

# Barriers to Trade in Global Apple Markets

by

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**Abstract:** Horticultural product trade has expanded considerably; U.S. fresh apple exports increased from \$11 million in 1970 to \$382 million in 1996. High tariff rates and technical barriers, however, continue to constrain international sales of apples to some markets. Phytosanitary protocols related to fire blight, codling moth, apple maggot, and other pests prohibit or limit U.S. apple exports to some countries. Tariff rate equivalents for phytosanitary requirements are estimated for Japan, South Korea, and Mexico and are sometimes found to be as large or larger than many tariff rates, ranging up to 58 percent. Removing tariffs and harmonizing these regulatory measures to current U.S. systems approaches to pest management for the three countries would substantially affect global apple trade, increasing imports by \$205 million in 1994/95 and by \$280 million in 1995/96.

**Keywords:** Apples, international trade, tariffs, phytosanitary requirements, technical barriers, Japan, South Korea, Mexico.

## Introduction

International trade in fresh apples more than tripled in the last 25 years, reaching 5 million metric tons in 1995. U.S. participation in this expansion has been significant, with U.S. apple exports totaling 590,649 metric tons in 1996, up 1,096 percent from 1970. Yet, there remain considerable barriers to trade. Several important trading partners maintain tariffs and technical barriers (TBs) that limit the flow of fresh apples across borders. Some countries prohibit imports of apples.

TBs are import standards or regulations that reflect a country's concern and valuation for safety, health, food quality, and the environment (Roberts and DeRemer; Hillman; and Thilmany and Barrett). TBs include: sanitary and phytosanitary measures related to food safety, animal and plant health; food standards of definition, measurement, and quality; and environmental or natural resource conservation measures.

Unlike a tariff, a TB may increase national social welfare if it rectifies a failure of the market to incorporate product or production method attributes in the product price. These attributes can be important to consumers and producers. For example, if a country is free of a damaging pest, imports from a country with that pest may be regulated on the grounds that the market price does not reflect the potential costs to society of pest infestation and eradication efforts. In the case of apples, some countries have concerns about the spread of fire blight, a bacterial disease that affects apple trees, and insects such as the codling moth and apple maggot. Some countries have implemented various phytosanitary protocols to reduce the risk of disease or pest infestation.

TBs insulate an importing country's domestic market from the world market, thus reducing (or eliminating) imports. With TBs limiting imports, domestic consumer and producer prices rise relative to world market prices, affording the domestic industry a measure of import protection. An importing country may apply different regulatory measures for different exporters. Import requirements in the plant health area are often bilateral because pest problems differ across countries, putting some countries at a comparative disadvantage.

Since the negotiation and signing of the Uruguay Round Agreement, tariffs have declined, but policymakers, agribusiness interests, and economists voice growing concerns that TBs now play a relatively more substantive role in limiting trade flows across countries. There are at least two key issues. First, do the technical measures target problems of market failure and provide a net social welfare gain to importing nations, or are they just a rationale to protect the domestic industry from foreign competition? Second, what are the trade and price effects of the TBs on importing and exporting nations? Both are complex issues; our focus here is on the latter. We examine the role of the United States in international apple markets, and investigate how tariffs and TBs create exporter-importer price differentials for Japan, South Korea, and Mexico. We focus only on TBs related to phytosanitary concerns. Finally, we estimate how eliminating these price differentials would affect international trade flows.

## The U.S. Apple Market and Trade

Apples are the third most valuable fruit crop grown in the United States, behind grapes and oranges. In 1996, the value of the commercial apple crop was \$1.7 billion. Production has grown from an annual average of 6.5 billion pounds in 1970-75 to 10.4 billion pounds in 1990-96. In 1994, production reached a record 11.6 billion pounds.

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Apple production is spread across many States, but Washington, Michigan, New York, and California dominate, typically accounting for 75 percent of total production. In 1996, 61 percent of commercial apple production went to the fresh market. Washington is the largest producer for both the fresh and processed market. Because of its large production and long-term storage technology, Washington ships apples to the fresh market year round and tends to account for the largest quantity shipped in any given month. In the 1995/96 marketing season (August 1995-July 1996), Washington accounted for 67 percent of the U.S. fresh apple supply. Michigan and New York shipments are heaviest from fall through spring, while California ships its largest amounts in the fall. In the spring, the United States supplements domestic supplies with imports from Southern Hemisphere producers.

Although many varieties of apples are produced in the United States, Red Delicious remains the most common. The U.S. Apple Association estimates Red Delicious production at 42 percent of the 1996 U.S. crop. Golden Delicious is the second most popular, with 14 percent of production. Granny Smith, Rome, and McIntosh comprise approximately 7, 6, and 5 percent of the market, respectively. These varietal shares have been rather stable over the 1990s. In contrast, Fuji and Gala apple production have increased rapidly, each growing from less than 2 percent of the market in the early 1990s to over 5 and 3 percent, respectively, in 1996. Jonathan, York, Stayman, Winesap, and other varieties have decreased in importance. This is an important structural change in the industry as producers are responding to high prices for the fresh export market and changing consumer preferences for sweeter apples. Fuji and Gala apples are particularly popular in important Asian export markets.

Americans consumed over 5 billion pounds of fresh apples in 1995/96, averaging 19 pounds per person. This level of per capita consumption is equal to the average of the previous 10 years. Because U.S. apple production increased while domestic fresh apple consumption remained relatively constant, exports are even more critical to the health of the domestic industry.

In 1995/96, the United States was the world's second largest fresh apple exporter. Washington State apples accounted for an estimated 79 percent of total U.S. exports in 1995/96. France, the Netherlands, and Italy were the first, third and fourth largest exporters. Much of European exports are intra-European. Chile was the fifth largest exporter.

