Staff Paper

Food Safety and Fresh Strawberry Markets

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Introduction

In a recent survey of retail produce buyers, food safety was ranked as the third most important challenge facing the retail industry. In fact, buyers ranked food safety as more important than attracting shoppers to produce or the quality of the product being sold (Heller, 2002). Consumer awareness of food safety issues is reshaping the retail food supply chain. For some retailers, public standards for food safety fail to provide the level of assurance demanded by their customers, so many are turning to private standards (Henson and Traill, 1993). Third-party certification of production and handling practices is requested by many buyers of fresh produce, yet there seems to be no standardization of certification methods used by different firms. The costs producers incur to comply with these private standards are not public information. Disparate, or exceptionally high, costs of certification will likely keep some firms from entering the marketplace, and cause still others, to exit.

Evidence on the effects of voluntary adoption of the Hazard Analysis Critical Control Point (HACCP) system on firm level costs in the U.S. slaughter industry suggests that voluntary sanitation processes increase costs for all processing firms (Ollinger and Mueller, 2003). Further, determinants of voluntary HACCP adoption in the U.K. dairy sector are distinctly correlated with firm size, market orientation or product type, internal efficiency and good practice in the firm (Henson and Holt, 2000). Voluntary food safety practices, whether mandated by retail customers or developed through grower led initiatives and USDA, have potentially significant and different consequences for large and small farms in the U.S. For some agricultural industries in the U.S., more stringent private food safety requirements will cause even further divisions

between those firms that produce for the mainstream retail market and those that direct market their products.

The reasons for, and reactions to, heightened awareness of food safety issues at every step in the supply chain for a particular fresh produce item are illustrative of pressures in the evolving market. The focus of this article is adoption of voluntary (i.e. not legislatively mandated) food safety practices by growers in the NAFTA fresh strawberry market and their implications for market structure across farm size and geographic region. We choose this focus because (1) strawberries have been implicated in several cases of foodborne illness in recent years resulting in clear decreases in consumer demand and changes in relationships between producers and retailers, and (2) fresh strawberries are widely grown in NAFTA by a mix of large and small farms and are often consumed with minimal processing (Primuslabs, 2002; Richards and Patterson, 1999).

The objectives of the paper are to:

1) describe the current structure of the fresh strawberry industry in the NAFTA region, and
2) determine the consequences of voluntary adoption of food safety practices through grower led initiatives and third-party certification of practices through retailer-led initiatives on the structure of the NAFTA fresh strawberry market using comparative statics.

Evolution of the Fresh Strawberry Market

Fresh strawberry producers in North America are divided into two distinct groups; very large firms that produce primarily for traditional retail grocery markets and smaller firms that produce for farmers markets, roadside stands, and u-pick operations. These two types of strawberry firms are further distinguished by the growing systems typically used, average cost of production, and yields per acre. From 2000 to 2002, California and Florida accounted for over 94 percent of the fresh strawberry production in the U.S., an increase of more than 20 percent since

the 1970s (Table 1). Farms in the other top-ten strawberry producing states are typically much smaller than farms in California and Florida and production is limited by cold weather, especially for states in the Northern U.S.

Table 1. Average Strawberry Production in the U.S., 1970-2002.

	1970-1979	1980-1989	1990-1999	2000-2002
	-million pounds-			
CA	387.7	718.2	1,246.9	1,570.0
FL	22.5	97.1	158.9	188.5
OR	50.1	67.0	57.0	36.4
WA	22.7	18.6	12.0	15.0
NC	4.3	7.7	15.5	21.7
MI	20.7	16.1	10.6	6.1
NY	7.5	14.5	10.5	6.3
OH	7.4	8.6	5.5	4.3
PA	4.8	6.8	6.0	7.5
WI	4.3	5.6	5.6	4.4
US	558.3	970.0	1,528.1	1,864.6

Source: USDA-ERS "The Strawberry Industry", 1999 and USDA-NASS, Non-citrus Fruits and Nuts Report,1999 and 2002

The average strawberry acreage among farms in California and Florida was 36 and 27 acres, respectively in 1997 (Table 2). Of the other states, farms in Oregon averaged more than 10 acres and farms in Washington averaged more than five acres. The majority of strawberries grown in these two Northwest states are for processing (Oregon State Statistical Service, 2001). Of course there is considerable within-state variation in the average size of farms that produce strawberries; however, agricultural census data is available only for California where 141 farms averaged less than 1.0 acre and 146 farms averaged over 50 acres in 1997. Anecdotal evidence on the Baja region of Mexico suggests that farm size mirrors that in California, and indeed, some large strawberry growers in California have branched out to produce in both regions.

