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The Economics of Food Safety: The Case of Green Onions and Hepatitis A Outbreaks

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Abstract

Using the example of recent foodborne illness outbreaks in the United States associated with green onions from Mexico, this report examines the economics of food safety. Incentives for growers to adopt additional food safety practices are somewhat weak. Because of asymmetric information problems, produce grown with more food safety practices does not receive higher prices. Growers that adopt more food safety practices do so to maintain markets and to reduce risk. Results from a survey before the outbreaks provide a view of the incentives for adopting more food safety practices. Interviews with growers after the outbreaks indicate how the costs of an outbreak vary depending on the food safety practices growers had already adopted. According to growers, the market impact lasted 1-4 months. Policy responses by growers, retailers and foodservice buyers, and governments conclude the report.

Keywords: food safety, green onions, produce, hepatitis A, foodborne illness outbreaks, Mexico, good agricultural practices (GAPs).

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Introduction

In fall 2003, large outbreaks of hepatitis A in the United States were associated with consumption of green onions from Mexico. Despite nearly a decade of industry and U.S. Food and Drug Administration (FDA) activities targeted at reducing microbial contamination of fresh produce at the grower level, outbreaks of foodborne illness, though infrequent, still occur. FDA acknowledges that it is not possible to guarantee food safety in terms of microbial contamination with current technology. Even growers with the best food safety practices may still have contaminated product—all sources of risk cannot be controlled. But there is concern that some growers are lagging behind government and consumer expectations in adopting safer practices.

The recent outbreaks of hepatitis A demonstrate one of the most important challenges in food safety. Incentives for individual growers to adopt stronger food safety programs are increasing but are still not adequate to entice all growers to upgrade their practices. Many Mexican growers had adopted safer practices before the outbreak. But as long as some growers do not adopt safer practices, all growers face the economic consequences of an outbreak.

Benefits and Costs of Adopting Better Food Safety Practices

When individual growers choose whether to adopt additional food safety practices, they weigh their private benefits and costs.[1] Typically, growers adopting a new production practice expect to either receive a higher price for a higher quality good, reduce risk, or lower their costs of production. In the case of adopting food safety practices, growers do not receive a higher price. As a result, some growers choose not to adopt safer practices.

But other benefits may influence growers' decisions to adopt better food safety practices. These benefits are mostly related to risk—the reduction in probability of unpleasant events, such as catastrophic drops in sales if contaminated produce is traced to their operations, damage to reputations, and lawsuits. These benefits only accrue in the event of an outbreak. Until an outbreak occurs, growers may think that the probability of ever experiencing the benefits is very low. Afterward, growers may revise their estimates of these benefits. A more immediate benefit of adopting better food safety practices is that many retailers and foodservice buyers now require third-party audits of grower food safety practices as a condition of purchase. Having higher food safety standards gives growers broader market access.

Weighing against the potential benefits of adopting new food safety standards are the costs, which are immediate and, often, large. Costs may include investments in new infrastructure such as water purification plants, training for workers to improve hygiene in the fields, upgrades to record-keeping systems, and use of third-party audits for compliance with good agricultural practices (GAPs) in the fields and good manufacturing practices (GMPs) in packinghouses. GAPs are voluntary guidelines for minimizing the risk of microbial contamination in produce. FDA published the guide-

[1]For now, the discussion assumes food safety practices are not mandated by law and growers' choices are not restricted. Mandatory food safety standards will be addressed later in this report.

lines for GAPs in 1998. FDA recommends, but does not require, GMPs for packinghouses handling raw, intact fruit and vegetables (app. 1).

Growers adopt new food safety practices if expected benefits exceed expected costs. However, not all growers make the same decisions with respect to adopting more food safety practices. Even among growers of the same crop, benefit-cost analyses upon which decisions are based can vary depending on characteristics of the grower and the operation.

Do the decisions individual growers make about food safety practices ensure the level of food safety desired by consumers and society at large? Possibly not (Caswell and Mojduszka, 1996; Mitchell, 2003). Markets do not always work smoothly for all goods. Private decisions by growers may not be socially optimal because of imperfect information and negative externalities.

Imperfect information, which exists when buyers and sellers can not identify certain characteristics of a product, may reduce the incentives to adopt new food safety practices by hindering the development of different prices for different levels of food safety (app. 2).

Negative externalities also affect the incentives to adopt additional food safety practices.[2] Society as a whole may demand higher levels of food safety than consumers in grocery stores or foodservice establishments. Of course, in the event of a large outbreak of foodborne illness, consumers are on the front-line facing health problems and medical bills, lost days of work, etc. But everyone along the marketing chain associated with the contaminated product will face potential costs. Even those not directly associated with contaminated product may suffer. For example, if a foodborne illness is traced to a particular product, but not a particular grower, all producers of that food item may feel the effects of decreased demand. The Centers for Disease Control and Prevention (CDC) and FDA incur substantial costs in tracing the outbreak back to the contaminated product. They also investigate farm and packinghouse operations and review inspection results. Some level of government often ends up paying for many of the medical costs incurred in an outbreak. In their private benefit-cost analyses, growers do not consider the benefits and costs that might accrue to others if food safety were improved and may therefore provide less food safety than society desires.

When there are outbreaks of foodborne illness, other groups in the produce industry, marketing chain, or government facing increased costs may try to impose new rules on growers to encourage or force them to implement food safety measures more in line with society's total demand for food safety. For example, grower organizations may put into place voluntary or mandatory practices to reduce the negative impact of one producer with contaminated produce on other producers of the same product. Retailers and foodservice buyers may require growers and packinghouses to obtain third-party audits showing compliance with GAPs and GMPs to reduce the chance that their businesses will be associated with an outbreak. Governments may also impose higher standards on producers.

[2]Negative externalities exist when one party's production or consumption choices have a negative impact on another party's well-being.

U.S. and Mexican Green Onion Industry

Mexico is the dominant force in North American green onion production. Most green onions consumed in the United States come from Mexico. In 1978 and 1979, all (or most) shipments were from the United States—shipment data do not always capture small amounts of trade (fig. 1). In 1980, shipments of green onions began entering from Mexico, and this production eventually replaced winter production in Arizona and parts of California. By 1986, Mexican shipments to the U.S. market exceeded U.S. shipments and this trend has continued ever since. Total shipments of green onions in the U.S. market (from Mexican and U.S. sources) are growing, up 48 percent from 1990 to 2003.