Taiwan, Mexico, and Canada were the largest markets for U.S. fresh apples in the 1995/96 season, accounting for 47 percent of total exports (table B-1). The most important markets are in Asia and the Americas. Of the top 16 export markets in 1995/96, all but the United Kingdom, Saudi Arabia, and the United Arab Emirates fell within this area. Most exports to Russia are to the Far East region of that country. Given the importance of exports to Pacific Rim countries, the huge growth in the Chinese apple industry is of concern. China is the world's largest apple producer and production increased 54 percent between 1993 and 1995.

Table B-1--Top U.S. apple export markets, 1995/96 1/

Country	Exports	Share of exports
	Metric tons	Percent
Taiwan	100,046	18.1
Mexico	79,278	14.4
Canada	78,952	14.3
Indonesia	48,508	8.8
Hong Kong	45,245	8.2
Thailand	25,570	4.6
United Kingdom	22,386	4.1
Philippines	17,721	3.2
Malaysia	16,136	2.9
Brazil	13,207	2.4
Saudi Arabia	13,051	2.4
Singapore	10,203	1.8
Russia	9,070	1.6
United Arab Emirates	7,211	1.3
Colombia	7,152	1.3
Guatemala	5,533	1.0
Total exports	552,129	100.0

1/ U.S. apple marketing year is August to July.

Source: U.S. Department of Commerce

In this article, our country coverage focuses on Japan, South Korea, and Mexico (see table B-2). These three countries are important actual or potential export markets for the United States, and each has important phytosanitary requirements or a ban on the import of apples from the United States. Currently, Japan limits imports of U.S. apples to Red and Golden Delicious apples from Washington and Oregon that have gone through rigorous import requirements. Exports to Japan have not been very profitable under these conditions. During the 1997/98 season there will be no U.S. apple exports to Japan because no growers have registered for the export program. South Korea bans apple imports from the United States because of phytosanitary concerns. In contrast, Mexico imports large quantities of apples from specified regions of the United States despite costly phytosanitary requirements.

## Japan

Japan is a major producer and consumer of apples. In 1995/96, Japan produced 963,300 metric tons of apples, making it the world's twelfth largest producer. Apple production is experiencing a slight downward trend, consistent with the general contraction of the Japanese agricultural sector. From 1990 to 1995, Japan's apple production declined 9 percent. Imports and exports both account for 1 percent or less of consumption. In 1995/96, Japan imported small amounts of apples from the United States, South Korea, and New Zealand. Japanese apples are famous for their very high quality and prices. Production costs for such expensive and high quality fruit are also high. Apples are often used as gifts and consumed as desserts rather than as snacks. Most apples are consumed fresh. Japan's processing sector used 17 percent of the apple crop in the 1995/96 marketing season.

Fuji and Tsugaru apples, which are particularly sweet and juicy, are the favorite varieties among Japanese consumers. Fuji is the most important apple with 52 percent of production

Table B-2--U.S., Japanese, South Korean, and Mexican apple production, trade, and consumption: 1994/95 and 1995/96 1/

		United States		Japan		Korea		Mexico	
		1994/95	1995/96	1994/95	1995/96	1994/95	1995/96	1994/95	1995/96
Production 2/	Metric tons	5,216,584	4,801,274	989,300	963,300	616,505	715,982	488,000	427,000
Production (commercial) 3/	"	5,139,836	4,712,824	909,700	879,100	616,505	715,982	438,000	387,000
Fresh imports 4/	"	130,149	173,913	8,900	1,089	0	0	80,000	80,000
Fresh exports 5/	"	692,511	552,129	1,800	2,506	2,293	5,315	0	0
Processing 6/	"	2,252,176	2,062,393	182,400	163,000	123,301	143,196	85,000	70,000
Consumption	"	2,325,298	2,272,215	814,000	798,883	490,911	567,471	483,000	437,000
Imports share of consumption	Percent	6	8	1	0	0	0	17	18
US share of imports	"	n.a.	n.a.	95	77	0	0	99	99

n.a. = not applicable

1/ For the United States and Mexico the marketing year is August-July and for Japan it is July-June. 2/ Commercial production in the United States. 3/ Utilized production in United States. 4/ Mexican imports are on a calendar year basis. Assuming calendar year 1995 exports are shipped to Mexico during the 1994/95 marketing year and calendar year 1996 exports are shipped during the 1995/96 marketing year. 5/ Exports for Korea are on a calendar year basis. 6/ The volume of Korean apples going to the processing market is estimated.

Source: Economic Research Service, Foreign Agricultural Service, and Statistical Yearbook of Foreign Trade, Customs Service, Republic of Korea, 1994 and 1995.

in 1995/96. Fuji apples are marketed year round although few are sold during the summer months. Tsugaru apples accounted for 15 percent of production in 1995/96. Japanese Red Delicious apples accounted for about 2 percent of production. Red Delicious acreage has been decreasing, with a 20-percent decline in production from 1994/95 to 1995/96.

In 1994, Japan lifted its long-standing ban on imports of U.S. apples and allowed imports of Red and Golden Delicious apples from Washington and Oregon with certain phytosanitary requirements. These phytosanitary requirements are commonly viewed as the most restrictive of any country, short of an outright ban on apple imports.<sup>2</sup> Japan is concerned with the spread of fire blight, codling moths, and apple maggots.

Fire blight is a bacterial disease that affects apple trees. While an orchard may be slightly infected with fire blight, there may be no effect on the trees in many years. Environmental conditions, such as warm and humid weather at bloom time, can promote an outbreak. The disease can spread under these conditions if infectious material is in the air. Affected branches are cut off to prevent the spread of the disease. In severe cases, a tree might be removed. Once fire blight is established in a country, it is virtually impossible to eradicate because the bacteria has many cultivated and wild hosts. A search of world scientific literature strongly indicates there is virtually no risk of transmission by commercially produced fruit. Treating the fruit with a chlorine dip adds additional quarantine security. Chlorine dip is an inexpensive procedure and does not damage apples.

