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The Effects of Phytosanitary Regulations on U.S. Imports of Fresh Fruits and Vegetables

Peyton Ferrier

United States Department of Agriculture

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Contents

Summary . . . .**ii**

Introduction **1**

Background **4**

Data Sources **6**

Trade and Phytosanitary Restrictions **11**

The Inspection and Clearance of Imports 13

Required Treatments of Imports 17

Inspection Regulation and Key Findings **20**

Findings 23

Conclusion **33**

References **34**

Appendix– Regression analysis of differences between imports recorded in trade data and inspections data **37**

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Abstract

Since the late 1980s, multilateral and bilateral trade agreements have reduced tariff rates and worked to restrain the arbitrary use of nontariff measures, including sanitary and phytosanitary regulations. U.S. imports of fruits and vegetables have risen steadily during this period as more pathways (specific country-commodity combinations) for legal importation to the United States have gained approval, regulations for gaining import access have been streamlined, and treatment options for phytosanitary issues have been expanded. This report compares 2011 tariff rates with phytosanitary treatments for 29 fruits and vegetables. In general, both tariffs and nontariff phytosanitary measures are relatively small across high-volume import pathways, and there is little evidence to suggest that phytosanitary regulations have a large effect on trade.

Keywords: phytosanitary, tariffs, nontariff measures, fruits and vegetables, imports

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United States Department of Agriculture

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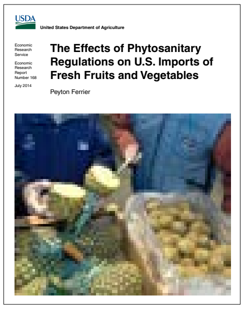

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The Effects of Phytosanitary Regulations on U.S. Imports of Fresh Fruits and Vegetables

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What Is the Issue?

Since fruits and vegetables are particularly susceptible to phytosanitary problems, their imports are often subject to a large number of regulatory requirements. While multilateral and bilateral trade liberalization agreements since the late 1980s have worked to restrain the arbitrary use of nontariff measures (including phytosanitary regulations), some argue that countries continue to use them to protect domestic producers because their complexity makes them difficult to challenge. While previous research has found examples where phytosanitary regulations reduce imports and protect domestic producers, relatively little work considers how these nontariff measures comprehensively affect the full range of fruit and vegetable imports.

This type of analysis is challenging because import regulations vary over time and by country of origin, and they are enforced by different agencies. For example, fruit and vegetable imports are regulated by the U.S. Department of Agriculture's (USDA) Animal and Plant Health Inspection Service (APHIS) for pest risk, USDA's Agricultural Marketing Service regulates for quality standards and marketing claims, and the U.S. Food and Drug Administration regulates for adulteration with pesticides and human pathogens. Moreover, enforcement data are typically not readily available, and imports and demand-substitution patterns are seasonal and diverse. Fruit and vegetable commodities are also regulated differently depending on the country of origin—each country-commodity combination (e.g., pineapples from Costa Rica) is considered a "pathway" by which pests may be introduced into the United States.

What Did the Study Find?

Using regulatory enforcement data, this study reports the rates at which fruit and vegetable imports receive discretionary phytosanitary treatments at the border as the result of an inspection (risk rates), and classifies these rates by the type of treatment ordered and the reason it was ordered. Combining this data with import data, this report has five main findings:

- For many imported commodities, the reported trade volume (as measured by the total weight) differs significantly between inspection data (collected by APHIS) and import data (collected by the U.S. Census Bureau) because of differences in the way these data are collected. This report compares the percentage difference between the quantity of a commodity recorded in imports data and the quantity of a commodity recorded in inspections data. Of the 29 goods considered, only 12 have differences (in absolute terms) of less than 10 percent and 6 have differences greater than 20 percent. These differences, however, are generally decreasing over time.

- U.S. imports of specific commodities are often dominated by a small number of countries, although a far larger number of pathways are permitted entry. Of the 29 goods considered, only 8 have more than 4 suppliers with import shares larger than 1 percent. Moreover, 18 of the 29 goods considered have a single country supplying more than 80 percent of U.S. imports of that good.

- About 8 percent of significant pathways (where a country ships more than 1 percent of all exports of a particular commodity to the United States) require a discretionary phytosanitary treatment more than 5 percent of the time, and about 30 percent of them require this type of treatment over 1 percent of the time. Of the 29 goods considered, 8 (apples, cassava, celery, corn, eggplant, papaya, peas, and pineapple) required discretionary phytosanitary treatments more than 1 percent of the time.

- Significant and nonsignificant pathways are about equally as likely to require a mandatory phytosanitary treatment. In 2012, 11 percent of significant pathways required a treatment as a condition of entry, compared with 13 percent of all pathways. Import requirements also vary across commodities—grapes, kiwi, peaches, and pears all have significant pathways that require mandatory treatments, while no significant pathways require treatments for bananas, tomatoes, and strawberries.

- Using the percentage of imports subject to discretionary treatments as an upper limit on the average cost of inspection, this report finds that both tariffs and nontariff measures are relatively small across significant pathways.

How Was the Study Conducted?

Four data sources—inspection enforcement data and regulatory data from APHIS, import data from the U.S. Census Bureau, and average tariff rates compiled by USDA's Economic Research Service—were used to develop a panel data set for month, commodity, and country of origin. These data include monthly import volumes, the volumes reported as being inspected, the inspection outcomes, and the average tariff rates. The inspection outcomes data were used to calculate the rates at which goods are ordered treatments, which were further classified by the specific type of risk (e.g., pests found, discrepancies in phytosanitary certificates, cargo contamination, prohibited products, or shipping material violations) and by the type of treatment ordered (e.g., whether the commodity was destroyed, returned, fumigated, cold treated, or given some other action). This report also includes the percentage of imports that entered under an APHIS preclearance program and the percentage of imports that entered the United States under the National Agricultural Release Program, a program where shipments of low-risk imports are inspected with less frequency than ordinary shipments.

The Effects of Phytosanitary Regulations on U.S. Imports of Fresh Fruits and Vegetables

Peyton Ferrier

Introduction

Since the late 1980s, multilateral and bilateral trade agreements (including the North American Free Trade Agreement, the Dominican Republic-Central American Free Trade Agreement, the Andean Free Trade Agreement, and the Chilean Free Trade Agreement) have incrementally reduced tariff rates for U.S. imports of fruits and vegetables. These agreements, along with comprehensive international agreements under the World Trade Organization, also created mechanisms to restrain the use of nontariff measures, such as technical barriers to trade (e.g., labeling requirements, minimum quality standards, restrictions on ingredients) and sanitary and phytosanitary (SPS) measures (e.g., treatment requirements for pests, quarantine restrictions). During roughly the same period, U.S. imports of fruits and vegetables have expanded steadily as the U.S. Department of Agriculture's (USDA) Animal and Plant Health Inspection Service (APHIS) has approved more pathways—specific country-commodity combinations—for legal importation into the United States.

As trade agreements have reduced tariff barriers to trade, some worry that industry groups will seek protection from import competition through regulatory (nontariff) measures. Underlying their argument is the suspicion that nontariff measures substantially inhibit trade in some or most cases by adding significant, unnecessary costs (Copeland, 1990; Lamb, 2006; Watson and James, 2013) (see box, "Theories of Nontariff Measures as Protectionism and Regulatory Capture," for discussion). While previous research has found examples where phytosanitary measures reduce imports and protect domestic producers (Orden et al., 2012; Peterson et al., 2013), relatively little work considers how these nontariff measures comprehensively affect the full range of fruit and vegetable imports. One reason for this may be the complexity of the issue—import regulations vary over time and by country of origin, and they are enforced by different agencies. For example, APHIS regulates fruits and vegetables for pest risk, USDA's Agricultural Marketing Service (AMS) regulates imports for quality standards and marketing claims, and the U.S. Food and Drug Administration (FDA) regulates imports for pesticide or pathogen adulteration. Moreover, enforcement data are typically not readily available, and imports and demand-substitution patterns are seasonal and diverse.

This report focuses on the regulation of imports for phytosanitary ("pest") concerns by APHIS. It describes the regulatory structure for 29 imported fruits and vegetables, particularly the import requirements for significant country-commodity pathways (e.g., Costa Rican pineapples, Chilean grapes) from 2006 to 2011. Most of the 1,072 permitted fruit and vegetable import pathways do not ship to the United States in large volumes. The rates at which imports in these low-volume pathways are ordered phytosanitary treatments are sensitive to the rejection of individual shipments and, as a

Theories of Nontariff Measures as Protectionism and Regulatory Capture

The "capture theory" of regulation argues that regulation largely serves the interests of rent-seeking industry groups; in contrast, the "public interest theory" emphasizes the role of regulation in addressing market failures (Viscusi et al., 2000). As a refinement to these theories, the "economic theory of regulation" notes that competition among interest groups checks each group's ability to influence regulation and that any group's influence is determined by its cohesion and organization relative to other competing interest groups (Becker, 1983; Tullock, 1975, 1967).

Within the context of this economic theory, industry groups may seek protection through mechanisms that are less transparent than tariffs because the harm to rival interest groups is more difficult to quantify or challenge on cost-benefit grounds. While the costs to consumers from tariff rates are fairly simple to estimate, similar costs of nontariff measures (as well as their potential environmental benefits) are more complex, which increases the difficulty in organizing political opposition. By this theory, a regulator will find it more difficult to eliminate an unjustified phytosanitary regulation that restricts imports of a commodity with a substantial, well-organized, domestic production interest group and weakly organized consumer or importer interests. For example, import access might be more easily secured for tropical or counter-seasonal fruits and vegetables that do not compete directly with domestic producer interests.

Several authors have examined the economic justification for and effect of nontariff measures without considering the role of inspections. Petersen et al. (2013) find that import requirements for 47 fruits and vegetables reduce trade, but that the effects of the treatment requirements diminish with market experience and when import levels from a country reach a certain threshold. Other authors (Livingston, 2007; Peterson and Orden, 2008; Yue and Beghin, 2009; Yue et al., 2006) have found mixed effects on the extent to which phytosanitary regulations affect trade, but because their conclusions typically consider the regulation of specific pathways, their findings are often difficult to extrapolate beyond the specific pathway in question. While researchers have developed various metrics (e.g., import notifications, regulatory heterogeneity indices) to proxy for the costs of nontariff measures (Beghin and Bureau, 2001; Disdier and Marette, 2010; Disdier et al., 2008; Li and Beghin, 2014) in estimating how these measures affect trade, it is difficult to develop a causal link between real regulatory actions that reduce nontariff barriers and trade. Other studies (Costello and McAusland, 2003; Mérel and Carter, 2008) have examined how risk-based tariffs may be used as adjuncts to nontariff measures in managing the risks associated with invasive species.

Authors have also considered why goods fail inspection at ports of entry and whether failed inspections may be explained by protectionist (i.e., capture) rather than risk-based reasons (Buzby et al., 2008). Baylis et al. (2009), for instance, find that Food and Drug Administration import refusals are correlated with domestic lobbying expenditures by industry groups in certain broad product categories. In general, however, most models of inspection of agricultural goods assume that inspection resources and import refusals represent the efficient allocation of resources under capacity constraints or limited information regarding risk (i.e., a public interest theory) (Moffitt et al., 2008; Springborn et al., 2010; Surkov et al., 2008; Surkov et al., 2009).

result, are highly variable across years. Consequently, this report focuses on the 118 "significant" pathways, where a country ships more than 1 percent of all exports of that commodity to the United States, and considers the other low-volume (nonsignificant) pathways in aggregate.

Unless addressed in a special import-inspection program, all U.S. fruit and vegetable imports are inspected for conformance to entry regulations, which may include a mandatory treatment for chronic pest problems. If a pest is found during an inspection, an action may be ordered that the shipment be treated, returned, or destroyed (among other actions). Based on USDA inspections data, this study calculates the risk and action rates for imported shipments. The risk rate describes the quantity share of inspected imports that carry some source of (untreated) pest risk, while the action rate describes the share of inspected imports that are ordered an action. In most cases (when a treatment is not mandatory), the aggregate values of these two rates are similar.[1] Additionally, because a good cannot be treated and must be destroyed in the worst case scenario, the risk rate is used to characterize the upper limit of the added unexpected cost (i.e., ordered treatments) resulting from inspections. The action rates are classified by treatments ordered (such as fumigation, cold treatment, or destruction), and the risk rates are classified by the specific sources (such as pest discovery, container contamination, or a documentation violation such as a "phyto discrepancy").

In addition to potentially requiring treatments, border inspections themselves add costs to importation. The National Agricultural Release Program (NARP) is a special import program that mandates fewer physical inspections for shipments in pathways designated as low risk by APHIS. While this program's primary purpose is to direct inspection resources to the highest risk shipments, it also reduces the costs of importation. Relatedly, APHIS allows agricultural inspections and treatments to occur at the country of disembarkation by creating producer-financed, pre-clearance programs. As both these programs affect the cost of inspections and phytosanitary regulations, this study also determines the percentages of imports that enter under NARP and APHIS pre-clearance programs.

[1]In general, the action rate, but not the risk rate, includes treatments (fumigation, cold treatment, and returned or destroyed goods) ordered before a pest is conclusively identified and, in some cases, fumigations that are mandatory as a condition of entry. On the other hand, the risk rate, but not the action rate, includes discrepancies in the phytosanitary certificate that are resolved without a treatment being ordered.

Background

In 1995, the World Trade Organization ratified *The WTO Agreement on the Application of Sanitary and Phytosanitary Measures* (World Trade Organization, 1995) to establish a scientific framework for assessing their validity for imports. In general, the agreement requires that member countries only implement nontariff measures that are nondiscriminatory, scientifically based, and designed to have the smallest impact on trade possible. For instance, the agreement encouraged countries to regionalize their quarantine-zone restrictions if a trade partner can adequately ensure that a pest threat is limited to a specific area and under control. The agreement also created dispute resolution mechanisms and called for increased transparency in regulations.[2]

In the United States, APHIS regulates imports of fruits and vegetables by pathway (a specific combination of commodity and country—i.e., apples from South Africa). Generally, once import access is granted, the commodity can be imported from anywhere in the exporting country unless APHIS has additional entry conditions. To justify its decision and the entry conditions it implements, APHIS conducts a pest risk assessment that catalogues the good's potential pest risk and treatment options. The import regulatory process has historically differed between fruits and vegetables and other agricultural goods (see box, "The Regulation of Fruits and Vegetables Versus the Regulation of Propagative Material"). The manner in which APHIS classifies commodities and records inspection data also has not historically corresponded with the way U.S. Customs and Border Protection (CBP) (and its predecessor institutions in the U.S. Treasury Department) has collected data on imports for tariff purposes.

Phytosanitary inspections address all potential pest threats, including hitchhiking pests, misidentified goods, and contamination. Particular emphasis is paid to systemic pest threats known to commonly occur in the pathway. If warranted, APHIS may require one or more mandatory pest treatments as a condition of entry. In these cases, inspections may simply involve a verification that the treatment has occurred. For instance, Spanish citrus requires a cold treatment to address the Mediterranean fruit fly, *Ceratitis capitata*. Not all pests, however, have practicable treatments, in which case the good may be prohibited from entry. Because gaining import access requires the time and resources of the petitioning country, a country's lack of import access may simply reflect a decision not to pursue access to a market in which it may have no cost, niche, or quality advantage. Ferrier (2010), however, notes that APHIS has streamlined import access with several policy innovations (APHIS, 2008).[3]

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[2]Many contemporaneous bilateral agreements also contain similar, independent frameworks for disputes over sanitary and phytosanitary measures.

