United States Department of Agriculture

Electronic Outlook Report from the Economic Research Service

www.ers.usda.gov

FTS-318-01

October 2005

Outlook

Resolution of the U.S.-Japan Apple Dispute

New Opportunities for Trade

Linda Calvin and Barry Krissoff

Abstract

The World Trade Organization (WTO) ruled in June 2005 that Japan's phytosanitary protocol related to fire blight for imports of U.S. apples was not justified and was in breach of Japan's WTO commitments. In August 2005, Japan issued a new phytosanitary protocol that complies with the WTO ruling. With the elimination of the restrictive fire-blight protocol, U.S. producers have a new opportunity to export apples to a high-quality export market, at a significantly lower cost than before. This analysis estimates that over the long run, Japanese apple imports will increase by an average of $144 million per year but that substantial variation from the average import estimate would be likely because of fluctuating market conditions from season to season.

Keywords: Apples, Japan, fire blight, phytosanitary barriers, World Trade Organization, trade disputes, ERS, USDA

Acknowledgments

The authors thank the many growers, shippers, industry representatives, and scientists who contributed to our understanding of the impact of the fire-blight protocol. We also acknowledge the staff of the U.S. Embassy in Japan for providing information on Japanese prices and transaction costs. We appreciate comments from our colleagues: Joy Harwood, Agnes Perez, Donna Roberts, and John Dyck of the Economic Research Service, USDA; John Love, World Agricultural Outlook Board, USDA; Carol Goodloe, Office of the Chief Economist, USDA; Larry Deaton, Heather Velthuis, and Doreen Chen-Moulec, Horticultural and Tropical Products Division, Foreign Agricultural Service, USDA; and Thomas Wahl and Thomas Schotzko, Washington State University. The authors likewise thank Priscilla Smith and Juanita Tibbs for excellent editorial and production assistance.

Introduction

The United States has a long history of trying to gain access to the Japanese apple market. Most recently, after U.S. complaints to the World Trade Organization (WTO), the WTO found that Japan's phytosanitary protocol with respect to fire blight for imports of U.S. apples was not justified and was in breach of Japan's WTO commitments. The WTO found that Japan's import restrictions on U.S. apples were without sufficient scientific evidence and not based on a risk assessment. In August 2005, Japan brought its phytosanitary protocol for apples from the United States into compliance with the WTO ruling.

Although Japan is recognized as a demanding market for apples, reducing the costs of complying with phytosanitary protocols should open up more export opportunities for U.S. apple growers. This report provides an estimate of the potential increase in Japanese apple imports. We begin with the history of U.S. efforts to gain access to the Japanese apple market. The next section describes the U.S. apple market and exports, particularly to Asia, as well as the Japanese apple market. A discussion follows of the previous Japanese phytosanitary protocol and the new one. This puts the Japanese protocol in perspective and explains why U.S. producers have not yet been successful in their efforts to develop a market for their apples in Japan.

Then the report turns to estimating the increase in trade made possible by the elimination of the restrictive fire-blight requirement. The first part of the analysis involves measuring the cost of the old fire-blight requirement, which we assume is equal to the decrease in U.S. export costs under the new Japanese protocol. The second part of the analysis takes the decrease in costs and estimates the volume of increased apple trade. The report ends with brief conclusions.

History of U.S.-Japan Apple Disputes

Japan officially opened its apple market in 1971, but its list of quarantine pests kept U.S. apples out of the market (Kajikawa, 1998). At bilateral talks in 1982 between the United States and Japan, the United States first asked officially for market access for U.S. apples. Japan rejected this request, citing the potential for introducing codling moth to their country. Japanese attention later shifted to fire blight. In 1993, with the U.S. apple industry having failed to gain access to the Japanese market, the U.S. Trade Representative threatened Section 301 general trade sanctions over Japan's failure to resolve the apple issue. Section 301 is the principal U.S. statute for addressing foreign government practices that are "unjustifiable, unreasonable, or discriminatory and [which] burden or distort" U.S. exports.

In 1994, Japan opened its market to U.S. Red and Golden Delicious apples from Washington and Oregon under a restrictive phytosanitary protocol directed at preventing the import of codling moth and fire blight (discussed in the following section). In 1995, U.S. growers shipped 8,935 metric tons of apples to Japan, with a Japanese import value of $14.8 million (table 1). This first year of the Japan protocol represented the high point of U.S. exports to Japan. Over the next 2 years, U.S. exports fell to 404 metric tons (1996) and 105 metric tons (1997). In 1998, no U.S. growers registered for the Japan export program. Limited demand for Red and Golden Delicious apples in Japan, a high tariff, and the costly and risky phytosanitary requirements combined to make U.S. apple exports to Japan less profitable than originally anticipated. A problem with pesticide residues in the first year of U.S. exports also had a negative impact on Japanese consumer demand (Foreign Agricultural Service, 1996). While this experience is often cited as evidence that U.S. apples can not meet demanding Japanese consumer expectations, the history of U.S. exports of cherries to Japan shows that U.S. firms can compete profitably with the right product at the right price (see box, "U.S. Cherry Exports to Japan").

In the 1970s, when the United States began research to develop a phytosanitary protocol for the export of Red and Golden Delicious apples, Red Delicious was

Table 1
Japanese apple imports

Year	Australia	France	Nepal	New Zealand	South Korea	United States[1]	Total
				Metric tons			
1994				235	7		242
1995				190	171	8,935	9,295
1996			1	254	51	404	710
1997		12	1	9	22	105	150
1998				112	108		221
1999	110				39	159	308
2000	247				251	96	594
2001	650				1,411	278	2,339
2002	120				1		120
2003	108						108
2004	16				2		18

[1]From 1994 to 1998, Japan limited U.S. apple imports to Red and Golden Delicious varieties. In 1999, Japan opened its market to five additional varieties of U.S. apples: Braeburn, Fuji, Gala, Granny Smith, and Jonagold.
Source: World Trade Atlas.

U.S. Cherry Exports to Japan

The success of U.S. cherry exports to Japan provides lessons that are relevant for apple exports. Japan imported 13,941 metric tons of fresh cherries in 2004, with 99 percent coming from California, Oregon, and Washington State. Japan has a relatively small cherry crop with a short marketing season. Imports accounted for an estimated 42 percent of the Japanese fresh cherry supply. The often-stated Japanese preference for domestic fruit does not prevent Japanese consumers from enjoying high-quality U.S. cherries.

In 2004, sales of California cherries began in late April and ended June 10 before the peak Japanese shipments that began in mid-June. Washington and Oregon cherries overlap with the Japanese season. By extending the cherry season and increasing supply during the traditional season, imports may increase consumer demand for cherries in general, benefiting both U.S. and Japanese producers. Cherry production area in Japan is increasing.

Most Japanese cherries are the Satonishiki variety, which is similar to the U.S. Rainier variety. Japanese traders have high regard for U.S. Rainier cherries which are largely used as gifts in Japan (Foreign Agricultural Service, 2004). Clearly U.S. cherry quality can meet the exacting Japanese consumer standards for flavor, size, and quality. Japan does not produce dark sweet cherries, yet U.S. exports of this type of cherry do very well in the Japanese market. Japanese consumers are obviously open to new varieties and tastes.

