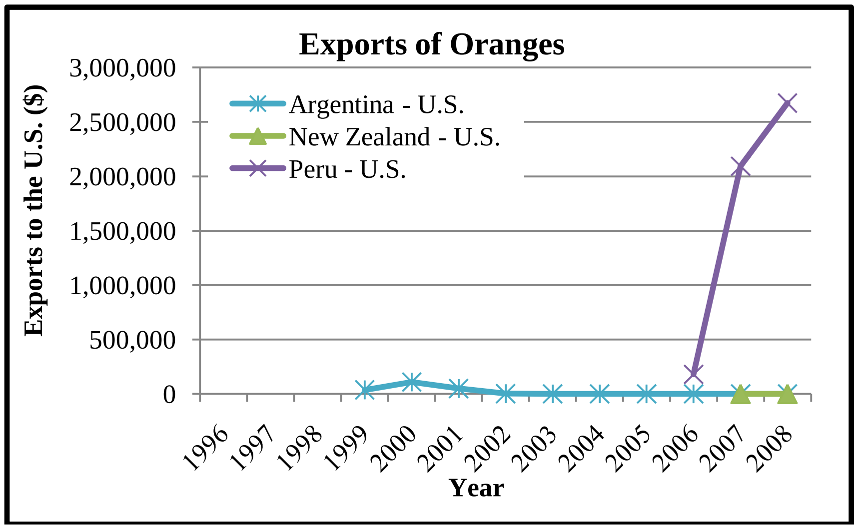

Exports of Peppers
Export to the U.S. ($)
12,000,000
10,000,000
8,000,000
6,000,000
4,000,000
2,000,000
0
Costa Rica - U.S.
Chile - U.S.
El Salvador - U.S.
Guatemala - U.S.
Nicaragua - U.S.
Honduras - U.S.
Spain - U.S.
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
Year

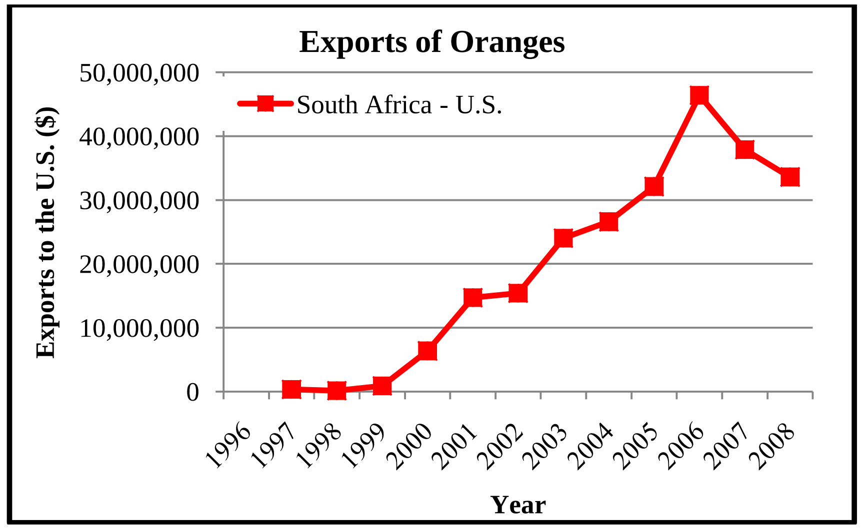

Exports of Papayas
Exports to U.S. ($)
6,000,000
5,000,000
4,000,000
3,000,000
2,000,000
1,000,000
0
El Salvador - U.S.
Guatemala - U.S.
Honduras - U.S.
Nicaragua - U.S.
Panama - U.S.
Brazil - U.S.
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
Year


Exports of Watermelons
Exports to the U.S. ($)
450,000
400,000
350,000
300,000
250,000
200,000
150,000
100,000
50,000
0
Brazil - U.S.
Peru - U.S.
Venezuela - U.S.
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
Year


Exports of Cranberries and Blueberries
Colombia - U.S.
Guatemala - U.S.
Peru - U.S.
Bolivia - U.S.
Exports to the U.S. ($)
70000
60000
50000
40000
30000
20000
10000
0
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
Year


Exports of Cranberries and Bluberries
Uruguay - U.S.
Exports to the U.S. ($)
4,900,000
3,900,000
2,900,000
1,900,000
900,000
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
Year


Exports of Oranges
Argentina - U.S.
New Zealand - U.S.
Peru - U.S.
Exports to the U.S. ($)
3,000,000
2,500,000
2,000,000
1,500,000
1,000,000
500,000
0
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
Year


Exports of Oranges
South Africa - U.S.
Exports to the U.S. ($)
50,000,000
40,000,000
30,000,000
20,000,000
10,000,000
0
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
Year

## Appendix C: Application for Permit to Import Plants and Plant Products

The following document is the PPQ 587 form which U.S. agents use to request permit from APHIS/USDA to import plants and plant products.