[3]Specifically, the Animal and Plant Health Inspection Service (APHIS) made import access a "notice-based process" rather than a "rule-based process," which removed the risk analysis requirements and reduced the time required for evaluating an import access petition. Furthermore, APHIS removed the requirement that treatments (i.e., irradiation or fumigation) necessarily be validated independently for every new pest-commodity combination.

The Regulation of Fruits and Vegetables Versus the Regulation of Propagative Material

Historically, fruit and vegetable imports and propagative material (plants for planting) imports have been treated differently from each other within Title 7, Section 319 of the Code of Federal Regulations (CFR), which addresses how USDA's Animal and Plant Health Inspection Service (APHIS) regulates imports. Specifically, fruit and vegetable imports are regulated under subsection 56 and are referred to as Q56 regulations, and propagative materials are regulated under subsection 37 and are referred to as Q37 regulations. As noted by Lehtonen and Tschanz (2008), several historical factors led to a divergence in the regulatory treatment of Q56 and Q37 goods. As the regulatory framework was being designed, most propagative material was imported as nursery stock rather than for direct sale in commerce, was derived from a small number of primarily European sources, and required fumigation. At that time, all taxa of propagative material were permitted entry by default, a risk assessment was not required unless the plant was imported in a growing media, few pre-export mitigation treatments were required, and monitoring of those pre-export mitigations was infrequent. Fruits and vegetables, on the other hand, were only enterable if a pest risk assessment had been performed specifically for that import pathway, and pre-export mitigations were often required and monitored.

In 2006 and 2009, APHIS proposed rules that liberalized Q56 regulations and tightened Q37 regulations. The Q56 regulatory changes facilitated the entry of new commodity pathways by making the approval of new commodities based on notifications (i.e., announcements of changes in the regulations) rather than subjecting them to the lengthy, formal rule-making process that required public participation (APHIS, 2007). It also allowed import pathways to be approved if they used established mitigation treatments that have been shown to address pest risk, rather than requiring a re-evaluation of the treatment specific to the commodity (Ferrier, 2010). The Q37 changes, on the other hand, created a new category of import treatment for propagative material called "Not Approved Pending Risk Assessment," or NAPPRA. The NAPPRA category included propagative material thought to bear an unacceptably high risk of introducing a harmful pest. The list of NAPPRA goods was created (in large part) based on the historical import record of these goods, but it was also open to public comment (APHIS, 2009). These rule changes were finalized in 2008 for Q56 goods and in 2011 for Q37 goods.

Data Sources

This report's data sets are derived from four primary sources – (1) regulatory data from APHIS, (2) inspections data from APHIS, (3) import data from the U.S. Census Bureau (Census), and (4) effective average tariff rates[4] from USDA's Economic Research Service (ERS). Regulatory data come from the APHIS Fruits and Vegetables Import Requirements (FAVIR) database, which organizes APHIS regulations on required conditions of entry for imported fruits and vegetables. Primarily, these data show whether goods are permitted access to the United States and what (if any) treatment or entry conditions are required. Nearly all agricultural goods require, at a minimum, an import permit and an inspection, which can only occur in U.S. or foreign ports in which CBP operates (table 1).[5] To enter the United States, the cargo may either be cleared during inspection or ordered some remedial action that allows it to meet entry requirements. A similar process is in place for clearing vessels themselves (cargo ships, cruise liners, aircraft, etc.), passengers, and returning military equipment.

Table 1
List of U.S. ports* by total imports of fruits and vegetables, 2006-11

Rank	Ports of entry	Total imports (mts)	Rank	Ports of entry	Total imports (mts)
1	Nogales, AZ	13,165,320	43	Eagle Pass, TX	109,492
2	Philadelphia, PA	8,909,834	44	Corpus Christi, TX	89,134
3	Wilmington, DE	7,784,100	45	West Palm Beach, FL	76,525
4	Pharr, TX	7,780,263	46	Los Angeles, CA	63,736
5	Port Hueneme, CA	4,595,435	47	Douglas, AZ	59,718
6	Otay Mesa, CA	4,247,160	48	Ft. Pierce, FL	44,742
7	Port Everglades, FL	4,100,076	49	Presidio, TX	42,521
8	Gulfport, MS	3,899,101	50	Brownsville, TX	37,122
9	Long Beach, CA	3,217,193	51	Chicago, IL	37,083
10	San Diego, CA	2,841,437	52	New Orleans, LA	34,795
11	Galveston, TX	2,017,574	53	Boston, MA	32,814
12	Port Manatee, FL	1,860,188	54	Charleston, SC	31,027
13	Brooklyn, NY	1,834,100	55	Sweetgrass, MT	30,339
14	Newark, Sea Cargo, NJ	1,825,222	56	Honolulu, HI	23,278
15	Newark, Air Cargo, NJ	1,747,958	57	Mayaguez, PR	19,037
16	Progreso, TX	1,684,515	58	Norfolk, VA	17,082
17	Laredo, Colombia, TX	1,495,490	59	Atlanta, GA	16,356
18	Miami Sea, FL	1,384,094	60	Blaine, Pacific Highway, WA	15,222

—continued

[4]These rates account for exemptions from stated tariff rates due to quotas or other special programs.

[5]Canada is exempted from the general import-permit requirement for goods.

Table 1
List of U.S. ports* by total imports of fruits and vegetables, 2006-11—continued

Rank	Ports of entry	Total imports (mts)	Rank	Ports of entry	Total imports (mts)
19	Freeport, TX	1,303,924	61	Dulles, VA	13,891
20	Calexico, East, CA	1,232,904	62	Eastport, ID	12,300
21	JFK Air Cargo, NY	1,161,459	63	Champlain, NY	11,823
22	Laredo, TX	927,002	64	Houston Air, TX	10,084
23	Rio Grande City, TX	720,040	65	Buffalo, Peace Bridge, NY	9,744
24	Miami Air Cargo, FL	708,378	66	Pembina, ND	7,068
25	San Juan Sea, PR	681,034	67	Dallas/Ft. Worth, TX	6,975
26	Tampa, FL	648,523	68	Buffalo, Lewiston Bridge, NY	6,562
27	San Luis, AZ	623,262	69	Raymond, MT	6,144
28	Columbus, NM	553,451	70	St. Thomas, VI	5,947
29	New Haven, CT	457,042	71	Baltimore, MD	5,611
30	Port Huron, MI	357,557	72	Romulus, MI	4,257
31	Los Indios, TX	230,019	73	San Francisco, CA	4,113
32	Houston Sea, TX	182,894	74	St. Croix, VI	3,830
33	Cape Canaveral, FL	156,552	75	Portal, ND	3,729
34	Oakland, CA	154,087	76	Blaine, WA	3,619
35	Seattle Sea, WA	145,682	77	Oroville, WA	3,338
36	El Paso, Ysleta, TX	139,120	78	Sumas, WA	3,228
37	Providence, RI	136,439	79	Derby Line, VT	2,944
38	Savannah, GA	126,892	80	Jacksonville, FL	2,502
39	Panama City, FL	120,440	81	Dunseith, ND	2,115
40	El Paso, BOTA, TX	120,061	82	Phoenix, AZ	2,067
41	Santa Teresa, NM	119,410	83	Orlando, FL	1,770
42	Detroit, MI	113,468	84	Seattle, Sea Cargo, WA	1,363

*Ports listed only include ports that received over 1,000 metric tons (mts) of agricultural goods between 2006 and 2011.
Source: USDA, Animal and Plant Health Inspection Service, PPQ 280 inspections data.

The inspections data set comes from the APHIS PPQ 280 database, a name derived from the Form 280 that inspectors file as part of the Agricultural Quarantine Activity System (AQAS), which tracks imported commodities. For each shipment to the United States, the database records the commodity, its origin, its weight (in kgs), and its disposition code (see box, "Defining a Shipment Through the Cargo Manifest"). The disposition code is a four-letter code that describes the risk (if any) found on the shipment and the action ordered as a result of the assigned risk.[6]

[6]The disposition code also distinguishes standard inspections from less frequent National Agricultural Release Program inspections.

Defining a Shipment Through the Cargo Manifest

Well-developed protocols have evolved for international trade. Consider a shipment of grapes moving by boat from Santiago, Chile, to Los Angeles, California. At the time of its departure, the shipment's cargo manifest details the contents of the shipment (the consignment), the names of the Chilean party sending the good (consignor), and the names of the U.S. party receiving the good (the consignee). By U.S. law, the cargo manifest must be forwarded to U.S. Customs and Border Protection (CBP) in advance of the cargo's arrival. The cargo manifest is then used to conduct a preliminary screening of the commodity, which might influence the rigor of the inspection.

The cargo manifest may detail separate commodities or separate consignees for goods arriving in the same vessel or cargo container. Similarly, the same vessel may contain several cargo manifests. The CBP uses the cargo manifest to assess whatever tariffs apply to the good at the time of its arrival. For the purposes of inspection, however, shipments must be broken out by commodity and destination. Therefore, within the inspection record, the number of shipments is a difficult figure to interpret because it does not necessarily refer to separate cargos (i.e., Chilean grapes on separate boats or Chilean grapes from different consignors) but can refer to a single cargo sent to different consignees. Depending on the sales arrangement within the United States, it may be more expeditious to ship the consignment to a single intermediary consignee who will divide it further among separate buyers, or to ship the consignment directly to several consignees. In the latter case, inspectors may be aware of this distinction but inspect the entire related cargo collectively, while reporting their work as separate inspections.

The import data set is collected by CBP and recorded by Census. This data set classifies imports with a 10-digit Harmonized Tariff Code (HTC), which is used to assign any relevant tariff that the Government has in place. At the time of entry, CBP determines the weight and value of the shipment entering the United States, as well as the appropriate tariff rate to be levied on the shipment (if any). In 2003, CBP absorbed inspections duties and staff from APHIS to perform pest inspections of fruits and vegetables, but the legacy of separate recording of products for tariff purposes in Census data and products for inspections purposes in USDA PPQ 280 data remains.[7]

The first six digits of HTC codes are uniformly assigned across countries by the General Agreement on Tariffs and Trade and can only be changed through a process of lengthy international agreement. The last four digits are determined by the importing country, often with the purpose of monitoring some policy component of trade, and can be unilaterally changed as the importing country sees fit. For instance, the six-digit tariff code 08.08.10 identifies a shipment as containing apples; in 2010, the U.S. HTC codes 08.08.10.00.30 identified apples valued at 22¢ per kg or less and 08.08.10.00.60 identified apples valued at over 22¢ per kg. In 2011, the United States further classified the 08.08.10.00.60 code into two separate codes: 08.08.10.00.45 identifying apples valued at over 22¢ per kg and certified organic, and 08.08.10.00.65 identifying apples valued at over 22¢ per kg and not certified organic.

[7]While U.S. Customs and Border Protection now performs and records inspections and their outcomes, the USDA Animal and Plant Health Inspection Service performs all risk analysis and regulation utilizing that data.

The tariff data set contains the average tariff rates applied to commodities entering the United States at the six-digit level. Tariff rates may not be uniform over the course of a year and, in some cases, tariffs are not assessed until a certain volume of goods has entered the United States. For these reasons, average tariff rates are likely to be less than marginal tariff rates. For instance, producers may ship more asparagus to the United States from September to November when the tariff rate for asparagus is lower. This, in turn, lowers the average tariff rate paid over the course of the year for asparagus.

It is important to note that the APHIS PPQ 280 and Census data sets are recorded for very different purposes. In general, APHIS records the names of goods with the primary purpose of identifying invasive species risk. Census, on the other hand, records import shipments to track commerce and collect tariff revenue. For instance, the tariff code 07.04.10 includes both cauliflower and headed broccoli within a single product category while the APHIS data set distinguishes between the two goods. The APHIS data set also contains several hundred varieties of cut flowers and propagative material categories, while the Census data set contains less than 40. In many regards, APHIS data identify goods with greater specificity than Census data and may serve as an independent verification for the accuracy of trade data.

Both the APHIS inspection data set and Census import data set largely capture the same flow of imported fruits and vegetables across borders in terms of volume. While APHIS staff monitors the recorded import data from Census, there is no requirement or mechanism that ensures that the two trade volumes be equal. As of 2011, CBP agents entering data into the PPQ 280 system do so independently of the figures entered in the Census system. Although there are significant differences in reported volumes between the two data sets, these differences have decreased over the 6-year period studied.

Both the tariff and the Census import data sets identify goods by the same HTC code, allowing the two to be directly linked. Similarly, the PPQ 280 data can be linked to the APHIS regulatory data in FAVIR. To link the combined Census and APHIS data, however, separate concordances must be developed that assign a common commodity name and a common country name across the two data sets. Unfortunately, this creates some aggregation of the data that obscures its richness. Table 2 provides a sample concordance between the APHIS inspections and Census import data sets. The merged data set can relate import levels with inspections levels, as well as compare tariff rates with action and risk rates.

Table 2
Sample concordance between APHIS inspections and Census import data sets

Common name	APHIS* inspection name	Census import identifier (HTC Code)
Avocado		08.04.40.00.00
Avocado	Avocado	
Avocado	Avocado, Sliced	
Banana		08.03.00.20.00
Banana	Banana	
Cabbage, Brussels Sprouts and other Brassica	Brussels Sprouts	
Cabbage, Brussels Sprouts and other Brassica	Cabbage	
Cabbage, Brussels Sprouts and other Brassica	Chinese Cabbage	
Cabbage, Brussels Sprouts and other Brassica	Chinese Kale	
Cabbage, Brussels Sprouts and other Brassica	False Pak-Choi	
Cabbage, Brussels Sprouts and other Brassica	Kale	
Cabbage, Brussels Sprouts and other Brassica	Kohlrabi	
Cabbage, Brussels Sprouts and other Brassica	Mustard	
Cabbage, Brussels Sprouts and other Brassica	Mustard Greens	
Cabbage, Brussels Sprouts and other Brassica	Pak Choi	
Cabbage, Brussels Sprouts and other Brassica	Rape	
Cabbage, Brussels Sprouts and other Brassica	Rutabaga	
Cabbage, Brussels Sprouts and other Brassica	Savory	
Cabbage, Brussels Sprouts and other Brassica		07.04.20.00.00
Cabbage, Brussels Sprouts and other Brassica		07.04.90.20.00
Cabbage, Brussels Sprouts and other Brassica		07.04.90.40.40
Pineapple		08.04.30.20.00
Pineapple		08.04.30.40.00
Pineapple		08.04.30.60.00
Pineapple	Pineapple	
Plum	Plum	
Plum	Plumcot	
Plum		08.09.40.20.00
Plum		08.09.40.40.00

*APHIS refers to USDA's Animal and Plant Health Inspection Service and HTC refers to the Harmonized Tariff Code.
Source: USDA, Economic Research Service.