Table 2. Average size of U.S. strawberry farms, 1997[a].

	FARMS	ACRES	AVERAGE
CA	755	27,582	36.5
FL	224	6,056	27.0
MI	363	1,498	4.1
NY	489	1,538	3.1
WI	270	1,011	3.7
NC	295	916	3.1
OR	334	4,413	13.2
WA	164	1,268	7.7

[a] Agricultural census data on average strawberry farm size was not available for all states
Source: USDA-NASS, Agricultural Census 1997

Large growers in California, Florida, and Baja, Mexico typically produce fresh strawberries using a plasticulture system. Plastic sheeting is laid on top of raised rows and strawberries are transplanted into the rows, which allow for soil fumigation and drip irrigation. Plasticulture is an annual system, so once plants have produced, they are removed, and often, replaced with some other rotational crop. Per acre costs are high; $26,300 and $31,065 in Florida and California respectively, but yields are also high with an average of 27,000 pounds (Klonsky and De Moura, 2001; University of Florida, 2001). Smaller strawberry producers more often use a matted row system, with raised bare beds and mulch. This system requires one year for plant establishment and then remains in production for 2-4 years. Cost of production estimates for a matted row system are typically $6,000 to $6,500 per acre with average yields ranging from approximately 6,000 pounds in the Midwest to approximately 10,000 pounds in the Northwest and Mid-Atlantic states (Pritts, 2000, Ohio State University Extension, 1999, Oregon State Statistical Service, 2002).

In the NAFTA region, fresh strawberry consumption has been rising steadily over the past decade (FAS, 2000). In the late-1990s and early-2000s, per capita consumption of fresh strawberries in the U.S. and Canada averaged 5 pounds and 4 pounds, respectively, and is

expected to continue increasing as consumers become more health conscious and as incomes increase. Canada imports nearly twice its domestic production of fresh strawberries, 96 percent of which come from the U.S. In 2000, Mexican strawberry production was forecast to be 140,000 tons, 32 percent of which was exported to the U.S. The largest customers for U.S. fresh strawberries are Canada, Japan, and Mexico (FAS, 2000). The supply chain for both large and small fresh strawberry producers is short, as is common for most fresh produce. Fresh strawberries are typically field packed by farm workers or owners, or customers visiting a u-pick operation, and after shipment and purchase, are eaten within a few days of picking. Since fresh strawberries are minimally processed, farm-level microbial contamination is a concern because of the potential for consumer illness and product spoilage.

Good Agricultural Practices and Third-Party Certification

The National Good Agricultural Practices (GAPs) program was developed in 1999 to educate growers and packers of fresh produce about methods to reduce the potential for microbial contamination at the producer and first-handler level. GAPs use a HACCP-like approach to address on-farm food safety issues through a set of practices developed by USDA which a grower may voluntarily adopt. Examples of GAPs practices a strawberry firm might adopt are: providing a clean, pest-free area to store containers from year to year; providing bathroom facilities for farm workers or consumers who visit the farm; and obtaining a safe, clean water source to use for overhead irrigation.

In contrast, third-party certification schemes, developed by several private food safety companies, involve mandatory adoption of some practices (many are similar or identical to GAPs) in order to achieve certification as “safe”. At least partially as a result of foodborne illness outbreaks and resultant litigation, many retailers are demanding certification of handling

practices from their fresh produce suppliers. Private certifiers inspect farms and provide consultation on how to reduce the likelihood of microbial contamination, all for a fee. For grocery retailers, the incentives for adopting more stringent food safety policies include the potential to capture increased profit margins and stopping the erosion of margins, especially when due to a specific outbreak, and for fear of, or in response to, litigation (Henson and Caswell, 1999).

Produce growers recognize the increasing importance of food safety issues. However, fee-based certification systems may exclude some small growers from the market (McCluskey and O'Rourke, 2000). Mandatory adoption of food safety practices and third-party certification might further accelerate the trend towards a bi-modal market structure for the NAFTA strawberry industry. The expense firms incur to become certified, which allow them to sell product to some retail firms, include fixed costs which may be too high for some small firms (You, 1995). Conversely, under certain circumstances, small firms can have an advantage in their ability to adjust production more quickly to suit changing consumer preferences and to convey product information to their consumers (You, 1995). A recent study of the costs of adopting voluntary sanitation systems in the meat and poultry slaughter industries suggests that new food safety practices increased costs by one-half percent across the industry (Ollinger and Mueller, 2003). In this paper, a set of stylized facts are derived from partial equilibrium analysis of three scenarios of GAPs adoption and third-party certification by fresh strawberry producers in the NAFTA region using comparative statics.