Japan claims its apple production areas to be free of fire blight and its regulations regarding fire blight are rigorous.<sup>3</sup>

<sup>2</sup> In addition to South Korea, other prominent examples of countries that completely ban imports of any U.S. fresh apples on phytosanitary grounds are Australia and Chile. India bans apple imports because of its balance of payments situation.

<sup>3</sup> Among major producers, only Japan claims to be free of fire blight. Australia did until recently. Australia bans all imports because of the threat of fire blight. In early 1997, evidence of fire blight was reported in two Australian botanical gardens. Australian officials confirmed the presence of fire blight in the botanical gardens but surveys have failed to detect fire blight in commercial orchards, nurseries, and other urban areas. The Australian Quarantine Inspection Service will survey Australian apple and pear orchards in their spring (October-November) of 1997 to determine fire blight status.

Japan requires a chlorine dip as one of several precautions against fire blight. Almost all countries accept U.S. systems approaches to pest management as an adequate precaution. A system approach consists of good commercial production practices, grading and sorting which further eliminates fruit with any pest infestation or damage, and visual inspection for pests. U.S. growers who wish to export apples to Japan must also register their acreage in advance for the Japanese protocol and comply with all phytosanitary requirements (see table B-3). An orchard shipping apples to Japan must be inspected three times each season by representatives of USDA's Animal and Plant Health Inspection Service (in the case of Washington apples, by a representative of the Washington State Department of Agriculture). The inspections must occur at bloom time, when the fruit size is 3 centimeters, and just prior to harvest when a Japanese inspector must be present. The Japanese inspector examines every tree in an orchard for evidence of fire blight. The orchard must have a 500-meter buffer zone with no pear trees or other natural fire blight host. The buffer zone is also inspected. If fire blight is found, all apples in that orchard block are banned from export to Japan for the season. The certification must be renewed each year.

Codling moths cause serious damage to apples. For most countries, U.S. systems approaches to pest control are considered adequate protection. Japan, as well as South Korean and Taiwan, claim to be free of codling moth. Japan requires a 55-day cold treatment to kill the eggs, followed by fumigation to kill the larvae. The U.S. Clean Air Act requires U.S. producers to stop using methyl bromide, the required fumigant for Japanese imports, by 2002.

During the 1994/95 season, the first year of apple trade with Japan, U.S. exports to Japan totaled 8,497 metric tons. The first shipments arrived in January 1995. Although U.S. apples accounted for 95 percent of imports, total imports were only 1 percent of Japanese consumption. U.S. exports declined in the 1995/96 season to 843 metric tons, shipped from December through April. Through March of the 1996/97 season, exports totaled only 106 metric tons. Acres enrolled in the Japanese apple export program totaled 2,406 in the 1994/95 season (with 2,508 in buffer zones), 2,123 in 1995/96, and 739 in 1996/97. No apple growers have registered acreage for the 1997/98 crop year.

Table B-3--Fresh apples: Technical barriers to trade

	Apples allowed	Major phytosanitary requirements 1/	Pest problem
Australia	No		Fire blight
Chile	No		Unspecified 2/
China	Yes, but only Red and Golden Delicious from Washington, Oregon, and Idaho 3/	Cold treatment for apple maggot and use of a registered packinghouse  Routine visual inspection for evidence of fire blight	Apple maggot  Fire blight
Japan	Yes, but only Red and Golden Delicious from Washington and Oregon	Statement that orchard is free of fire blight and use of a chlorine dip  Methyl bromide fumigation for the larvae stage and 55-day cold treatment for the egg stage	Fire blight  Codling moth
Korea	No		Codling moth
Mexico	Yes, but only from certain States	Cold treatment which requires use of a certified cold treatment facility, plus inspections by Mexican officials (supported by the U.S. industry)  Leaves must not exceed a maximum average of two per box	Apple maggot  Unspecified

1/ Phytosanitary requirements are complex, detailed, and subject to change. This table highlights only some major requirements for a few countries. More detail is provided in the text.

2/ The Ceris database does not specify the pests of concern but Chile is particularly concerned about fire blight, apple maggot, and plum curculio.

3/ China limits imports to these States due to concern over Mediterranean fruit fly.

Source: Ceris database, copyright held by Purdue Research Foundation

Several factors explain why U.S. apple exports failed in Japan. First, Japanese consumer demand was lower than expected. Exports to Japan were limited to Red and Golden Delicious apples, which are not as popular with Japanese consumers as sweeter varieties such as Fuji. In the first year of exports, many Japanese consumers were disappointed with the quality of the earliest U.S. apples to reach their market. Bad publicity regarding minute traces of a fungicide on U.S. apples that is not approved in Japan for post-harvest use further dampened consumer interest. Japan's Ministry of Health and Welfare determined that the fungicide was not considered dangerous to public health. U.S. industry representatives determined that the apples were accidentally contaminated during the packing process by apples treated with the fungicide and destined for other markets.

U.S. apples are not all the same high quality as Japanese apples. Japan has four grades. Washington apples can compete well with the lower Japanese grades and the best Washington apples available are thought to be comparable with the best Japanese grade (Schotzko). Traditionally, Japanese producers only marketed their best quality apples. U.S. apples were marketed as a cheaper, every-day apple, not a luxury gift apple. Prices 20-30 percent below comparable Japanese apples were an important part of this strategy.

Japanese producers responded to U.S. imports by marketing a lower quality apple (previously used for processing) at a price that was approximately 20 percent lower than the previous year. Producers also made some production changes to reduce labor costs. The changing Japanese marketing strategy also reduced demand for U.S. apples (Jenni).