Trade and Phytosanitary Restrictions

Reduction in tariffs; improvements in shipping and preservation; an increasing preference for fresh, out-of-season produce; and the liberalization of SPS restrictions have all contributed to the increase in fresh fruit and vegetable imports since the late 1980s. In that period, the number of country-commodity pathways permitted entry into the United States (e.g., guavas from Mexico, mangoes from India) has risen substantially. However, imports are not necessarily diversified by source, and most U.S. fruit and vegetable imports arrive from only a handful of countries. Table 3 lists the share of imports for the top 10 exporters for the 29 fruits and vegetables discussed in this report. This report's metrics on inspection outcomes—the action and risk rates of commodities—are sensitive to the problem of small numbers. If the volume of imports from a specific source (the denominator in the action and risk rate) is small, the rate swings dramatically in response to the rejection of individual shipments. For this reason, only individual countries whose share of imports is greater than 1 percent are considered significant pathways in this analysis. The remaining imports are aggregated as "All Other Countries" (AOC).

Table 3
Market shares of top exporters of U.S. fruit and vegetable imports, 2006-11

	1 – Apple		2 – Apricot		3 – Artichoke	
1	Chile	58.7%	Chile	87.2%	Mexico	97.5%
2	New Zealand	23.1%	New Zealand	10.2%	Peru	1.0%
3	Canada	15.9%	Turkey	2.0%	Egypt	0.6%
4	Argentina	2.0%	China	0.2%	Spain	0.5%
5	Brazil	0.2%	Poland	0.2%	Canada	0.4%
6	Japan	0.1%	Pakistan	0.1%	France	0.0%
7	Mexico	0.0%	Netherlands	0.1%	Argentina	0.0%
8	China	0.0%	Afghanistan	0.0%	Chile	0.0%
9	Uruguay	0.0%	Argentina	0.0%	Colombia	0.0%
10	South Africa	0.0%	Canada	0.0%	Ecuador	0.0%
	Total (mts)+	1,023,677	Total (mts)	10,715	Total (mts)	7,392
	4 – Asparagus		5 – Avocado		6 – Banana	
1	Peru	54.0%	Mexico	70.7%	Guatemala	28.7%
2	Mexico	44.6%	Chile	24.3%	Ecuador	23.6%
3	Canada	0.8%	Dom. Rep.	4.3%	Costa Rica	21.5%
4	Ecuador	0.2%	Peru	0.5%	Honduras	11.3%
5	Chile	0.1%	New Zealand	0.2%	Colombia	10.9%
6	Colombia	0.1%	Haiti	0.0%	Mexico	2.3%
7	Argentina	0.1%	Dominica	0.0%	Nicaragua	0.8%
8	Guatemala	0.0%	Antigua/Barbuda	0.0%	Peru	0.5%
9	France	0.0%	Brazil	0.0%	Panama	0.3%
10	New Zealand	0.0%	Canada	0.0%	Dom. Rep.	0.0%
	Total (mts)	885,920	Total (mts)	2,048,533	Total (mts)	23,654,174
	7 – Carrot		8 – Cassava		9 – Celery	
1	Canada	62.3%	Costa Rica	89.3%	Mexico	79.6%
2	Mexico	32.9%	Ecuador	3.7%	Canada	20.1%
3	Costa Rica	2.2%	Ghana	2.3%	China	0.2%
4	Israel	2.1%	Nicaragua	2.0%	Dom. Rep.	0.0%
5	Guatemala	0.5%	Honduras	1.1%	India	0.0%
6	Peru	0.0%	Nigeria	0.4%	Netherlands	0.0%
7	Brazil	0.0%	Brazil	0.3%	El Salvador	0.0%
8	France	0.0%	Panama	0.3%	Belgium	0.0%
9	Belgium	0.0%	Colombia	0.2%	Costa Rica	0.0%
10	Germany	0.0%	Dom. Rep.	0.2%	Dominica	0.0%
	Total (mts)	809,901	Total (mts)	251,515	Total (mts)	186,529

—continued

Table 3

Market shares of top exporters of U.S. fruit and vegetable imports, 2006-11—continued

	10 – Cherries		11 – Corn		12 – Cucumber	
1	Chile	84.3%	Mexico	91.9%	Mexico	82.7%
2	Canada	12.8%	Canada	7.9%	Canada	11.7%
3	Argentina	2.0%	Guatemala	0.1%	Honduras	4.5%
4	Australia	0.5%	China	0.0%	Dom. Rep.	0.7%
5	New Zealand	0.4%	Vietnam	0.0%	Costa Rica	0.1%
6	Brazil	0.0%	Peru	0.0%	Netherlands	0.1%
7	Peru	0.0%	Honduras	0.0%	Spain	0.1%
8	China	0.0%	Thailand	0.0%	Guatemala	0.0%
9	Germany	0.0%	France	0.0%	Panama	0.0%
10	Mexico	0.0%	Costa Rica	0.0%	Nicaragua	0.0%
	Total (mts)	106,134	Total (mts)	234,846	Total (mts)	3,118,022
	13 – Eggplant		14 – Grapes		15 – Kiwi	
1	Mexico	81.8%	Chile	91.2%	Chile	40.5%
2	Honduras	12.9%	Peru	4.1%	New Zealand	36.6%
3	Canada	1.7%	Brazil	3.5%	Italy	22.1%
4	Dom. Rep.	1.3%	Mexico	0.7%	Greece	0.6%
5	Netherlands	1.2%	Italy	0.3%	France	0.1%
6	Guatemala	0.6%	South Africa	0.1%	Spain	0.0%
7	Spain	0.2%	South Korea	0.0%	Thailand	0.0%
8	Nicaragua	0.0%	Argentina	0.0%	Panama	0.0%
9	Italy	0.0%	Egypt	0.0%	Israel	0.0%
10	Portugal	0.0%	Spain	0.0%	Peru	0.0%
	Total (mts)	319,401	Total (mts)	2,436,388	Total (mts)	304,211
	16 – Olive		17 – Onion		18 – Papaya	
1	Mexico	99.6%	Mexico	57.1%	Mexico	72.2%
2	Greece	0.3%	Peru	18.7%	Belize	20.6%
3	Lebanon	0.0%	Canada	15.5%	Brazil	2.5%
4	France	0.0%	Chile	4.3%	Guatemala	2.2%
5	Italy	0.0%	New Zealand	1.0%	Dom. Rep.	1.7%
6	Bangladesh	0.0%	China	1.0%	Jamaica	0.7%
7	Belgium	0.0%	Guatemala	0.6%	Panama	0.1%
8	Peru	0.0%	Netherlands	0.4%	Nicaragua	0.0%
9	Jordan	0.0%	Brazil	0.3%	Costa Rica	0.0%
10	Morocco	0.0%	France	0.3%	Thailand	0.0%
	Total (mts)	48,427	Total (mts)	2,122,480	Total (mts)	844,684
	19 – Peaches		20 – Pears		21 – Peas	
1	Chile	97.4%	Argentina	47.0%	Guatemala	60.4%
2	Mexico	1.5%	Chile	26.2%	Mexico	24.8%
3	Canada	0.9%	China	11.3%	Peru	13.9%
4	Argentina	0.2%	South Korea	11.0%	Canada	0.7%
5	China	0.1%	New Zealand	3.3%	China	0.1%
6	Hong Kong	0.0%	South Africa	0.8%	Netherlands	0.0%
7	Peru	0.0%	Japan	0.2%	Costa Rica	0.0%
8	Cook Islands	0.0%	Canada	0.1%	Serbia	0.0%
9	Australia	0.0%	Brazil	0.0%	Honduras	0.0%
10	New Zealand	0.0%	Mexico	0.0%	Poland	0.0%
	Total (mts)	334,892	Total (mts)	505,244	Total (mts)	194,802
	22 – Peppers		23 – Pineapple		24 – Plum	
1	Mexico	83.9%	Costa Rica	83.0%	Chile	99.3%
2	Canada	11.4%	Mexico	5.1%	Argentina	0.3%
3	Netherlands	2.3%	Ecuador	3.9%	Guatemala	0.1%
4	Dom. Rep.	0.9%	Guatemala	3.0%	New Zealand	0.1%
5	Honduras	0.4%	Honduras	2.9%	St. Vincent	0.1%
6	Israel	0.3%	Panama	1.4%	China	0.0%
7	Spain	0.2%	Thailand	0.5%	Ecuador	0.0%
8	El Salvador	0.2%	Colombia	0.0%	El Salvador	0.0%
9	Nicaragua	0.1%	Dom. Rep.	0.0%	Iran	0.0%
10	Guatemala	0.1%	China	0.0%	Dominica	0.0%
	Total (mts)	3,948,293	Total (mts)	4,390,379	Total (mts)	181,738

—continued

Table 3
Market shares of top exporters of U.S. fruit and vegetable imports, 2006-11—continued

	25 – Potatoes		26 – Spinach		27 – Squash	
1	Canada	100.0%	Mexico	82.1%	Mexico	94.3%
2	Dom. Rep.	0.0%	Canada	17.6%	Honduras	1.6%
3	Ghana	0.0%	China	0.3%	Costa Rica	1.5%
4	China	0.0%	Jamaica	0.0%	Canada	1.2%
5	Cameroon	0.0%	Belgium	0.0%	Panama	0.6%
6	Peru	0.0%	Costa Rica	0.0%	New Zealand	0.2%
7	France	0.0%	Dominica	0.0%	Guatemala	0.2%
8	Mexico	0.0%	Dom. Rep.	0.0%	Dom. Rep.	0.1%
9	India	0.0%	Guatemala	0.0%	Chile	0.1%
10	Costa Rica	0.0%	Israel	0.0%	Nicaragua	0.1%
	Total (mts)	2,738,374	Total (mts)	42,016	Total (mts)	1,552,624
	28 – Strawberry		29 – Tomato			
1	Mexico	99.4%	Mexico	88.4%		
2	Canada	0.3%	Canada	10.6%		
3	China	0.1%	Guatemala	0.4%		
4	Peru	0.1%	Netherlands	0.3%		
5	Argentina	0.0%	Dom. Rep.	0.2%		
6	New Zealand	0.0%	Spain	0.1%		
7	Hong Kong	0.0%	Belgium	0.0%		
8	Egypt	0.0%	Costa Rica	0.0%		
9	Poland	0.0%	Israel	0.0%		
10	Chile	0.0%	New Zealand	0.0%		
	Total (mts)	491,279	Total (mts)	7,392,580		

+Mts refers to metric tons.
Source: U.S. Department of Commerce, U.S. Census Bureau, U.S. Imports of Merchandise: 2006-11.

The Inspection and Clearance of Imports

Since the U.S. Department of Homeland Security (DHS) absorbed the inspection duties of APHIS in 2003, CBP has performed all inspections of fruits and vegetables for pests. Several other agencies have an independent inspection authority with regard to issues surrounding food adulteration and safety and conservation (see box, "Authority of Different Agencies Over Import Inspection"). However, the regulatory authority for inspection (including rulemaking, import access, and risk analysis) remains with APHIS.

For example, APHIS performs the pest risk assessment and cost-benefit analysis for new country-commodity pathways and analyzes the risks in existing import pathways based on inspection data (along with existing science). APHIS can then direct the actions of inspectors at CBP on the conduct of inspections if it believes that a certain commodity poses a heightened, unaddressed risk. APHIS also determines whether a particular pest is *actionable*, indicating that it poses a risk to U.S. agriculture, economy, or environment, and is neither established nor controlled within the United States. In contrast, shipments carrying living, but non-actionable, organisms, such as common fungi or mealworms, are generally permitted entry by CBP.

If the pest is actionable, the shipment is prohibited entry unless the risk is mitigated with an approved treatment. In some cases, the pest cannot be identified immediately and is deemed actionable by default until a conclusive identification is made (see box, "Plant Inspection and Systematics"). APHIS trains agricultural inspectors within CBP on pest interception and the regulations, and it maintains the port identification stations for precisely identifying the pests on imports. APHIS also maintains its own staff for inspecting propagative materials and, when appropriate, quarantining plants for planting, as these inspection responsibilities are not assigned to DHS.

Authority of Different Agencies Over Import Inspection

In 2003, U.S. Customs and Border Protection (CBP) assumed inspection responsibilities for monitoring nonpropagative imports for invasive species threats and acquired all USDA Animal and Plant Health Inspection Service inspectors, as well as staff from the U.S. Department of Justice and other agencies. The commonly cited rationale for the consolidation of inspection authorities under a single agency was to facilitate the sharing of information and coordination regarding potential immediate security risks (Naim, 2005). Importantly, however, inspections for threats not deemed to be immediate were not incorporated into CBP. As outlined in Ferrier (2010), these inspections include those for food safety (performed by the U.S. Food and Drug Administration) and those for illegally harvested wildlife (performed by the U.S. Fish and Wildlife Service). In both cases, inspections are typically targeted based on historical risk criteria and do not necessarily occur immediately upon the good's arrival in the United States.

Plant Inspection and Systematics

When an inspector finds that a shipment contains an unknown pest, the shipment is placed on hold until it can be determined whether the pest is actionable (i.e., a risk to the United States and not already established in the import region). If the pest is actionable, it must be mitigated with an approved treatment before the shipment is released. If the pest is not actionable, the shipment is released immediately. In most cases, the pest is identified immediately by the inspector.

When the pest cannot be identified, it is sent to a USDA-maintained Plant Inspection Station, typically at a facility that inspects imported propagative material under Q37 regulations, and logged in an electronic tracking system. If the Plant Inspection Station cannot make a determination, then the pest will be sent to the Smithsonian Institution for formal classification. In this manner, USDA monitors the types of pests on imports and the spread of pests across countries (e.g., if a pest native to Australia is found in a shipment of South African grapes, it may be assumed that the pest has become established outside its native range), as well as potentially classifying new species. The fields of systematics (the process of classifying species according to their hierarchical structure to each other) and taxonomy (naming and organizing species) are essential to this process.

When identification is difficult and lengthy, shippers can treat the pest to avoid the costs of shipping delays if a treatment is available. While insect pests might be fumigated, bacterial or fungal pests cannot be destroyed in this manner, and these shipments must be destroyed or returned. One benefit of a strong and efficient systematic infrastructure among inspectors is its potential to reduce the frequency of unnecessary rejections.

Pests on a commodity may be distinguished as being *systemic* or *incidental*. Systemic risks are endemic to the commodity in the production regions where it is found. For example, Mediterranean fruit flies, which are found in Spanish citrus groves, require fruit to lay eggs and complete their life cycle, increasing the likelihood that these commodities carry this pest. For systemic risks, APHIS presumes that the pest will be present on the commodity upon its entry into the United States and requires the commodity to undergo a mandatory mitigation treatment,[8] regardless of whether the pest is actually observed. In recent years, APHIS has created regulatory systems approach protocols (RSAPs), which involve a set of actions undertaken both in the United States and at the point of origin, which collectively reduce systemic pest risks to levels equivalent to those ensured by single-step treatments (see box, "The Regulatory Systems Approach Protocol").

Incidental risks arise when actionable pests are found sporadically on a commodity (typically hitch-hiker insects, which attach themselves to a commodity and are found within a shipment). Producers can often reduce the likelihood of incidental pests by relatively simple biosafety measures, such as shaking or washing produce before shipment or maintaining clean processing facilities with physical barriers (such as screens in packing warehouses). Alternatively, a commodity may carry a fungus that is identified and found harmful to U.S. agriculture or simply cannot be identified in a speedy manner. When a good is found with an incidental pest, it must undergo a treatment to mitigate the pest threat. If no treatment is available or if the importer opts not to pay for the treatment, the commodity is prohibited entry and is returned to the importer or destroyed at the importer's request.

