

Part III. Market and Regulatory Incentives for Food Safety Innovation

Market Incentives for Food Safety Innovation: Lessons from the Meat Industry

The ERS survey and the two case studies illustrate how the meat processing industry has developed mechanisms for partially overcoming the incentive problems caused by asymmetric information in food safety markets. In this section, we identify and discuss eight primary drivers of food safety innovation in the meat industry, as revealed by the survey and case studies.

Emerging Markets for Food Safety Overcome Market Failure

By far, the dominant drivers of food safety innovation in the meat industry are the stringent requirements on product safety and quality demanded by large fast food restaurants, such as Burger King, Jack in the Box, McDonald's, and Wendy's. By demanding safer products from their suppliers, these restaurants have successfully created markets for food safety. The success of these markets rests on the ability of these large buyers to enforce standards through testing and process audits—and to reward suppliers who meet safety standards and punish those who do not. Through contracts with these large buyers, meat processors are able to appropriate the benefits of their investments in food safety.

The emergence of savvy buyers who demand quality alleviates two market failure problems that typically occur in markets for food safety. The first problem characterizing most food markets is that demand for product differentiation on the basis of safety is typically episodic because consumers are largely uninformed about food safety. The large fast food restaurants reverse this trend; they are anything but uninformed. To protect their investments in brand equity, these restaurants have become educated about food safety processes and testing. They are pushing food suppliers to provide safer products—something that typical food consumers rarely do.

The second market failure problem, that of asymmetric information, is also alleviated by the emergence of demanding large buyers. In typical food markets, producers who use the safest processes and produce the

safest products have a difficult time differentiating themselves from their less safe competitors, since most buyers cannot tell the difference between safe and unsafe product. Because large retailers have the capability to test or otherwise verify safety, food processors that use safe processes can differentiate themselves from their competitors and seek compensation for higher quality products. Thanks to the emergence of these technically proficient buyers, safer meat processors can appropriate some of the benefits of their investments in safety through price premiums or guaranteed sales.

In the market for hamburger, fast food restaurants have adopted the role of channel captains, monitoring the safety of products up and down the supply chain. They have created markets for food safety that have stimulated demand for safety and provided processors with mechanisms for appropriating the benefits of food safety innovation. Slaughter plants subject to buyer specifications invest in more food safety activities than those without buyer specifications.

The experiences of Texas American/Jack in the Box and Frigoscandia Equipment/Excel illustrate the advantages of a market for food safety. These companies gained reputations for safety and benefited from increased demand and market stability. As pointed out in the Texas American case study, the fact that there are so many advantages to creating markets for food safety raises the question of why markets for food safety have not developed as quickly in other parts of the food industry. In particular, though some grocery stores are beginning to monitor the safety practices of their suppliers, why have food retailers generally not adopted the same channel captain role as restaurant chains in overseeing the quality of hamburger sold through their outlets? Why have food retailers not been as aggressive in demanding safer inputs? Maybe the real question is: What prompted the large fast food restaurants to break ranks with other retailers and begin to demand safer inputs?

Branding to Appropriate Benefits from Food Safety Innovation

Branding also plays an important role in helping firms appropriate the benefits of safety investments. Though

the ERS survey did not reveal more safety investment by branded slaughter plants, this result is probably explained by the fact that many respondents misunderstood the branding question. A better indicator of the importance of branding for food safety innovation is the key role that the major name brand fast food restaurants have had in driving safety innovation. As discussed above, these companies have emerged as savvy food safety consumers and have succeeded in stimulating food safety innovation.

The major, name-brand fast food restaurants are able to appropriate some of the benefits of their investments in food safety because of their reputations for safe food. Even more important, perhaps, these firms benefit from their investments through a reduced risk of being associated with a foodborne illness outbreak. A firm that is identified as being responsible for a foodborne illness outbreak faces the potential for bad publicity, liability, and recalls. A food safety outbreak could cost the firm in terms of market share, equity value, and legal liability. As previously mentioned, in the 18 months after the 1993 outbreak of *E. coli* O157:H7, Jack in the Box and its parent company, Foodmaker, Inc., lost about \$160 million (Roberts et al., 1997).