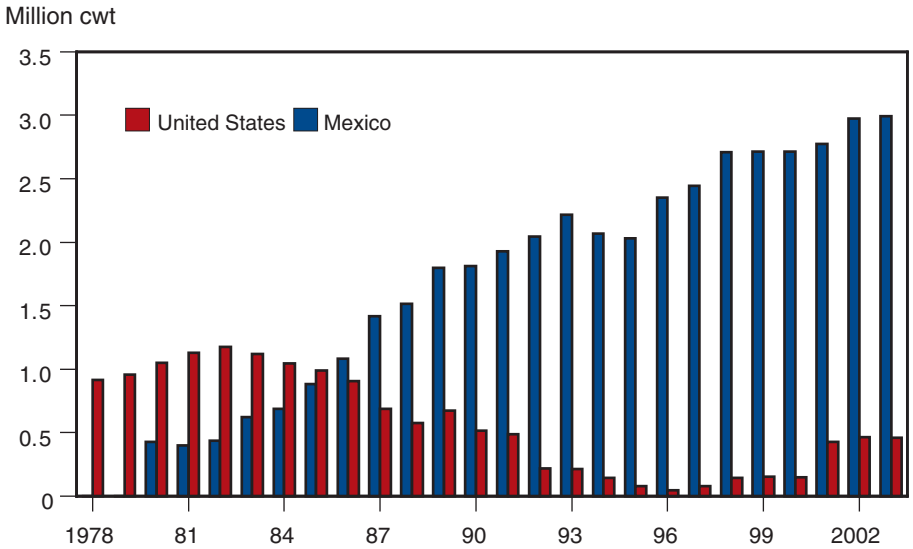
As a labor-intensive crop, green onions are cheaper to grow in Mexico than in the United States. Green onions, like radishes and other crops that are hand bunched, involve more hand labor in the harvesting and packing process than most fruit and vegetables. Each person that handles green onions potentially increases the probability of microbial contamination. For example, in a typical operation, as many as nine different people might touch a green onion. If harvesting and packing plant operations ever become more mechanized, costs might be reduced sufficiently that green onion production would return to the United States.

The North American green onion industry is highly integrated. Buyers demand green onions on a year-round basis, and shippers source from both Mexico and the United States depending on season and availability. In 2003, shipment data show that 87 percent of the supply available in the United States came from Mexico.[3] U.S. shipments are largest during the summer months, and Mexican shipments peak during the winter (fig. 2). California accounted for 68 percent of U.S. shipments.

[3]Shipment data do not pick up production in all States so the data undercount the importance of U.S. production. In 2003, the data captured production from California, South Carolina, Texas, and Arizona only. Production in other States was not covered.

Figure 1

Annual shipments of green onions to the U.S. market[1]



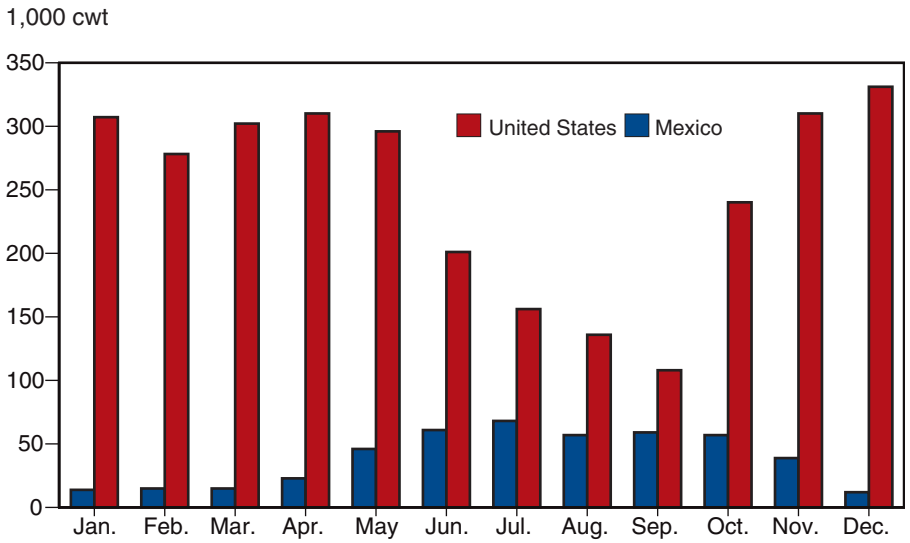
[1]In 2003, other green onions from Canada and Guatemala totaled less than 1 percent of shipments.

Source: *Fresh Fruit and Vegetable Shipments.* Agricultural Marketing Service, USDA.

Originally, the Mexican green onion export industry produced only during the winter in Mexicali, Baja California, and San Luís Río Colorado in the adjoining State of Sonora (fig. 3). The demand for year-round supplies has led some growers to produce all year. Summer production is located in the cooler western coastal range in such areas as Ojos Negros, Valle de la Trinidad, El Cóndor, and Valle de Guadalupe. The summer production areas

Figure 2

Monthly shipments of green onions to the U.S. market, 2002[1]

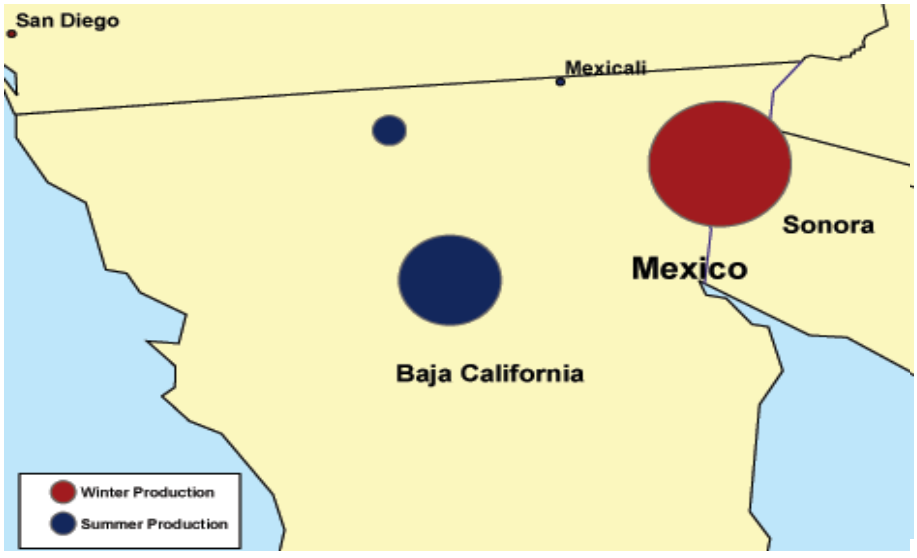


[1]This figure presents monthly shipments for 2002, the last year before the food safety outbreaks.