The Regulatory Systems Approach Protocol

In general, USDA's Animal and Plant Health Inspection Service (APHIS) evaluates the efficacy of a treatment at mitigating a pest threat at the probit-9 level, a standard indicating that the dose-response relationship in a treatment results in 99.9968 percent efficacy (Follett and Neven, 2005). In recent years, APHIS has expanded the range of potential treatment options to include regulatory systems approach protocols (RSAPs), a series of treatments that cumulatively address the pest threat at the probit-9 level. An RSAP might include pest surveys, trapping and sampling, field treatments, post-harvest safeguards, restrictions on crop maturity, and other measures. For example, an RSAP for Israeli bell peppers requires that they only be produced in greenhouses secure from the intrusion of Mediterranean fruit flies, located in regions where this pest is rare, and monitored via trapping. Follett and Neven note that implementing an RSAP requires coordination and agreement between governments because many of the required steps occur on foreign soil and are verified by that country's analogue agency to APHIS. Other examples of RSAPs include those developed for Mexican avocados (Peterson and Orden, 2008), South African stone fruit, and bananas from ECOWAS (West African) countries.[1]

[1]As of February 2013, the Animal and Plant Health Inspection Service was not issuing import permits for bananas from these countries because they had not met the import requirements.

[8]If multiple pests are systemic, multiple treatments may be required.

If a commodity is frequently found with a hitchhiker pest, APHIS can unilaterally alter its inspection manual to make a pest treatment mandatory, which can be disruptive to importers. For example, eggs of the moth *Copitarsia delorosa* were chronically found on Peruvian asparagus in the late 1990s. After several years in which spot fumigation treatments were ordered on large shares of the imported product, APHIS made the treatment mandatory in 2001. In addition to its costs and the potential loss of organic asparagus sales, the fumigation treatment reduces the number of marketing days because it accelerates ripening by raising the temperature of the commodity during treatment.

By default, *all fruit and vegetable shipments* to the United States are inspected *at the border*, where an inspector examines approximately *2 percent of a randomly selected portion of the shipment* in search of pests. The emphasis added to the prior sentence highlights areas where significant deviation from this default rule may occur.

First, APHIS maintains NARP, where shipments of certain goods judged to be low risk are inspected only periodically. This risk assessment is based on historical records of inspections and the types of pests likely to be found on the good. When inspections occur, they are more rigorous than ordinary inspections and follow explicit protocols to ensure that sampling is random. NARP inspections are primarily designed to re-verify the low-risk status of the country-commodity pathway, rather than to detect and intercept pests in individual shipments. When a NARP inspection finds a pest, the affected good may be temporarily or permanently suspended from the program. While there is no firm rule regarding their frequency, NARP inspections occur for less than 10 percent of shipments.

NARP may be considered a systematic way of tailoring inspections to the pathway's specific risks to economize on port inspection resources. Differences in inspection protocols often exist informally at ports and are not typically recorded in inspection records, although they certainly affect costs. APHIS charges user fees per vehicle or vessel that is subject to inspection, but this fixed cost of entry is charged regardless of the actual inspection protocol applied.[9]

A less rigorous inspection of a shipment may lower importer costs in two ways. It can reduce the logistical delays of import entry and the costs associated with the inspections themselves. To understand these costs, one must first understand the different levels or intensities of inspection.[10] The least rigorous (and quickest) level of inspection is a check of the cargo manifest and, if required, the phytosanitary certificate. This type of inspection is relatively common when the risk is low. Certain commodities, such as cut flowers and certain tomatoes, are verified to have been grown in greenhouses and produced under conditions that make a pest infestation unlikely. A more rigorous container inspection, known as a tailgate inspection, samples the shipment from an easily accessed area so as not to require unpacking. Finally, a partial or total devanning unloads a part of (or the entire) commodity shipment from the container so that random sampling may occur easily. Unpacking a container in this manner is expensive, requires considerable time, and may harm the product to the extent it breaks the cold chain of refrigeration. While APHIS does not charge for the inspections, the importer bears the costs associated with unpacking and reloading shipments.

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[9]The Animal and Plant Health Inspection Service does not add any charge per inspected shipment even though a vehicle paying a user fee may have several shipments that might require inspection.

[10]While different inspection intensities are not recorded in the PPQ 280 inspections data, they are recorded in the more detailed Agricultural Quarantine Inspection Monitoring system, which the Animal and Plant Health Inspection Service maintains to monitor the efficacy of inspections.

Second, specific countries also maintain pre-clearance programs in which goods are inspected for import requirements and released for entry prior to their shipment to the United States. Typically, APHIS staff (either U.S. citizens or foreign nationals) provides the inspection service.[11] Pre-cleared goods do not necessarily represent a low-risk pathway—for example, Chilean grapes, which are often pre-cleared, must be fumigated as a condition of entry. The value of the pre-clearance program is to ease the logistics of entry into the United States and reduce the possibility of having to treat a good at the border. It is unclear whether the shipper of a good that fails an inspection under a pre-clearance program typically pays for a discretionary treatment (like fumigation), sells the good in the country of origin, or ships it to a third country.[12]

Figure 1 provides a flow chart of the import regulation and inspections process. If a country-commodity pathway has import conditions on the farm or a required treatment, the import requirement might be more extensive than that of a standard port inspection (even if having the regulation only results in checks of documents during inspections at the port). Alternatively, if the good is in a pre-clearance program or NARP, the actual inspection element at U.S. ports may be similarly minor. In each case, however, commodities may be re-inspected to verify that the import regulations are appropriate. If inspections provide information that the import inspections protocol or conditions of entry are not appropriate to the risk, APHIS can change the import requirements, including its inclusion in NARP, as it deems appropriate.

Finally, inspectors are not necessarily bound to inspect 2 percent of a randomly selected portion of the shipment. They have the discretion to adjust inspections according to the shipment's risk and logistical constraints associated with daily work flow. Moreover, certain commodities (e.g., apples, citrus, grapes, and stone fruit from South Africa) have inspection protocols that may specifically call for a larger inspection rate and devanning so that sampling may be random.

Required Treatments of Imports

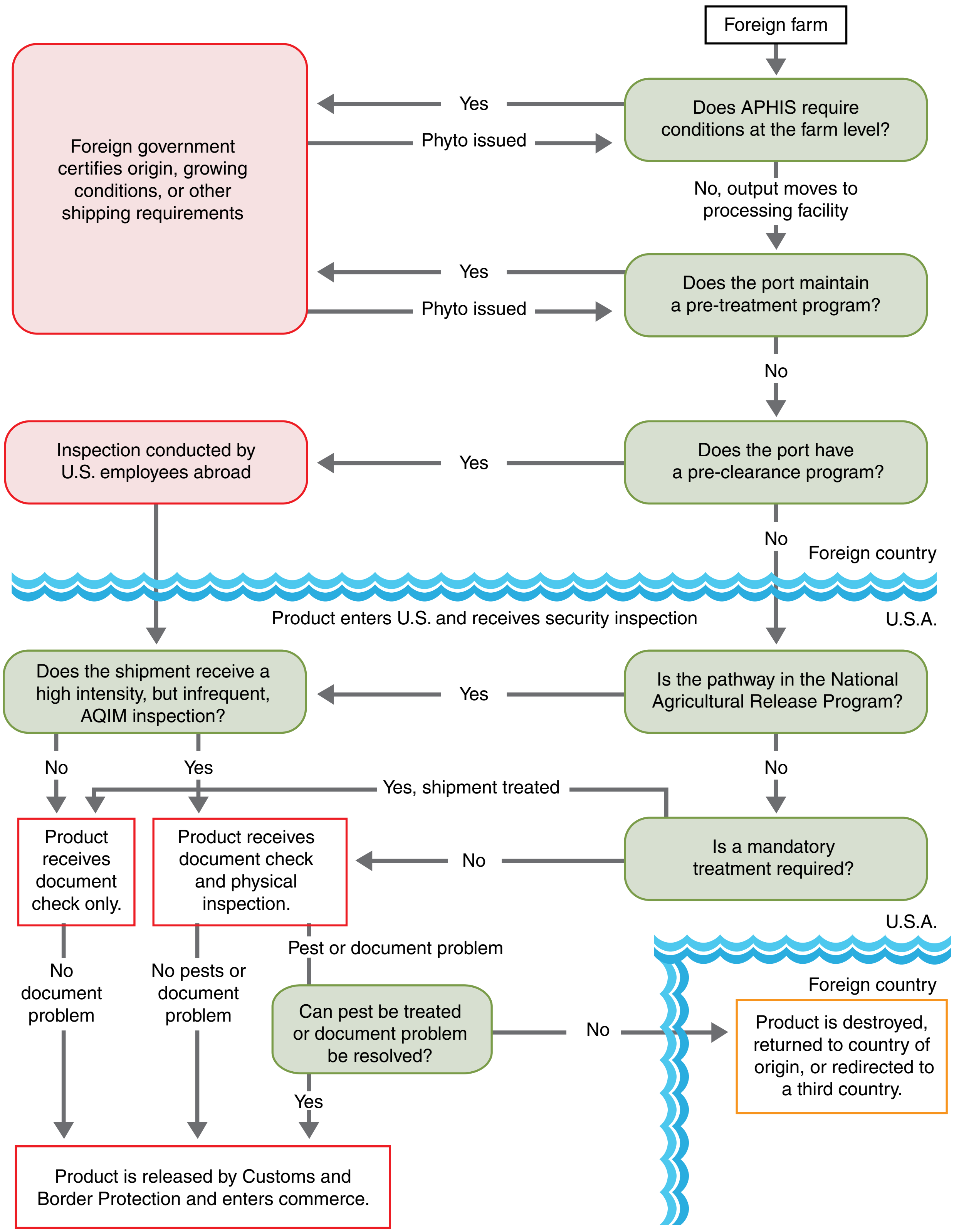
Several possible treatments allow commodities with actionable pests to gain access to U.S. import markets, including fumigation, cold treatment, heat treatments (hot air, hot water, steam), and irradiation. For systemic risks, treatment options are typically evaluated within the pest risk assessment and established as a condition of entry at the time the commodity is permitted entry into the United States. For incidental risks, treatment options may or may not be available for the specific pest found. Most insect pests can be treated by fumigation or irradiation, but fungal, bacterial, or viral pests cannot. Additionally, irradiation cannot practically be applied as a spot treatment due to labeling and packaging requirements (Ferrier, 2010). Most, if not all, spot treatments involve fumigation.

A great deal of specificity also underlies how phytosanitary treatments can be applied effectively to different commodities. For example, heat treatments may not work for large commodities where the pest is deep beneath the skin of the good. Additionally, high doses of irradiation can cause spotting in avocados (Thomas and Bramlage, 1986) and damage nuts through its effects on fat (Gölge and Ova, 2008). Cold treatment works best on goods that store well, such as apples and citrus, but not on more delicate goods like asparagus. Pests themselves may be present in only certain regions of the

[11]Pre-clearance only pertains to the Animal and Plant Health Inspection Service's entry regulations, not to the more comprehensive security regulations conducted by Customs and Border Protection upon entry into the United States.

[12]Failure to meet U.S. import entry requirements does not necessarily ban a good from international markets. For example, Canadian quarantine restrictions are far more accommodating to insect pests because Canada produces a more limited variety of domestic crops and its cold winter kills many insects that might survive warmer climates.

Figure 1
Flow chart of import regulation and inspection



Source: USDA, Economic Research Service.
Notes: APHIS refers to the Animal and Plant Health Inspection Service, and AQIM refers to the Agricultural Quarantine Inspection Monitoring System.

country and may be a threat to only parts of the United States, in which case destination and origin restrictions can be incorporated into import regulations (see box, “Different Time Periods Required for Cold Treatments”).

Different Time Periods Required for Cold Treatments

Different treatments have different impacts on certain commodities. For example, USDA’s Animal and Plant Health Inspection Service’s Fruits and Vegetables Import Requirements (FAVIR) database states that oranges (*citrus sinesis*) from Costa Rica may only be imported if they receive a cold treatment (specifically, treatment T107-b) to address the Mexican fruit fly (*Anastrepha ludens*), a treatment requiring a minimum of 20 days at 34^{o} F. Treatment of Spanish oranges for the Mediterranean fruit fly (*Ceratitis capitata*) requires only 14 days at the same temperature. Treatment of oranges from the Republic of South Africa for three insects (False Codling Moth, *Thaumatotibia leucotreta*; Natal fruit fly, *Ceratitus rosa;* and *Bactrocera invadens*) requires 24 days at 31^{o} F. Most cold treatments occur *en route* in cargo ships to reduce the delays associated with treatments. However, Mexican oranges can receive hot air, steam, irradiation, or fumigation treatments instead of the 20-day cold treatment, all of which require less than a day and potentially allow Mexican exporters to capitalize on short-run U.S. price fluctuations.

Inspection Regulation and Key Findings

To understand this report's key findings on inspections and trade, one must first understand how inspections for import pests occur and how paths are regulated. An inspection involves a CBP agent examining a shipment of a commodity to ensure that it meets its entry requirements. These requirements may involve (1) that the shipment have an import permit, (2) that the shipment carry a phytosanitary certificate,[13] (3) that only commercial shipments be permitted, (4) that goods only arrive from a certain region of the country (i.e., an origin restriction), (5) that goods only be shipped to certain destinations in the United States (i.e., a destination restriction), or (6) that goods receive a mandatory treatment that is verified by the inspector or certified by an agent at the shipment's origin point. If the shipment meets these inspection requirements, it is released for entry. All shipments must have a cargo manifest indicating the contents of the shipment, its value, origin, destination, consigner, and consignee.

At the time of inspection, the good is given a four-letter disposition code (table 4). Within the disposition code itself, two letters indicate the risk associated with the commodity and two letters indicate the action (if any) taken to deal with that risk. In the large majority of cases, the good is assigned the IRMR disposition code, indicating it was "Inspected and Released" (IR) because the shipment "Meets Requirements" (MR) for entry. However, other disposition codes can be assigned to characterize the rate at which goods bear some phytosanitary risk (the risk rate) out of all possible goods, and the rate at which these goods are ordered some action as a result of an inspection or as a pre-condition of entry (the action rate). The possible risks described by the disposition codes and their corresponding two-letter codes are as follows: Actionable Pest (AP), Container Contamination (CC), Product Contamination (PC), Phyto Discrepancy (PD) (a discrepancy between the phytosanitary certificate and what the inspector sees in the goods or cargo manifest), Prohibited Product (PP), and Wood Packing Material Violation (WP). Additionally, the two-letter code PQ indicates that an unknown organism has been found and is presumed to be actionable unless it is later identified and found to be innocuous. Each of these codes indicates that the shipment is out of compliance with the import regulations.