Not only do branded firms have more equity investment at risk than unbranded firms if they are associated with an outbreak, they also have a higher probability of being identified and held liable in the case of food safety problems. Name brand recognition is a double-edged sword: it allows consumers (and regulators) to identify and reward firms that produce high-quality, safe products, but it also increases their chances of identifying firms that are guilty of safety lapses. Branding reduces the chances of remaining anonymous in case of a foodborne disease outbreak.

The fact that the advantages of anonymity are forfeited with branding may explain why fast food restaurant chains, and not foodstores, have been the first to become channel captains in the meat industry. The ability of these restaurants to remain anonymous may have been very limited in the first place, meaning that they had little to lose by aggressively branding their products. For slaughter plants, meat processors, and foodstores, product mixing reduces the chance that the source of a foodborne illness will be identified and that the guilty party will be held accountable. For these firms, the value of remaining anonymous may be larger than the value of branding and channel capturing.

In addition, since restaurants have final responsibility for meat preparation, they bear final responsibility for proper meat handling and cooking. They are clearly liable if food is improperly prepared, while such liability is less clear cut in the case of slaughter plants or processors. The added risk of liability is likely another factor driving more and more restaurants to shoulder the role of channel captains.

In fact, only a limited number of input providers or retailers have chosen to brand and to become channel captains. For example, few if any U.S. food retailers engage in premium or luxury house branding of meats. With this approach, retailers attempt to build a name for quality and safety that umbrellas all of the store-branded products—including their branded meat products. Surprisingly, European retailers have been using this strategy for some time with great success. For example, as early as 1992, supermarket chains' brands accounted for about 50 percent of sales in the United Kingdom (Selame and Kolligian, 1992). In the United Kingdom and European Union generally, grocery stores have taken on the role of channel captain and many developments in food safety management on that side of the Atlantic can be traced to the major grocery stores. The question remains as to why European retailers find it advantageous to relinquish their anonymity and become channel captains, while U.S. retailers do not.

International Trade Stimulates Demand for Safety and Provides Technological Spillovers

International trade has played an important role in stimulating the demand for food safety, with many foreign buyers playing a channel captain role in much the same way as the large fast food restaurants. Foreign buyers who demand high safety standards tend to test product for safety and to pay premiums or to guarantee sales for safe producers; these are the buyers who fuel the growth of markets for food safety and stimulate safety innovation. The ERS survey data reveal that slaughter plants with foreign buyers invested in more safety activities than those serving exclusively domestic markets.

The Frigoscandia Equipment case study illustrates another potential benefit of trade in food safety: technology spillovers between countries. The development of the Steam Pasteurization System benefited from the technological expertise that the Swedish company had built up over 50 years in the cold storage business.

Swedish technological expertise provided spillovers that benefited U.S. food safety innovation.

First Movers Appropriate the Benefits of Innovation and Encourage Diffusion

The Texas American case study illustrates the importance of first-mover advantage in establishing a means to appropriate the benefits of innovation. Texas American did not patent the Bacterial Pathogen Sampling and Testing Program or seek any other sort of protection for the innovation. It was confident that its first-mover advantage would forestall pressure from the competition and provide it with space for appropriating the benefits of the innovation. In fact, the complexities of the Bacterial Pathogen Sampling and Testing Program, along with continued innovative activity, have helped Texas American build and maintain a competitive advantage. In addition, as a first mover, it was able to capture a significant share of the market for safety-controlled hamburger patties, making entry less attractive to other firms.

Not only did Texas American choose not to seek protection for the innovation, it actually sought to disseminate the Bacterial Pathogen Sampling and Testing Program throughout the industry. Jack in the Box and Texas American have both been very active in sharing the innovation with other members of the hamburger patty supply chain. Both companies argue that hamburger-borne outbreaks hurt everyone in the industry and that anything that helps reduce the possibility of outbreaks associated with hamburgers is good for business.