According to the Paperwork Reduction Act of 1995, an agency may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a valid OMB control number. The valid OMB control numbers for this information collection are 0579-0049, 0172, 0173, and 0319. The time required to complete this information collection is estimated to average .5 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information.

**OMB APPROVED**
**0579-0049, 0172,**
**0173, 0293, and 0319**

**U.S. DEPARTMENT OF AGRICULTURE**
**ANIMAL AND PLANT HEALTH INSPECTION SERVICE**
**PLANT PROTECTION AND QUARANTINE**

**APPLICATION FOR PERMIT TO IMPORT PLANTS OR PLANT PRODUCTS**

**INSTRUCTIONS: PLEASE TYPE OR PRINT CLEARLY. PERMITS ARE NOT ISSUED TO P.O. BOXES. READ THE ENTIRE APPLICATION BEFORE COMPLETING. ATTACH ADDITIONAL SHEETS OF PAPER IF MORE SPACE IS NEEDED.**

**FORWARD COMPLETED APPLICATION TO:**
**USDA-APHIS-PPQ**
**Permit Unit**
**4700 River Road, Unit 133**
**Riverdale, MD 20737-1236**
**1-877-770-5990; FAX: (301) 734-5786**

**1. NAME AND UNITED STATES ADDRESS OF U.S. RESIDENT/LEGAL ALIEN:**

**APPLICANT'S NAME:**

**ORGANIZATION NAME:**

**U.S. ADDRESS (*Include City, State, and ZIP Code*):**

**PHONE:** **FAX:**

**E-MAIL:**

**MAILING ADDRESS (*if different than physical address*):**

**2. PLANTS OR PLANT PRODUCTS TO BE IMPORTED:**

| Country of Origin (*Province or territory, if applicable*) | Scientific Names of Plants or Plant Products | Plant Parts (*seeds, cuttings, rhizomes, plants, bulbs, fruits, etc.*) | U.S. Port or Ports of Arrival |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

**3. INTENDED USE:** ☐ Plants/parts for planting (*Nursery stock*) ☐ Small lots of seed ☐ Fruit and vegetables ☐ Other

**4. MEANS OF IMPORTATION:** ☐ Mail or Express carrier ☐ Cargo shipment ☐ Personal baggage or car

| 5. SIGNATURE OF APPLICANT: | 6. PRINTED NAME OF APPLICANT: | 7. DATE: |
|---|---|---|
| | | |

**PPQ FORM 587 (MD)**
**JUL 2009**

**WARNING: Any alteration, forgery, or unauthorized use of this document is subject to civil penalties of up to $250,000 (7 U.S.C. 7734(b)) or punishable by a fine of not more than $10,000, or imprisonment of not more than 5 years, or both (18 U.S.C. 1001).**

## Instructions for completing PPQ Form 587
## Application for Permit to Import Plants or Plant Products

**Please TYPE or PRINT legibly to complete. You must complete all of the boxes.**

1. Enter the name and street address of the person responsible for the importation. The applicant must be a United States resident. Enter the organization or company name, if applicable. A physical address of the facility or business is required. You may include a post office box address **in addition** to the street address for mailing purposes. Enter your daytime telephone number, including the Area Code. Enter your facsimile number, including the Area Code. Enter your e-mail address if applicable.

2. In the first column, enter a country or countries (if from Canada include Province, if from Mexico include State) from which you want to import the plants or plant products (the term **"various"** will **not** be accepted). In the second column, enter the scientific (Latin) name of each plant. If you do not know the scientific name(s), try to find out from the exporter. As a last resort, enter the English common name(s). In the third column, enter the type of plant parts you plan to import for each species. In the fourth column, enter the City and State of the preferred port(s) of arrival. If you do not know the port, enter "N/A." (Check your permit when you receive it for the approved ports.)

3. Check the appropriate box. Select "Plants for planting", if the plants/plant parts you want to import will be planted or sold for planting. Select "Small lots of seed" if you want to import under the small lots of seed program (see below*). Select "Fruits and Vegetables" if you are importing fruits and vegetables for consumption or resale. Select "Other" if the article you want to import does not fall into any of the other categories. List the category or additional information needed to describe the article (i.e., Cut flowers, broomcorn, etc...). *** Special instructions for small lots of seed:** Small lots of eligible seed may be imported without a phytosanitary certificate with a written permit. See the permit unit website (http://www.aphis.usda.gov/import_export/plants/plant_imports/ smalllots_seed.shtml) for help in determining eligibility. In part #2 list the seed species and countries from which you want to ship each species. If the list of species and/or countries of origin is long, you may enter "eligible taxa." By using this option, you are accepting responsibility for determining the eligibility of the seeds. A permit is issued for taxa that are enterable with no restrictions beyond port of entry inspection. If port of entry inspectors find prohibited or restricted seeds in your shipment, they will remove the ineligible kinds.