Cherries also face phytosanitary restrictions in the Japanese market. While U.S. cherries must be fumigated with methyl bromide, like U.S. apples, the fumigation has had less impact on cherry quality than on apple quality.

the most common type of apple grown in the United States and Japan (Kajikawa, 1998). Over the next two decades, sweeter varieties became more popular in both countries, particularly in Japan. Before the United States received Japanese clearance for exports of Red and Golden Delicious apples, U.S. growers realized that other apple varieties were likely to have stronger demand in Japan. But Japan required the efficacy of the codling moth treatment to be tested individually on each variety, a lengthy and expensive process. U.S. negotiators did not add additional varieties to the discussions out of concern that they might jeopardize their progress on Red and Golden Delicious apples and because of their belief that approval for these two varieties would ease the approval process for other varieties. New Zealand, which began negotiations with Japan at a later date when the shift in Japanese consumer preferences was more obvious, asked for permission to export varieties more likely to do well in the Japanese market. In 1993, 1 year before the United States gained access, Japan gave New Zealand permission to export Fuji, Gala, Royal Gala, Red Delicious, Braeburn, and Granny Smith apples to Japan.

The United States had long argued against testing for the efficacy of a quarantine treatment for insects on each variety of apple, claiming that a treatment to kill an insect on one variety of apple is equally effective on another variety. In 1997, the United States brought the varietal testing issue to the WTO. In 1998, the WTO concluded that Japan's varietal testing of apples was not consistent with the WTO Sanitary and Phytosanitary Agreement because varietal testing was not supported by scientific evidence, was more trade restrictive than required, and was nontransparent (APHIS, 1999). Japan appealed the decision, and, in 1999, the WTO again sided with the United States. Japan announced that it would eliminate the import bans on five additional U.S. varieties—Braeburn, Fuji, Gala, Granny Smith, and Jonagold—beginning with the 1999/2000 season.

Two U.S. shippers registered for the phytosanitary protocol in the 1999/2000 season. In February 2000, the U.S. began selling Fuji apples in Japan. Two U.S. shippers registered for the program in 2000/01, the last season with exports to Japan. In 2001/02, one U.S. shipper registered for the protocol but did not export any apples. Clearly, U.S. firms felt that the expected costs of participating in the Japanese phytosanitary protocol exceeded the expected benefits even with access for apple varieties thought to be more competitive in Japan. Apple exporters in other countries have faced similar challenges in exporting to Japan (see box, "Other Countries that Export to Japan").

Other Countries that Export to Japan

Japan opened its markets to imported apples in 1971. However, no country has exported large volumes on a regular basis. Before 1993, only North Korea and South Korea exported apples to Japan. In 1996 and 1997, Nepal shipped small quantities of apples to Japan. These countries do not have fire blight or codling moth so do not need to follow the same type of phytosanitary protocols as the United States. South Korea has the longest history of exports to Japan but exports have been very small in most years.

Countries with fire blight had to develop phytosanitary protocols with Japan. In 1993, New Zealand received permission to export Fuji, Gala, Royal Gala, Red Delicious, Braeburn, and Granny Smith apples to Japan. New Zealand growers exported for 5 years, but like their U.S. counterparts, found that the expected benefits of the Japanese export program were outweighed by the expected costs. In September 1997, France received permission to export Golden Delicious apples to Japan but only shipped during that year. In December 1998, Australia received permission to export Tasmanian Fuji apples to Japan. Australia claims to not have fire blight and does not therefore have to comply with the type of protocol the United States faces for this disease. But growers do have to fumigate for codling moth, as do U.S. growers. Exports to Japan are limited to the island of Tasmania, the only fruit-fly-free area in Australia. While Tasmania has exported apples every year since it gained entry to the market, the level of trade is very low in part because it is a small industry. Trade has declined rapidly from its 2001 high. Growers have had problems meeting Japanese size and color preferences for their relatively high-priced apples (Foreign Agricultural Service, 1999). Also, methyl bromide fumigation has caused problems with fruit deterioration. Australia's efforts to change the protocol to allow fumigation in Japan have not been successful. This change would reduce the problem of shortened shelf life.

While Chinese apples are a rapidly growing presence in Asian markets, Japan prohibits the import of fresh Chinese apples due to codling moth and oriental fruit fly. Currently, China has not requested that Japan lift the import ban nor has there been any discussion to establish a protocol.

The United States also took aim at the Japanese requirements for fire blight. The United States argued that the fire-blight requirements were not based on science—specifically, that mature, symptomless fruit do not carry the disease. In 1997, the United States asked Japan to modify its phytosanitary protocol (Yue, Beghin, and Jensen, 2005). The United States and Japan conducted joint research that confirmed the U.S. position on the transmission of fire blight. In October 2001, Japan refused to change its protocol with respect to fire blight.

In 2002, the United States requested and was granted a panel by the WTO Dispute Settlement Body to hear the case, and, in July 2003, the panel agreed with the U.S. position (Office of the U.S. Trade Representative, 2003). Japan appealed the decision and lost again in December 2003. In June 2004, Japan submitted a revised protocol that the United States deemed inadequate to bring the protocol into compliance. In July 2004, the United States asked the WTO to review the revised protocol.[1] In June 2005, the WTO panel found that Japan's revised protocol was still inconsistent with its WTO obligations. In August 2005, Japan issued a new phytosanitary protocol for apple imports from the United States that complies with the WTO ruling (Office of the U.S. Trade Representative, 2005). The United States and Japan jointly notified the WTO that Japan had ended the practices that were inconsistent with its WTO obligations.

[1]The United States also sought authorization to impose trade sanctions against Japan in the amount equal to damages based on the annual value of forgone apple sales (Office of the U.S. Trade Representative, 2004).

Apple Markets in the United States and Asia

The United States is the second-largest apple producer in the world, after China, with 4.2 million metric tons in 2003, and is usually the largest apple exporter in the Western Hemisphere. The well-being of the U.S. apple industry depends on strong export markets. In the 2003/04 season, exports accounted for 18 percent of domestic fresh-market production. U.S. producers have a long history of exporting to a large number of countries and catering to diverse consumer preferences. In 2003, the United States exported 528,487 metric tons of fresh apples. Mexico and Canada were the largest markets for U.S. fresh apples, accounting for 43 percent of total export volume (table 2). Asian countries are also top markets for U.S. apple exports, despite considerable recent competition from China. Taiwan, Indonesia, and Hong Kong accounted for 24 percent of total U.S. fresh apple exports. Other Asian markets in the top 20 U.S. destinations for U.S. apple exports—Malaysia, India, Thailand, Singapore, China, and the Philippines—accounted for another 11 percent of the export volume. The U.S. share of imports in these Asian countries ranged from 4 percent in the Philippines (a country that has drastically reduced its imports of U.S. apples in favor of cheaper Chinese apples) to 47 percent in Indonesia. The prospect of gaining access to the high-income Japanese market has enticed U.S. growers for years.