Another reason that firms may have an interest in sharing new technologies with their competitors and with government regulators is to influence the “standard of care” for the industry. For innovators such as Frigoscandia Equipment, the advantage of setting the standard of care is simple: more sales of its patented Steam Pasteurization System. For a firm like Texas American, which is not selling its innovation, the advantages are subtler, though potentially as large. Setting a standard of care that is difficult to meet can help set a barrier to entry that benefits the innovating firm. First adopters gain larger market shares (and maybe market power) if the expense or complexity of the innovation forces some producers out of business. Even if all firms eventually adopt the innovation, first movers will benefit from limited competition during the period when their competitors are installing and adapting the new technologies or processing protocols.

Collaboration Facilitates Innovation and Dissemination

The observation that the performance of the industry as a whole affects the reputation and profitability of all firms in the industry provides incentives for firms to collaborate to improve overall industry performance. In both case studies, the innovative process was dependent on collaboration. The successful collaboration of Frigoscandia Equipment, Excel, and Kansas State University led to the development of the Steam Pasteurization System. In the case of the Bacterial Pathogen Sampling and Testing Program, Texas American, Jack in the Box, Qualicon, USDA-FSIS, and the National Cattlemen’s Beef Association worked collaboratively to develop the innovation and improve industry performance.

In each case, the technical and managerial expertise of the collaborators combined to facilitate the development of the innovation and ensure that it would be effective in a commercial setting. Teamwork is essential to move an industry:

...innovation...requires careful, dedicated, and enthusiastic attention to detail—to the specifics of product and services and markets and materials—by all kinds of people in the organization. These people are not merely implementers; they are strategists too, because any really good idea can change a company—and an industry.”
(Mintzberg, 2002, p. 143)

In addition to technical and managerial benefits, collaboration also provides important risk-sharing benefits. In both case studies, collaboration between buyers like Excel and Jack in the Box and sellers like Frigoscandia Equipment and Texas American reduced marketing risks and provided feedback that improved the quality and success of the innovation. In both case studies, collaboration was essential to the willingness of the innovators to commit time and resources to the endeavor. Collaboration between buyers and sellers also helps speed diffusion of the innovation.

Market Conditions Push Large Firms to Innovate

The ERS survey indicates that large slaughter plants had much higher food safety technology ratings than smaller ones, particularly with respect to more capital-intensive activities. For the capital-intensive activities of equipment, testing, and careful dehidating, large

plants had ratings about twice that of smaller plants whereas for the more labor-intensive activities of sanitation and operations, they had only about a 20-percent higher rating. These differences in technology ratings suggest that economies of scale, i.e., much lower unit costs for large plants versus small ones, play a major role in whether plants adopt capital-intensive food safety technologies. However, economies of scale do not sufficiently explain all differences. Two characteristics peculiar to the beef industry and food safety also explain some of the differences in food safety investment between large and small plants.

First, large and small slaughter plants face different markets. Large plants tend to supply large, homogeneous markets with relatively elastic demand, while smaller plants tend to serve smaller markets with less elastic demand. In homogeneous markets, in which a number of firms produce and market similar or identical products, any slip in safety could reduce demand for products from the offending plant. In less elastic markets, products are less fungible, and buyers may be more willing to overlook food safety slips or to work with a plant to overcome safety problems. To protect their markets, large plants may therefore have more incentive than small firms to adopt food safety innovations. In fact, slaughter plants that can consistently supply high levels of product safety, as required by a number of major food retailers, gain access to almost guaranteed markets for large volumes of product. Large firms may therefore have more incentive than small firms to pursue food safety innovation.

Another reason large firms may invest more in food safety than small firms is that food safety lapses have the potential to be more costly for large firms because they may involve larger amounts of product. Large amounts of contaminated product increase both the probability of detection and the cost of wasted product or recall as illustrated in the Frigoscandia case study, though smaller lot sizing can help control the extent and cost of contamination. For large firms, the cost of not adopting the safety innovation may be greater than the cost of adopting the innovation. For small firms, the cost of not innovating may be much less and therefore not provide the same motivation.