4. Check the appropriate box or boxes that apply to the means of importation.

5. The applicant named in box #1 must sign the form.

6. Printed name of person who signed the form.

7. Enter the date the form is completed and signed.

**If you attach additional sheets of paper, type or print PPQ Form 587, the applicant's name, and the company name at the top of each page.**

Send the completed application by facsimile to (301) 734-5786, or mail to:

USDA-APHIS-PPQ
Permit Unit
4700 River Road, Unit 133
Riverdale, MD 20737-1236

Call our automated phone number at 1-877-770-5990 if you have questions.

**Appendix D: Specification of the Generic Gravity Model (Case 1)**

The entire dataset contains 14,551 observations, but the 7,129 and 6,082 observations were generates after dropping 5,456 ineligible trade flows and 40 observations with zero production levels, as well as accounting for, 1,644 missing exporter production values, 520 (263 different from exporter production) missing global export market share values, 3 (1 different than exporter share and production) missing U.S. customs values, 28 (13) missing U.S. production values, 12 (5) missing tariff rates and finally 2,273 (1,047) missing values due to two period lags of NMA.

This study uses an already existing dataset for the period of 1996 through 2007, which has been updated to contain the year of 2008 as well as to include other relevant independent variables related to NMA, and their potential joint effects on U.S. FF&V imports. The major additions and alterations to the data include: adding an additional year's worth of data for the year of 2008 and the addition of the U.S. - world price ratio and bilateral applied tariff rates. In order to specify the generic model presented in Table 6.1, auxiliary regressions were run after every step of the gradual transformation of the data sample used by Karov *et al*. (2009). The purpose of using this model development method is threefold: 1) to establish a connection between the models of Karov *et al*., (2009) and this thesis 2) to show the changes in the results of Karov *et al*., (2009) base model [52] due to adding an additional year and some independent variables and 3) to lay out the building blocks of the generic model used in this thesis.

It is important to mention that the coefficient estimates of the auxiliary regressions are very similar to those in the base model estimated by Karov *et al*. (2009). In summary, as a result

[52] Scenario 1 is the base model Karov *et al*. (2009) used to assess the effects of SPS treatments on U.S. Imports of FF&V.

the aforementioned dataset changes, the marginal effect of phytosanitary treatments and NMA dropped from 88 percent to 85 percent and from 65 percent to 47 percent, respectively.

**Appendix E: Stata Code**

1. **Gravity Models Estimated with the PPML Estimator (Cases 1 through 6)**

**Case 1:**

```
poisson cvalue ldist lusprod lrowprod_iplte1 nafta_frt nafta_veg cafta_dr fta fruit trend ler
lshriexp mainland treat treat_lshriexp lus_row_price ltarahs1d nma_all, rob
```

Marginal Effect of NMA:

```
nlcom (m4_nma_all: (exp(_b[nma_all])-1)*100)
```

**Case 2:**

```
poisson cvalue ldist lusprod lrowprod_iplte1 nafta_frt nafta_veg cafta_dr fta fruit trend ler
lshriexp mainland treat treat_lshriexp lus_row_price ltarahs1d nma_all nma_1 nma_2, rob
```

Marginal Effects of NMA:

```
nlcom (m5_nma_1: (exp(_b[nma_all]+ _b[nma_1])-1)*100)
nlcom (m5_nma_2: (exp(_b[nma_all]+ _b[nma_1]+_b[nma_2])-1)*100)
```

Paired t-test code:

```
ttest nma_all=nma_2 if e(sample)
```

**Case 3:**

```
poisson cvalue ldist lusprod lrowprod_iplte1 nafta_frt nafta_veg cafta_dr fta fruit trend ler
lshriexp mainland treat treat_lshriexp lus_row_price ltarahs1d nma_all nma_1 nma_2
nma_lshriexp, rob
```

Marginal Effect of NMA:

```
quietly summarize lshriexp if e(sample) & nma_all==1
local meanlshr = r(mean)
nlcom (m6_lshr: (exp(_b[nma_all]+ _b[nma_1] + _b[nma_2] +  _b[nma_lshriexp]*
`meanlshr')-1)*100)
```