Table 2

U.S. apple exports to top 20 markets in 2003

Country	U.S. exports	U.S. share of country's imports
	Metric tons	*Percent*
World	528,487	
Mexico	121,248	69
Canada	107,613	76
Taiwan	50,978	45
Indonesia [1]	40,783	47
Hong Kong	36,055	34
Malaysia	24,429	10
United Kingdom	24,077	4
United Arab Emirates	19,094	NA
India[1]	10,748	41
Thailand	9,157	12
Singapore	8,138	9
Saudi Arabia	6,924	NA
Greece [1]	5,367	5
Colombia[1]	5,154	6
China	4,676	46
Philippines[1]	4,547	4
Costa Rica	3,621	NA
El Salvador	3,293	NA
Guatemala	3,233	NA
Kuwait	3,227	NA

NA= not available.

[1]U.S. share of imports based on 2002 data.

Sources: U.S. Department of Commerce and World Trade Atlas.

Hundreds of varieties of apples exist and different groups of consumers often favor particular varieties, as well as certain sizes. In the United States, the Red Delicious apple remains the most common variety, although its share of production and consumption has declined. The U.S. Apple Association estimates Red Delicious production at 29 percent of the U.S. crop in 2003, compared with 43 percent in 1994. Golden Delicious is the second most popular apple, maintaining approximately a 13- to 14-percent share of production over the last decade. In contrast, Fuji, Gala, and other new varieties (Braeburn, Jonagold, and Pink Lady) have increased in production, with Fuji and Gala each growing from less than 2 percent of total U.S. production in the early 1990s to nearly 10 percent in 2003. This change in varieties represents a response to changing U.S. consumer preferences for sweeter apples and high prices for these apples in the fresh export market.

Japan is a significant producer and consumer of apples, famous for its high-quality and very expensive fruit. In 2003, Japan ranked 13th in world apple production with 891,700 metric tons. The Japanese apple industry has thousands of small, high-cost producers. However, the country's apple industry has been declining slowly over the last decade as area planted and production have decreased. In 2003, production was down approximately 15 percent from 1990 and acreage had declined 20 percent. The number of growers is also down, as Japan's population of apple producers is aging and the lifestyle has failed to attract a younger generation (World Apple Review, 2004).

The Fuji is the most popular apple variety grown in Japan, accounting for approximately 55 percent of the nation's production. Producer prices for Fuji apples are higher than for other varieties. Production practices differentiate Fuji apples; there are bagged Fuji and sun Fuji. Bagged Fuji apples are individually covered with bags until just before harvest. This technique protects the fruit from blemishes and yields an almost iridescent coloring. These pampered apples are often used as gifts; they are sold individually wrapped or boxed in department stores at very high prices. Production of bagged Fuji apples is declining because of the high labor costs. Sun Fuji apples are grown without the protective bag, similar to U.S. Fuji apples, and sell at lower prices than bagged Fuji apples.

With phytosanitary restrictions on most imports, Japan has high domestic prices and relatively low per capita apple consumption. Japanese consumers often eat apples as a dessert with one apple divided among several diners. They do not tend to eat them as snacks as do U.S. consumers. Japanese apple consumption has the potential to grow.

Figure 1 shows per capita consumption for six major Northern Hemisphere production groups and Taiwan (World Apple Review, 2004; Korea Rural Economic Institute, 2002). The high-income North American and European countries have a tradition of apple production and consumption. From 1991 to 2003, per capita apple consumption averaged 8.1 kilograms (kg) in the United States and 11.8 kg in Canada. Per capita consumption in the 11 European Union countries averaged 17.9 kg, but ranged from an average of 9.3 kg in the United Kingdom to 24.0 kg in Austria.[2] In China, the world's largest apple producer, apple consumption averaged 12.6 kg per capita.[3] Northern China may have a higher consumption level than southern China, which is more tropical. In Taiwan, a tropical and subtropical country with

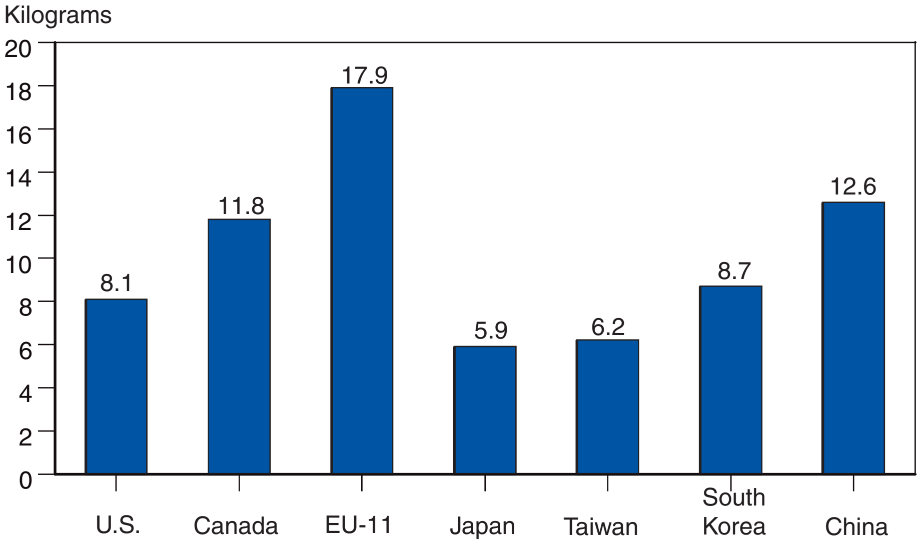
[2]The 11 countries are Austria, Belgium, Denmark, France, Germany, Greece, Italy, the Netherlands, Spain, Sweden, and the United Kingdom.

[3]Consumption data in figure 1 are based on disappearance data, not actual consumption data from consumer surveys. With disappearance data, fresh consumption equals production plus imports minus exports and processing. This is the maximum possible consumption. Losses at many levels reduce actual consumption. Losses can occur in the field, packinghouse, retail outlets, and the kitchens of consumers. If losses are more substantial in China, the per capita consumption numbers for that country may be inflated.

obvious cultural similarities to southern China, per capita consumption averaged 6.2 kg. Taiwan has a small domestic apple industry and imports over 90 percent of all apples consumed (Foreign Agricultural Service, 2003). Japan has relatively low per capita consumption, averaging 5.9 kg per person—just 73 percent of U.S. consumption levels. In South Korea, which also restricts imports, per capita consumption averaged 8.7 kg—slightly above U.S. consumption levels and 47 percent more than Japanese levels.

Figure 1

Average per capita apple consumption, 1991-2003[1]



[1]For South Korea, average consumption for 1991-2001.
Sources: World Apple Report and Korea Rural Economic Institute.