Source: *Fresh Fruit and Vegetable Shipments: By Commodities, States, and Months.* Agricultural Marketing Service, USDA.

Figure 3

Green onion production areas in Baja California and Sonora, Mexico



Source: Economic Research Service, USDA.

are more isolated with poorer infrastructure, which may be more challenging from a food safety perspective.

At the time of the hepatitis A outbreaks in the United States in fall 2003, there were 26 green onion growers in Mexicali and San Luís Río Colorado. Eight of these growers also had summer operations in the mountains. One additional grower grew green onions only in the summer growing region. Summer shipments (mid-May through early October) to the United States accounted for about 27 percent of total calendar year shipments in 2002. The output of the four firms named by FDA as being the source of the contaminated produce represented a relatively small share of the area's summer production of green onions and an even smaller share of total winter and summer production. But the problems of these firms affected the whole industry.

Shippers in the United States market Mexican green onions. Shippers and their suppliers typically develop close relationships, whether the suppliers are domestic or foreign. Often, Mexican firms grow for a U.S. firm that demands the same standards from their domestic and foreign suppliers. A shipper may require that a grower have a third-party audit verifying compliance with GAPs or GMPs. A wide range of individual food safety programs exists on both sides of the border.

Before the 2003 outbreaks of hepatitis A in the United States, many growers in Mexico already used third-party certification for GAPs and GMPs. Despite survey results suggesting that most growers have an interest in food safety, a lack of concern by only a few growers can affect the entire industry. Table 1 shows results from a 2002 survey of GAP use by horticultural producers in the Mexicali Valley, Mexico (parts of Baja California and Sonora). Results for use of GMPs were similar. While the survey's sample size is small, the results provide some insight into why growers adopt better food safety practices.[4] Three of seven respondents were completely GAP compliant. Mexico is the North American market leader in green onions, with many dynamic and sophisticated producers. For some growers, adopting GAPs and GMPs is part of providing a differentiated product—organic certification, pesticide-residue-free certification, and GAP and GMP certification. One grower expected the next step to be applying a Hazard Analysis Critical Control Point program to his iceless packinghouse. According to the survey, two growers were in the

Table 1—Grower use of GAPs in the Mexicali Valley, Mexico, 2002

Item	Number of growers
Level of GAP compliance	
GAP compliant	3
In process of becoming GAP compliant	2
No GAP program	2
Source of motivation for adopting GAPs	
Own initiative	5
Shipper demands	1
Own initiative and shipper demands	1
Most important reason for adopting GAPs	
Maintain market access	3
Produce a safer product	2
Receive higher price	1
Other	1

Source: Avendaño, 2004.

[4]Firms in the sample grew green onions and exported to the United States. Growers were questioned about their operations in the Mexicali and San Luís Río Colorado areas. Firms were selected based on proportional random sampling with respect to farm size.

process of becoming GAP compliant. Most growers plan investments in new food safety practices over a several-year period. Two growers did not use GAPs.

While growers could conceivably do their own food safety testing, third-party audits of a GAP program provide a level of additional credibility. All five producers with some level of GAP use had third-party audits. Developing stronger food safety programs is expensive. In recent years, the costs for Mexican green onion growers to become GAP and GMP compliant have ranged from $700,000 to $2,500,000 (Avendaño and Schwentesius, 2003). Costs vary by size of operation, whether firms have their own packing shed, and environmental conditions. For example, growers with access only to open-ditch irrigation water may face higher costs than those with access to deep well water to achieve the same level of expected food safety.

Almost all growers (5 of 7) in the survey stated that the decision to adopt better food safety practices was, or would be, due to their own initiative, not due to the requirements of their shipper. All seven growers responded regardless of their compliance with GAPs. One grower reported that shipper demands were, or would be, an important factor in decision making. And one said both factors played, or would play, a role in the decision.

Growers cited different reasons for adopting GAPs. Three of seven growers adopted more food safety practices to maintain market access in an environment characterized by growing consumer concern about food safety. Certain U.S. and Canadian buyers require that products meet high standards for food safety, and growers had to adopt GAPs to compete for those sales. Many growers say that in the past, buyers were concerned about food safety, but food safety was not necessarily their top concern when buying green onions. Since the outbreak, buyers are, for the time being at least, requiring growers to comply with GAPs and GMPs. About a quarter of the Mexican growers sell to the United Kingdom (UK), a very demanding market in terms of food safety, in addition to the United States and Canada. Mexican growers selling to the UK market must also comply with EurepGAPs, the private European version of GAPs. The core food safety components of GAPs and EurepGAPs are very similar, but EurepGAPs also address other issues, such as environmental quality and worker welfare. Growers typically produce to one set of standards that will meet the needs of all their buyers.

Two producers said the most important reason for adopting new food safety practices was to ensure production of safer food. Safer practices enable firms to minimize risk in their operations. Outbreaks traced to growers lead to catastrophic loss of sales and reputation. Food safety is a particularly important issue for firms that have products with brand-name recognition. The produce industry is not typically associated with strong brand name recognition, but fresh-cut products, such as bagged salads and bagged baby carrots, are an exception. The green onion industry sells fresh-cut green onions. Most of the industry's products are targeted at the foodservice industry and involve washed, chopped, or diced green onions packaged in consumer ready bags. A fresh-cut component to an industry promotes the adoption of more food safety practices.

Although one grower responding to the survey cited the prospect of a higher price as the most important reason for adopting new food safety practices, the general view in the industry is that compliance with GAPs increases marketing opportunities rather than price.