**Case 4:**

```
poisson cvalue ldist lusprod lrowprod_iplte1 nafta_frt nafta_veg cafta_dr fta fruit trend ler
lshriexp mainland treat treat_lshriexp lus_row_price ltarahs1d nma_all nma_1 nma_2
nma_lshriexp nma_frt, rob
```

Marginal Effect of NMA:

```
quietly summarize lshriexp if e(sample) & nma_all==1
local meanlshr = r(mean)
quietly summarize fruit if e(sample) & fruit==1
local meanfrt = r(mean)
nlcom (m7_fruit: (exp(_b[nma_all]+ _b[nma_1] + _b[nma_2] +  _b[nma_lshriexp]* `meanlshr'
+  _b[nma_frt]* `meanfrt')-1)*100)
```

**Modified Case 4:**
poisson cvalue ldist lusprod lrowprod_iplte1 nafta_frt nafta_veg cafta_dr fta trend ler  lshriexp mainland treat treat_lshriexp lus_row_price ltarahs1d nma_all nma_1 nma_2 nma_lshriexp nma_apl nma_avcd nma_egpl nma_lem nma_mndr nma_mngo nma_meln nma_orng nma_papy nma_pprs nma_tomt nma_wtrm  nma_crbl nma_frbn nma_commresd comm1 comm2 comm3 comm4 comm5 comm6 comm7 comm8 comm9 comm10 comm11 comm12 comm13 comm14 comm15 comm16 comm17 comm18 comm19 comm20 comm21 comm22 comm23 comm24 comm25 comm26 comm27 comm28 comm29 comm30 comm31 comm32 comm33 comm34 comm35 comm36 comm37 comm38 comm39 comm40 comm41 comm42 comm43 comm44 comm45 comm46 comm47, rob

**Case 5:**
poisson cvalue ldist lusprod lrowprod_iplte1 nafta_frt nafta_veg cafta_dr fta fruit trend ler lshriexp mainland treat treat_lshriexp lus_row_price ltarahs1d nma_all nma_1 nma_2 nma_lshriexp nma_frt nma_treat, rob

Marginal Effect of NMA:
```
  quietly summarize lshriexp if e(sample) & nma_all==1
  local meanlshr = r(mean)
  quietly summarize fruit if e(sample) & fruit==1
  local meanfrt = r(mean)
  quietly summarize treat if e(sample) & nma_all==1
  local meantreat = r(mean)
  nlcom (m8_ntreat_frt: (exp(_b[nma_all]+ _b[nma_1] + _b[nma_2] +  _b[nma_lshriexp]*
`meanlshr' +  _b[nma_frt]* `meanfrt' +  _b[nma_treat]* `meantreat')-1)*100)
```

**Case 6:**
poisson cvalue ldist lusprod lrowprod_iplte1 nafta_frt nafta_veg cafta_dr fta fruit trend ler lshriexp mainland lus_row_price ltarahs1d nma_all nma_1 nma_2 nma_lshriexp nma_frt methylbrom water pestspecific cold fum_refri mb_cold or_fum_refri treatresd lshriexp_mbf lshriexp_wtr lshriexp_pshv lshriexp_cld lshriexp_fprf lshriexp_mbcld lshriexp_orfprf lshriexp_treatresd nma_mbf nma_wtr nma_cld  nma_treatresd, rob

Marginal Effect of NMA:
```
  quietly summarize lshriexp if e(sample) & treat==1
  local meanlshr = r(mean)
  quietly summarize fruit if e(sample)
  local meanfrt = r(mean)
  quietly summarize methylbrom if e(sample) & methylbrom==1
  local meanmbf = r(mean)
  quietly summarize cold if e(sample) & cold==1
  local meancld = r(mean)
  quietly summarize treatresd if e(sample) & treatresd==1
  local meantreatresd = r(mean)
  nlcom (m11_n_mbf: (exp(_b[nma_all]+  _b[nma_frt]* `meanfrt' + _b[nma_mbf]* `meanmbf')-
1)*100) (m11_n_cld: (exp(_b[nma_all]+  _b[nma_frt]* `meanfrt' + _b[nma_cld]* `meancld')-
```

1)*100) (m11_n_treatresd: (exp(_b[nma_all]+  _b[nma_frt]* `meanfrt' + _b[nma_treatresd]* `meantreatresd')-1)*100)

**2. Computing R-squared:**

```
predict fitted
qui cor fitted cvalue
di as txt " R-squared   "  (`r(rho)')^2
```

**3. Robustness Check Models**

**3.1 Exclusion of Mexican Hass Avocados**

**Case 1:**

poisson cvalue ldist lusprod lrowprod_iplte1 nafta_frt nafta_veg cafta_dr fta fruit trend ler lshriexp mainland treat treat_lshriexp lus_row_price ltarahs1d nma, rob