Japan's Phytosanitary Protocol for Apples

In 2004, the United States exported apples to 85 countries. Many export markets accept U.S. apples produced under standard industry operating practices with the addition of a phytosanitary certificate asserting that the packed apples have been inspected and are free of diseases or pests of concern. Other countries require additional production or postharvest practices beyond the standard U.S. industry operating practices. Exporting to these countries can be much more expensive. In some cases, for example, a government may require fumigation to kill a pest. In other countries, a government may require a systems approach to protect its domestic industry. A systems approach uses a combination of risk-mitigating measures that individually and cumulatively reduce the risk of the target diseases or pests to an acceptable level. This approach is typically employed in cases where a country or region cannot qualify as a disease-free or pest-free zone, or the postharvest treatment damages the commodity or leaves unacceptable chemical residues. Japan's previous protocol required a systems approach for fire blight. In extreme cases, a country may refuse to accept U.S. apples under any conditions.

The previous Japanese protocol for U.S. apples that was challenged by the United States in the WTO had two main parts—preharvest activities, which dealt with fire blight, and postharvest cold treatment and methyl bromide fumigation, which dealt mostly with codling moth—that are not part of U.S. standard industry operating practices. The new 2005 protocol eliminates the fire-blight requirements, but the codling-moth requirements remain in force. Japan also is concerned about lesser apple worm and apple maggot but we do not address those pests here.

As part of the old Japanese fire-blight protocol, growers from Washington and Oregon, the only growers then allowed to export to Japan, had to register their core acreage for the program in early spring. Representatives of USDA had to inspect each tree in the orchard three times for signs of fire blight—at blossom time, when the fruit was 3 centimeters in size, and just prior to harvest in the presence of a Japanese inspector. In the event of hail, the orchard had to be re-inspected because conditions might increase the risk of fire blight.[4]

[4]While no other country requires this type of orchard inspection program for fire blight, several countries, such as Australia and South Africa, reject U.S. apples outright because of the presence of fire blight in the United States. In the wake of the WTO ruling, these restrictions may change.

Additionally, each orchard block had to have a 500-meter buffer zone on all sides, which involved a substantial area, to ensure that no fire blight was near the apples in the core area. Pear trees or other natural fire-blight hosts in the buffer zone also had to be individually inspected on the same schedule. Although not required by the Japanese protocol, Washington and Oregon growers decided to ban pear trees in the buffer zone to minimize the risk of fire blight. Apple orchards typically surrounded the core acreage so the buffer zones usually required inspection. Any evidence of fire blight found in the orchard or the buffer zone eliminated the orchard from the export program for that year. If there was no evidence of fire blight at the final orchard inspection before harvest, apples from the core acres were eligible to continue in the export program. Apples from the buffer acres were not allowed into Japan. In 1994/95, the first season of the export protocol, only about half of the core acres still qualified for export by harvest time; over time, as growers became more familiar with the protocol, this share increased (table 3).

At harvest, growers had to decide whether to proceed with the postharvest protocol. If apples were free of fire blight but a high percent of the apples were not consistent with Japanese consumer demands, the grower might have decided to quit the program before incurring more costs. Japanese consumers are used to large and very good-looking apples. Market conditions posed another risk to producers. All the decisions regarding participation had to be made before relative market conditions in the United States and Japan were known. Growers could comply with every phytosanitary requirement only to discover that market conditions precluded trade. Japan is a major apple producer and would not necessarily be expected to import large volumes every year if its domestic supplies were ample. At harvest time, there might have been enough information for a grower to decide there were no Japanese market opportunities and redirect the apples to other markets.

The new protocol eliminates orchard registration, buffer zones, and orchard inspection. The old protocol included inspection of packed apples to ensure that there was no evidence of fire blight and this provision remains in force. The new protocol also requires tests for maturity on any shriveled fruit. In addition, the new protocol allows imports of California apples (Office of the U.S. Trade Representative, 2005).

The postharvest treatment, which remains in effect, is mostly directed at killing codling moth and its larva. Apples are held in cold storage rooms dedicated to the Japan export program. U.S. and Japanese inspectors check the monitoring equipment, and then seal the apples in the storage room for 55 days of cold treatment to kill codling moth. Once apples are removed from cold storage, they are fumigated with methyl bromide, which kills the codling moth larva. Japan is the only country that requires methyl bromide fumigation of U.S. apples. It also requires apples to be fumigated in field bins instead of in packed cartons. This requirement raises costs because all

Table 3

Washington/Oregon apple export program for Japan

Season	Core acres	Buffer acres[1]	Core acres qualified at harvest	Shipments to Japan
	Acres			*Metric tons*
1994/95	2,386	4,843	1,212	8,872
1995/96	2,188	2,510	1,390	1,050
1996/97	739	656	739	231
1997/98[2]	0	0	0	0
1998/99	0	0	0	0
1999/00	450	511	361	362
2000/01	321	408	321	505
2001/02	250	142	250	0
2002/03	0	0	0	0
2003/04	0	0	0	0
2004/05	0	0	0	0

[1]Acres in buffer zones in the early years of the program are estimates.
[2]No growers participated in the program for the 1997/98-1998/99 and 2002/03-2004/05 seasons.
Source: James Archer, Northwest Fruit Exporters.

apples from an orchard must be fumigated whether or not they meet the quality and size standards for the Japanese market.[5]

Methyl bromide fumigation may damage fruit or reduce its shelf life, but the impact is not observable immediately. Once the phytosanitary protocol activities are completed, the apples are graded and packed, and both U.S. and Japanese inspectors sign off on the phytosanitary export permit. At this stage, growers may still decide not to export if relative market prices are unfavorable. If fruit is exported and then methyl bromide damage is discovered after it arrives in Japan, buyers may discount the price or reject the load.

[5]Depending on the technology used, some packers can presort apples before they go into cold storage. Then the grower can reduce costs by fumigating just those bins that contain fruit most likely to meet Japanese consumer preferences.

Measuring the Cost of the Fire-Blight Requirements

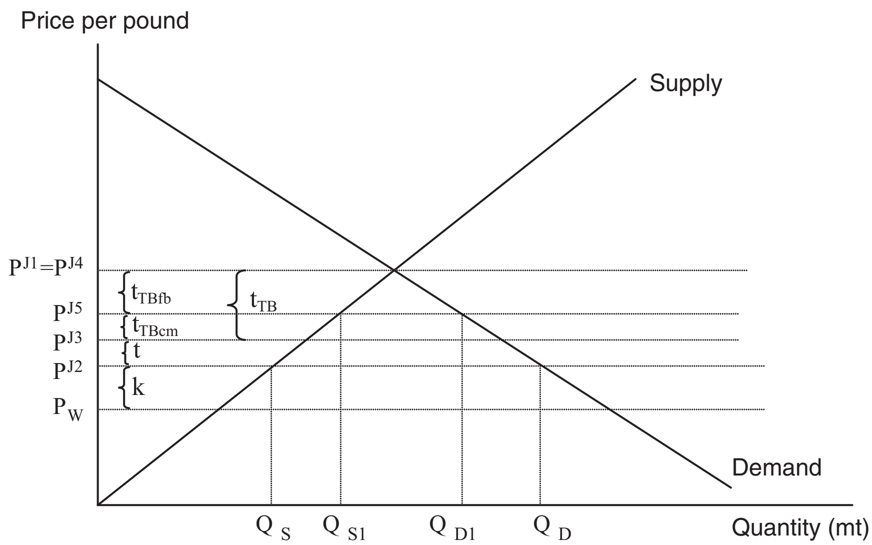
To determine the expected increase in Japanese imports with the new phytosanitary protocol, we look to the past and estimate the level of trade that would have occurred in the absence of Japan's fire-blight requirements. The first step in this analysis is to estimate the cost of the fire-blight protocol in the past and use this figure to represent the decrease in the cost of imported apples in the Japanese market with the new protocol. In the next step, we estimate the increase in Japanese apple imports in response to the decrease in imported apple costs.

