Strategy and Policy in the Food System: Emerging Issues

EDITED BY
Julie A. Caswell and Ronald W. Cotterill

Proceedings of NE-165 Conference
June 20-21, 1996
Washington, D.C.

PART FIVE: Avenues for Improving the Quality of Benefit/Cost Analysis of Food Regulations

18. Improving Cost/Benefit Analysis for HACCP and Microbial Food Safety: An Economist's Overview

Laurian Unnevehr and Tanya Roberts

Food Marketing Policy Center
Department of Agricultural and Resource Economics
University of Connecticut
and
Department of Resource Economics
University of Massachusetts, Amherst

Improving Cost/Benefit Analysis for HACCP and Microbial Food Safety: An Economist's Overview

Laurian Unnevehr (laurian@uiuc.edu)

Tanya Roberts

Department of Agricultural and Consumer Economics
University of Illinois, 305 Mumford Hall
1301 West Gregory Drive
Urbana, IL 61801

Keywords: HACCP, cost/benefit analysis

18

Improving Cost/Benefit Analysis for HACCP and Microbial Food Safety: An Economist's Overview

Laurian Unnevehr and Tanya Roberts[1]

This is an exciting moment to be taking stock of the research agenda for microbial food safety. Both industry and policy makers need to know more about the costs and benefits of controlling microbial foodborne pathogens. As there are many simple things that we don't know about the costs and benefits of control strategies like HACCP, our job of defining a research agenda is fairly straightforward. Carrying out that agenda will be more challenging. We want to discuss the basic framework for cost/benefit analysis of HACCP, and then turn to what we see as the research priorities.

First, what is the HACCP (Hazard Analysis Critical Control Point) system? It's a general approach to hazard control in food processing that includes seven general steps (NACMCF 1992):

1. Assess the hazard,
2. Determine critical control points (CCPs),
3. Establish critical limits for each CCP,
4. Establish procedures to monitor each CCP,
5. Establish corrective actions,
6. Establish record keeping,
7. Establish verification procedures.

Note that: (a) HACCP can be applied to any point in a food production chain (i.e. farm, packing/processing, food service) and (b) the choice of a safety standard is implied by the choice of a critical limit.

The U.S. Department of Agriculture's Food Safety and Inspection System (FSIS) and the Food and Drug Administration (FDA) claim the following advantages for HACCP over current U.S. food safety regulatory programs: prevents largely avoidable events to reduce contamination of food from farm to retail; uses scientific risk assessment for pathogens likely to be associated with each food; places food safety responsibility clearly on the food manufacturer or distributor; improves food safety practices by setting public health-oriented targets; fosters scientific and technological innovation by removing regulatory obstacles; permits more efficient and effective government oversight because the recordkeeping on HACCP sanitation, pathogen testing, and other procedures allows inspectors to better assess safety than spot checks or visual inspection; and helps food companies compete more effectively in international markets where HACC requirements are becoming common.

To evaluate costs and benefits, we first need to understand how HACCP differs from our usual model of production. First, HACCP does not explicitly include marginal cost/benefit analysis of trade-offs in setting any particular limit (Unnevehr and Jensen 1996). As originally practiced in producing food for astronauts, the implicit risk standard was as close to zero as possible, but now the concept is applied to raw meat products where zero microbial risk is infeasible. The firm's choice of a risk standard is implicit in the process of setting up the HACCP system. It will be challenging for economists to apply the framework of marginal cost/benefit analysis to HACCP, but this is needed in order to set a risk standard where benefits are greater than costs.

A recent innovation for beef carcasses illustrates this point. Frigoscandia's Steam Pasteurization Process was developed after the 1993 *E. coli* O157:H7 outbreak to reduce pathogens on beef. Before sides of beef go into the chiller, they are treated with steam for 6-8 seconds to kill pathogens. The capital costs of this process range from about .02 cents per pound for large plants to .2 cents/pound for smaller plants. Phebus (1995) evaluated pathogen reduction under this process and found large reductions (3.5 log cycles) with carcasses inoculated with a high level of pathogens. On real-life slaughter lines where the bacteria are in smaller numbers, reductions were not as pronounced. The economic issue here is whether the costs of the unit will match the benefits in different real world situations.[2]

Another economic dimension to HACCP is process redesign. HACCP is one kind of process control or quality management system. In implementing these kinds of systems, it is often more important to redesign the production process to improve quality than it is to address specific causes of quality variation in an existing process (Mazzocco 1996). More problems arise from a poorly designed process than from a poorly executed one. Furthermore, rapid innovation in technologies for pathogen control and testing create new possibilities for process redesign and verification. This means that we need to model the costs and benefits of changing the process rather than of specific interventions.