For U.S. producers, the Japanese protocol is very expensive and risky. During the first year of the program, the extra cost of the protocol was estimated at \$10 per carton, yielding an FOB price of about \$26 per carton (Jenni). A grower could comply with the protocol and not produce any apples acceptable for the Japanese market. Japan's very expensive distribution system further increases costs of getting U.S. apples to Japanese markets. Limited demand, a high tariff (20 to 19 percent from 1994 to 1996), and the costly phytosanitary requirements have led to less profit in exporting to Japan than originally anticipated.

The United States is currently trying to expand Japanese import approval to other apple varieties that are more popular in Japan. The United States began negotiating with Japan in 1972 for entry of Red and Golden Delicious apples, the primary U.S.-grown apples at that time. Japan bans imports of a variety until tests for quarantine treatment for that vari-



ety have been completed, even if tests for other varieties of apples have been successful. The United States contends that each variety of apple should not have to be tested individually for the efficacy of the treatment for a quarantine insect pest. Following talks in June 1997, the United States and Japan failed to reach an agreement on this issue and the United States is now eligible to call for a World Trade Organization dispute panel to resolve the issue.

New Zealand began negotiating with Japan much later than the United States. Because many newer varieties were rapidly expanding acreage at that time, New Zealand began testing on Red Delicious, Royal Gala, Gala, Fuji, Braeburn, and Granny Smith—all of which are currently allowed into the Japanese market. New Zealand reached an agreement with Japan earlier than the United States and started exporting apples 8 months earlier. Fuji and Royal Gala have been the most important exports to Japan. Although New Zealand can export more varieties than the United States, growers in both countries have experienced some of the same problems trying to export apples profitably to Japan with such costly and risky phytosanitary requirements. In addition, New Zealand has had problems controlling for apple scab, which is not a serious problem for Washington growers because of their dry climate.

### **South Korea**

South Korea is also a major apple producer, the world's seventeenth largest. In 1995/96, South Korea produced 715,982 metric tons of apples, up 16 percent from the previous year because of high yields. Apple production area declined from 50,000 hectares in 1994/95 to an estimated 44,000 in 1995/96. The U.S. Embassy in South Korea attributes the decline in area to increasing imports of other types of fruits that provide alternatives to apples, and to a shift in consumer preferences towards pears. Fuji is the most important variety of apple produced in Korea with 77 percent of total production in 1992. Tsugaru and Jonagold account for 12 and 1 percent of production. Most apples are consumed fresh with only about 20 percent going into the processing sector.

South Korea imports no apples because of phytosanitary concerns. But if apple imports were allowed, the high tariff (50 to 49 percent from 1994 to 1996) would still be a serious deterrent to trade. Exports are small and of very high quality. In 1994, exports totaled 2,293 metric tons and in 1995 they rose to 5,315 metric tons. Taiwan is South Korea's primary export market with 43 percent of total exports in 1995. Production techniques for these export-oriented apples are very labor intensive. U.S. industry analysts suggest that South Korean Fuji apples are approximately equivalent to Washington Extra Fancy grade and that any exports to that country would have to be of a similar high quality.

### **Mexico**

Mexican commercial apple production totaled 387,000 metric tons in 1995/96, down 12 percent from the previous year. Mexico's main apple producing areas have suffered the effects of drought during the 1994/95 and 1995/96 seasons and the increase in competition from the United States

since ratification of the North American Free Trade Agreement (NAFTA). Golden and Red Delicious apples are the main varieties grown in Mexico. In Chihuahua, Mexico's most important apple producing state, about 60 percent of production is Golden Delicious and about 40 percent is Red Delicious. Golden Delicious production in Chihuahua is increasing relative to Red Delicious.

Mexico was a minor market for U.S. apples in 1990. Trade increased rapidly after Mexico eliminated import permits in 1991 and after intensive negotiations to develop a phytosanitary work plan. Apple tariffs were 20 percent before NAFTA but under the trade agreement they are phased out over a 10-year period. By the 1995/96 season, Mexico was the second most important market. U.S. exports to Mexico increased from 11,326 metric tons in the 1989/90 season to 157,108 metric tons in the 1993/94 season. Although exports fell during the Mexican economic crisis beginning in late 1994, they are slowly recovering.

Mexico imported 80,000 metric tons of apples in 1995/96, accounting for 18 percent of fresh consumption. In 1993/94, that figure was 28 percent but it fell to 17 percent in 1994/95 during the peso crisis. Most Mexican apple imports are from the United States, with smaller amounts from Canada, Chile, and New Zealand. Mexican storage facilities are somewhat limited, so much of the production is sold early in the crop year. Imported apples usually dominate the Mexican market later in the season, from January through the end of the crop year. Red and Golden Delicious are the most common varieties of apples shipped to Mexico, and all grades of apples are shipped to supply the diverse needs of the Mexican market. Average Mexican apple quality is generally considered to be lower than the average U.S. quality.

Phytosanitary certificates are required for export to Mexico due to concerns primarily regarding apple maggot. Apple maggot is a fruit fly that lays eggs in the apple and the larvae damage the fruit. Most countries accept U.S. systems approaches for pest management as adequate protection against the threat of apple maggot. Fruit for export to Mexico requires cold treatment. For some other countries, proof that fruit came from an apple maggot free area is an alternative precaution. Based on a trapping and quarantine program, the central Washington apple production region is considered apple maggot free.

Currently apple exports to Mexico are limited to the States of Washington, Oregon, California, Idaho, Colorado, Utah, Michigan, New York, Pennsylvania, Virginia, and West Virginia, with the exception of any area regulated for fruit flies of quarantine importance. Within these areas, only storage/treatment facilities that have been inspected and cleared by Mexican phytosanitary officials can participate in the export program. To date, only producers in Washington, Oregon, and Idaho participate in the program, which is very expensive. These States can spread the cost of inspection over a large volume of apples. The Northwest apple industry is charged for the cost of Mexican inspectors who are in residence during the entire shipping season to monitor the pro-

gram. The industry collects money from shippers throughout the season to pay for the phytosanitary requirements.