For this analysis, we use a price wedge methodology to measure the cost of the fire-blight protocol (Calvin and Krissoff, 1998). This method recognizes that phytosanitary technical barriers can alter relative prices between world and national markets, thus creating a price wedge between potential traders. A technical barrier is any import standard or regulation that reflects a country's concern and valuation for safety, health, food quality, and the environment. When the price wedge is removed, market forces rather than government regulatory policy determine trade flows. This methodology is often used in empirical analyses of technical barriers and is most appropriate for analyzing homogeneous products. We argue here that the average Japanese Fuji apple is equivalent to the highest quality Washington Fuji apple. Yue, Beghin, and Jensen (2005) develop the more general case where products are imperfect substitutes, but they have no empirical estimate of the degree of substitutability between U.S. and Japanese apples.

Figure 2 illustrates the price wedge, or tariff equivalent, methodology. For ease of exposition, we first assume Japan allows no imports. In this case, the Japanese domestic price per pound of apples is P^{J1}. Now, consider the reverse

Figure 2

Japanese apple market



Source: Economic Research Service, USDA.

case—where Japan does not impose any import restrictions—no technical barriers or tariffs. The law of one price would suggest that, for like products, internal Japanese prices would equal worldwide prices adjusted for transaction and transportation costs. Since the United States is the leading Western Hemisphere producer and an important exporter, we assume that U.S. prices can serve as a reasonable proxy for world prices.[6] Furthermore, we assume that Washington apple prices represent world prices, as most U.S. apple exports originate from that State. Then the world price in Japan equals:

$$P^{J2} = P_W + k,$$

where P^{J2} is the price per pound of a Washington apple delivered to Japan. P_W is the price per pound of a Washington apple in the United States, produced with standard industry operating practices that would allow the apple to be exported to most countries with just a routine and relatively inexpensive phytosanitary certificate. Let k represent transaction and transportation costs to Japan per pound of apples. In this situation, Japan would import the difference between consumer demand and producer supply evaluated at P^{J2}, or Q_D less Q_S, the free market solution.

Japan currently imposes an *ad valorem* tariff and this protection raises Japanese prices by an additional 17 percent over the world price.[7] Let:

$$P^{J3} = P_W + k + t,$$

where P^{J3} is the cost of delivering a pound of Washington apples to Japan with a tariff, and t is the additional per-pound cost of an apple associated with the tariff. Japanese producers would sell their product at P^{J3} and Japanese consumers would pay this price for both domestic and imported apples. Japanese producers would supply less to the market than under the no trade scenario and consumers would purchase more. While it is possible that the tariff may create a price wedge sufficient to eliminate excess demand, we have illustrated the case where the tariff reduces but does not eliminate trade.

A phytosanitary technical barrier can also act as a barrier to trade, similar to a tariff. It increases the price wedge between world and Japanese markets and can be measured as a tariff equivalent of the technical barrier (t_{TB}). This adds to the cost of delivering a Washington apple to Japan. No U.S. grower would participate in the export program and ship to Japan unless the price they received for their commodity covered the additional cost of complying with the phytosanitary protocol. Let P^{J4} equal the price of a pound of Washington apples in the Japanese market with a tariff and after compliance with the fire-blight and codling-moth protocols. In figure 2, the t_{TB} and tariff just eliminate trade so that in this case $P^{J4} = P^{J1}$:

$$P^{J4} = P^{J1} = P_W + k + t + t_{TB} \Rightarrow t_{TB} = P^{J4} - P_W - k - t.$$

Figure 2 is a good representation of the current Japanese market where phytosanitary barriers are a serious barrier to trade. Japanese apple imports relative to the size of the domestic market have been very small in the last several years. In the 1994/95 season, when U.S. apple exports to Japan were at their peak, U.S. apples accounted for just 1 percent of Japanese fresh apple consumption. The Japanese tariff and phytosanitary protocols relating to fire blight and codling moth have made trade unprofitable. With the elimination of the restrictive fire-blight protocol, t_{TB} will decrease so trade may increase.[8]

[6]The United States is usually the largest Western Hemisphere exporter but in 2003/04, which was a low export year for the United States, Chilean exports led Western Hemisphere exports.

[7]Since Japan has an *ad valorem*, not a fixed value, tariff, t in the model will vary depending on the price of the apples. Japan imposes tariffs on the cost, insurance, and freight (cif) value of the apples.

[8]It is possible that the phytosanitary barrier would more than eliminate trade and the price wedge would not be distinguishable from that which would just eliminate trade. So, the price wedge model could just be the observable portion of the true value of the technical barrier. In this case it would be possible to partially relax the technical barrier and still have no trade.

Because the recent WTO decision only addresses the fire-blight protocol, we estimate trade with the codling-moth protocol still in place. Now the t_{TB} needs to distinguish between the barriers caused by the fire-blight (t_{TBfb}) and codling-moth (t_{TBcm}) protocols. Let:

$t_{TB} = t_{TBfb} + t_{TBcm}$.

Then let P^{J5} equal the price U.S. growers must receive to cover the costs of participating in the codling-moth protocol and exporting to Japan:

$$P^{J5} = P_W + k + t + t_{TBcm} \Rightarrow t_{TBfb} = P^{J4} - P^{J5}.$$

With the removal of the fire-blight protocol, the price of exporting U.S. apples to Japan falls by t_{TBfb}, and the volume of trade increases to the quantity $Q_{D1} - Q_{S1}$.

The most difficult challenge in estimating t_{TBfb} is determining which apples (and consequently which price relationships) to compare. Our objective is to compare products that are homogeneous—same variety, grade, and size—at the same point in the marketing chain so that price differentials will not reflect quality differences. In this analysis, there are two groups of apples: Fuji and "all other apples." We have information on Fuji apples for both the United States and Japan so we can separate out Fuji as a relatively homogeneous product. The category of "all other apples" in the United Sates and Japan is less homogeneous. Other than Fuji, the main types of apples produced and consumed in Japan are Tsugaro, Jonagold, and Ohrin.