**Case 2:**

poisson cvalue ldist lusprod lrowprod_iplte1 nafta_frt nafta_veg cafta_dr fta fruit trend ler lshriexp mainland treat treat_lshriexp lus_row_price ltarahs1d nma nma_l nma_ll, rob

**Case 3:**

poisson cvalue ldist lusprod lrowprod_iplte1 nafta_frt nafta_veg cafta_dr fta fruit trend ler lshriexp mainland treat treat_lshriexp lus_row_price ltarahs1d nma nma_l nma_ll nma_m_lshriexp, rob

**Case 4:**

poisson cvalue ldist lusprod lrowprod_iplte1 nafta_frt nafta_veg cafta_dr fta fruit trend ler lshriexp mainland treat treat_lshriexp lus_row_price ltarahs1d nma nma_l nma_ll nma_m_lshriexp nma_m_frt, rob

**Case 5:**

poisson cvalue ldist lusprod lrowprod_iplte1 nafta_frt nafta_veg cafta_dr fta fruit trend ler lshriexp mainland treat treat_lshriexp lus_row_price ltarahs1d nma nma_l nma_ll nma_m_lshriexp nma_m_frt nma_m_treat, rob

**Case 6:**

poisson cvalue ldist lusprod lrowprod_iplte1 nafta_frt nafta_veg cafta_dr fta fruit trend ler lshriexp mainland lus_row_price ltarahs1d nma nma_l nma_ll nma_m_lshriexp nma_m_frt methylbrom water pestspecific cold fum_refri mb_cold or_fum_refri treatresd lshriexp_mbf lshriexp_wtr lshriexp_pshv lshriexp_cld lshriexp_fprf lshriexp_mbcld lshriexp_orfprf lshriexp_treatresd nma_m_mbf nma_m_wtr nma_m_cld nma_m_treatresd, rob

**3.2 Endogeneity Bias**

drop if lshriexp==.

**Case 1:**

poisson cvalue ldist lusprod lrowprod_iplte1 nafta_frt nafta_veg cafta_dr fta fruit trend ler lshriexphs4 mainland treat treat_lshriexphs4 lus_row_price ltarahs1d nma_all, rob

**Case 2:**
poisson cvalue ldist lusprod lrowprod_iplte1 nafta_frt nafta_veg cafta_dr fta fruit trend ler lshriexphs4 mainland treat treat_lshriexphs4 lus_row_price ltarahs1d nma_all nma_1 nma_2, rob

**Case 3:**
poisson cvalue ldist lusprod lrowprod_iplte1 nafta_frt nafta_veg cafta_dr fta fruit trend ler lshriexphs4 mainland treat treat_lshriexphs4 lus_row_price ltarahs1d nma_all nma_1 nma_2 nma_lshriexphs4, rob

**Case 4:**
poisson cvalue ldist lusprod lrowprod_iplte1 nafta_frt nafta_veg cafta_dr fta fruit trend ler lshriexphs4 mainland treat treat_lshriexphs4 lus_row_price ltarahs1d nma_all nma_1 nma_2 nma_lshriexphs4 nma_frt, rob

**Case 5:**
poisson cvalue ldist lusprod lrowprod_iplte1 nafta_frt nafta_veg cafta_dr fta fruit trend ler lshriexphs4 mainland treat treat_lshriexphs4 lus_row_price ltarahs1d nma_all nma_1 nma_2 nma_lshriexphs4 nma_frt nma_treat, rob

**Case 6:**
poisson cvalue ldist lusprod lrowprod_iplte1 nafta_frt nafta_veg cafta_dr fta fruit trend ler lshriexphs4 mainland lus_row_price ltarahs1d nma_all nma_1 nma_2 nma_lshriexphs4 nma_frt methylbrom water pestspecific cold fum_refri mb_cold or_fum_refri treatresd lshriexphs4_mbf lshriexphs4_wtr lshriexphs4_pshv lshriexphs4_cld lshriexphs4_fprf lshriexphs4_mbcld lshriexphs4_orfprf lshriexphs4_treatresd nma_mbf nma_wtr nma_cld nma_treatresd, rob