At the beginning of the season, Mexican inspectors examine the storage/treatment facilities to ensure temperature probes are approved and calibrated. After the cold treatment is over, treatment records are reviewed. Apples destined for Mexico are subjected to cold treatment for 40 days at 32 degrees F or 90 days at 37.9 degrees F. Due to the cold treatment requirement, most U.S. apples are marketed in Mexico later in the season when much of the Mexican harvest has already been sold. The 40-day treatment carries more risk of low temperature damage to the fruit but is an attractive choice from a marketing perspective. Exports to Mexico must be free of plant debris and soil (there is a maximum average tolerance of two leaves per box which is more problematic for Golden than Red Delicious apples). This requirement is unique to Mexico.

### **Barriers to Trade**

A TB measure may be a social welfare enhancing policy in the importing country if the expected gains associated with reducing the risk and cost of a pest infestation, for example, exceed the expected loss to consumers resulting from their reduced ability to purchase foreign products. A country's concerns about the entry of a foreign product may be based on sound scientific principles and risk assessments. In some cases, though, the likelihood of a pest infestation may be overstated by the industry. Furthermore, the application of health and sanitary risk management measures or other standards by governments may be overly trade restrictive. In these cases when industry concerns are dominant, there may be a net social cost with the adoption of a TB.

Tariffs and TBs can be implemented to moderately or severely alter relative prices and trade. TBs to protect human, animal, and plant health can vary across countries. In some cases, a complete ban on trade is imposed because no available treatment methods are considered adequate given an acceptable level of risk. In other cases, negotiation can yield scientific standards that permit trade while maintaining acceptable risk levels for plant and animal protection. For example, chlorine dip to control fire blight bacteria is acceptable in some countries, while others still prohibit imports. TBs can be further refined by imposing varietal or regional restrictions rather than national restrictions.

Even in the instances where countries have agreed upon scientific standards, trade still may not occur because of the cost of compliance. U.S. Red and Golden Delicious producers will not export to Japan in 1997/98 because of the costly phytosanitary requirements. Similarly, Northeast producers have not pursued the on-site inspection required to access the Mexican market.

Tariffs and TBs alter relative prices between world and national markets. To compare the effects of the two types of policies, we estimate a tariff rate equivalent of the TBs. To see how this affects international trade, consider a simple case. Suppose a small country importer at first does not im-

pose any border measure. Assuming no storage, the country will import the difference between consumer demand (D) and producer supply (S) (figure B-1). At a world price of WP, the small country will import QD less QS. Now, suppose the small country imposes a tariff, raising the domestic price to DP. At this higher internal price producers supply more to the market and consumers purchase less so that the market equilibrates where domestic production equals consumption. There is no longer any trade. The tariff has created a price wedge sufficient to raise prices and eliminate excess demand. Of course, most tariffs are not so large as to completely eliminate trade.

Now, consider a TB (vis-a-vis all exporters) that prohibits apple imports because of phytosanitary concerns. The economic effect is exactly the same as the tariff. In essence, a price wedge or a tariff rate equivalent is created between the global market and the small country.<sup>4</sup> Again, a TB protocol can be so prohibitive as to cut off trade completely, as in the case of apples to Japan, or it can have a more limited effect as in the case of U.S. exports to Mexico. In the Japanese case, the cost of phytosanitary requirements is at least large enough to just eliminate trade, raising the price to DP where Japanese demand equals supply. The TB tariff rate equivalent may actually be even higher, but that additional cost is not observable beyond DP since the impact on the Japanese market is identical to the rate that just eliminates trade. The implication is that a prohibitive TB can be relaxed but still be sufficiently stringent to eliminate trade. For example, the U.S.- Japanese agreement on a protocol to allow importation of Red and Golden Delicious apples generates a U.S. traded price that intersects at or above where supply equals demand, so that the U.S. apple industry still does not find it economical to trade in the 1997 marketing year. The three countries considered in this study all have tariffs and TBs that constrain trade.

### **Empirical Analysis of Tariffs and TBs**

For our empirical analysis, we first estimate the tariff rate equivalents of TBs for Japan, South Korea, and Mexico. Then we examine the trade effects of removing tariff rates and the estimated TB tariff rate equivalents for these same countries. The tariff rate equivalents vary from year to year depending on market conditions so we use data from both the 1994/95 and 1995/96 U.S. apple marketing seasons to achieve a more realistic estimate of the impact of TBs.

To estimate the tariff rate equivalents of the TB regulations, we compare the monthly CIF prices (landed prices including freight and insurance costs) of U.S. apples in a foreign country with wholesale prices in the foreign market. We assume the price gap consists of the tariff and TB tariff rate equivalent. Monthly comparisons are made to capture the range of market conditions over a year. It is important to compare prices of a like apple (i.e., same

<sup>4</sup> The trade effects of a TB may differ from our simple diagram if the measure affects consumers' demand for or producers' supply of the product. For example, a country of origin label may stimulate or deter consumer demand for the foreign product.

variety, grade, and size) during the same time period and at a similar place in the marketing chain.

Fuji apples were chosen for comparison for Japan and South Korea since Fuji apples are the most important variety grown in both countries. For Japan, we chose to estimate the effects of TBs on the Fuji market, which is viewed as having more potential for U.S. exports, instead of the Red and Golden Delicious markets even though a protocol exists for those apples. For Mexico we used both Red and Golden Delicious apples for our comparison because these varieties dominate production there.

Wholesale prices for the specific varieties in Japan, South Korea, and Mexico come from official national market statistics. For Japan and South Korea, the prices represent average national wholesale prices. Mexican data are for the Mexico City wholesale market.