To create the Fuji category, we use Tokyo wholesale market prices for Japanese Fuji apples, P^{J4}. We compare Japanese wholesale market prices with our estimate of what it would cost to deliver a Washington Fuji apple to the Japanese wholesale market in Tokyo under the codling-moth protocol, P^{J5}. However, the two countries do not share common grading or sizing standards so we must make assumptions about what are comparable Fuji apples. While the top quality Japanese bagged Fuji apples are extraordinarily beautiful, large, and expensive, wholesale market prices reflect the average Fuji apple—a range of all qualities of bagged Fuji and lower cost sun Fuji apples. A current estimate puts the sun Fuji share of total Fuji production at 70 percent (U.S. Embassy in Japan, 2004). Also, in the mid-1990s, in anticipation of apple imports, Japanese producers began to market lower grades of apples at lower prices (Foreign Agricultural Service, 1996). For an equivalent U.S. apple, we use very large (size 72) Washington State Extra Fancy Fuji apples—the highest quality. We assume these apples would compare very favorably with the average Japanese Fuji apples.[9]

For the category of all other apples, we use average Japanese wholesale apple price data and average U.S. free-on-board (fob) shipping price data. We adjust both price series to exclude the share attributable to Fuji prices based on the shares of Fuji apples in each market, approximately 55 percent in Japan and 10 percent in the United States.

To estimate the costs of delivering a Washington Fuji or another type of apple to the Japanese wholesale market without the fire-blight protocol, we start with the Washington fob apple price and add the direct cost of the codling-moth protocol, transaction and transportation costs, and the tariff.[10] Japanese prices are converted to U.S. dollars for purposes of comparison.

[9]Apples vary with respect to other characteristics such as brix. Other quality issues cannot be addressed in this model since there are no comparable data on prices as a function of other characteristics.

[10]The transaction and transportation costs in delivering a Washington State apple to the Japanese wholesale market, costs in both the United States and Japan, include the following: the postharvest costs of the codling moth protocol (t_{TBcm}); shipping costs from the Washington growing area to the port of Seattle; freight and insurance costs to ship apples from Seattle to Japan; the Japanese tariff (based on the landed value including the cost of insurance and freight (cif)); the 5 percent Japanese consumption tax; customs clearance and terminal service charges; warehouse charges and transportation costs from the port to the warehouse; and importer margins (Archer, 2004; Agricultural Marketing Service, 2004; U.S. Embassy in Japan, 2004, and Washington Growers Clearing House Association, 2004). In our previous analysis (Calvin and Krissoff, 1998), information on transportation and transactions costs was limited just to costs incurred in delivering apples to the Japanese port.

We calculate the price wedge for the last six U.S. apple seasons (August-July), 1998/99 to 2003/04, for Fuji and all other apples (table 4). For each season, we first calculate the monthly price wedge and then average them to determine the annual price wedge.[11] The values of the price wedge vary substantially between months and years and are a function of the exchange rate, market prices in the two countries, and marketing costs; the value for Fuji apples ranges from 43 cents per pound to 1 cent, with an average of 19 cents. The variation does not reflect changes in phytosanitary requirements. Within a season, the price wedge usually begins high, declines during the middle of the season, and then increases toward the end of the season. Across years, the price wedge is large in the 1998/99, 2000/01, and, to a lesser degree, 1999/2000 seasons and small in the 2001/02-2003/04 seasons.

The main source of variation in the price wedge between the two countries is weather conditions, which affect both yields and prices (figure 3). For example, the large price wedge in 1998/99 is due to high production and low prices in the United States, and low production and high prices in Japan. In the 2000/01 season, total U.S. production was down a bit from the previous year (although

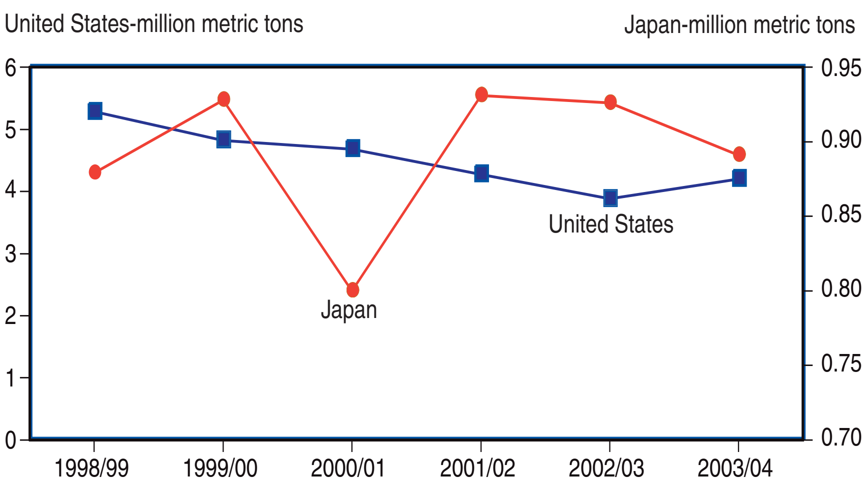
[11]Since apple markets are very thin in the summer months, we exclude July and August from our annual price wedge calculations. Also, in calculating the annual price wedge, we use zeros in the months with a negative price wedge, implying that U.S. apples are not competitive in those months.

Table 4
Price wedge and tariff equivalent of the technical barrier for fire blight

Season	Fuji apples		Other apples	
	Price wedge	Tariff equivalent	Price wedge	Tariff equivalent
	Dollars/lb.	*Percent*	*Dollars/lb.*	*Percent*
1998/99	0.40	87	0.68	503
1999/00	0.22	40	0.44	236
2000/01	0.43	113	0.55	334
2001/02	0.04	9	0.11	57
2002/03	0.01	2	0.19	83
2003/04	0.06	10	0.33	119

Source: Economic Research Service, USDA.

Figure 3
U.S. and Japanese apple production



Source: Food and Agriculture Organization of the United Nations.

Washington State production was up 20 percent) but Japanese production fell, down 14 percent from the previous year, again yielding a large price wedge. In contrast, in the 2001/02-2003/04 seasons, Japan produced large crops, lowering prices substantially. U.S. apple production was at very low levels in the 2001/02-2003/04 seasons with high domestic prices, which reduced the U.S. price advantage in exporting to Japan.

Without the fire-blight protocol, Japanese imports would have been potentially quite large in the first three of the six seasons. That does not imply, however, that the fire-blight protocol did not have an adverse impact on U.S. growers in the latter period. Rather, it demonstrates the importance of using several years of data on observed prices to approximate the expected price wedge. For a fruit with considerable year-to-year production fluctuations, relying on one year's *ex post* observed prices is not adequate to paint a complete picture of a grower's *ex ante* decision to participate, which is based on expected prices. Expected prices are a function of experience over time.

Measuring the Potential Longrun Trade Increase

The second step in this analysis is to estimate the expected volume and value of imports that will occur now that Japan's fire-blight requirements have been eliminated, but with the codling-moth protocol remaining in place. To estimate trade flows, we use a spatial partial-equilibrium model of the Japanese apple market as illustrated in figure 2 and the estimates for the reduction in costs with the new phytosanitary protocol. We look at the trade that would have occurred in the 1998/99-2003/04 seasons if the fire-blight protocol had not been in place. This model estimates total Japanese imports, not imports from any particular country. Since the WTO decision on fire blight is with respect to the United States, we assume all gains to trade would accrue to the United States.