### 3.3 Specific Fixed Effects

**Case 1:**
poisson cvalue ldist lusprod lrowprod_iplte1 nafta_frt nafta_veg cafta_dr fta ler lshriexp mainland treat treat_lshriexp lus_row_price ltarahs1d nma_all comm1 comm2 comm3 comm4 comm5 comm6 comm7 comm8 comm9 comm10 comm11 comm12 comm13 comm14 comm15 comm16 comm17 comm18 comm19 comm20 comm21 comm22 comm23 comm24 comm25 comm26 comm27 comm28 comm29 comm30 comm31 comm32 comm33 comm34 comm35 comm36 comm37 comm38 comm39 comm40 comm41 comm42 comm43 comm44 comm45 comm46 comm47 ctry1 ctry2 ctry3 ctry4 ctry5 ctry7 ctry8 ctry9 ctry10 ctry11 ctry12 ctry13 ctry14 ctry15 ctry16 ctry17 ctry18 ctry19 ctry20 ctry21 ctry22 ctry23 ctry24 ctry25 ctry26 ctry27 ctry28 ctry29 ctry30 ctry31 ctry32 ctry33 ctry34 ctry35 ctry36 ctry37 ctry38 ctry39 ctry40 ctry41 ctry42 ctry43 ctry44 ctry45 ctry46 ctry47 ctry48 ctry49 ctry50 ctry51 ctry52 ctry53 ctry54 ctry55 ctry56 ctry57 ctry58 ctry59 ctry60 ctry61 ctry62 ctry63 ctry64 ctry65 ctry66 ctry67 ctry68 ctry69 ctry70 ctry71 ctry72 ctry73 ctry74 ctry75 ctry76 ctry77 ctry78 ctry79 ctry80 ctry81 ctry82 ctry83 ctry84 ctry85 ctry86 ctry87 ctry88 ctry89 year1 year2 year3 year4 year5 year6 year7 year8 year9 year10 year11 year12 year13, rob

**Case 2:**
poisson cvalue ldist lusprod lrowprod_iplte1 nafta_frt nafta_veg cafta_dr fta ler lshriexp mainland treat treat_lshriexp lus_row_price ltarahs1d nma_all nma_1 nma_2 comm1 comm2 comm3 comm4 comm5 comm6 comm7 comm8 comm9 comm10 comm11 comm12 comm13 comm14 comm15 comm16 comm17 comm18 comm19 comm20 comm21 comm22 comm23 comm24 comm25 comm26 comm27 comm28 comm29 comm30 comm31 comm32 comm33 comm34 comm35 comm36 comm37 comm38 comm39 comm40 comm41 comm42 comm43 comm44 comm45 comm46 comm47 ctry1 ctry2 ctry3 ctry4 ctry5 ctry7 ctry8 ctry9 ctry10 ctry11 ctry12 ctry13 ctry14 ctry15 ctry16 ctry17 ctry18 ctry19 ctry20 ctry21 ctry22 ctry23 ctry24 ctry25 ctry26 ctry27 ctry28 ctry29 ctry30 ctry31 ctry32 ctry33 ctry34 ctry35 ctry36 ctry37 ctry38 ctry39 ctry40 ctry41 ctry42 ctry43 ctry44 ctry45 ctry46 ctry47 ctry48 ctry49 ctry50 ctry51 ctry52 ctry53 ctry54 ctry55 ctry56 ctry57 ctry58 ctry59 ctry60 ctry61 ctry62 ctry63 ctry64 ctry65 ctry66 ctry67 ctry68 ctry69 ctry70 ctry71 ctry72 ctry73 ctry74 ctry75 ctry76 ctry77 ctry78 ctry79 ctry80 ctry81 ctry82 ctry83 ctry84 ctry85 ctry86 ctry87 ctry88 ctry89 year1 year2 year3 year4 year5 year6 year7 year8 year9 year10 year11 year12 year13, rob

**Case 3:**
poisson cvalue ldist lusprod lrowprod_iplte1 nafta_frt nafta_veg cafta_dr fta ler lshriexp mainland treat treat_lshriexp lus_row_price ltarahs1d nma_all nma_1 nma_2 nma_lshriexp comm1 comm2 comm3 comm4 comm5 comm6 comm7 comm8 comm9 comm10 comm11 comm12 comm13 comm14 comm15 comm16 comm17 comm18 comm19 comm20 comm21 comm22 comm23 comm24 comm25 comm26 comm27 comm28 comm29 comm30 comm31 comm32 comm33 comm34 comm35 comm36 comm37 comm38 comm39 comm40 comm41 comm42 comm43 comm44 comm45 comm46 comm47 ctry1 ctry2 ctry3 ctry4 ctry5 ctry7 ctry8 ctry9 ctry10 ctry11 ctry12 ctry13 ctry14 ctry15 ctry16 ctry17 ctry18 ctry19 ctry20 ctry21 ctry22 ctry23 ctry24 ctry25 ctry26 ctry27 ctry28 ctry29 ctry30 ctry31 ctry32 ctry33 ctry34 ctry35 ctry36 ctry37 ctry38 ctry39 ctry40 ctry41 ctry42 ctry43 ctry44 ctry45 ctry46 ctry47 ctry48 ctry49 ctry50 ctry51 ctry52 ctry53 ctry54 ctry55 ctry56 ctry57 ctry58 ctry59 ctry60 ctry61 ctry62 ctry63 ctry64 ctry65 ctry66 ctry67 ctry68 ctry69 ctry70 ctry71 ctry72 ctry73 ctry74 ctry75 ctry76 ctry77 ctry78 ctry79 ctry80 ctry81 ctry82 ctry83 ctry84 ctry85 ctry86 ctry87 ctry88 ctry89 year1 year2 year3 year4 year5 year6 year7 year8 year9 year10 year11 year12 year13, rob