In the case of Japan, renowned for the quality of its apples, we assume the wholesale price represents very high quality apples and compare the Japanese wholesale price with the estimated CIF price for the high end of the price range reported by USDA's Agricultural Marketing Service (AMS) for Washington Extra Fancy Fuji apples.<sup>5</sup> For South Korea, which also produces very high quality apples, we compare the highest price Washington Extra Fancy Fuji apples with Korean medium quality Fuji apples.<sup>6</sup> For both Japan and South Korea, we select size 72, the largest size for which we have data, because consumers in those countries prefer larger sizes.

The average Mexican apple is thought to be lower in quality than the average U.S. apple. We use either Washington or U.S. Fancy grade apples for comparison with the Mexican wholesale prices in the September-December period when Mexican production dominates the market (only 19 and 8 percent of U.S. exports to Mexico occurred during this period during the 1994/95 and 1995/96 seasons, respectively).<sup>7</sup> During the January-August period imports dominate the Mexican market and we use an average of

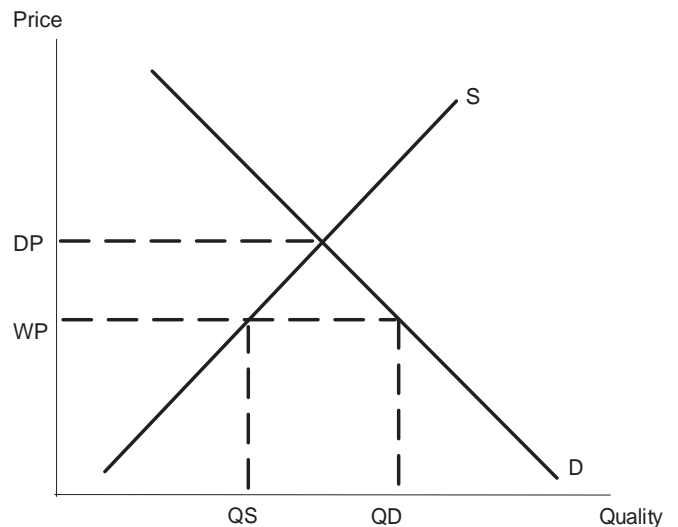
<sup>5</sup> U.S. federal grades are based on color, shape, firmness, blemishes, and other factors. The Washington State apple industry created additional grades, Washington Extra Fancy and Washington Fancy. The major Federal and Washington grades for export range from U.S. Number 1, U.S. Fancy, Washington Fancy, U.S. Extra Fancy, and Washington Extra Fancy.

<sup>6</sup> For both the 1994/95 and 1995/96 seasons, AMS data on Extra Fancy Washington Fuji apples are only available for regular storage apples, not controlled atmosphere apples, which means the time series ends midway through the season. To complete the time series, we use data from the Washington Growers Clearing House Association (WGCHA) on average monthly prices for all Fuji apples as a basis to estimate a price for Washington Extra Fancy apples during the controlled atmosphere storage part of the season. An average premium is estimated from the AMS and WGCHA data during the regular storage season. This premium is used with the average monthly WGCHA prices for all Fuji apples during the latter part of the season to attain estimates for the higher quality Fuji.

<sup>7</sup> For Red Delicious we use Washington Fancy grade (no data are available from AMS in either year for U.S. Fancy). For Golden Delicious we use U.S. Fancy in 1995/96 and Washington Fancy in 1994/95 because no other data are available. As in the case of Fuji prices, Golden Delicious Washington Fancy prices for the 1994/95 season are only reported for regular storage. We use the Washington Growers Clearing House data on all Fancy Golden Delicious prices to estimate the rest of the time series for Washington Fancy apples.

Figure B-1

### Price Effects of Barriers to Trade



Washington Extra Fancy and the Fancy qualities used in the September-December period. Mexican consumers prefer smaller apples so we use size 100s for the Mexican comparison.

To estimate the price of a U.S. apple in a foreign wholesale market we use Washington FOB prices and add estimates of insurance and transportation costs to Tokyo, Seoul, and Mexico City. Data from AMS and industry estimates are used for these transport costs.<sup>8</sup> We do not have data on internal transactions costs for Japan and South Korea so we understate the costs of bringing a U.S. apple to the foreign wholesale market where apples must move from the port to a wholesale market. For Mexico, apples are trucked directly to the wholesale market so the transportation costs are accounted for although marketing costs are still unknown.

Once the difference in price between the U.S. apple delivered in the foreign country and the wholesale price for a similar apple in the foreign wholesale market is known, the monthly price wedge (in percentage terms) is calculated. The monthly price wedge is divided into the known tariff rate and the TB tariff rate equivalent, which is the residual. The annual TB tariff rate equivalent is the simple average of monthly rates for those months with U.S. apples on the market (October-July for Fuji apples and August-July for Red and Golden Delicious apples).

Table B-4 shows the tariff rates and TB tariff rate equivalents for the three countries. Average annual tariff rates ranged from 49.7 percent for Korea to 17.5 percent for

<sup>8</sup> For Japan and South Korea, we use AMS data on shipping costs based on Red and Golden Delicious trade to Japan. Adequate data are not available on appropriate shipping costs to Korea, so we use the Japanese costs. Although South Korea is a longer shipping distance, Japanese port costs are particularly high, so the bias due to using Japanese shipping costs is unknown. Industry estimates of shipping costs are used for Mexico.