To attain results, we make assumptions regarding the responsiveness of demand and supply to changes in price, that is, how much Japanese demand and supply would change as price falls from P^{J4} to P^{J5} with the removal of the fire-blight protocol. Kajikawa (1999) estimated Japanese apple demand elasticities for 1977-1995 and found -0.57 for all apples, -0.67 for Fuji apples, and -0.37 for Red Delicious apples. That is, for every 1-percent decrease in Fuji prices, consumers in Japan would respond by increasing the quantity demanded by 0.67 percent. In our analysis we use demand elasticities of -0.67 for Fuji apples and-0.37 for all other apples. We use the lower price elasticity of demand for all other apples to reflect the change in Japanese demand for a price change in U.S. Red Delicious apples since this is the most common apple produced in the United States.

We found no empirical estimates of apple supply elasticities available for the Japanese market. For Fuji apples, we use a longrun supply elasticity of 1; for a 1-percent decrease in Fuji apple prices, Japanese producers would respond with a 1-percent decline in output. Previous analyses also have assumed a longrun elasticity of 1 (Calvin and Krissoff, 1998; Yue, Beghin, and Jensen, 2005). Now that the restrictive fire-blight protocol has been lifted, it will take some time for growers to adjust resources in response to the new economic conditions. Japanese farmers confronted with lower prices may decide to reduce production or at least curtail any planned increases. A supply elasticity of 1 for Fuji apples is a reasonable estimate to reflect these longrun trends.[12] For other apples we assume a much smaller longrun supply response of 0.2. Japanese growers of other apples (mainly Tsugaru, Jonagold, and Ohrin) are not likely to substantially alter their production patterns in reaction to a price change of U.S. all other apples (mainly Red and Golden Delicious).

[12]Recently, Devadoss and Wahl (2004) estimated an apple supply elasticity for India of 0.696.

Table 5 presents the impact of removing the t_{TBfb}. These estimates for future trade changes are based on simulations for average Japanese imports that would have prevailed in the last six seasons if there had been no t_{TBfb}. The estimated changes in trade are substantial. Average annual Japanese apple imports of Fuji and all other apples would have been 190,876 metric tons (the quantity Q_{D1} - Q_{S1} in figure 2), with a value of $143.6 million. Actual annual Japanese apple imports averaged only 581 metric tons for calendar years 1999-2004 (table 1). For Fuji apples, the increase in imports would have been

109,138 metric tons or $110.5 million. The overall change in apple trade volume represents about 5 percent of average U.S. production and 21 percent of average Japanese production (see table 6 for average U.S. and Japanese apple and Fuji apple production levels). Comparing our findings with the top three U.S.-apple importing countries, Mexico and Canada imported at least 100,000 metric tons of all types of apples in the 1999-2003 period but both had less than 100,000 in 2004. Taiwan imported over 100,000 metric tons of all types of apples from the United States in 2000, although the volume of trade has since declined.

With lower import prices, Japanese consumers would increase their consumption of apples by 10.8 percent, raising their per capita consumption to 6.4 kg, still below the 2003 per capita consumption in the United States of 6.8 kg (World Apple Review, 2004). In terms of Japanese producers, the increased competition from the United States would suggest that there would be less production, a decline of 10.6 percent (table 7). While this represents a substantial decrease in Japanese production, it is only slightly more than the average year-to-year variation in production in the last six seasons (1998/99-2003/04) which is approximately 8 percent.

There is one further point to make about U.S. bilateral trade with Japan. Our analysis assumes that all benefits from the relaxation of the Japanese phytosanitary barrier would accrue to U.S. growers. Only the United States is involved in the WTO case against Japan. Thus, all else being equal, only U.S. exports to Japan would be affected by the WTO decision. Countries that currently have

Table 5

Estimated change in Japanese apple imports with the elimination of the fire-blight protocol

	Change in trade					
Season	Fuji	All other	Fuji	All other	Total	
	Million dollars		*Metric tons*		*Million dollars*	*Metric tons*
1998/99	228.0	42.9	226,000	143,487	270.8	369,487
1999/00	152.1	41.1	126,286	100,943	193.2	227,229
2000/01	193.3	36.9	230,790	102,107	230.2	332,897
2001/02	35.1	14.0	31,724	31,691	49.1	63,415
2002/03	8.9	23.3	7,067	46,122	32.2	53,189
2003/04	45.6	40.4	32,958	66,077	86.0	99,036
6-year average[1]	110.5	33.1	109,138	81,738	143.6	190,876

[1]Average season is based on 1998/99-2003/04 marketing years.

Source: Economic Research Service, USDA.

Table 6

Average U.S. and Japanese apple production, 1998/99-2003/04

Country	Total apple production[1]	Fuji production[1]
	1,000 metric tons	
United States[2]	4,203	388
Japan[3]	892	490

[1]Considering total production for the fresh and processed markets.
[2]Total production data are from the National Agricultural Statistics Service, USDA and Fuji production data are from the U.S. Apple Association.
[3]Data on Japanese production are from various issues of the GAIN attache reports from the Foreign Agricultural Service, USDA.
Sources: National Agricultural Statistics Service, USDA; the U.S. Apple Association; and various issues of GAIN attache reports, Foreign Agricultural Service, USDA.

approved phytosanitary protocols to deal with fire blight—France and New Zealand—would have to enter into independent negotiations with Japan regarding changes to their phytosanitary protocols. In the mean time, there would be no change in their competitiveness in the Japanese market. Furthermore, while France is the world's largest apple exporter, it is unlikely to be much of a market force in Asia. France's share of imports for nine Asian markets in 2003 ranged from 6 percent in Malaysia to 0 percent in Taiwan, China, and the Philippines (table 8). U.S. shares in the same set of countries ranged from 47 percent in Indonesia to 4 percent in the Philippines. Total French apple exports to these countries were just 6 percent of U.S. exports. The United States will always have an advantage over France in terms of transportation distance to Asia. New Zealand's competitiveness would improve if the fire-blight protocol were dropped and it might provide increased competition for U.S. growers during the summer months. In 2003, New Zealand's exports to the nine Asian markets were 31 percent of U.S. exports.

Other U.S. competitors are unlikely to gain. Australia does not have fire blight, so its phytosanitary barriers to trade would not change. Similarly, South Korea, North Korea, and Nepal, would not gain any advantage.[13] In fact, South Korea, with a protected domestic market and falling prices in Japan, would not find the Japanese market as profitable as in past years. China is still not allowed into the Japanese market because of various phytosanitary issues.

[13]In the Yue, Beghin, and Jensen analysis of the impact of removing the fire-blight protocol, their estimate of the total change in Japanese apple imports equaled $202 million (higher than our estimate of $144 million) and they allocated $48 million as the U.S. share. They based the U.S. share on its 24-percent share (in terms of value) of Japanese apple imports in 2000. In 2000, only Australia, South Korea, and the United States exported to Japan (table 1). Since Australia and South Korea do not have fire blight, any change in the fire-blight protocol would not affect them. If U.S. growers could export to Japan without the fire-blight protocol, the U.S. share should be much higher than it was in 2000.