Scenario 1: All Firms Adopt GAPs

In this scenario all fresh strawberry growers adopt GAPs with no changes in consumer demand since no efforts are made to inform consumers of the new food safety practices in place.

This scenario is representative of current retailer practices for promoting fresh strawberries and other fresh produce items. Many retailers promote their entire operation as a source of high quality, safe products and see no need to adjust their message to highlight individual items, first because the changes ensure that existing claims are accurate, and second, because new information about food safety may cause some consumers to doubt the retailer's credibility since they had already been promoting safety. Even if the product is direct marketed, suppliers may see promotion of the change as unnecessarily highlighting safety issues.

Such changes can be illustrated with a partial equilibrium framework (Figure 1). Before GAPs adoption, the market equilibrium price for fresh strawberries across firms is P, with resulting supplies from large and small firms at Q_L and Q_S. Costs incurred by individual firms from GAPs adoption include fixed and variable costs associated with the adoption of specific practices. These costs may include the fixed cost of the purchase of portable restroom facilities or digging a new irrigation pond, and variable costs like maintaining the restroom facilities or buying new single-use trays for use by "pick your own" customers. Following adoption of GAPs by all fresh strawberry producers, the magnitude of shifts in supply are a function of firms' ability to allocate such fixed and variable costs across production. Transaction costs may also play a significant role in firm's abilities to adopt GAPs. Examples would include the risks associated with adopting a new production system and the time spent collecting and implementing new food safety knowledge. Large firms are likely to be better able to handle transaction costs, due to economies of scale and their ability to absorb risk. While large and small firms will both incur these costs, GAPs will be relatively more expensive for small firms to adopt. Supply from large firms declines by a smaller amount (from S_L to S_L') than supply from small firms where costs increase by a proportionately greater amount (S_S to S_S'). The new

market equilibrium quantity and price are Q_T' and P', which leads to a lesser quantity supplied from each region given by Q_L' and Q_S'. Again the decrease by the small firms is proportionally greater than that of large firms.

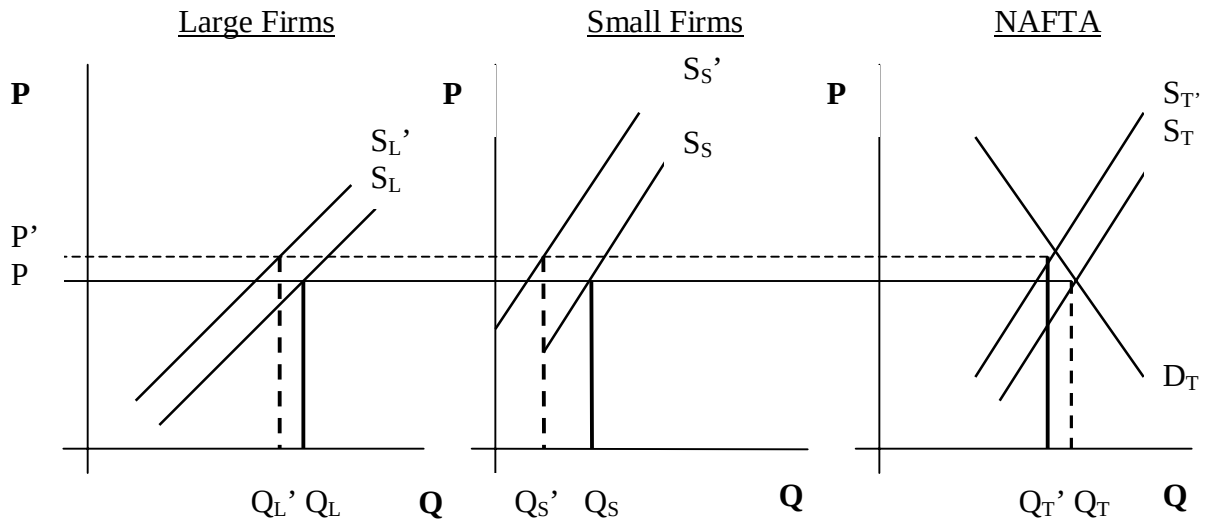

Figure 1: All firms adopt GAPs.

In this example, consumer demand for fresh strawberries does not change. Elasticity of demand will influence whether the costs associated with adopting GAPs may or may not be shifted to producers and consumers equally. Estimates of the price elasticity of demand for fresh fruits range from -0.22 to -0.796, which means demand is relatively price inelastic. This suggests that consumers will bear more of the burden through higher retail prices should production costs increase. If the demand curve in Figure 1 were flatter and supply decreased as a result of higher production costs, price in the NAFTA region would increase less than that illustrated. In the long run, supply effects among large firms are unclear, while among small firms, we would expect that supply would decline as costs of production remain higher with no increases in the price of fresh strawberries.