Outbreaks Spur the Demand for Safety and Accelerate Innovation

The 1993 outbreak of *E. coli* O157:H7 was a seminal food safety event in the United States. This outbreak led to increased consumer awareness of food safety

issues and triggered a spike in demand for food safety that is still being felt in the industry. It is directly responsible for the decision by fast food restaurants to assume channel captain roles—a decision that has had repercussions for the safety of the whole industry.

The outbreak also pushed the Federal Government to reassess the beef industry's food safety standards and to make a number of key policy changes, including declaring *E. coli* O157:H7 an adulterant in raw ground beef. The effects of this change have yet to be fully appreciated. The outbreak also accelerated efforts to update the Federal inspection system with PR/HACCP.

Technological Validation is as Important as Technological Opportunity in Driving Innovation

The Steam Pasteurization System case study highlights an important observation about technological innovation for food safety: the design and fabrication of the technology may be secondary to technological validation in determining the ultimate success of an innovation. Not only is it difficult to measure pathogen control and technological efficacy, but even the best technology can be undermined by deficiencies in the overall safety system. The actual efficacy of the technology may vary greatly from plant to plant, depending on the characteristics of each plant's safety system. As a result, innovators may have a difficult time certifying or otherwise guaranteeing the efficacy of the technology for controlling pathogen contamination.

One of the largest stumbling blocks Frigoscandia Equipment faced in the development of the Steam Pasteurization innovation was the validation of the technology. The long and arduous series of testing that Frigoscandia Equipment required prior to marketing the technology was necessary to gain market acceptance. Nevertheless, even this level of testing was unable to convince all U.S. or foreign beef companies of the dependability of the equipment in different production environments.

Designing Regulatory Incentives for Food Safety Innovation

Asymmetric information in food safety markets may result in a level of food safety investment that is less than socially optimal. If policymakers determine that intervention is necessary to stimulate innovation, they then face the task of determining which policy tools to

use. As discussed in the previous section, the ERS survey and the two case studies reveal a number of mechanisms developed by the beef industry to overcome asymmetric information problems and stimulate innovation. What can policymakers learn from industry experience? Has the market evolved in such a way as to make some policy choices more efficient than others? This section examines those policy options suggested by the theoretical and empirical evidence.

Strengthen Appropriability Through Safety Information

The success of the fast food restaurants and other channel captains in stimulating innovation reveals the importance of the ability to verify safety and quality claims. Channel captains require their suppliers to provide testing and/or other evidence that food safety standards have been met. As a result, asymmetric information problems are reduced—and food safety innovators can more easily appropriate the benefits of their investments.

Likewise, reducing asymmetric information is probably an important step in any government policy designed to stimulate food safety innovation. Government programs that provide consumers (both final consumers and input consumers) with food safety information, particularly information on safe and unsafe producers, will help the market to operate more efficiently. With more safety information, consumers will be able to choose the level of food safety (and price) that best matches their preferences. As a result, the market supply of food safety and food safety innovation will better reflect consumer preferences. For example the introduction of irradiated meat patties in some markets has expanded the welfare of consumers who place a high value on safety. These consumers are able to pay a premium to purchase meat virtually guaranteed free of pathogens.

With better informed consumers, it is more likely that unsafe firms will bear some of the costs of unsafe production, such as recall, liability, and bad publicity. Information therefore strengthens market incentives for firms to produce safe foods—and to invest in food safety innovation. Information helps firms appropriate the benefits of safety investments and helps ensure that unsafe firms “appropriate” at least some of the costs of safety failures. Jin and Leslie (2003) found that consumer demand was sensitive to hygiene quality grades required by Los Angeles County and posted in restaurant windows. Information about hygiene helped clean

restaurants benefit from their investments while restaurants that did not meet county standards paid the price of their negligence in the form of fewer customers. In addition, foodborne hospitalizations decreased after the 1998 Los Angeles County requirement.