For example, rather than generically controlling sanitation using visual inspection, HACCP will require redesigning the process to explicitly control specific pathogens. The reduction in cases of listeriosis by 40 percent in the last decade illustrates the contribution of process redesign, along with regulatory and educational efforts (Tappero et al. 1996). Changes in production made to control *Listeria monocytogenes* include: (1) reconfiguring conveyor belts on meat processing lines and reducing use of high pressure water sprays which splashed *Listeria* out of drains and from floors onto the underside of low conveyor belts, and (2) creating pressurized rooms for peeling hot dogs from their casing and putting them into consumer packages to prevent aerosol contamination from rooms where raw product is handled (Roberts and Pinner 1990).

So with that as background, let's look at the benefits from HACCP. Benefits flow from accompanying risk reduction. These will be difficult to quantify in a public sense if HACCP is mandated without an outcome standard, and difficult in a private sense if the outcome standard is implicit. If we do know how much risks are reduced, then the social benefits can be quantified along a continuum from the cost of illness to the existence value of safe food (Roberts 1991). The NE-165 researchers have done a great deal of work to demonstrate these benefits using many different methodologies, as demonstrated in the two books edited by Caswell. This work has been crucial in influencing policy makers' understanding that benefits are large.

In addition to consumer valuation of food safety, there are other benefits of HACCP that we know less about. Private benefits to firms may arise from longer product shelf-life; access to new, distant markets, including international markets; greater reliability to customers; reduced product liability; or possible x-efficiency gains in plant organization. Public benefits in terms of implementation may arise from ease of monitoring for the regulatory agency, since costs of testing are high.

What are the costs of HACCP? These include the costs of designing and implementing controls that achieve the standard for pathogen reduction. The array of control options available will vary with type of animal product and by the type of changes required to control a specific pathogen. HACCP involves a large fixed investment to develop the plan and to train staff. It may also require new capital equipment. These fixed costs mean that there are economies of scale in HACCP. The variable costs are often minor in terms of labor or materials. Thus costs will vary by scale of plant, with implications for industry structure. A full accounting of costs would recognize process redesign. However, these generalizations may not hold for HACCP at the farm level, where variable costs could be more important.

What are the net benefits of HACCP? Ideally we would like to compare the costs and benefits of different levels of risk reduction, but to do so requires knowing how interventions affect risk, how different mixes of interventions affect risk, and how different intensities of intervention affect risk. This is a very tall order!

So, finally, what kind of research is needed to support cost/benefit analysis? We would argue strongly that this is a great area for multidisciplinary research to merge industrial engineering, microbiology, and economics. There are many fascinating questions, but we believe that there are two big questions that are crucial to answer.

What Are the Most Cost-Effective Points of Intervention?

Other disciplines only now are beginning to understand how much controls will reduce risk, how pathogen levels in food translate into foodborne illness risk, how changes in production practices influence risk, and other basic models of risk (e.g., Roberts et al. 1995a). Economists need to work with risk modelers to do the following:

a. Rank pathogens in economic importance—now that a wide variety of methodologies and cases have been used to demonstrate that food safety has value to consumers, there is a need to focus benefits work on ranking pathogens as a first step towards analysis of control points.
b. Measure costs and benefits of reducing pathogens at different points and to different levels. For example, Agricultural Research Service risk modelers have shown that the greatest risk often arises from events in the tail of the distribution: the few heavily contaminated pieces of food, contamination with strains of pathogens which can survive treatments designed to kill most pathogens, those strains that are able to grow the fastest, or those spores that germinate the earliest (Whiting 1995). Economists need to analyze whether addressing these risks would provide the greatest net benefit.
c. Identify how much information we need in an integrated database to monitor food safety (Roberts et al. 1995b). Economists can help to identify where information has the greatest value, needs to be collected continually, and made publicly available.

What Are the Most Efficient Mechanisms for Reducing Transactions Costs in the Market for Food Safety?

Information costs are high for consumers. Food safety is largely <u>not</u> an “experience good” because of inability to link many syndromes to their foodborne cause. This is especially true for sequelae or complications following the initial acute infection. Information costs are high for producers because microbial testing is expensive, the outcomes are highly variable, and test results available after two days or more are difficult to integrate into an on-line production system. HACCP addresses hazard control through prevention, but another approach would be to address the lack of information directly. Other public or private strategies to reduce risk could be more effective or complementary to HACCP.