The Hepatitis A Outbreaks

On November 15, 2003, FDA announced that hepatitis A outbreaks in September in Tennessee, North Carolina, and Georgia were associated with raw or undercooked green onions (FDA, 2003a). At that time, FDA reported that the green onions in the Tennessee case "appeared" to be from Mexico. One person in Tennessee died (*The Packer*, 2003a). On November 20, 2003, FDA announced that green onions from Mexico were implicated in the Tennessee and Georgia outbreaks (FDA, 2003b). FDA never determined the source of the green onions associated with the outbreak in North Carolina. In late October and early November, before FDA's first announcement regarding contaminated green onions, another very large outbreak of hepatitis A occurred in Pennsylvania among diners at one restaurant. Over 500 people contracted hepatitis A and three died (Dato et al., 2003). On November 21, FDA announced that this outbreak was also associated with green onions from Mexico and named the four firms that grew the product associated with the outbreak (FDA, 2003c). Identification of the four firms was based on epidemiological and traceback evidence.

Hepatitis A is a liver disease caused by the hepatitis A virus. In most cases, the symptoms are mild (jaundice, fatigue, abdominal pain, loss of appetite, nausea, diarrhea, and fever). Most people recover fully from the disease, and some never even know they have the virus. Hepatitis A occasionally can be severe, particularly for people with liver disease. The virus is transmitted by the fecal-oral route. Produce can become contaminated when a person who has hepatitis A, or whose hands are contaminated with the virus, comes into contact with the produce or when the produce is exposed to water contaminated with the hepatitis A virus.

Contaminated green onions have been implicated in previous foodborne illness outbreaks in the United States. In 1999, FDA began testing a sample of domestic and imported produce for three microbial pathogens (but not hepatitis A). Contamination was found on both domestic and imported green onions (FDA, 2001b and FDA, 2001c). Green onions may be particularly susceptible to contamination because "plant surfaces are particularly complex or adherent to viral or fecal particles" (Dato et al., 2003).

CDC and FDA investigated the cause of the 2003 hepatitis A outbreaks. First, CDC looked for the product that was most likely to be the source of the contamination. In each case, the contaminated product was found to be consumed in a restaurant (FDA, 2003a). Local health officials, who must first determine whether the contamination occurred at the point of service in their jurisdiction, decided that the original contamination occurred at some point before the green onions arrived at the restaurants. In the Pennsylvania case, restaurant workers also became ill at the same time as the patrons, implying they were not the original source of contamination. However, officials noted that the storage practices used at the restaurant in Pennsylvania

could have contributed to intermingling of uncontaminated and contaminated green onions, which may explain the extent of the outbreak (Dato et al., 2003).

Once local officials determined the green onions were not contaminated in the restaurants, FDA became involved in the traceback to determine the origin of the contaminated product. FDA believed the green onions originated in Mexico and were contaminated there, too. It is difficult to pin down exactly where the produce became contaminated—at the farm, packing shed, or in the distribution chain as the produce made its way into the U.S. food system. However, the hepatitis A virus sequences from the outbreaks traced to Mexico were identical or very similar to sequences of sick people living along the U.S.-Mexican border or returning from visits to Mexico (FDA, 2003d).

FDA named four growers in Mexico as being associated with the outbreaks and issued an import alert, ordering border inspectors to reject all shipments of green onions from these firms. The four firms named by FDA as being associated with the outbreak did not have third-party audits of GAPs for their summer operations, although one did for its winter operation. As often happens, many of those most hurt by the news of contaminated product were not necessarily those who may actually have been responsible for the problem. The fields associated with the contaminated green onions only produced in the summer season (mid-May through early October) and were not in production when the adverse publicity broke in November. With an incubation period of up to 50 days, green onions associated with illness in September and early November could have been harvested from July through early September (assuming 7 weeks for incubation and 1 week for packing and shipping). In November, winter production was in full swing in Mexicali, Baja California, and San Luís Río Colorado in the adjoining State of Sonora. Unfortunately, consumers did not distinguish between the two groups of producers, much to the dismay of winter producers without any connection to the implicated summer production.

Mexican officials inspected the four firms named by FDA. Because FDA could not provide any corroborating physical evidence, Mexico did not accept its claims that the green onions were contaminated on the four farms. The Mexican Secretary of Health, however, temporarily suspended operations at one of the four farms for unsanitary conditions.

During the first week of December 2003, CDC and FDA officials joined with Mexican officials in an investigation of green onion farms in Baja California and Sonora, Mexico. Following an outbreak of foodborne illness, FDA and CDC will often go to a foreign country, if invited, to participate in an investigation to try to determine the causes of the contamination and measures to prevent a reoccurrence. Of the four firms that were implicated in the traceback, none were growing in the summer production area, three were producing green onions in the winter production area, and one was growing other produce items but not green onions. As a result, U.S. officials did not necessarily expect to find the point of contamination. The mission was more broadbased—to identify conditions that could promote contamination.

On December 9, FDA issued a press release outlining some of its preliminary findings from the trip to Mexico. FDA did not find evidence of hepatitis A on the four farms. It did, however, identify issues of concern that could have played a role in the spread of the disease, including "poor sanitation, inadequate hand-washing facilities, questions about worker health and hygiene, the quality of water used in the fields, packing sheds, and the making of ice" (FDA, 2003d). It also noted that many firms were in the process of, or had just completed, improvements to their water systems and other facilities.

As is common with produce, there is no reliable test for the presence of hepatitis A on green onions. Microbial contamination is usually low level and sporadic, making it hard to detect. FDA does routine testing for pesticide residues but these are much easier to detect: if one piece of produce shows evidence of pesticides, all produce from the same field is likely to have the same problem. Because of the difficulty in testing for microbial contamination, FDA cannot depend on tests conducted at the border and instead relies on promoting adoption of GAPs and GMPs to reduce the incidence of microbial contamination. Also, there is rarely any physical evidence in a foodborne illness outbreak. By the time people begin to show symptoms of illness, the contaminated food has usually been consumed or discarded. In the case of hepatitis A, which has a long incubation period, there is even less likelihood of existence of produce that can be tested for the presence of contamination.