The government has a number of tools at its disposal to reduce asymmetric information and transform credence attributes, such as food safety, into attributes more closely resembling search attributes that consumers can evaluate by reading labels or investigating other information sources prior to purchasing products (Caswell and Mojduszka, 1996). Labeling programs could provide general food safety information like the safe-handling labels on retail meat and poultry packages in the United States, or more specific information like the “*Salmonella* Free” labels available to Danish poultry producers. Government safety labeling programs could be mandatory, like nutrition labeling, or voluntary, like some allergen labeling.

Labeling is not the only government program targeted at increasing food safety information and the transparency of the safety system. For example, both FSIS and the FDA post a list of recalls for contaminated, adulterated, or misbranded products. In another program, FSIS requires that the results of the HACCP *Salmonella* testing program for meat and poultry be published annually and made available to the public (though, unfortunately, results are not reported for individual firms, as was originally proposed by FSIS).

Other government programs that could be used to provide consumers with more information about food safety include time/temperature indicators for each package of refrigerated food; harvest/lay/slaughter dates on each package of an animal protein product; pathogen performance information on each company and its products; and a government-certified label for low-risk foods, so companies can compete on providing safety from pathogens.

As a prerequisite to providing consumers with information on safe and unsafe producers, the government must generate data on safety records. In the United States, the Federal Government and other public health officials have taken strides in building the infrastructure for tracking the incidence and sources of foodborne illness. The Foodborne Diseases Active Surveillance Network (FoodNet) combines active surveillance for foodborne diseases with related epidemiologic studies to help public health officials better respond to new and emerging foodborne diseases.

FoodNet is a collaborative project of the Centers for Disease Control and Prevention (CDC), nine States, the United States Department of Agriculture, and the Food and Drug Administration.

Another network, PulseNet, based at CDC, connects public health laboratories in 26 States, Los Angeles County, New York City, the FDA, and USDA to a system of standardized testing and information sharing. PulseNet helps reduce the time it takes disease investigators to find and respond to foodborne outbreaks. Both FoodNet and PulseNet differ from passive surveillance systems that rely on reporting of foodborne diseases by clinical laboratories to State health departments, which in turn report to CDC. Under passive information gathering, only a fraction of foodborne illnesses are routinely reported to CDC.

In addition to improving market results, information on safe and unsafe producers is also important for targeting government enforcement activities. Unless regulators can distinguish between safe and unsafe processors, they cannot ensure that those with poor records pay the cost of their safety lapses. Information is vital to government efforts to ensure that food safety innovators appropriate the benefits of their investments and the shirkers appropriate the costs of any failures.

Strengthen Appropriability Through Increasing the Costs of Failure and the Benefits of Success

Not only do restaurants and other entities acting as channel captains distinguish between safe and unsafe producers, they provide real benefits to those who consistently produce safe products. Suppliers that meet standards benefit in terms of sales contracts and/or price premiums, while those that fail standards lose access to these important markets. The ERS survey results indicate that plants with buyer specifications had higher levels of safety activities than those without. Government policies targeted at strengthening the costs of food safety lapses and the benefits of food safety compliance and investment may likewise stimulate innovation.

Policies specifically targeted to rewarding producers of safe products include government safety certification and preference in government procurement programs. Policies specifically targeted to increasing the cost of food failures include recalls, testing schedules linked to performance, and higher fines or longer plant closures in cases of noncompliance. Any policy that

increases the probability of getting caught selling unsafe food also increases the probable cost of producing unsafe food.

A potential drawback to any policy targeted to strengthening appropriability is the possibility that imitation and the diffusion of new technologies will be slowed. When innovating firms have strong appropriability mechanisms, the costs of imitation rise, reducing the rate of diffusion. In the case of food safety, the stimulating effect of strengthened appropriability on social welfare may outweigh the dampening effect of lowered diffusion.