Scenario 2: Large Firms Become Certified

Third-party certification was developed as a mechanism to signal adoption of food safety practices, including GAPs, to buyers and potentially to the legal system. More recently, certifiers' stamps have begun to appear on product packages in retail stores, albeit with little or no explanation to consumers. Based on these facts, Scenario 2 illustrates the effects of third-party certification of production practices which is possible for all fresh strawberry growers but, based on the cost considerations illustrated above, more heavily adopted by large firms.

In order to capture some benefits from consumer reactions, a successful effort must be made to educate consumers about the implications of third-party certification for food safety, likely through labeling and advertisement. The market for fresh strawberries thus becomes segmented, one for non-certified strawberries and one for certified strawberries (Figure 2). The literature suggests that certified strawberries will command a premium. For example, empirical evidence from the period following the outbreaks of "mad-cow" disease in France suggest consumers are willing to pay a premium for food labeled as safe from the disease (McCluskey, 2003; Thompson and Glaser, 2000).

Drawing from literature on the effects of organic labeling on consumer demand, some consumers decide to purchase food safety certified fresh strawberries, meaning demand for non-certified strawberries decreases and the quantity consumed decreases (Q_N to Q_N'), while demand for certified strawberries increases. As noted above, costs of production are higher for certified fresh strawberries, causing supply to shift (S_C to S_C'), however, increasing demand and prices lead to an increase in the quantity purchased (Q_C to Q_C') In the long-run, supply from non-certified firms is expected to decrease as lower prices cause some firms to exit the market.

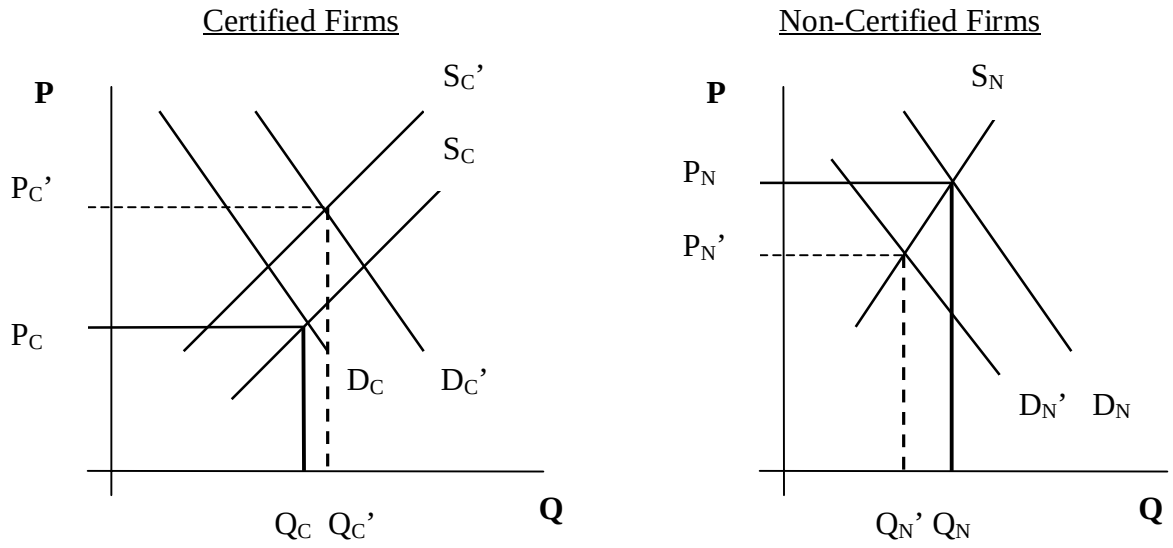

Figure 2: Market for fresh strawberries.

Scenario 3: A Catastrophic Food Safety Event

Despite increased adoption of GAPs and/or third-party certification, the probability of an outbreak does not go to zero. The likely consumer response to such an event is a decrease in demand, at least in the short run. Empirical evidence for a large short-term reduction in demand exists from 1996 and 1997 when California strawberries were wrongly implicated as the source of a major food safety outbreak in the western U.S. (Richards and Patterson, 1999). Factors that affect behavior in the face of risk include the amount of information available on the risk, how consumers perceive the plausibility of the event, and a tendency to over-estimate low probability risks (Camerer and Kunreuther, 1989). In the case of foodborne illnesses, widespread media attention may cause consumers to overestimate the probability of the risks from consuming fresh produce, thus further altering buying patterns.