The United States and Mexico disagreed in this case about the level of evidence needed to implicate the four Mexican firms. FDA had epidemiological evidence and traceback records associating the outbreaks with green onions shipped from the four farms in Mexico and determined that conditions on the farms were consistent with potential hepatitis A contamination at the farm level. FDA considered this information to be an adequate basis for its decision. Mexico argued that FDA did not have physical evidence linking the contamination to the farms and that the green onions could have been contaminated at some point in the U.S.-based marketing chain. This analysis examines the impact of FDA's announcement that the contaminated green onions originated in Mexico. It does not depend on where the green onions were actually contaminated, which is beyond the scope of economics.

Because of the difficulty of finding physical evidence of contaminated produce, FDA sometimes bases decisions on epidemiological and traceback evidence alone. For example, in 1996, FDA used epidemiological and traceback evidence to associate a large foodborne illness outbreak—1,465 people—in the United States and Canada with Guatemalan raspberries. After 2 consecutive years of outbreaks, FDA denied all imports of Guatemalan raspberries. Issuing an import alert without physical evidence was very rare in 1997. FDA based its decision on epidemiological and traceback evidence related to past outbreaks and its observations on production practices (Calvin et al., 2002). In 1999, a handful of Guatemalan growers were allowed to begin exporting raspberries to the U.S. market.[5] Not until 2000, after several years of U.S. outbreaks, did FDA actually observe the parasite *Cyclospora* on a Guatemalan raspberry (Ho et al., 2002). Waiting

[5]The growers had to adhere to the Model Plan of Excellence, which was a mandatory food safety program developed by the Guatemalan government and the Guatemalan Berry Commission, in consultation with FDA. Growers also had to pass Guatemalan government and FDA inspections before exporting the raspberries.

until 2000 before trying to resolve the contamination problem would have put more U.S. consumers at risk. Since 1997, FDA has become less reluctant to deny imports based on epidemiological and traceback evidence alone.

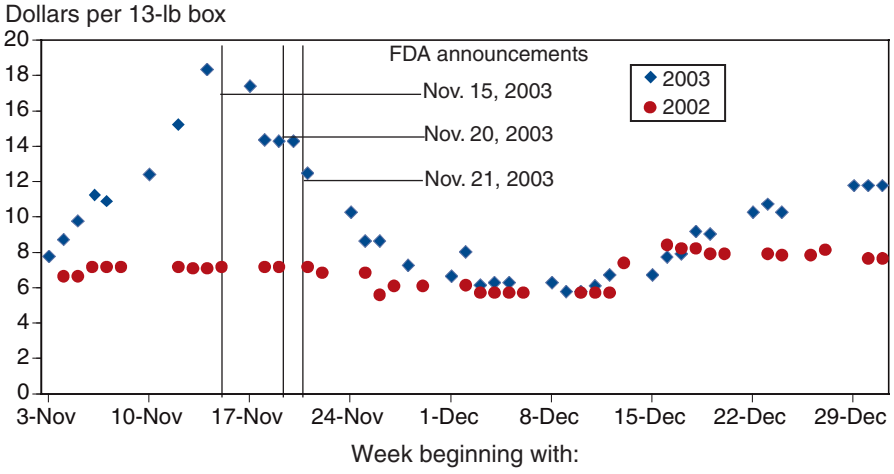
Economic Impact of the Outbreaks

A foodborne illness outbreak can have a severe impact on shipments and prices of the food item associated with the outbreak. Free-on-board (F.O.B.) prices of green onions peaked on Friday, November 14, 2003, at $18.30 per box of medium green onions (48 bunches to a box), the day before FDA's first announcement implicating the product in the outbreaks (fig. 4).[6] This announcement said that the green onions "appeared" to come from Mexico. On Thursday, November 20, FDA announced that the green onions came from Mexico. Growers think this second announcement had the most significant effect on general market demand. By Friday, November 21, when FDA issued its third announcement, identifying four Mexican growers associated with the outbreak, prices of green onions had declined to $12.43 per box. One week later, the day after Thanksgiving, prices had declined to $7.23 per box.

Amid falling demand and confusion triggered by the FDA announcements, the industry tried to right itself. Buyers called their shippers to determine what kinds of food safety programs they and their growers had in place or to seek concrete evidence of earlier verbal assurances regarding food safety practices. Buyers also sent out inspection teams to examine growing and packing operations. Shippers also dispatched audit teams to their growers. Shippers and growers faxed copies of their third-party audits for compliance with GAPs and GMPs, if they had audits. For some growers and buyers, the level of concern regarding food safety practices clearly fluctuates with events.

Figure 4

Daily green onion free-on-board prices in the United States, 2002 and 2003[1]



[1]Free-on-board price is the average, unweighted unit price received by the shipper or grower-shipper. It excludes freight and insurance costs. Prices are for 13-lb boxes of medium green onions (48 bundles to a box)—both Mexican and U.S.—sold from U.S. distribution points.
Source: *Western Melon and Vegetable Report*. Agricultural Marketing Service, USDA.

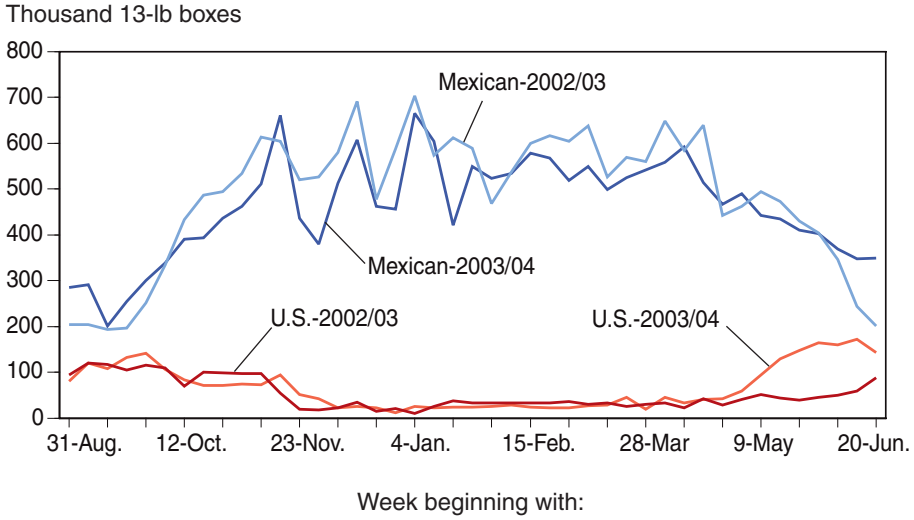
[6]Free-on-board price is the average, unweighted unit price received by the shipper or grower-shipper. It excludes freight and insurance costs.