If a shipment is out of compliance upon its arrival, it can still be released for commerce if additional documentation (i.e., the correcting of a phytosanitary certificate) or a discretionary treatment brings the shipment into compliance. If the importer opts against treating the shipment or no treatment is available, then the product may be returned or destroyed. The first two letters of the disposition code indicate these corresponding actions: Fumigation (FU), Cold Treatment (CT), Destroyed (DE), Returned (RX), and Other Action Taken (OT). Additionally, cargo may arrive at the port pre-cleared or having undergone a previous treatment,[14] and it is still given a cursory inspection that may be oriented primarily to ensure that the inspection occurred abroad. Another set of codes, organized collectively as "Released," characterizes imports that do not require an action. The action rate is the percentage of the volume of goods that require an action. In most cases, the risk and action rates will be similar in aggregate, differing only due to the rare use of the "PQ" risk code (when actions occur at the behest of the importer before risks can conclusively be identified) or when a good arrives at a port still needing a treatment as a condition of entry (typically a fumigation). As it excludes treat-

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[13]In certain cases, the phytosanitary certificate may include information that verifies that several steps of a regulatory systems approach protocol have been performed.

[14]Cold treatment, for example, typically occurs in transit.

Table 4
PPQ 280 disposition codes and organization as treatment and risk rates

General category	Disposition code	Description	Risk category	Action category	Included as inspected	Included in import totals
Destroyed goods	DEAP	Destroyed, Actionable Pest	Actionable Pest	Destroyed	Yes	No
	DEAR	Destroyed, Actionable Pest (NARP*) - an actionable pest is detected during an AQIM+ inspection under NARP Program	Actionable Pest	Destroyed	Yes	No
	DECC	Destroyed, Container Contamination	Container Contamination	Destroyed	Yes	No
	DEPC	Destroyed, Product Contamination	Product Contamination	Destroyed	Yes	No
	DEPD	Destroyed, Phyto Discrepancy	Phyto Discrepancy	Destroyed	Yes	No
	DEPP	Destroyed, Prohibited Product	Prohibited Product	Destroyed	Yes	No
	DEPQ	Destroyed, Precautionary - the importer requests the shipment be destroyed because a pest is found that is presumed to be actionable	Unknown	Destroyed	Yes	No
Fumigated goods	FUAP	Fumigated, Actionable Pest	Actionable Pest	Fumigated	Yes	Yes
	FUAR	Fumigated, Actionable Pest - detected in AQIM inspection under NARP Program	Actionable Pest	Fumigated	Yes	Yes
	FUCC	Fumigation, Container Contamination	Container Contamination	Fumigated	Yes	Yes
	FUPC	Fumigation, Product Contamination	Product Contamination	Fumigated	Yes	Yes
	FUPQ	Fumigation, Precautionary - action taken at discretion of importer because the pest is presumed to be actionable	Unknown	Fumigated	Yes	Yes
	FUPT	Fumigation - this treatment is required to be performed as a condition of entry	NONE	Fumigated	No	Yes
Other action taken	OTAP	Other Action Taken - actionable pest	Actionable Pest	Other Action Taken	Yes	Yes
	OTAR	Other Action Taken, Actionable Pest Detected in AQIM Inspection Under NARP Program	Actionable Pest	Other Action Taken	Yes	Yes
	OTCC	Other Action Taken, Container Contamination	Container Contamination	Other Action Taken	Yes	Yes
	OTPC	Other Action Taken, Product Contamination	Product Contamination	Other Action Taken	Yes	Yes
	OTPD	Other Action Taken, Phyto Discrepancy	Phyto Discrepancy	Other Action Taken	Yes	Yes
	OTPP	Other Action Taken, Prohibited Product	Prohibited Product	Other Action Taken	Yes	Yes
	OTPQ	Other Action Taken, Precautionary - action taken at discretion of inspector because the pest is presumed to be actionable	Unknown	Other Action Taken	Yes	Yes
	OTPT	Other Action Taken - a mandatory (precautionary) treatment is required to be performed as a condition of entry	NONE	Other Action Taken	No	Yes

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Table 4
PPQ 280 disposition codes and organization as treatment and risk rates—continued

General category	Disposition code	Description	Risk category	Action category	Included as inspected	Included in import totals
Returned goods	RXAP	Returned, Actionable Pest	Actionable Pest	Returned	Yes	No
	RXAR	Returned, Actionable Pest, NARP Inspection	Actionable Pest	Returned	Yes	No
	RXCC	Returned, Contained Contamination	Container Contamination	Returned	Yes	No
	RXPC	Returned, Product Contamination	Product Contamination	Returned	Yes	No
	RXPD	Returned, Phyto Discrepancy	Phyto Discrepancy	Returned	Yes	No
	RXPP	Returned, Prohibited Product	Prohibited Product	Returned	Yes	No
	RXPQ	Returned, Precautionary - action taken at discretion of importer because the pest is pre-sumed to be actionable	NONE	Returned	Yes	No
	RXWP	Returned, Wood Packing Material Violation	Wood Packing Material Violation	Returned	Yes	No
Cold-treated goods	CTPT	Cold Treatment - this treatment is required to be performed as a condition of entry	NONE	NONE	No	Yes
Released goods	IRAR	Inspected and Released, Meets Requirements (NARP Inspection)	NONE	NONE	Yes	Yes
	IRMR	Inspected and Released, Meets Requirements	NONE	NONE	Yes	Yes
	IRPD	Inspected and Released, Phyto Discrepancy	Phyto Discrepancy	NONE	Yes	Yes
	CCNA	Cargo Clearance, Not Applicable – refers to good cleared with a review of documents or temperature logs in the case of cold treatment	NONE	NONE	Yes	Yes
Other codes	PCIR	Preclearance, Inspected and Released	NONE	NONE	No	Yes
	PCNA	Preclearance, No Action Taken	NONE	NONE	No	Yes
	REAR	Released Without Inspection Under NARP Program	NONE	NONE	No	Yes
	TEOC	Transit and Export, Other Country	NONE	NONE	No	No
	IEND	Immediate Export, No Diversions	NONE	NONE	No	No

*NARP refers to the National Agricultural Release Program.
+AQIM refers to the Agricultural Quarantine Inspection Monitoring System.
Source: USDA, Economic Research Service; USDA, Animal and Plant Health Inspection Service, PPQ 280 inspections data.

Data for Individual Commodities

The PPQ 280 data allow commodity pathways to be disaggregated by sources of risk (i.e., whether an actionable pest was found versus whether a prohibited product was found) and by the specific treatments ordered (i.e., fumigation versus cold treatment). This report includes only the data for 2006-11—the data for individual years is posted on the USDA's Economic Research Service website (www.ers.usda.gov).[1] On the website, each of the 29 individual commodities has a file containing 22 tables. The first table lists the volumes of the top 10 importers of the commodity from 2006 to 2011. The following 21 tables contain 3 tables for each of the following 7 periods: 2006, 2007, 2008, 2009, 2010, 2011, and 2006-11. For each period, the first table includes volume data (in metric tons) on imports, inspected goods (based on inspection data), pre-cleared goods and goods entering via the NARP program, rate data on tariffs, and the action and risk rates. The second table disaggregates the action rate for each period into whether the good was fumigated, destroyed, cold treated, returned, or ordered some other action. The third table disaggregates the risk rate for each year into whether the risk involved the finding of an actionable pest, a phyto discrepancy, contamination, whether the good was pre-treated, the finding of a prohibited product, a wood packing material violation, or the finding of an unidentified pest.

[1]Related work from the Economic Research Service, titled "Phytosanitary Regulation of Fruits and Vegetables" (http://www.ers.usda.gov/data-products/phytosanitary-regulation.aspx), considers the extent to which 45 individual fruits and vegetables are imported by the United States. While not addressing either mandatory or incidental treatments, the data present the percentages of world production and world trade permitted entry into the United States under any condition. Owing to difficulties resolving the inspections data with trade data, this report addresses only 29 of the 45 fruits and vegetables covered in that earlier work. In particular, the Census trade data sets contain overly broad categories, including "Lemons and Limes," "Other Citrus," "Jicama and Breadfruit," "Guavas, Mangoes and Mangosteens," and "Roots and Tubers," that cannot easily be reconciled with inspections data. "Dates" and "Figs" are also excluded because they are often shipped in a preserved state (which the Animal and Plant Health Inspection Service regulates differently than fresh goods) that does not appear to be distinguished in Census trade data. Specifically, trade data suggest that large volumes of these goods arrive from prohibited origins.

ments as a condition of entry, the risk rate best represents the likelihood (on average) that a shipment will be ordered an unexpected treatment.

Findings

This report provides five main findings about the relationships among the inspections, trade, and regulatory data. The first two findings address the issue of data quality and the correspondence between inspections and import data. The last three findings address the relative role of inspections, regulations, and tariffs in explaining trade flows.

Volumes reported in inspections and imports data differ. Data on the volume of inspected goods and on the volume of imported goods represent overlapping records of the number of kilograms of fruits and vegetables entering the United States. Conceptually, these volumes should be identical, although that does not always prove to be the case. Moreover, some research questions may be better addressed using inspections data, which often contain more distinctions in variety and origin than imports data (despite their lack of price or value information).

Accounting for goods that port inspectors order to be destroyed or returned (and, consequently, do not appear in U.S. imports data), this report compares the percentage difference between the quantity of a commodity recorded in imports data and the quantity of a commodity recorded in inspections data. With regard to whether this difference is small or decreasing over time, no uniform finding is apparent across all goods. Table 5 provides a general description of the differences across goods, with more specific information provided in the online data. Of the 29 goods considered, only 12 have differences (in absolute value terms) less than 10 percent in the aggregate volume of inspected goods. Six of the goods have differences greater than 20 percent. The online data show that these differences are, in general, decreasing over time (but not in every case)—see appendix for further discussion of this topic.

This report does not consider the specific reasons why the two data sets differ. However, the differences may occur for innocuous reasons. For example, inspectors may place frozen or peeled carrots and potatoes in a processed goods category because they pose little pest risk, even when they are recorded in Customs as unprocessed. Shippers may also have leeway to have imported goods declared within multiple categories and have some discretion to have raw goods shipped to free trade zones (which may include processing facilities). In this last case, the good's entry status is suspended in Customs data until the good enters commerce, at which point it may enter commerce as a processed product following its treatment at the facility. Inspections data would not account for this change in processing status. Additionally, U.S.-produced raw commodities may "re-enter" the United States after they have been processed abroad, which may affect how they are recorded in either data set.

Import flows are dominated by a small number of significant pathways. Only a few countries export significant volumes of fruits and vegetables to the United States (relative to the number permitted to do so). Table 3 shows the shares of imports from the top 10 exporters of each commodity. While there are numerous ways to describe the concentration of imports across countries, a simple way is to count the number of countries with a share of imports larger than 1 percent. Of the 29 goods considered, only 8 (apples, bananas, cassava, eggplant, onion, papaya, pears, and pineapple) have more than 4 suppliers fitting this criterion. Moreover, 18 of the 29 goods considered have a single country supplying more than 80 percent of U.S. imports. In a few cases, this high concentration level can be explained entirely by sanitary and phytosanitary regulations. For example, fresh olives, potatoes, and corn are only permitted import from Mexico or Canada except under special circumstances.[15] Other high concentration levels may be attributed to limited trade access, as with apricots, plums, and peaches from Chile—only 15 or fewer countries can ship these products to the United States.

Moreover, these figures are likely to understate the concentration of imports along certain pathways owing to the seasonality of these imports. For instance, 98 percent of asparagus imports come from Mexico or Peru, but these two countries (which are in different hemispheres with reversed growing seasons) generally do not export goods at the same time. Similarly, while the arrival of imports is concentrated from certain origins, there are also many pathways for which little trade occurs, although it is permitted.

Risk rates are low, only exceeding 5 percent for about 8 percent of significant pathways. Inspection is costly and imperfect. Due to the nature of the sampling process, inspections will fail to intercept all hazardous materials at the border. Moreover, the costs of administering a treatment to

[15]Exceptions may include specially permitted imports for breeding or research purposes or diplomatic reasons.

Table 5

Tariff, risk, and action rates* by significant pathway+, 2011

1 – Apple

Country	Treatment	Pre-clearance rate	NARP rate	Imports	Entered	Tariff rate	Action rate	Risk rate
AOC	N.A.**	14.87%	0.00%	424	381	0.00%	0.01%	0.01%
Argentina	Cold treat	100.00%	0.00%	4,551	6,806	0.00%	0.00%	0.00%
Canada		0.00%	0.00%	18,547	1,032	0.00%	0.00%	0.00%
Chile		99.78%	0.00%	91,141	107,569	0.00%	0.00%	0.00%
New Zealand		88.62%	0.00%	33,291	34,297	0.00%	10.98%	10.40%
Total				147,953	150,084	0.00%	2.47%	2.34%
Difference between imports and entered goods				1.43%	Number of approved pathways			19
Percent of pathways requiring treatments								52.63%

2 – Apricot

Country	Treatment	Pre-clearance rate	NARP rate	Imports	Entered	Tariff rate	Action rate	Risk rate
AOC	N.A.	0.00%	0.00%	5	0	0.04%	0.00%	0.00%
Chile		99.73%	0.00%	1,247	1,543	0.00%	0.00%	0.00%
New Zealand		24.05%	0.00%	73	92	0.06%	10.88%	10.88%
Turkey		0.00%	0.00%	97	0	0.06%	0.00%	0.00%
Total				1,422	1,636	0.01%	0.56%	0.56%
Difference between imports and entered goods				13.98%	Number of approved pathways			13
Percent of pathways requiring treatments								53.85%

3 – Artichoke

Country	Treatment	Pre-clearance rate	NARP rate	Imports	Entered	Tariff rate	Action rate	Risk rate
AOC	N.A.	0.00%	0.00%	22	20	11.30%	0.00%	0.00%
Egypt		0.00%	0.00%	-	-	0.00%	0.00%	0.00%
Mexico		0.00%	0.00%	1,977	2,078	0.00%	0.09%	0.09%
Peru		0.00%	0.00%	44	39	0.00%	0.00%	0.00%
Spain		0.00%	0.00%	18	-	11.30%	0.00%	0.00%
Total				2,061	2,137	0.22%	0.08%	0.08%
Difference between imports and entered goods				3.64%	Number of approved pathways			28
Percent of pathways requiring treatments								0.00%

4 – Asparagus

Country	Treatment	Pre-clearance rate	NARP rate	Imports	Entered	Tariff rate	Action rate	Risk rate
AOC	N.A.	3.21%	0.00%	354	415	6.45%	18.19%	5.74%
Canada		0.00%	0.00%	1,482	60	0.00%	0.00%	0.00%
Mexico		0.00%	96.35%	86,727	66,150	0.00%	0.09%	0.09%
Peru	Fumigation	0.03%	0.00%	86,085	94,938	0.01%	97.07%*	0.00%
Total				174,648	161,563	0.02%	47.93%	0.06%
Difference between imports and entered goods				-7.78%	Number of approved pathways			56
Percent of pathways requiring treatments								7.14%

5 – Avocado

Country	Treatment	Pre-clearance rate	NARP rate	Imports	Entered	Tariff rate	Action rate	Risk rate
AOC	N.A.	6.04%	0.00%	9,950	10,305	0.69%	1.96%	1.96%
Chile		98.57%	0.00%	69,834	67,723	1.88%	0.00%	0.00%
Dom. Rep		0.00%	0.00%	16,731	17,520	0.00%	0.73%	0.75%
Mexico		0.00%	1.00%	318,938	320,357	0.00%	0.03%	0.03%
Total				415,453	415,905	0.33%	0.10%	0.10%
Difference between imports and entered goods				0.11%	Number of approved pathways			24
Percent of pathways requiring treatments								4.17%