**Case 4:**
poisson cvalue ldist lusprod lrowprod_iplte1 nafta_frt nafta_veg cafta_dr fta ler lshriexp mainland treat treat_lshriexp lus_row_price ltarahs1d nma_all nma_1 nma_2 nma_lshriexp nma_frt comm1 comm2 comm3 comm4 comm5 comm6 comm7 comm8 comm9 comm10 comm11 comm12 comm13 comm14 comm15 comm16 comm17 comm18 comm19 comm20 comm21 comm22 comm23 comm24 comm25 comm26 comm27 comm28 comm29 comm30 comm31 comm32 comm33 comm34 comm35 comm36 comm37 comm38 comm39 comm40 comm41 comm42 comm43 comm44 comm45 comm46 comm47 ctry1 ctry2 ctry3 ctry4 ctry5 ctry7 ctry8 ctry9 ctry10 ctry11 ctry12 ctry13 ctry14 ctry15 ctry16 ctry17 ctry18 ctry19 ctry20 ctry21 ctry22 ctry23 ctry24 ctry25 ctry26 ctry27 ctry28 ctry29 ctry30 ctry31 ctry32 ctry33 ctry34 ctry35 ctry36 ctry37 ctry38 ctry39 ctry40 ctry41 ctry42 ctry43 ctry44 ctry45 ctry46 ctry47 ctry48 ctry49 ctry50 ctry51 ctry52 ctry53 ctry54 ctry55 ctry56 ctry57 ctry58 ctry59

ctry60 ctry61 ctry62 ctry63 ctry64 ctry65 ctry66 ctry67 ctry68 ctry69 ctry70 ctry71 ctry72 ctry73 ctry74 ctry75 ctry76 ctry77 ctry78 ctry79 ctry80 ctry81 ctry82 ctry83 ctry84 ctry85 ctry86 ctry87 ctry88 ctry89 year1 year2 year3 year4 year5 year6 year7 year8 year9 year10 year11 year12 year13, rob

**Case 5:**
poisson cvalue ldist lusprod lrowprod_iplte1 nafta_frt nafta_veg cafta_dr fta ler lshriexp mainland treat treat_lshriexp lus_row_price ltarahs1d nma_all nma_1 nma_2 nma_lshriexp nma_frt nma_treat comm1 comm2 comm3 comm4 comm5 comm6 comm7 comm8 comm9 comm10 comm11 comm12 comm13 comm14 comm15 comm16 comm17 comm18 comm19 comm20 comm21 comm22 comm23 comm24 comm25 comm26 comm27 comm28 comm29 comm30 comm31 comm32 comm33 comm34 comm35 comm36 comm37 comm38 comm39 comm40 comm41 comm42 comm43 comm44 comm45 comm46 comm47 ctry1 ctry2 ctry3 ctry4 ctry5 ctry7 ctry8 ctry9 ctry10 ctry11 ctry12 ctry13 ctry14 ctry15 ctry16 ctry17 ctry18 ctry19 ctry20 ctry21 ctry22 ctry23 ctry24 ctry25 ctry26 ctry27 ctry28 ctry29 ctry30 ctry31 ctry32 ctry33 ctry34 ctry35 ctry36 ctry37 ctry38 ctry39 ctry40 ctry41 ctry42 ctry43 ctry44 ctry45 ctry46 ctry47 ctry48 ctry49 ctry50 ctry51 ctry52 ctry53 ctry54 ctry55 ctry56 ctry57 ctry58 ctry59 ctry60 ctry61 ctry62 ctry63 ctry64 ctry65 ctry66 ctry67 ctry68 ctry69 ctry70 ctry71 ctry72 ctry73 ctry74 ctry75 ctry76 ctry77 ctry78 ctry79 ctry80 ctry81 ctry82 ctry83 ctry84 ctry85 ctry86 ctry87 ctry88 ctry89 year1 year2 year3 year4 year5 year6 year7 year8 year9 year10 year11 year12 year13, rob