On November 24, 2003, the National Restaurant Association advised its members to stop using Mexican green onions or to cook them thoroughly.[7] Several major U.S. restaurant chains announced that they were removing green onions from their menus until further notice (*The Packer*, 2003b). Some retailers also removed green onions from their stores. Green onions are not a menu staple in the United States and in many food preparations, regular onions can serve as a substitute for green onions. Shippers tend to disagree about the relative sensitivity of the retail and foodservice markets to bad publicity.

In November and early December 2002, the price of green onions was nearly steady, compared with more dramatic price swings during the same period in 2003. The industry considered the 2003 price the day before the first FDA announcement to be extraordinarily high. Between November 14 and December 10, 2003, prices fell 72 percent. Demand for green onions dropped because of food safety concerns. Supplies from Mexico dwindled. Prices then rose steadily from $5.73 on December 10 to $11.73 on December 31, 2003. Consumer demand for green onions during the November and December holidays is typically high, and alternative supplies were not available. After the first of the year, however, prices declined again and did not increase above the previous year's corresponding prices until April.

Shipments of green onions from Mexico actually increased in the week following the first FDA announcement on November 15 (fig. 5). Growers already had green onions packed and waiting in their coolers, and demand was strong in the runup to Thanksgiving. The second and third FDA announcements on November 20-21 had a more serious impact on shipments. During the next 2 weeks (November 23 to December 6, 2003), Mexican shipments of green onions to the United States declined 42 percent, compared with a 13-percent decline during the same time in 2002. Beginning the week of December 7, 2003, shipments began to rebound, and during the

Figure 5
Weekly U.S. and Mexican green onion shipments, 2002/03 and 2003/04



Source: *Fresh Fruits, Vegetables, and Ornamental Crops*: *Weekly Summary Shipments.* Agricultural Marketing Service, USDA.

[7]Thoroughly cooking green onions can reduce or eliminate the hepatitis A virus.

week beginning December 21, shipments were 97 percent of the volume of the same week in 2002. In the first 3 months of 2004, after the high holiday demand, shipments generally lagged behind the levels of the previous year.

For the 2-week period November 16-29, 2003, estimated losses for Mexican growers, considering lost sales and lower prices on actual sales, totaled $10.5 million. Growers incurred additional losses when fields went unharvested due to low demand. In the last week of November, Mexican growers left 48 hectares of green onions unharvested. In December, an additional 317 acres were left unharvested. Green onion fields are planted every few weeks to provide a continuous supply for harvest. With the decline in demand, growers probably cancelled some planned plantings. The decline in harvest resulted in a decline in demand for labor, which had a serious impact on the local economy.

In other foodborne illness cases, markets for the foods implicated in the illness rebounded when outbreaks ceased and the problem appeared to have been resolved. But in cases with repeated outbreaks, industries associated with the contaminated product can face serious long-term impacts. Mexican cantaloupes were associated with back-to-back U.S. outbreaks of *Salmonella* in 2000, 2001, and 2002 (Calvin, 2003). FDA put all Mexican cantaloupes under import alert, and only six Mexican growers can currently export cantaloupes to the United States. In 1997, FDA put all Guatemalan raspberries under an import alert after consecutive outbreaks associated with that product. With the economic losses associated with the outbreaks and the cost of adopting more food safety practices, the Guatemalan industry declined to a handful of producers. The few remaining growers did not export to the United States at all in the spring of 2004. The Mexican raspberry industry benefited from the problems in Guatemala and is now a major supplier of raspberries to the United States. If one production area has food safety problems, alternative sources may become more attractive.

Outbreaks Affected Growers in Different Ways

Interviews with a limited number of Mexican growers in June 2004 indicated that the impact of the hepatitis A outbreaks varied across growers of dif-

Table 2—Impact of food safety outbreak on Mexican growers, by GAP status

	Impact on:	
GAP status	Volume of green onion sales	Demand for other products
GAPs	Fairly constant	No impact
Partial GAPs	Down a bit	Some impact
No GAPs	Down by 50 percent	Down by about 30 percent
No GAPs and named by FDA	No sales and most fields plowed under	Shippers stopped selling all or almost all products from these growers

Source: Avendaño and Calvin (2004).

ferent types.[8,9] First, while all growers were affected by the general loss of consumer confidence in green onions and lower prices, growers with third-party audits of compliance with GAPs had higher volumes of sales than other growers (table 2). If buyers needed green onions, they sought growers with the best food safety programs although they did not pay more for the green onions. For these growers, green onion shipments did not decrease markedly nor were their other crops affected. Growers who were in the process of becoming GAP compliant and had audits to demonstrate their progress to date in improving food safety also fared reasonably well. Their shipments of green onions usually fell a bit and demand for some of their other crops dropped slightly. For producers who were not GAP compliant, their green onion sales declined to about half the normal volume and demand for other products sold by these firms declined by about 30 percent. For those growers who were not compliant with GAPs and were named by FDA as being associated with the contaminated green onions, the impact was catastrophic. Shippers did not want green onions or any of their other products. These growers plowed up most of their green onions and sold small amounts to the domestic Mexican market.

The market impact also depended on a grower's particular buyers. Growers could face a dramatic loss in sales if they had several big retail or foodservice buyers who decided to take green onions off their shelves or menus until consumer confidence was reestablished. Some retailers and foodservice firms have still not resumed purchases of green onions. In interviews, growers were divided about which market, retail or foodservice, was most sensitive to the food safety problem, and their views probably depended on their particular experience with buyers. Growers not named by FDA said the negative market impacts lasted from 1 to 4 months.