6 – Banana

Country	Treatment	Pre-clearance rate	NARP rate	Imports	Entered	Tariff rate	Action rate	Risk rate
AOC	N.A.	0.00%	0.00%	33,230	32,123	0.00%	0.26%	0.26%
Colombia		0.00%	0.00%	384,505	398,723	0.00%	0.06%	0.06%
Costa Rica		0.00%	0.00%	844,530	871,800	0.00%	0.04%	0.04%
Ecuador		0.00%	0.00%	879,414	908,983	0.00%	0.11%	0.11%
Guatemala		0.00%	0.00%	1,333,496	1,324,440	0.00%	0.05%	0.05%
Honduras		0.00%	0.00%	445,223	475,717	0.00%	0.02%	0.18%
Mexico		0.00%	83.96%	148,695	148,744	0.00%	0.05%	0.03%
Nicaragua		0.00%	0.50%	35,585	39,130	0.00%	0.00%	0.00%
Peru		0.00%	0.00%	23,266	27,616	0.00%	0.38%	0.38%
Total				2,141,680	2,211,629	0.00%	0.07%	0.07%
Difference between imports and entered goods				3.21%	Number of approved pathways			74
Percent of pathways requiring treatments								16.22%

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Table 5
Tariff, risk, and action rates* by significant pathway+, 2011—continued

7 – Carrot								
Country	Treatment	Pre-clearance rate	NARP rate	Imports	Entered	Tariff rate	Action rate	Risk rate
AOC	N.A.	0.00%	0.00%	1,657	1,787	0.00%	0.11%	0.11%
Canada		0.00%	0.00%	97,791	2,504	0.00%	0.00%	0.00%
Costa Rica		0.00%	0.00%	3,153	3,481	0.00%	1.98%	1.98%
Mexico		0.00%	91.75%	67,167	75,845	0.00%	0.14%	0.14%
Israel		0.00%	0.00%	8,854	7,801	0.02%	0.00%	0.00%
Total				178,621	91,418	0.00%	0.09%	0.09%
Difference between imports and entered goods				-64.6%	Number of approved pathways			38
Percent of pathways requiring treatments								0.00%

8 – Cassava								
Country	Treatment	Pre-clearance rate	NARP rate	Imports	Entered	Tariff rate	Action rate	Risk rate
AOC	N.A.	0.45%	0.00%	521	445	0.00%	0.00%	0.00%
Brazil		0.00%	0.00%	47	20	7.02%	0.00%	0.00%
Costa Rica		0.00%	0.00%	35,791	36,759	0.00%	0.87%	0.87%
Dom. Rep.		0.00%	0.00%	30	29	0.00%	0.00%	0.00%
Ecuador		0.00%	0.00%	1,413	1,535	0.23%	0.00%	0.00%
El Salvador		0.00%	0.00%	111	111	0.00%	0.00%	0.00%
Ghana		0.00%	0.00%	962	0	0.00%	0.00%	0.00%
Honduras		0.00%	0.00%	762	880	1.40%	1.47%	1.47%
Mexico		0.00%	0.00%	437	480	0.00%	0.00%	0.00%
Nicaragua		0.00%	0.00%	1,549	1,075	0.15%	9.35%	9.35%
Total				41,623	41,333	0.05%	1.12%	1.12%
Difference between imports and entered goods				-0.70%	Number of approved pathways			46
Percent of pathways requiring treatments								0.00%

9 – Celery								
Country	Treatment	Pre-clearance rate	NARP rate	Imports	Entered	Tariff rate	Action rate	Risk rate
AOC	N.A.	0.00%	0.00%	121	10	6.03%	0.00%	0.00%
Canada		0.00%	0.00%	6,029	78	0.01%	0.00%	0.00%
Dom. Rep.		0.00%	0.00%	408	634	0.00%	2.57%	2.57%
Mexico		0.00%	0.00%	40,048	40,475	0.00%	1.43%	1.40%
Netherlands		0.00%	0.00%	498	498	0.00%	0.00%	0.00%
Total				47,104	41,696	0.02%	1.24%	1.21%
Difference between imports and entered goods				-12.18%	Number of approved pathways			18
Percent of pathways requiring treatments								0.00%

10 – Cherries								
Country	Treatment	Pre-clearance rate	NARP rate	Imports	Entered	Tariff rate	Action rate	Risk rate
AOC	N.A.	0.00%	0.00%	11	9	0.00%	0.00%	0.00%
Argentina	Cold Treat	99.17%	0.00%	508	450	0.00%	0.00%	0.00%
Canada		0.00%	0.00%	2,968	925	0.00%	0.00%	0.00%
Chile		99.02%	0.00%	16,909	22,782	0.00%	0.34%	0.00%
Total				20,396	24,166	0.00%	0.28%	0.00%
Difference between imports and entered goods				16.92%	Number of approved pathways			7
Percent of pathways requiring treatments								57.14%

11 – Corn								
Country	Treatment	Pre-clearance rate	NARP rate	Imports	Entered	Tariff rate	Action rate	Risk rate
AOC	N.A.	0.00%	0.00%	163	189	5.79%	.23%	0.23%
Canada		0.00%	0.00%	3,038	256	0.00%	0.00%	0.00%
Mexico		0.00%	0.00%	44,970	50,658	0.00%	2.56%	2.46%
Total				48,171	51,103	0.02%	2.39%	2.30%
Difference between imports and entered goods				5.91%	Number of approved pathways			44
Percent of pathways requiring treatments								0.00%

12 – Cucumbers								
Country	Treatment	Pre-clearance rate	NARP rate	Imports	Entered	Tariff rate	Action rate	Risk rate
AOC	N.A.	0.00%	0.00%	3,106	3,914	3.17%	0.00%	0.00%
Canada		100.00%	0.00%	76,112	2,383	0.00%	0.04%	0.04%
Dom Rep.		0.00%	0.00%	3,871	7,470	0.00%	1.57%	1.57%
Honduras		99.78%	0.00%	33,616	39,117	0.01%	0.31%	0.31%
Mexico		88.62%	0.00%	477,724	451,923	0.00%	0.05%	0.05%
Total				594,429	504,807	0.02%	0.07%	0.07%
Difference between imports and entered goods				-16.31%	Number of approved pathways			47
Percent of pathways requiring treatments								0.00%

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Table 5

Tariff, risk, and action rates* by significant pathway+, 2011—continued

13 – Eggplant								
Country	Treatment	Pre-clearance rate	NARP rate	Imports	Entered	Tariff rate	Action rate	Risk rate
AOC	N.A.	0.00%	0.00%	513	510	0.37%	4.67%	4.67%
Canada		0.00%	0.00%	1,198	23	0.00%	0.00%	0.00%
Dom. Rep.		0.00%	0.00%	3,041	5,013	0.00%	5.11%	5.10%
Guatemala		0.00%	0.00%	1,278	2,034	0.01%	5.97%	5.97%
Honduras		0.00%	0.00%	4,353	3,370	0.00%	6.49%	6.49%
Mexico		0.00%	92.42%	41,001	37,834	0.00%	0.13%	0.12%
Netherlands		0.00%	0.00%	1,085	1,616	0.66%	1.53%	1.53%
Total				52,469	50,402	0.02%	1.15%	1.15%
Difference between imports and entered goods				-4.02%	Number of approved pathways			38
Percent of pathways requiring treatments								0.00%

14 – Grapes								
Country	Treatment	Pre-clearance rate	NARP rate	Imports	Entered	Tariff rate	Action rate	Risk rate
AOC	N.A.	1.81%	0.00%	2,049	2,049	0.28%	87.47%*	0.00%
Brazil	Fumigation	0.00%	0.00%	12,565	12,565	0.27%	87.18%*	0.28%
Chile	Fumigation	1.41%	0.00%	450,895	450,895	0.00%	98.58%*	0.00%
Mexico		0.00%	99.79%	3,161	113,438	0.00%	0.04%	0.01%
Peru	Cold Treat	0.04%	0.00%	39,053	39,053	0.00%	6.01%	2.07%
Total				507,722	617,999	0.01%	90.52%	0.17%
Difference between imports and entered goods				19.59%	Number of approved pathways			53
Percent of pathways requiring treatments								88.68%

15 – Kiwi								
Country	Treatment	Pre-clearance rate	NARP rate	Imports	Entered	Tariff rate	Action rate	Risk rate
AOC	N.A.	0.00%	0.00%	527	322	0.00%	0.00%	0.00%
Chile	Fumigation	1.42%	0.00%	22,180	25,475	0.00%	98.3%*	0.00%
Italy	Vapor/Cold	0.00%	0.00%	14,691	15,761	0.00%	3.57%	0.14%
New Zealand		0.90%	0.00%	20,334	24,278	0.00%	3.12%	2.59%
Total				57,732	65,836	0.00%	39.76%	0.95%
Difference between imports and entered goods				13.12	Number of approved pathways			11
Percent of pathways requiring treatments								63.64%

16 – Olive								
Country	Treatment	Pre-clearance rate	NARP rate	Imports	Entered	Tariff rate	Action rate	Risk rate
AOC	N.A.	0.00%	0.00%	27	-	2.86%	0.00%	0.00%
Mexico		0.00%	0.00%	2,511	2,360	0.00%	0.00%	0.00%
Total				2,537	2,360	0.03%	0.00%	0.00%
Difference between imports and entered goods				-7.26%	Number of approved pathways			1
Percent of pathways requiring treatments								0.00%

17 – Onion								
Country	Treatment	Pre-clearance rate	NARP rate	Imports	Entered	Tariff rate	Action rate	Risk rate
AOC	N.A.	0.03%	0.00%	1,962	1,582	5.61%	5.96%	5.96%
Argentina		0.00%	0.00%	268	0	0.00%	0.00%	0.00%
Canada		0.00%	0.00%	29,631	4,261	0.00%	0.40%	0.40%
Chile		73.72%	0.00%	14,650	13,626	0.00%	0.00%	0.00%
China		0.00%	0.00%	4,101	3,915	4.93%	0.55%	0.55%
France		0.00%	0.00%	2,730	2,414	2.03%	1.27%	1.27%
Guatemala		0.00%	0.00%	1,600	2,333	0.00%	60.95%	60.95%
Mexico		0.00%	82.84%	251,968	294,742	0.00%	0.23%	0.20%
Total				311,061	326,748	0.16%	0.59%	0.57%
Difference between imports and entered goods				4.92%	Number of approved pathways			93
Percent of pathways requiring treatments								1.08%

18 – Papaya								
Country	Treatment	Pre-clearance rate	NARP rate	Imports	Entered	Tariff rate	Action rate	Risk rate
AOC	N.A.	0.00%	0.00%	1,322	1,329	0.00%	0.00%	0.00%
Belize		0.00%	8.86%	26,372	24,482	0.02%	0.50%	0.50%
Brazil		0.27%	9.69%	3,582	5,508	0.05%	0.48%	0.48%
Dom. Rep.		0.00%	0.00%	2,165	3,078	0.00%	0.61%	0.61%
Guatemala		0.00%	0.00%	6,183	6,595	0.00%	0.40%	0.40%
Jamaica		96.84%	0.00%	547	554	0.00%	0.00%	0.00%

—continued

Table 5
Tariff, risk, and action rates* by significant pathway+, 2011—continued

Mexico		0.00%	0.00%	100,875	101,797	0.00%	1.97%	1.78%
Total				141,046	143,341	0.00%	1.54%	1.41%
Difference between imports and entered goods				1.61%	Number of approved pathways			32
Percent of pathways requiring treatments								3.13%
19 – Peaches								
Country	Treatment	Pre-clearance rate	NARP rate	Imports	Entered	Tariff rate	Action rate	Risk rate
AOC	N.A.	98.65%	0.00%	75	175	0.00%	0.00%	0.00%
Canada		0.00%	0.00%	309	29	0.00%	0.00%	0.00%
Chile	Fumigation	99.15%	0.00%	46,537	54,757	0.00%	0.77%	0.00%
Mexico	Cold Treat***	0.00%	0.00%	86	96	0.00%	0.00%	0.00%
Total				47,007	55,057	0.00%	0.77%	0.00%
Difference between imports and entered goods				15.78%	Number of approved pathways			15
Percent of pathways requiring treatments								66.67%
20 – Pear								
Country	Treatment	Pre-clearance rate	NARP rate	Imports	Entered	Tariff rate	Action rate	Risk rate
AOC	N.A.	0.00%	0.00%	17	15	0.05%	0.00%	0.00%
Argentina	Cold Treat	100.00%	0.00%	38,962	45,539	0.15%	0.00%	0.00%
Chile		100.00%	0.00%	20,644	24,751	0.00%	0.00%	0.00%
China		0.00%	0.00%	6,241	6,631	0.22%	3.96%	3.96%
New Zealand		100.00%	0.00%	1,761	2,993	0.01%	0.00%	0.00%
S. Africa	Cold Treat	9.81%	0.00%	861	978	0.00%	0.00%	0.00%
S. Korea		92.53%	0.00%	9,302	8,828	0.11%	1.75%	1.75%
Total				77,788	89,735	0.11%	0.53%	0.53%
Difference between imports and entered goods				14.26%	Number of approved pathways			16
Percent of pathways requiring treatments								68.75%
21 – Peas								
Country	Treatment	Pre-clearance rate	NARP rate	Imports	Entered	Tariff rate	Action rate	Risk rate
AOC	N.A.	0.00%	0.00%	211	148	5.30%	3.63%	3.63%
Canada		0.00%	0.00%	514	740	0.00%	3.90%	3.90%
Guatemala		0.00%	0.00%	21,631	31,855	0.00%	0.95%	0.95%
Honduras		0.00%	0.00%	436	436	0.00%	0.00%	0.00%
Mexico		0.00%	54.43%	11,113	9,362	0.00%	0.08%	0.08%
Peru		0.00%	0.00%	3,905	4,260	0.00%	8.91%	8.91%
Total				37,809	46,801	0.03%	1.56%	1.56%
Difference between imports and entered goods				21.25%	Number of approved pathways			33
Percent of pathways requiring treatments								12.12%
22 – Peppers								
Country	Treatment	Pre-clearance rate	NARP rate	Imports	Entered	Tariff rate	Action rate	Risk rate
AOC	N.A.	1.38%	0.00%	6,785	6,549	0.80%	2.09%	1.92%
Canada		0.00%	0.37%	85,312	2,587	0.00%	5.02%	4.77%
Dom. Rep.		0.00%	0.00%	10,080	14,683	0.00%	5.23%	5.17%
Honduras		0.00%	0.00%	4,328	4,526	0.00%	0.74%	0.74%
Israel		0.00%	0.00%	1,013	964	0.19%	2.51%	2.51%
Mexico		0.04%	41.38%	651,372	639,486	0.00%	0.19%	0.18%
Netherlands		0.00%	0.00%	20,610	21,605	1.74%	2.62%	2.62%
Total				779,500	690,401	0.05%	0.87%	0.83%
Difference between imports and entered goods				-12.12%	Number of approved pathways			37
Percent of pathways requiring treatments								8.11%
23 – Pineapple								
Country	Treatment	Pre-clearance rate	NARP rate	Imports	Entered	Tariff rate	Action rate	Risk rate
AOC	N.A.	0.00%	0.00%	6,522	2,486	0.18%	0.14%	0.14%
Costa Rica		0.00%	0.00%	697,648	769,692	0.00%	4.01%	3.07%
Ecuador		0.00%	0.00%	21,557	25,276	1.45%	2.00%	2.00%
Guatemala		0.00%	0.00%	14,634	14,247	0.00%	2.45%	1.84%
Honduras		0.00%	0.00%	27,241	30,648	0.00%	3.21%	1.98%
Mexico		0.00%	10.79%	36,440	36,336	0.00%	1.11%	1.07%
Panama		0.00%	0.00%	14,113	13,029	0.00%	1.13%	1.13%
Total				818,154	891,713	0.04%	3.70%	2.84%
Difference between imports and entered goods				8.60%	Number of approved pathways			71
Percent of pathways requiring treatments								2.82%