**Case 6:**
poisson cvalue ldist lusprod lrowprod_iplte1 nafta_frt nafta_veg cafta_dr fta ler lshriexp mainland lus_row_price ltarahs1d nma_all nma_1 nma_2 nma_lshriexp nma_frt methylbrom water pestspecific cold fum_refri mb_cold or_fum_refri treatresd lshriexp_mbf lshriexp_wtr lshriexp_pshv lshriexp_cld lshriexp_fprf lshriexp_mbcld lshriexp_orfprf lshriexp_treatresd nma_mbf nma_wtr nma_cld nma_treatresd comm1 comm2 comm3 comm4 comm5 comm6 comm7 comm8 comm9 comm10 comm11 comm12 comm13 comm14 comm15 comm16 comm17 comm18 comm19 comm20 comm21 comm22 comm23 comm24 comm25 comm26 comm27 comm28 comm29 comm30 comm31 comm32 comm33 comm34 comm35 comm36 comm37 comm38 comm39 comm40 comm41 comm42 comm43 comm44 comm45 comm46 comm47 ctry1 ctry2 ctry3 ctry4 ctry5 ctry7 ctry8 ctry9 ctry10 ctry11 ctry12 ctry13 ctry14 ctry15 ctry16 ctry17 ctry18 ctry19 ctry20 ctry21 ctry22 ctry23 ctry24 ctry25 ctry26 ctry27 ctry28 ctry29 ctry30 ctry31 ctry32 ctry33 ctry34 ctry35 ctry36 ctry37 ctry38 ctry39 ctry40 ctry41 ctry42 ctry43 ctry44 ctry45 ctry46 ctry47 ctry48 ctry49 ctry50 ctry51 ctry52 ctry53 ctry54 ctry55 ctry56 ctry57 ctry58 ctry59 ctry60 ctry61 ctry62 ctry63 ctry64 ctry65 ctry66 ctry67 ctry68 ctry69 ctry70 ctry71 ctry72 ctry73 ctry74 ctry75 ctry76 ctry77 ctry78 ctry79 ctry80 ctry81 ctry82 ctry83 ctry84 ctry85 ctry86 ctry87 ctry88 ctry89 year1 year2 year3 year4 year5 year6 year7 year8 year9 year10 year11 year12 year13, rob

## 4. Gravity Models Estimated with the OLS Estimator

**Case 1:**
reg lcv ldist lusprod lrowprod_iplte1 nafta_frt nafta_veg cafta_dr fta fruit trend ler lshriexp mainland treat treat_lshriexp lus_row_price ltarahs1d nma_all, rob

**Case 2:**
reg lcv ldist lusprod lrowprod_iplte1 nafta_frt nafta_veg cafta_dr fta fruit trend ler lshriexp mainland treat treat_lshriexp lus_row_price ltarahs1d nma_all nma_1 nma_2, rob

**Case 3:**
reg lcv ldist lusprod lrowprod_iplte1 nafta_frt nafta_veg cafta_dr fta fruit trend ler lshriexp mainland treat treat_lshriexp lus_row_price ltarahs1d nma_all nma_1 nma_2 nma_lshriexp, rob

**Case 4:**
reg lcv ldist lusprod lrowprod_iplte1 nafta_frt nafta_veg cafta_dr fta fruit trend ler lshriexp mainland treat treat_lshriexp lus_row_price ltarahs1d nma_all nma_1 nma_2 nma_lshriexp nma_frt, rob

**Case 5:**
reg lcv ldist lusprod lrowprod_iplte1 nafta_frt nafta_veg cafta_dr fta fruit trend ler lshriexp mainland treat treat_lshriexp lus_row_price ltarahs1d nma_all nma_1 nma_2 nma_lshriexp nma_frt nma_treat, rob

**Case 6:**
reg lcv ldist lusprod lrowprod_iplte1 nafta_frt nafta_veg cafta_dr fta fruit trend ler lshriexp mainland lus_row_price ltarahs1d nma_all nma_1 nma_2 nma_lshriexp nma_frt methylbrom water pestspecific cold fum_refri mb_cold or_fum_refri treatresd lshriexp_mbf lshriexp_wtr lshriexp_pshv lshriexp_cld lshriexp_fprf lshriexp_mbcld lshriexp_orfprf lshriexp_treatresd nma_mbf nma_wtr nma_cld nma_treatresd, rob