Those growers with buyers from the UK were fortunate since sales to that country appear to have been unaffected. There were no cases of hepatitis A related to green onions outside the United States, and commercial buyers in the UK, who already demanded strong food safety practices from their suppliers, appeared to be confident in the product. Although there were no cases of green onion-related hepatitis A in Canada either, demand in that market did fall.[10] It is not clear what accounted for the difference in market response. The outbreak was probably not as well publicized in the UK as it was in the United States and Canada.[11]

The impact also varied by type of packing process. Traditionally, green onions have been packed in a box and then covered with ice to prevent them from drying out during shipment. A newer technique involves iceless packing. The green onions are packed in polyethylene bags in a cold room held at 3.3°C to 4.5°C. This pack does not require ice during transportation although cooling is required. The foodservice industry and the UK market favor the iceless pack. Some buyers feel iceless green onions are less risky than green onions packed with ice—water being a potential source of contamination. Those firms with iceless production appeared to have fared a bit better in terms of sales than firms not employing this technique. Some firms expect the iceless pack trend to continue growing due to the perception by some buyers that it reduces the risk of contamination.

[8]Here, we discuss the impact only on Mexican growers. There were so few U.S. growers selling green onions at the time of the FDA announcements about the outbreaks that there was virtually no negative impact on the U.S. industry.

[9]These post-outbreak interviews with eight growers were independent of the 2002 pre-outbreak survey.

[10]Officials from the Canadian Food Inspection Agency also visited Mexico in February 2004 to examine production and packing facilities but did not issue import alerts. In practice, since all Mexican green onions are sold by shippers located in the United States, the U.S. import alert also affected Canada with or without an official import alert.

[11]Researchers estimated the impact of positive and negative publicity in a foodborne illness outbreak associated with strawberries (Richards and Patterson, 1999). Prices responded more strongly to bad news than good news.

Response to the Outbreaks

At the end of October 2004, three of the four Mexican growers that FDA put on import alert were still trying to resolve their food safety issues and remove their names from the alert. One of the four was removed from the import alert in late October 2004. To have the alert lifted, a grower must provide FDA with documentation showing compliance with GAPs and GMPs. Then, FDA, with Mexican Federal and State officials, inspects the firm to determine if the import alert can be lifted. Growers on import alert are in the unenviable position of having to continue summer production just to clear their reputation with FDA and buyers. Some growers might have preferred to abandon summer production. The firm that was closed down by Mexican health officials for unsanitary conditions has reopened. It can sell to the Mexican market but not ship to the U.S. market.

All green onion growers who did not already comply with GAPs and GMPs, not just the four growers named by FDA, had to undertake investments because of new buyer demands for food safety assurances. Some growers will face more costly investments than others because of their environmental conditions, such as dependence on open-ditch irrigation canal water. Growers wanted some group action to ensure that a few noncompliant growers could not hurt their businesses and reputations again in the future. This issue is particularly important given the large investments growers are making to improve food safety practices. Growers wanted the Mexican government to enforce mandatory compliance with GAPs and GMPs. Some growers with very strong food safety programs wanted even higher standards that would have put them in a more competitive position with respect to the rest of the growers. As the cost of doing business increases, not everyone will be able to participate.

The growers worked with the Mexican government agency charged with food safety, Servicio Nacional de Sanidad, Inocuidad y Calidad Agroalimentaria (SENASICA), and the State government of Baja California to develop an export protocol for green onions.[12] This plan was approved in Mexico in July 2004. SENASICA, in conjunction with the green onion export industry, developed its own set of GAPs and GMPs largely based on the FDA guidelines for minimizing microbial contamination but with more specific requirements instead of general guidelines. Growers must be certified by SENASICA as meeting the standards to export.

Growers will need to evaluate the benefits and costs of the export regime. Some may decide to stop exporting. Some growers with packinghouses may find it too costly to comply with the new requirements, and they may end up making arrangements with other firms to pack their green onions. In the case of fixed investments, smaller growers will face a higher per unit increase in costs than larger growers, which makes it more difficult for smaller growers to remain competitive. Growers who decide to continue exporting have no choice but to conform to mandated food safety practices. Growers may still want to consider adopting additional food safety practices above the minimum required and would have to consider the expected benefits and costs of doing so.

[12]SENASICA is part of the Mexican equivalent of the U.S. Department of Agriculture, Secretaría de Agricultura, Ganadería, Desarollo Rural, Pesca y Alimentación (SAGARPA).

Growers had to apply for SENASICA certification by October 31, 2004. By late October, 19 percent of the growers had met the food safety requirements and received SENASICA certification (Roche, 2004). Another 38 percent had practices in place and had submitted their paperwork. They were awaiting certification. These two groups of growers, 57 percent of firms, can export as far as Mexico is concerned. A group of small producers, 43 percent of firms, were not yet ready to apply for certification. For many growers, developing adequate food safety practices over such a short period of time was not possible. Currently, the small producers are exporting. It is not yet clear how SENASICA intends to deal with this group in the future. Regardless of SENASICA certification, the three growers who remain on import alert will still not be able to export until FDA approves their operations.

Mexico is a major supplier of produce to the U.S. market, and outbreaks associated with green onions may affect consumer confidence in other Mexican produce items. SENASICA may have considered this negative externality on other producers when it designed a mandatory food safety program for green onion exporters.

Every outbreak of foodborne illness provides FDA with an opportunity to gain information and, if necessary, reassess its strategies to promote food safety. In January 2004, FDA and CDC met with produce industry leaders to discuss their desire for commodity-specific GAPs that would provide guidelines tailored to individual commodities (*The Packer*, 2004a). The produce industry met on June 9-10, 2004, to consider additional commodity-specific guidelines for several products, including green onions. Much of the industry debate focused on whether additional commodity-specific guidelines or just universal compliance with current GAP guidelines was needed. Industry leaders urged producers and supply chain participants to be proactive in developing and implementing appropriate, voluntary food safety systems rather than be regulated by the government. At the meeting, FDA announced its own proposed new action plan on food safety—"Produce Safety from Production to Consumption"—which was unveiled on June 21, 2004 (FDA, 2004a). The final action plan was released in October 2004 (FDA, 2004c). This initiative has four objectives: prevent contamination of fresh produce; minimize the public health impact when contamination of fresh produce occurs; improve communication with producers, preparers, and consumers about fresh produce; and facilitate and support research relevant to fresh produce.