—continued

Table 5
Tariff, risk, and action rates* by significant pathway+, 2011—continued

Country	Treatment	Pre-clearance rate	NARP rate	Imports	Entered	Tariff rate	Action rate	Risk rate
24 – Plum								
AOC	N.A.	74.17%	0.00%	135	93	0.00%	0.00%	0.00%
Chile	Fumigation	96.21%	0.00%	29,383	33,140	0.00%	3.12%	0.00%
Total				29,517	33,233	0.00%	3.11%	0.00%
Difference between imports and entered goods				11.84%	Number of approved pathways			15
Percent of pathways requiring treatments								80.00%
25 – Potatoes								
Country	Treatment	Pre-clearance rate	NARP rate	Imports	Entered	Tariff rate	Action rate	Risk rate
AOC	N.A.	0.00%	0.00%	49	5	0.26%	0.00%	0.00%
Canada		0.16%	0.01%	491,449	49,103	0.00%	0.36%	0.36%
Total				491,498	49,108	0.00%	0.36%	0.36%
Difference between imports and entered goods				-163.7%	Number of approved pathways			1
Percent of pathways requiring treatments								0.00%
26 – Spinach								
Country	Treatment	Pre-clearance rate	NARP rate	Imports	Entered	Tariff rate	Action rate	Risk rate
AOC	N.A.	0.00%	0.00%	16	16	0.00%	10.14%	10.14%
Canada		0.00%	3.10%	1,168	38	0.00%	0.00%	0.00%
Mexico		0.00%	0.00%	5,025	6,350	0.00%	0.92%	0.87%
Total				6,209	6,403	0.00%	0.77%	0.73%
Difference between imports and entered goods				3.09%	Number of approved pathways			35
Percent of pathways requiring treatments								0.00%
27 – Squash								
Country	Treatment	Pre-clearance rate	NARP rate	Imports	Entered	Tariff rate	Action rate	Risk rate
AOC	N.A.	6.98%	1.70%	2,910	4,738	0.21%	2.23%	2.23%
Canada		0.00%	0.00%	4,507	151	0.00%	0.00%	0.00%
Costa Rica		0.00%	0.00%	1,753	13,141	0.00%	0.19%	0.19%
Honduras		0.00%	0.00%	4,005	4,441	0.00%	2.97%	2.97%
Mexico		0.00%	85.17%	259,153	301,796	0.00%	0.09%	0.08%
Panama		0.00%	0.00%	872	941	0.00%	6.22%	6.22%
Total				273,200	325,207	0.00%	0.18%	0.17%
Difference between imports and entered goods				17.38%	Number of approved pathways			47
Percent of pathways requiring treatments								0.00%
28 – Strawberry								
Country	Treatment	Pre-clearance rate	NARP rate	Imports	Entered	Tariff rate	Action rate	Risk rate
AOC	N.A.	7.89%	0.00%	443	229	0.07%	1.32%	1.32%
Mexico		0.00%	96.19%	110,162	91,393	0.00%	0.10%	0.08%
Total				110,605	91,622	0.00%	0.10%	0.08%
Difference between imports and entered goods				-18.77%	Number of approved pathways			94
Percent of pathways requiring treatments								1.06%
29 – Tomato								
Country	Treatment	Pre-clearance rate	NARP rate	Imports	Entered	Tariff rate	Action rate	Risk rate
AOC	N.A.	0.00%	0.00%	5,499	6,468	0.33%	1.04%	1.13%
Canada		0.00%	0.16%	141,349	6,207	0.00%	3.00%	2.15%
Guatemala		0.00%	0.00%	17,351	19,094	0.00%	0.02%	0.02%
Mexico		0.00%	97.02%	1,327,312	1,164,916	0.00%	0.04%	0.04%
Total				1,491,511	1,196,685	0.00%	0.33%	0.24%
Difference between imports and entered goods				-21.93%	Number of approved pathways			66
Percent of pathways requiring treatments								4.55%

*High action rates associated with imports requiring mandatory fumigation likely reflect a small number of imports not being fumigated prior to port entry and not being assigned the precautionary treatment code.

+Significant pathways are those comprising more than 1 percent of 2006-11 aggregate imports.
**Not applicable.

***No treatment required from fruit-fly-free areas.

Note: NARP refers to the National Agricultural Release Program, and AOC refers to All Other Countries.

Source: USDA, Animal and Plant Health Inspection Service, PPQ 280 inspections data; U.S. Department of Commerce, U.S. Census Bureau, U.S. Imports of Merchandise.

remediate a pest problem found during an inspection are higher than the costs of that same treatment if it is planned. For example, a cold treatment can often be performed while the good is in transit, significantly reducing the storage and logistical disruptions of a treatment. Similarly, fumigations are performed more efficiently in large volumes, a circumstance easier to arrange prior to shipment.

APHIS is likely to make a treatment mandatory if the likelihood is high that a shipment requires a treatment. Moreover, as this likelihood rises, CBP is likely to order more rigorous inspections on the commodity, which raises the associated costs of unpacking and packing the shipment.[16] Subsequently, risk rates (capturing the likelihood of a discretionary treatment) rarely exceed some maximum threshold because APHIS is likely to make the treatment mandatory for a pathway that is frequently found to have pests. In most cases, the discretionary treatments associated with the finding of an actionable pest involve quickly fumigating the shipment for insect pests, and a large portion of the commodity's value is retained. A more harmful scenario occurs when goods must undergo a cold treatment or be returned, causing substantial logistical delays. At worst, no treatment is possible and returning the shipment is not feasible (perhaps because it is highly perishable), so the good is destroyed and all the value of the good is lost. Assuming that the costs of treatments are primarily the direct costs paid by the import, and the lost value of the commodity is primarily in terms of quality rather than reputation (including loss of consumer goodwill from supply chain disruptions), the risk rate acts as an upper limit on the costs of discretionary treatments.[17] If the rate is 3 percent, then suppliers as a group might lose a maximum of 3 percent of the value of imports if, in the most extreme case, all goods are ordered to be destroyed. This risk rate would be comparable to a 3-percent tariff that reduces the average value of shipments by that amount.

Of the 118 significant pathways, only 10 (about 8 percent) had risk rates exceeding 5 percent (table 5).[18] An additional 25 significant pathways had risk rates between 1 and 5 percent, so that about 30 percent of significant pathways have risk rates exceeding 1 percent. Of the 29 goods considered, 8 (apples, cassava, celery, corn, eggplant, papaya, peas, and pineapple) had average risk rates greater than 1 percent. Moreover, in most cases (with the exceptions of asparagus, onions, and spinach), average risk rates for nonsignificant ("AOC," or "All Other Countries") pathways are within 2 percentage points of either the average rate or the rate for a significant pathway.

Some significant commodity pathways have conditions of entry requiring treatments. In addition to listing treatment requirements for permitted pathways, table 5 provides the number of approved pathways for importation and the percentage of pathways requiring a treatment. In 2011, 13 of 118 (or 11 percent) significant commodity pathways required a mandatory treatment as a condition of entry, compared with 140 of 1,072 (or 13 percent) of all pathways.[19] Petersen et al. (2013) find that, while requirements to treat shipments reduce a country's exports to the United States, this effect becomes negligible once an exporter ships more than a certain threshold, and a large share of exporters (between 64 and 92 percent depending on the model specification) overcome this threshold. The slightly higher rate at which nonsignificant pathways have required treatments supports the general notion that required treatments inhibit trade, but that the effect seems limited. Additionally,

[16]This may also lead to "port shopping" if certain ports target inspections more rigorously than others.

[17]High action rates (over 80 percent) are discounted in cases where a mandatory fumigation is required, as these high rates likely reflect the importer not undertaking a required treatment.

[18]Of these goods, only one pathway – onions from Guatemala – had a risk rate exceeding 11 percent.

[19]Table 5 provides the percentage of pathways requiring a mandatory treatment and the number of pathways for the 29 commodities. This figure is a weighted average of the individual percentages.

the expectation of an importer being required to perform a treatment may deter it from seeking trade access at all.

Import requirements vary across commodities. As table 5 indicates, grapes, kiwi, peaches, and pears all have multiple significant pathways that require mandatory treatments. On the other hand, tomatoes and strawberries have 66 and 94 pathways, respectively, approved for importation with no required treatments, and bananas have 74 pathways for which only 12 (nonsignificant) pathways require treatment. These three commodities also differ significantly in the concentration of their import shares. Bananas have eight significant pathways, tomatoes three, and strawberries one. For most commodities, the share of significant trade pathways requiring treatment is smaller than the share of nonsignificant pathways requiring treatment. Asparagus and peaches, however, are notable exceptions to this pattern.

A complete list of entry requirements for each commodity for 2012 is posted on the ERS website titled "Phytosanitary Regulation." [20] From these tables, several other observations emerge. First, importers often have multiple treatment options, with some treatments being more expensive than others.[21] Second, while RSAPs have been developed in recent years, they are not necessarily implemented. For instance, ECOWAS countries (i.e., West African countries) have had RSAPs for both bananas and peppers but have yet to implement the domestic conditions of these protocols. Third, regionalization, which limits regulation or quarantine restrictions to specific areas, is relatively common. For example, Tasmania can often export goods under less restrictive conditions than the rest of Australia because it is free from the Mediterranean fruit fly and the Queensland fruit fly. Similarly, the United States often restricts entry of imports to Puerto Rico and Hawaii that are not restricted entry to the mainland.[22] The United States also often restricts the ports at which goods can make entry. Importantly, these restrictions do not restrict the movement of goods once they enter the United States—instead, they represent early attempts at destination regionalization of goods originating from European countries and pre-date recent, more formal destination restrictions, such as those affecting Mexican avocados after 1997 (Peterson and Orden, 2008).

Both tariffs and nontariff measures are relatively small across significant trade pathways. In general, U.S. tariff rates on imports vary significantly across origin and commodity. The general tariff rate is typically the highest and affects the fewest countries. The most-favored-nation tariff rate is more generally applicable, being assessed for most nations in good diplomatic standing with the United States. Special lower tariff rates are levied or even eliminated for specific countries covered by bilateral or multilateral agreements including, most recently, the Korean, Colombian, and Dominican Republic-Central American Free Trade Agreements.

Tariff rates are generally low for goods with significant import pathways (table 5). Of the 118 significant pathways for the 29 commodities, only 2 (Spanish artichokes and Brazilian cassava) faced tariff rates greater than 5 percent. An additional seven significant pathways faced tariff rates between

[20]www.ers.usda.gov/data-products/phytosanitary-regulation

[21]Reviewing the sparse systematic work of the costs of sanitary and phytosanitary treatments, Ferrier (2010) finds that the cost of irradiating produce ranges from 2 to 6 cents per pound, while the cost of methyl bromide fumigation ranges from 1 to 3 cents per pound (depending on the commodity). For grapes from Chile unloaded in Philadelphia, fumigation may cost $8 to $10 per 1,200-pound pallet or 0.67 to 0.83 cents per pound (Quinones, 2013). Relatedly, Calvin et al. (2008) find that the value of the quality reduction for apples (5 cents per pound) may be larger than the actual cost of the treatment.

[22]Only regulations for the mainland United States are included in entry conditions because import regulations for Hawaii, Puerto Rico, Guam, and the Commonwealth of the Northern Mariana Islands differ significantly.

1 and 5 percent, so that about 8 percent of these pathways face tariffs exceeding 1 percent. Of the nonsignificant pathways, 6 of the 29 groups of countries included within the AOC aggregate faced tariff rates over 5 percent, and an additional 2 groups faced rates between 1 and 5 percent—consequently, 28 percent of these pathways faced tariff rates over 1 percent.

While the risk rates are higher than the tariff rates for both significant and nonsignificant pathways in most cases, a treatment is likely to cost or reduce the quality-adjusted price of a commodity by only a fraction of its value. However, even in the worst-case scenario, where the finding of a pest destroys the entire value of the commodity, this loss represents less than 5 percent of the value of shipments in the majority of cases. In most cases, the treatment ordered (most commonly fumigation) results in far less than a total value loss and, as previously shown, mandatory treatments only applied to about 13 percent of trade pathways.

Conclusion

U.S. imports of fresh fruits and vegetables have grown dramatically since the early 1990s. In the same period, both tariffs and nontariff measures have been liberalized with the passage of several bilateral and multilateral trade agreements. Compared to tariffs, nontariff measures are more difficult to assess in terms of their relative effects on trade. In considering significant import pathways (i.e., countries that ship more than 1 percent of all U.S. imports of a particular commodity), the risk rate is greater than 5 percent for only 8 percent of these pathways, and treatments typically do not destroy the full value of the good—this rate represents the upper limit to the average tariff-equivalent cost to discretionary treatments resulting from inspections. Less significant trade partners do not face appreciably higher risk or action rates than significant trade partners.

Only 11 percent of significant commodity pathways require a mandatory treatment (compared with 13 percent for all pathways). Because both the types and effects of mandatory treatments differ across commodities, it is difficult to assign a dollar value to the cost of mandatory treatments. Between significant and nonsignificant pathways, the relative similarity in the rates at which pathways are subject to mandatory treatments or ordered discretionary treatments following an inspection suggests that large importers do not face substantially different regulations regarding treatments or inspections than small ones. While we cannot rule out all possibility of regulatory protectionism, there is no clear evidence that nonsignificant pathways face a different pattern of regulation than significant pathways (a pattern that would be apparent if compliance with phytosanitary regulations and inspections acted as a large fixed cost to trade). Instead, findings seem more consistent with the idea that mandatory and discretionary treatments are assigned based on risk. However, this study did not consider whether phytosanitary restrictions support regulatory protectionism where:

1. Regulatory costs (mandatory or discretionary treatments) deter trade generally without bias to significant or nonsignificant trading countries;
2. Countries do not seek import access because they expect prohibitively high ex-post regulatory costs; or
3. Countries facing very high regulatory costs do not ship goods at all.

This report comprehensively describes national measures to address phytosanitary concerns for various fruits and vegetables. By considering many commodities simultaneously, this study avoided only choosing import regulations for measures that appear too challenging or unjustified to importers. Importantly, this research addresses neither private standards implemented by large retailers nor food safety measures implemented by the FDA. While significant, these restrictions are more challenging to characterize because private standards are voluntary and do not apply to all producers in a pathway, while FDA's targeted inspections process is specific to importers rather than pathways. This research can provide a framework for future work addressing the impact of import regulations on trade.

References

Ameden, H.A., P.C. Boxall, S.B. Cash, and D.A. Vickers. 2009. "An Agent-Based Model of Border Enforcement for Invasive Species Management," *Canadian Journal of Agricultural Economics/ Revue canadienne d'agroeconomie* 57(4):481-496.