Table B-4--Tariff and TB rates and associated changes in imports with elimination of trade barriers

	Tariff rate	TB rate	TB+ tariff rate 1/ --Percent--	Elasticity		Increase in imports with the elimination of			
				Demand	Supply	TB		TB+Tariff	
						Quantity	Value	Quantity	Value
						1,000 metric tons	Million \$	1,000 metric tons	Million \$
Japan--Fuji									
1994/95	19.8	58	78	-0.3	0.1	56	99	75	132
				-0.2	0.1	42	74	56	99
				-0.3	0.0	42	74	56	99
				-0.2	0.0	28	49	38	66
1995/96	19.3	24	43	-0.3	0.1	31	60	57	109
				-0.2	0.1	24	45	43	82
				-0.3	0.0	24	45	43	82
				-0.2	0.0	16	30	28	54
Korea--Fuji									
1994/95	49.7	4	54	-0.3	0.1	5	8	62	109
				-0.2	0.1	3	6	46	82
				-0.3	0.0	3	6	46	82
				-0.2	0.0	2	4	31	55
1995/96	49.2	0	49	-0.3	0.1	0	0	124	238
				-0.2	0.1	0	0	93	178
				-0.3	0.0	0	0	93	178
				-0.2	0.0	0	0	62	119
Mexico--Red Delicious									
1994/95	18.0 (16)	20	36	-0.3	0.1	10	5	19	10
				-0.2	0.1	8	4	14	7
				-0.3	0.0	8	4	15	8
				-0.2	0.0	6	3	10	5
1995/96	17.5 (16)	13	29	-0.3	0.1	7	4	15	10
				-0.2	0.1	5	3	11	7
				-0.3	0.0	5	4	12	8
				-0.2	0.0	4	2	8	5
Mexico--Golden Delicious									
1994/95	18.0 (16)	52	68	-0.3	0.1	34	16	44	21
				-0.2	0.1	25	12	32	15
				-0.3	0.0	27	13	35	17
				-0.2	0.0	18	9	24	11
1995/96	17.5 (16)	11	27	-0.3	0.1	9	7	21	16
				-0.2	0.1	7	5	16	12
				-0.3	0.0	7	5	17	13
				-0.2	0.0	5	4	12	8

1/ For Mexico, not equal to the sum of the tariff rate and TB tariff rate equivalent shown because the tariff is a percent of the value of apples at the United States-Mexico border, and the TB tariff rate equivalent is a percent of the price of apples when they arrive in Mexico City. The tariff rate as a percent of the Mexico City price is presented in parentheses.

Mexico.<sup>9</sup> TB tariff rate equivalents vary between years and within years. The variation reflects changes in market conditions and tariffs rather than changes in phytosanitary requirements. The magnitude of the TB tariff rate equivalent reflects phytosanitary import requirements and the importer's and the exporter's market conditions. For example,

<sup>9</sup> In Japan, the tariff rate varies by fiscal year which starts in April. The tariff was 20 percent in fiscal year 1994, 19.5 percent in 1995, and 19 percent in 1996. South Korea's tariff rate was 50 percent in calendar year 1994, 49.5 percent in 1995, and 49 percent in 1996. Before NAFTA, the Mexican tariff on apples was 20 percent. With NAFTA, the tariff varies over the course of the year. The preferential NAFTA tariff was 18 percent in calendar year 1994, 16 percent in 1995, and 14 percent in 1996. However, U.S. imports at the preferential NAFTA tariff are limited. The tariff rate quota for fresh U.S. apples was 55,000 metric tons in 1994 and increases at a 3-percent compounded annual rate. Over-quota apples enter at the lower of Mexico's 1993 or current Most Favored Nation duty at the time of the over-quota imports. U.S. apple exports to Mexico have exceeded the tariff rate quota every year.

the 1994/95 season produced a record U.S. apple crop, lowering U.S. apple export prices and generating larger TB tariff rate equivalents than in the 1995/96 season. In a closed or relatively closed apple market like South Korea and Japan, internal prices can vary substantially from year to year depending on production. Because the TB tariff rate equivalent can vary so much from year to year, a longer time series of price data would provide a more meaningful estimate of the average economic effect of a TB.

In 1994/95 the Japanese TB tariff rate equivalent was 58 percent but in 1995/96 it was 24 percent (Japanese and South Korean TB tariff rate equivalents, like *ad valorem* tariffs, are measured as a percent of the estimated CIF value). In 1995/96, the TB tariff rate equivalent was 72 percent in September, 0 from October through March, and averaged 48 percent from April through July. Less than 1 percent of the season's production was marketed in Septem-



ber. In some months, the estimated U.S. CIF price plus the tariff is more than the Japanese wholesale market price, i.e., no trade would occur even without a phytosanitary restriction because the tariff alone is sufficient to eliminate trade. In those cases the TB tariff rate equivalent is equal to zero.

South Korea's tariff rate for apples is very high and with such a large tariff, the TB tariff rate equivalent is not always positive. The TB tariff rate equivalent was 4 percent in 1994/95 when using the medium quality Korean Fuji apple. If using the high quality Korean Fuji apple, the TB tariff rate equivalent would have been 11 percent. In 1995/96, Korea had a very large crop and the United States had a short crop. As a result, average prices in South Korea were lower than the prices of U.S. apples if they could have been delivered to South Korea.

For Mexico, the TB tariff rate equivalents for Red Delicious and Golden Delicious are quite similar for the 1995/96 season at 13 and 11 percent, respectively. During the 1994/95 season, the estimates vary dramatically. The Red Delicious TB tariff rate equivalent is 20 percent and the Golden Delicious TB rate is 52 percent. During the early part of the season there is a large price spread between U.S. and Mexican prices. U.S. producers cannot ship apples to Mexico until the apples have completed the cold treatment, so the only U.S. exports during those months are a very limited number from the previous season. During the rest of the season, exporters must still comply with phytosanitary requirements and tariffs, but the length of cold treatment is not a constraining factor to trade. In the 1994/95 season, the TB tariff rate equivalent for Red Delicious was 32 percent during the September-December period and 13 percent during the rest of the year. For Golden Delicious the TB tariff rate equivalent was 76 percent during the fall period and 40 during the rest of the year. This pattern of a higher TB rate during the fall was not repeated in the 1995/96 season for either variety.