In the late spring and early summer 2004, U.S. shipments of green onions were up substantially from the year before (fig. 5). U.S. shippers may have been hedging their bets by having a bit more domestic production available. However, production costs are higher in the United States than in Mexico, and many U.S. growers are facing fairly low prices. Industry experts expect U.S. shipments will return to more normal levels next year. The impact of the outbreak on U.S. food safety practices remains unclear. Mexican green onion producers, who are now required to be certified for compliance with GAPs and GMPs if they want to export while their U.S. competitors still face only voluntary guidelines, are particularly interested in this issue. However, almost all retailers and food stores now demand GAPs and GMPs

for green onions even if they did not before the outbreaks of hepatitis A in 2003. Many growers will be forced to adopt new food safety practices because of buyer demands. These food safety practices will be a cost of doing business, not a personal choice to distinguish the firm. These additional costs may put some U.S. producers at an economic disadvantage because many of them are only summer producers growing for a short season, compared with Mexican growers producing over an extended season or even on a year-round basis.

On the legal front, more than 300 people filed claims against the restaurant in Pennsylvania where contaminated green onions were served. The restaurant has already settled 134 claims. In turn, the restaurant sued three of its U.S. suppliers of the contaminated green onions in July 2003 (*The Packer*, 2004b).

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Appendix 1–Good Agricultural Practices (GAPs) and Good Manufacturing Practices (GMPs)

There are many sources of potential microbial contamination for produce. Some of the major sources at the grower and shipper level include soil, water, green or inadequately composted manure, dust in the air, wild and domestic animals, human handling, and contaminated equipment (FDA, 2001a). Sources of water contamination include water used to irrigate crops, mix with pesticides, wash and rinse produce, or make ice to cool produce. Different food safety practices can mitigate the chances of microbial contamination. Some crops and regions may present more challenges to preventing contamination than others.

FDA published good agricultural practices (GAP) principles in 1998 to provide growers, both domestic and foreign, with voluntary guidelines to reduce the potential for microbial contamination of their products (FDA, 1998). Guidelines cover growing, harvesting, sorting, packing, and storage operations. National-level guidelines on GAPs enhance the consistency and scientific basis of food safety programs developed by public and private institutions. Using GAPs reduces but does not eliminate all risk.

Under FDA's guidelines, growers and shippers are directed to evaluate their operations in terms of water quality; manure/municipal biosolids; worker hygiene; field, facility, and transport sanitation; and traceback capabilities. Traceback is the ability to track food from the consumer point of purchase back to the grower. Recommended practices are provided to mediate each risk. Since there are numerous potential ways to reduce risk, FDA encourages growers to pick the most cost-effective combination of practices. Therefore, two growers in different areas with different environmental conditions could both adhere to GAP principles but use different methods to do so.

GAP guidelines do not outline specific testing and monitoring regimes because scientific data are lacking for establishing more specific guidelines (FDA, 2001a). According to the GAP guidelines: "Water quality should be adequate for its intended use. Where water quality is unknown or cannot be controlled, growers should use other good agricultural practices to minimize the risk of contamination." The guidelines do not specify how to measure whether water quality is adequate; no one knows for sure and what is adequate varies by crop. For example, irrigation water for a crop that matures on the ground may need to be cleaner than water for an orchard crop.

While GAPs are new and refer specifically to produce, GMPs date from 1969 and apply to any facility processing food (FDA, 2004b). The Code of Federal Regulations spells out the regulations for maintaining sanitary conditions in all food processing facilities to ensure safe and wholesome food. GMPs address methods, equipment, facilities, and controls for producing processed food. For example, GMPs discuss worker hygiene and maintenance, layout, and operations of food processing facilities. GMPs are required for firms packing fresh-cut products, such as bagged, chopped green onions, but are only recommended for firms packing raw, intact fruit and vegetables, such as green onions.

Appendix 2–Imperfect Information and Prices for Safer Food

If the price of produce varied with its safety, there would be more incentive for growers to provide safer food. Other observable characteristics of produce (size, color, etc.) frequently receive price premiums. As long as buyers and sellers can clearly identify the different qualities of produce, growers will produce a variety of distinguishable qualities that consumers want to buy.

In most cases, it is difficult to tell if produce is contaminated until a consumer gets sick. Assume there are two types of produce—high-safety and low-safety. When buyers and sellers can not identify the two types of produce, economists say the market is characterized by "imperfect information." Consumers may not be willing to purchase an item if they think the probability of contamination is relatively high and they have no information on which items may be safer than others. When either the seller or buyer has the advantage of having more information than the other about the food safety characteristics of a product, economists call this "asymmetric information." A grower could deliberately underinvest in food safety, compared with other growers, to reduce costs and then sell this produce, which is more likely to be contaminated, to unsuspecting consumers. Imperfect and asymmetric information hinder the efficient operation of markets (Akerlof, 1970).

Consumers would prefer more information before they purchase produce. Market participants try to provide more information on food safety characteristics of their produce, but this is particularly difficult since there are often no good tests for the presence of microbial contamination. One increasingly important strategy is for growers to use third-party audits to verify their compliance with GAPs and GMPs. A successful audit verifying compliance with GAP and GMP principles does not guarantee food safety--an audit is an informed opinion on the state of farm operations at a particular point in time. It is, however, an important first step in improving food safety and signaling to buyers that certain practices are in place conforming to U.S. Food and Drug Administration (FDA) guidelines. FDA is concerned that some outbreaks have been traced back to firms that have successfully completed third-party audits (Calvin, 2003). Firms with third-party audits can have very different commitments to food safety.

Traceback to the grower is another mechanism that provides information about the food safety level of produce although it only provides information after the outbreak occurs (Golan et al., 2004a). A complete traceback to the grower of the contaminated product is not always possible. As the traceability process improves, poor production practices will become increasingly difficult to hide. If the grower of the contaminated product is identified, that firm will suffer a loss of reputation and commercial buyers may shift to other suppliers. Other growers will take note of the negative economic impact and perhaps reassess their own need for more food safety practices.

Despite more information about the probability of safety, a market for produce of various food safety characteristics and prices has not developed. Growers with sophisticated food safety programs do not receive a price premium for their products. Advertising product from one producer as being safer may be a

risky strategy for a retailer or foodservice firm since in most cases it is not actually possible to guarantee food safety. Also, advertising a particular source of product as being safer than others may provide consumers with information that undermines their confidence in the product in general, regardless of the source (Golan et al., 2004b). For example, suppose a retailer advertises a produce item from a particular source as having less probability of some type of contamination than other sources. If consumers never knew that kind of contamination was possible on produce, this information may make them less willing to buy that type of produce, regardless of safety claims.