Baylis, K., A. Martens, and L. Nogueira. 2009. "What Drives Import Refusals?" *American Journal of Agricultural Economics* 91(5):1477-1483.

Becker, G.S. 1983. "A Theory of Competition Among Pressure Groups for Political Influence," *The Quarterly Journal of Economics* 98(3):371-400.

Beghin, J.C., and J.C. Bureau. 2001. "Quantification of Sanitary, Phytosanitary, and Technical Barriers to Trade for Trade Policy Analysis," *Économie internationale* 87:107-130.

Borjas, G.J. 1980. "The Relationship Between Wages and Weekly Hours of Work: The Role of Division Bias," *The Journal of Human Resources* 15(3):409-423.

Buzby, J.C., L.J. Unnevehr, and D. Roberts. September 2008. *Food Safety and Imports: An Analysis of FDA Food-Related Import Refusal Reports*, EIB-39, U.S. Department of Agriculture, Economic Research Service. www.ers.usda.gov/publications/eib-economic-information-bulletin/eib39.aspx (accessed April 2014).

Calvin, L., B. Krissoff, and W. Foster. 2008. "Measuring the Costs and Trade Effects of Phytosanitary Protocols: A U.S.–Japanese Apple Example," *Review of Agricultural Economics* 30(1):120-135.

Copeland, B.R. 1990. "Strategic Interaction Among Nations: Negotiable and Non-Negotiable Trade Barriers," *The Canadian Journal of Economics / Revue canadienne d'Economique* 23(1):84-108.

Costello, C., and C. McAusland. 2003. "Protectionism, Trade, and Measures of Damage From Exotic Species Introductions," *American Journal of Agricultural Economics* 85(4):964-975.

Disdier, A.C., L. Fontagné, and M. Mimouni. 2008. "The Impact of Regulations on Agricultural Trade: Evidence from the SPS and TBT Agreements," *American Journal of Agricultural Economics* 90(2):336-350.

Disdier, A.C., and S. Marette. 2010. "The Combination of Gravity and Welfare Approaches for Evaluating Nontariff Measures," *American Journal of Agricultural Economics* 92(3):713-726.

Ferrier, P. 2010. "Irradiation as a Quarantine Treatment," *Food Policy* 35(6):548-555.

Follett, P.A., and L.G. Neven. 2005. "Current Trends in Quarantine Etymology," *Annual Review of Entomology* 51(1):359-385.

Gölge, E., and G. Ova. 2008. "The Effects of Food Irradiation on Quality of Pine Nut Kernels," *Radiation Physics and Chemistry* 77(3):365-369.

Lamb, R. 2006. "Rent Seeking in U.S.-Mexican Avocado Trade," *Cato Journal* 26(1).

Lehtonen, P., and A. Tschanz. 2008. *Revision of Quarantine 37*, U.S. Deparment of Agriculture, Animal and Plant Health Inspection Service. www.nisaw.org/2011/USDAITAP/Q-37Revision.pdf (accessed April 2014).

Li, Y., and J.C. Beghin. 2014. “Protectionism Indices for Non-Tariff Measures: An Application to Maximum Residue Levels,” *Food Policy* 45(0):57-68.

Livingston, M.J. 2007. “The Mediterranean Fruit Fly and the United States: Is the Probit 9 Level of Quarantine Security Efficient?” *Canadian Journal of Agricultural Economics* 55(4):515-526.

Mérel, P.R., and C.A. Carter. 2008. “A Second Look at Managing Import Risk From Invasive Species,” *Journal of Environmental Economics and Management* 56(3):286-290.

Moffitt, J.L., J.K. Stranlund, and C.D. Osteen. 2008. “Robust Detection Protocols for Uncertain Introductions of Invasive Species,” *Journal of Environmental Management* 89(4):293-299.

Naim, M. 2005. *Illicit*. New York: Random House.

Orden, D., J. Beghin, and G. Henry. 2012. “Key Findings of the NTM-IMPACT Project,” *The World Economy* 35(8):967-972.

Peterson, E., J. Grant, D. Roberts, and V. Karov. 2013. “Evaluating the Trade Restrictiveness of Phytosanitary Measures on U.S. Fresh Fruit and Vegetable Imports,” *American Journal of Agricultural Economics* 95(4):842-858.

Peterson, E.B., and D. Orden. 2008. “Avocado Pests and Avocado Trade,” *American Journal of Agricultural Economics* 90(2):321-335.

Quinones, Geronimo. 2013. “Re: Question on the Cost of Grading Fruits and Vegetables,” Personal Communication, U.S. Department of Agriculture, Agricultural Marketing Service.

Springborn, M., C. Costello, and P. Ferrier. 2010. “Optimal Random Exploration for Trade-Related Non-Indigenous Species Risk,” *in Bioinvasion and Globalization: Ecology, Economics, Management and Policy*, C. Perrings, H.A. Mooney, and M. Williamson, eds. Oxford: Oxford University Press.

Stewart, A. 2007. *Flower Confidential: The Good, the Bad, and the Beautiful*. Chapel Hill: Algonquin Books.

Surkov, I.V., A.G.J.M. Oude Lansink, and W. van der Werf. 2009. “The Optimal Amount and Allocation of Sampling Effort for Plant Health Inspection,” *European Review of Agricultural Economics* 36(3):295-320.

Surkov, I.V., A.G.J.M. Oude Lansink, O. Van Kooten, and W. Van Der Werf. 2008. “A Model of Optimal Import Phytosanitary Inspection Under Capacity Constraint,” *Agricultural Economics* 38(3):363-373.

Thomas, P., and W.J. Bramlage. 1986. “Radiation Preservation of Foods of Plant Origin. Part IV. Subtropical Fruits: Citrus, Grapes, and Avocados,” *CRC Critical Reviews in Food Science and Nutrition* 24(1):53-89.

Tullock, G. 1967. “The Welfare Costs of Tariffs, Monopolies, and Theft,” *Economic Inquiry* 5(3):224-232.

Tullock, G. 1975. “The Transitional Gains Trap,” *The Bell Journal of Economics* 6(2):671-678.

U.S. Department of Agriculture, Animal and Plant Health Inspection Service. 2006-2011. *PPQ* 280 Inspections Data.

U.S. Department of Agriculture, Animal and Plant Health Inspection Service. 2007. “Revision of Fruits and Vegetables Import Regulations; Final Rule,” *Federal Register* 39482-528.

U.S. Department of Agriculture, Animal and Plant Health Inspection Service. 2008. *APHIS' Quarantine 56 Revision*. www.aphis.usda.gov/publications/plant_health/content/printable_version/faq_q56reg.pdf (accessed April 2014).

U.S. Department of Agriculture, Animal and Plant Health Inspection Service. 2009. “Importation of Plants for Planting; Establishing a Category of Plants for Planting Not Authorized for Importation Pending Pest Risk Analysis,” *Federal Register* 36403-14.

U.S. Department of Commerce, U.S. Census Bureau. 2006-11. *U.S. Imports of Merchandise*.

Viscusi, W.K., J.M. Vernon, and J.E. Harrington. 2000. *Economics of Regulation and Antitrust*. New York: The MIT Press.

Watson, K.W., and S. James. 2013. “Regulatory Protectionism: A Hidden Threat to Free Trade,” *Policy Analysis* (723). Washington, DC: Cato Institute. www.cato.org/sites/cato.org/files/pubs/pdf/pa723.pdf (accessed April 16, 2014).

World Trade Organization. 1995. *The WTO Agreement on the Application of Sanitary and Phytosanitary Measures*. Geneva, Switzerland. www.wto.org/english/res_e/booksp_e/agrmnt-series4_sps_e.pdf (accessed April 16, 2014).

Yue, C., J. Beghin, and H.H. Jensen. 2006. “Tariff Equivalent of Technical Barriers to Trade with Imperfect Substitution and Trade Costs,” *American Journal of Agricultural Economics* 88(4):947-960.

Yue, C., and J.C. Beghin. 2009. “Tariff Equivalent and Forgone Trade Effects of Prohibitive Technical Barriers to Trade,” *American Journal of Agricultural Economics* 91(4):930-941.

Appendix– Regression analysis of differences between imports recorded in trade data and inspections data

Table A provides the results of regression analysis considering the difference between imports recorded in trade data and inspections data. In five related models based on equation (1), the β coefficients of the dependent variables are estimated where *diff* is the percentage difference between imported and entered volumes (the import difference), *Commodity* is a dummy variable for each commodity, and *year, Imports*, and *Entered* are each control variables.

To allow for easy interpretation, the control variables of *year*, *Inspections,* and *Entered* are transformed to be their distances from their averages (2008.5, 343,835, and 338,680, respectively), the intercept term is omitted, and dummy variables are included for each commodity. This transformation allows the $\beta_{Commodity}$ term to be interpreted as the average difference for a specific commodity without further calculation regarding the controls.[23]

$$(1) \quad diff = \beta_{year}\, year + \beta_{Imports}\, Imports + \beta_{Entered}\, Entered + \beta_{Commodity}\, Commodity$$

In table A, variables are added sequentially to consider possible specification error. In model (1) (the base model), the three control variables—*year, Imports*, and *Entered*—are omitted from the estimation, thereby making the $\beta_{Commodity}$ estimate equivalent to the simple average import difference for each commodity. In model (2), the *year* and *Imports* variables are added, while in model (3), *year* and *Entered* are added. Because the close correlation between *Imports* and *Entered* creates multicollinearity, simultaneous inclusion of both variables will lead to inconsistent results. In each of these models, however, *Imports* and *Entered* goods are significant, suggesting that they have some explanatory power. Because, *diff* simultaneously includes positive and negative differences that can offset and attenuate the estimated effects of the control variables on *diff*, the *diff* is modified to be the square of the import difference in model (4) and absolute value of the import difference in model (5).

Based on 174 observations (29 goods in the 6 years from 2006 to 2011), the coefficient is significantly negative in each of the models (table A). This suggests that the import difference is shrinking over time. However, for many commodities, the coefficient on the commodity dummy variable ($\beta_{Commodity}$) is significantly different from zero,[24] indicating the average import difference is greater than zero even after controlling for other factors. Of the 29 commodities, 8 commodities have average import differences that are significantly different from zero in model (1), as do 16 in model (2). These differences may understate an estimate of the fall in the import differences because the import difference may be positive or negative, even as it falls in absolute value. To address this issue, models (4) and (5), which use the square and absolute values of the import difference as the dependent variable, still show that the β_{year} coefficient is significantly negative, so the difference between

[23]This specification also makes the standard error of each of the commodity dummy parameters (not shown) equal.

[24]The p-value indicates the probability that the estimated coefficient is equal to zero if there was, in fact, no effect of the dummy variable on the percentage difference between inspection and entry rates and the observed data relationship was simply occurring by chance. If the p-value is less than 0.5, the probability is less than 5 percent that effect is due to chance alone and the coefficient is said to be statistically significant at the 5-percent level.

Table A

Regression of the percentage difference in quantities recorded as imported in trade data and entered in inspections data

Commodity		Base model (1) – diffs.	Model 2 – diffs.	Model 3 – diffs.	Model 4 - squared diffs.	Model 5 – absolute diffs.
	Parameter	*Est.*	*Est.*	*Est.*	*Est.*	*Est.*
	β year	--	-0.0251***	-0.0169**	-0.0158***	-0.0275***
	β Imported	--	5.26E-07***	--	4.11E-08	8.876E-08
	β Entered	--	--	-8.02E-08***	--	--
1	β Apple	0.1999***	0.2909***	0.184*	0.0726**	0.22***
2	β Apricots	-0.0477	0.1323	-0.0747*	0.1664***	0.3356***
3	β Artichoke	0.1135*	0.2938***	0.0864*	0.0426	0.156***
4	β Asparagus	-0.0057	0.0975	-0.021*	0.0108	0.0637
5	β Avocado	-0.0396	-0.0383	-0.0383*	0.0023	0.0398
6	β Banana	-0.0896	-1.9846***	0.2303	-0.1348	-0.2301
7	β Carrot	0.6805***	0.7903***	0.6586*	0.4738***	0.699***
8	β Cassava	0.0163	0.1749**	-0.0076*	0.0184	0.0878
9	β Celery	0.131**	0.2951***	0.106*	0.0358	0.1638***
10	β Cherry	0.0549	0.2265**	0.0292*	0.0986**	0.2495***
11	β Corn	-0.3496***	-0.1894**	-0.3723*	0.1683*	0.3766***
12	β Cucumber	0.0577	-0.0349	0.0699*	0.0149	0.123***
13	β Eggplant	0.0068	0.1594*	-0.0161*	0.0166	0.0783
14	β Grapes	-0.3012***	-0.334***	-0.2857*	0.1075***	0.2957***
15	β Kiwi	-0.0258	0.1284	-0.0487*	0.0202	0.102*
16	β Olive	0.0125	0.1892**	-0.014*	0.0148	0.0526
17	β Onions	-0.0229	0.0081	-0.0268*	0.0191	0.123***
18	β Papaya	-0.027	0.0796	-0.0425*	0.0126	0.0653
19	β Peaches	0.0131	0.1646**	-0.0095*	0.1107***	0.2991***
20	β Pear	0.0228	0.1593**	0.0022*	0.0377	0.1643***
21	β Peas	-0.13**	0.0334	-0.1542*	0.0326	0.1576***
22	β Pepper	0.0608	-0.1047	0.0832*	-0.0077	0.0361
23	β Pineapple	-0.1098*	-0.3143***	-0.0715*	-0.0026	0.0752
24	β Plum	0.0314	0.1963**	0.0066*	0.0447	0.1782***
25	β Potatoes	1.6038***	1.5445***	1.5806*	2.569***	1.5938***
26	β Spinach	-0.0281	0.1491*	-0.0547*	0.0203	0.0971*
27	β Squash	-0.1626**	-0.1181*	-0.1652*	0.0335	0.1701***
28	β Strawberry	0.2154***	0.3531***	0.1936*	0.0717**	0.2386***
29	β Tomato	0.2149***	-0.2526	0.2678	0.0143	0.1361
	d.f.	175	174	174	174	174
	R-squared	0.8495	0.8634	0.8566	0.9838	0.9188

The superscripts "*","**","***" indicate 90-percent, 95-percent, and 99-percent significance levels for the estimated β parameters, respectively.
Source: USDA, Economic Research Service.

measured imports and inspected goods is decreasing. The *Imports* and (closely correlated) *Entered* control variables are only found to be significant in model (2).[25]

While certain modeling assumptions would undoubtedly affect these specific results (for example, controlling for heteroskedasticity, weighting the regression results by import flows, or breaking out observations on a country and commodity level to increase the number of observations), this basic regression analysis of the data sets indicates systematic differences between the two.

[25]A potential endogeneity problem may arise because the *Entered* and *Imports* variables are used to construct the *diff* terms ((*Imports* – *Entered*)/(*Imports* + *Entered*)/2) as independent variables on the right hand side of table A. There should be a correlation between *Imports* and *Entered* of 1 so that any nonzero value of difference is explained primarily through measurement error, rather than *Imports* or *Inspections* themselves. If the measurement error is not of direct interest, the significance of these parameters might easily be misinterpreted (see Borjas (1980) for an example with division bias), in which case the problem may be addressed with instrumental variables estimation.