Provide Flexibility in Choice of Food Safety Technology

Regulation that does not dictate any particular technology is likely to encourage efficiency and innovation. When government safety standards focus on performance, not process, individual firms can choose the most efficient approach to achieve a particular standard. For some firms, capital-intensive activities will be more efficient than labor-intensive activities; for other firms, the opposite will be true. Performance standards encourage efficiency by letting firms use whatever approach is best for their particular production process.

Performance standards encourage innovation by giving firms the freedom to develop new approaches to achieve outcome targets. Past regulations have often prescribed particular remediation technologies. For example, in pollution control, the government has specified “best available technology” and “best available control technology,” while food safety regulation has focused on the prescription of Good Manufacturing Practices. The specification of process is deeply rooted in U.S. practice and implies that one technology is best, which discourages innovation. As Porter and Linde (1995) note, the government should maximize the opportunity for innovation by letting industries discover how to solve their own problems.

The Steam Pasteurization System case study directly illustrates the power of a flexible regulatory approach for stimulating innovation. PR/HACCP provides food processors with flexibility to innovate and adopt new safety technologies as critical control point measures in a plant’s PR/HACCP system. If PR/HACCP had specified particular technologies for each critical control point, the drive for more efficient control point measures would have been severely dampened and

Frigoscandia Equipment would have had little incentive to develop the Steam Pasteurization System.

The variety of food safety activities listed in the ERS survey results provides more evidence of the role of regulator flexibility in stimulating innovation and efficiency. If PR/HACCP had specified particular technologies for each critical control point, then the variety of safety activities would likely have been restricted and large and small firms would have had more difficulty finding an efficient mix of capital- and labor-intensive activities.

Invest in the Scientific Infrastructure and Support Research on Safety Testing

The ERS survey and the two case studies did not highlight any food safety innovations that directly depended on government research and development or on government expertise. This does not mean that government-supported institutional infrastructure, such as intellectual property rights protection, was not important to the development of the innovations highlighted in the empirical investigation (patent rights were critical in enabling the invention of the Steam Pasteurization System technology). Nor does it mean that basic government-funded research did not contribute indirectly to the development of these innovations. By expanding the general pool of knowledge about pathogen testing and food processing, government researchers helped build the infrastructure for both the Steam Pasteurization System technology and the Bacterial Pathogen Sampling and Testing Program.

Fuglie et al. (1996) contend that government research and development plays an important role in food safety innovation: They note:

The private sector often underinvests in agricultural research because only a share of the total economic benefits can be captured. This is most true of fundamental (pre-technology) research and is also true for applied research that generates important non-market benefits,

such as environmental, social science, food safety, and nutrition research. (p. 33)

Government can also play a role in building collaborations—something that the case studies showed to be important to successful innovation. Governments encourage collaborations through a number of vehicles, including cooperative funding agreements, outreach programs, and tax-free research areas. In the United States, the Federal Technology Transfer Act of 1986 and the National Cooperative Research and Production Act of 1993 (National Science Board, 2002) bolster collaborative research efforts.

The Frigoscandia Equipment case study suggests a more direct sort of technical research support that could be provided by government research: validated testing methodologies or certification for pathogen control technologies. To successfully commercialize the Steam Pasteurization System technology, Frigoscandia Equipment needed to establish the efficacy of the technology. However, as with many pathogen reduction technologies, success was not easy to prove, particularly given the wide range of production technologies in different slaughter plants. When standards are technically difficult to verify, government services may be instrumental in helping to establish testing norms. For example, the Grain Inspection, Packers, and Stockyards Administration has established a reference laboratory to evaluate and verify the validity of analytical techniques applied to the detection of genetically enhanced traits in grains and grain products (for more information, see <http://www.usda.gov/gipsa/newsroom/backgrounders/b-reference-lab.htm>).

Another important function for government research and development may be to improve food safety monitoring capabilities. Advances in technology are key to supporting, and in many cases, stimulating information provision. For example, “DNA fingerprinting” technology makes it easier to link illness to specific firms. Such information may be key in health investigations of outbreaks and in food safety litigation (Buzby et al., 2001).