If consumers feel safer buying fresh strawberries where they perceive having more information about the supply chain, they are more likely to switch purchases to local suppliers

where they can see the farms or the people directly responsible for strawberry production. In Scenario 3, GAPs adoption is prevalent among small and large fresh strawberry producers, but consumers switch to buying direct marketed strawberries from local producers since they perceive them as less risky than the strawberries available from retail outlets (Figure 3). Consistent with scenarios 1 and 2, we assume that demand for fresh strawberries is relatively inelastic. Following the food safety outbreak, demand for fresh strawberries sold through grocery stores decreases dramatically (D_R to D_R'), while demand for fresh strawberries sold through direct market outlets increases (D_D to D_D'). Consumers feel safer in the short run buying from local sellers. Consistent with other cases of food safety outbreaks in fresh strawberries, consumers will likely return to purchasing through grocery stores as the impact of the outbreak is lessened over time (Richards and Patterson, 1999).

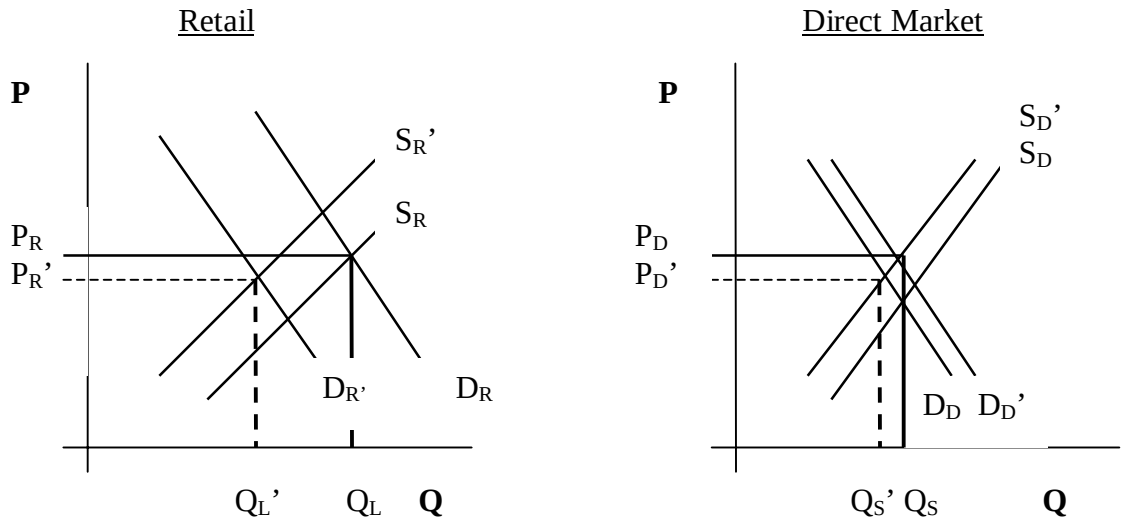

Figure 3: Market for fresh strawberries following catastrophe.

Conclusion

Our analysis of three scenarios of food safety adoption showed that small and large fresh strawberry firms will likely be affected by increasing food safety concerns differently. The consequence for fresh strawberry producers in NAFTA will be to further isolate marketing channels for small and large firms.

In scenario one, where all firms adopt GAPs voluntarily, we see that adoption costs for small firms are relatively higher than for large firms. This results in a decreased supply of fresh strawberries from smaller firms. In scenario two, where mostly large firms become third-party certified, we find that costs increase for these firms, but so does demand as consumers become more aware of food safety risks and search out alternatives. In scenario three, a food safety catastrophe causes demand for all fresh strawberries to decrease, but some consumers switch to buying more product from local markets because of the perception that locally produced strawberries are safer since consumers can evaluate for themselves the safety of the farm. All of the scenarios represent current conditions in the NAFTA fresh strawberry market. This analysis will prove useful to guide empirical evaluation of the effects of food safety practices at the farm level, whether voluntary or by private mandate.

The fresh strawberry industry in NAFTA is bi-modal, with clear distinctions between firm size, production method, and geographic location among retail and farm market suppliers. Large and small fresh strawberry producers will have to incur increased costs as they adopt food safety practices, either in anticipation of, or in response to, consumer demands.

For small firms who still sell to grocery retailers, but who cannot afford certification, these markets may disappear as the gateways are closed to them by more demanding food safety requirements from retailers. Small firms will likely still be able to sell directly to local customers through farm markets and u-picks. As consumers become even more educated about food safety,

local firms may find that they too have to adjust production practices and that they may be in a better position to sell product should a food safety outbreak occur.

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