Table 7
Estimated changes in Japanese consumption and production

Changes in market volume due to:	Fuji	Other apples	Fuji	Other apples	Total	
	Metric tons		*Percent[1]*		*Metric tons*	*Percent[1]*
Gain in consumption	43,681	52,904	4.9	5.9	96,585	10.8
Loss in production	65,456	28,834	7.3	3.2	94,290	10.6

[1]Percent change from average total apple production (1998/99 to 2003/04).
Source: Economic Research Service, USDA.

Table 8
Apple imports in select Asian countries, 2003[1]

	Taiwan	Indonesia	Hong Kong	Malaysia	India	Thailand	Singapore	China	Philippines
	Metric tons								
Total imports	108,745	83,769	102,378	76,596	20,093	84,229	50,616	41,636	50,023
Share of imports from:	*Percent*								
United States	45	47	34	10	41	12	9	46	4
Canada	0	2	0	0	1	0	0	0	1
France	0	4	1	6	2	2	4	0	0
South Korea	4	0	0	0	0	0	0	0	0
Japan	14	0	0	0	0	0	0	0	0
China	0	41	36	46	16	76	56	0	90
New Zealand	13	4	12	11	12	4	16	22	0
Australia	3	1	1	7	23	0	4	0	1
Other Southern Hemisphere countries[2]	21	1	15	19	3	5	10	32	0
Others	0	1	1	0	2	1	1	0	5

[1]Statistics for Indonesia, India, and the Philippines are based on 2003 data.
[2]Chile, South Africa, and Argentina.
Source: World Trade Atlas.

Conclusions

With Japan's elimination of its restrictive phytosanitary protocol for fire blight in August 2005, U.S. apple growers will see increased export opportunities. This report provides an estimate of the expected long-term trade gains. The analysis uses a price wedge methodology that is a standard procedure for analyzing the cost of nontariff barriers for homogeneous goods. The results depend crucially on the assumption that average Japanese Fuji apples and the highest quality Washington State Fuji apples are comparable in the eyes of Japanese consumers. The elimination of the restrictive fire-blight protocol suggests that, in the long run, Japan will import an average of 190,876 metric tons of Fuji and other apples valued at $143.6 million annually. There may be substantial variation, however, from the average import level because of fluctuating market conditions from season to season. This market growth will occur over a decade. The estimate assumes a period of adjustment that will allow U.S. and Japanese growers an opportunity to respond to new market conditions. It also will take some time for Japanese consumers to learn more about U.S. apples and reassess their consumption choices.

The new level of trade may have a significant impact on the U.S. apple industry, increasing demand for apples by nearly 5 percent. By assuming a longrun period of adjustment, the United States could respond by changing production plans to favor Fuji apples, probably with limited longrun upward price pressure. As for Japanese producers, the adjustment implies approximately an 11-percent decrease in production. Japanese consumers, though, would benefit from lower prices and greater availability of the most preferred Fuji and other apple varieties.

References

Agricultural Marketing Service (AMS), U.S. Department of Agriculture. "Ocean Rate Bulletin-Apples." various issues. Accessed June 15, 2004: http://www.ams.usda.gov/tmd/Ocean/index.asp.

Animal and Plant Health Inspection Service (APHIS), U.S. Department of Agriculture. "Japan Varietal Testing Case" in *Technical Trade Report*, May 1999. Accessed June 10, 2004: http://www.aphis.usda.gov/is/tst/Publications/TTreports/1999May.pdf.

Archer, James. Northwest Fruit Exporters Association, personal communication, 2004.

Calvin, Linda, and Barry Krissoff. "Technical Barriers to Trade: A Case Study of Phytosanitary Barriers and U.S.-Japanese Apple Trade." *Journal of Agricultural and Resource Economics* 23(1998): 351-66.

Devadoss, Stephen and Thomas Wahl. "Welfare Impacts of Indian Apple Trade Policies." *Applied Economics* 36(2004): 1289-1294.

Foreign Agricultural Service (FAS), U.S. Department of Agriculture. "Japan: Fresh Deciduous Fruit-Tasmanian Fuji Apples Sold for the First Time to Japan." GAIN Report #JA9077, June 24, 1999. Accessed June 2, 2004: http://www.fas.usda.gov/gainfiles/199906/25454940.pdf.

Foreign Agricultural Service (FAS), U.S. Department of Agriculture. "Japan: Fresh Deciduous Fruit-The 2004 Japanese Sweet Cherry Market-Production and Trade." GAIN Report #JA4065, August 24, 2004. Accessed April 25, 2005: http://www.fas.usda.gov/gainfiles/200408/146107356.pdf.

Foreign Agricultural Service (FAS), U.S. Department of Agriculture. "Japan: Fresh Deciduous Fruit-Review of U.S. Apple Export Season in Japan." AGR Number JA6018, May 17, 1996. Accessed April 4, 2004: http://www.fas.usda.gov/scriptsw/attacherep/display_gedes_report.asp?Rep_ID=10009417.

Foreign Agricultural Service (FAS), U.S. Department of Agriculture. "Taiwan Fresh Deciduous Fruit Annual 2003." GAIN Report TW3032, September 10, 2003. Accessed April 13, 2004: http://www.fas.usda.gov/gainfiles/200309/145986037.pdf.

Food and Agriculture Organization of the United Nations. Accessed April 13, 2004: http://faostat.fao.org/faostat/collections?version=ext&hasbulk=0&subset=agriculture.

Kajikawa, Chikako. "Apple Economy and Quantitative Analysis." *Nourin Toukei Kyoukai,* (April) Tokyo, Japan, 1999.

Kajikawa, Chikako. "Quality Level and Price in Japanese Apple Market." *Agribusiness* 14 (1998): 227-234.

Korea Rural Economic Institute. *Food Balance Sheet*, 2001. South Korea, December 2002.

Office of the U.S. Trade Representative. “U.S. Wins WTO Appeal on Japan’s Restrictions on U.S. Apples.” Press release, December 1, 2003.

Office of the U.S. Trade Representative. “U.S. Dissatisfied with Japan over Apple Dispute.” Press release, July 19, 2004.

Office of the U.S. Trade Representative. “United States Succeeds in Removing Japan’s Barriers to U.S. Apples.” Press release, August 31, 2005.

U.S. Apple Association. Production and Utilization Analysis, various issues.

U.S. Embassy in Japan, personal communication, 2004.

Washington Growers Clearing House Association. Weekly Bulletin, various issues, 1997-2004. Accessed June 3, 2004: http://www.waclearinghouse.org/.

World Apple Review. Belrose, Inc., Pullman WA, 2002, 2003, and 2004.

Yue, Chengyan, John Beghin, and Helen Jensen. “Tariff Equivalent of Technical Barriers to Trade With Imperfect Substitution and Trade Costs.” Working Paper 05-WP 383, February 2005.