Finally, we estimate the value of trade that would have occurred if there were no tariffs and TB requirements were harmonized to current U.S. systems approaches to pest management. Before discussing the results, the estimates require some explanation and discussion of the simplifying assumptions used. Harmonizing phytosanitary requirements means meeting current U.S. systems approaches to pest management that are adequate for exports to most countries (commercial production practices, grading and sorting, and visual inspection). It does not mean meeting the additional costs associated with the more demanding Japanese and Mexican import requirements. When TB tariff rate equivalents are eliminated, the standard U.S. practices are continued without any additional costs of compliance.

To attain results, we make assumptions regarding the responsiveness of demand and supply to changes in domestic price in the importing countries. We assume a demand elasticity of -0.2 and -0.3. That is, for every 1-percent decrease in price, consumers in each importing country respond by increasing the quantity demanded by 0.2 to 0.3 percent. We further assume a supply elasticity of 0.0 and 0.1. That is, producers respond to a 1-percent decrease in price with

either no change in supply or a 0.1-percent decrease. Grower response would be greater over several years as more time would allow for planting new trees and maturation. The responsiveness estimates are based on a limited literature review.<sup>10</sup> We also assume that an increase in import demand for each country does not affect world prices. Furthermore, we limit our calculations to changes in Fuji imports for Japan and South Korea, and changes in Red and Golden Delicious imports for Mexico.

Table B-4 presents the range of results for the removal of the TB tariff rate equivalents and for the removal of both the tariffs and TB tariff rate equivalents. The estimated changes in trade are substantial. The average estimate (average of the four combinations of supply and demand elasticities) for the increase in imports, from all sources, of the three countries if both the tariff and TBs are eliminated equals \$205 million and \$280 million for the 1994/95 and 1995/96 seasons, respectively. The increase in imports is equivalent to 49 and 77 percent of the value of U.S. apples exports in the 2 years. Removing both the tariff and TB tariff rate equivalent would have led to an average increase in Japanese and South Korean imports of Fuji apples, from all sources, of 102,000 metric tons in 1994/95 and 136,000 metric tons in 1995/96. U.S. Fuji production in 1995/96 totaled 199,939 metric tons, although production is increasing rapidly. The increase in Japanese and South Korean Fuji imports and Mexican Red and Golden Delicious imports would have been equal to 5, 16, and 6 percent of the 1995/96 consumption in each country, respectively. The removal of only the TB tariff rate equivalent yields a mid-range estimate of \$97 million for 1994/95 and \$53 million for 1995/96.

## Conclusions

While global markets have experienced a substantial increase in the value of apple trade, large tariffs and TBs limit the market for expansion. We find that tariffs and TBs create price wedges that reduce imports or potential imports. Based on 1994/95 and 1995/96 data, we estimate that Japan, South Korea, and Mexico would have substantially increased their imports of apples if tariffs and TB tariff rate equivalents were both eliminated. The mid-range estimate of the increase is \$205 million in 1994/95 and \$280 million in 1995/96. If only TB tariff rate equivalents were removed—trade is harmonized to U.S. systems approaches to pest management—the corresponding estimates would equal \$97 million in 1994/95 and \$53 in 1995/96. These results indicate that TBs have significant effects on trade. This further suggests that trade liberalization discussions must consider harmonization of phytosanitary requirements.

Deriving our estimates required a number of simplifying assumptions and therefore the results should be interpreted as approximate, not exact. Some assumptions may lead to

<sup>10</sup> Cho and Cho estimated an own-price elasticity of demand for Korean apples of -0.2. Also Huang estimates a complete price and expenditure system for specific U.S. fruits and finds a 0.2 decrease in demand with a 1 percent increase in apple prices. On the supply side, Baumes and Conway estimate a price elasticity at the farm level of .007 for fresh apples.

overstating our estimates. First, we assumed that world prices are not affected by the changes in imports. The estimated large increases in imports by these three countries, however, would likely have an impact on world prices. If world prices rose, exporting countries would benefit from the higher prices but potential export sales volume would fall. Second, we may have overstated the price differentials. To the extent that Japanese and South Korean Fuji apples are of higher quality than the top Extra Fancy Washington State Fuji apples, the price differentials reflect quality differences rather than a technical barrier. In the case of Mexico, which produces and imports a wide range of apple qualities, our assumption regarding the quality of apples in the wholesale market may be inadequate. Additionally, our price differential calculations did not fully reflect the transaction costs of moving U.S. apples from the foreign country border to wholesale markets. Third, insular Japanese and South Korean apple industries do not necessarily face incentives to improve marketing channels and adopt technological innovations. With fewer trade barriers, these apple industries would have incentives to reduce costs and compete with international traders. Fourth, we have implicitly assumed that other, perhaps new, regulatory measures and marketing procedures would not limit trade.

There are at least three reasons why our estimates may understate import penetration if tariffs and TBs were eliminated. First, we considered only a short-run supply response to an opening of the Japanese, South Korean, and Mexican markets. In a medium- to long-run outlook, exporters will respond to higher prices in foreign markets by increasing plantings. This may be particularly true for Fuji and other new varieties, as production in the United States is still relatively small. Production of new varieties of apples is currently increasing in the United States and other countries, as producers respond to changes in consumer taste. Second, our TB tariff rate equivalent estimates represent the minimum price difference created by a regulatory measure, the price difference that just eliminates trade. TB tariff rate equivalents could be greater than our estimates in

the cases of prohibitive measures. Third, we have not considered substitution across varieties. To the extent that foreign consumers are willing to purchase other varieties than we considered, exporters would have more market opportunities.

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