Economists need to identify the most efficient mechanisms for reducing the transaction costs to consumers wishing to purchase greater safety—e.g., private advertising on safety, government certification of consumer labels, or government certification of production processes that can “significantly reduce pathogens.” FSIS started using the latter approach in 1995 with approval of Frigoscandia’s steam pasteurization process for beef carcasses. Such certification lowers the information cost to purchasers about the safety performance of the process.

Another approach would be legal reform. In 1990 the United Kingdom increased the legal liability of firms in food safety cases with the Food Safety Act that requires firms to use "due diligence" in producing safe food. Hobbs and Kerr (1992) conclude this act will encourage new forms of vertical coordination among U.K. firms to minimize the probability of microbial contamination of food. However, Viscusi (1989) theorizes that high information costs for tort liability will limit its usefulness in redressing health and safety problems. Basically, it is difficult to attribute illness to a specific food.

To evaluate different kinds of interventions like certification or liability reform, we need to know how consumers and producers will respond to the incentives created by this new information. Will consumers demand greater food safety and will this encourage industry innovation in response? Klepper stresses the importance of demand factors "in shaping the rate and direction of technological change" (Klepper 1996: 563). Public outrage over the 1993 *E. coli* O157:H7 outbreak associated with hamburgers in Western fast food restaurants did motivate the beef industry to fund new research to control this pathogen (Allen 1996).

As the market for meat products is very dynamic, it is difficult to predict how food safety demand and regulation will interact with changes in industry structure, international trade, and new technologies for hazard control. How will relationships with input suppliers change, such as requiring HACCP systems be in place or stipulating that product be tested for specific pathogens? For example, HACCP has changed the role of industry laboratories (Flickinger 1996). When is vertical integration more efficient in achieving pathogen control goals than contract specifications (Boon 1996)? Is it possible that increasing vertical integration could also decrease competition in providing safer products? How will industry structure change in response to regulation and/or greater demand for food safety?

In conclusion, we would like to reemphasize that there is much to learn about how the market for safety attributes will evolve, and about where the marginal benefits of risk reduction are greatest. Research is needed to inform both public policy and private strategy. The available data and research do not support such analysis. We need to get to work!

Notes

[1]Laurian Unnevehr is Associate Professor, Department of Agricultural and Consumer Economics, University of Illinois and Tanya Roberts is a Senior Economist in the Food and Consumer Economics Division of USDA's Economic Research Service.

[2] Apparently many processors believe the benefits are greater than the costs, since Frigoscandia has installed the new process in Excel/Cargill's large plants and another 60 units have been ordered by U.S. and international firms (personal communication with Frigoscandia's Craig Wilson, June 1996).

References

Allen, D. M. 1996. Remarks at Research Forum on Improving Benefit/Cost Analysis: The Case of HACCP and Microbial Food Safety. *Strategy and Policy in the Food System: Emerging Issues.* Washington, DC, June 20-21.

Boon, A. 1996. Vertical Coordination and Systemic Innovations in Agri- and Food Business: Theoretical Foundations and Case Illustrations. In *Proceedings of the 2nd International Conference on Chain Management in Agri- and Food Business*, ed. J. H. Trienekens and P. J. P. Zuurbier, 447-460. Agricultural University Wageningen: The Netherlands.

Caswell, Julie A., editor. 1991. *Economics of Food Safety*. New York, NY: Elsevier Science Publishing Company.

Caswell, Julie A., editor. 1995. *Valuing Food Safety and Nutrition*. Boulder, CO: Westview Press.

Flickinger, Bruce. 1996. Independent Laboratories: New Roles and Opportunities in the Age of HACCP. *Food Quality* II(May):17-30.

Hobbs, Jill E. and William A. Kerr. 1992. Costs of Monitoring Food Safety and Vertical Coordination in Agribusiness: What Can Be Learned From the British Food Safety Act of 1990? *Agribusiness* 8(6):575-584.

Klepper, S. 1996. Entry, Exit, Growth and Innovation over the Production Life Cycle. *American Economic Review* 88(3):562-583.

Mazzocco, Michael. 1996. HACCP as a Business Management Tool. *American Journal of Agricultural Economics* 78(August):770-774.

National Advisory Committee on Microbiological Criteria for Foods (NACMCF). 1992. Hazard Analysis and Critical Control Point System. *International Journal of Food Microbiology* 16:1-23.

Phebus, Randall K. 1995. Steam Pasteurization, Vacuum/Hot Water Spot Cleaning, and Lactic Acid in Combination with Trimming and Washing for Pathogen Removal from Beef Surfaces. Report summarizing results from January and February trials at Kansas State University.

Porter, M. E. 1983. The Technological Dimension of Competitive Strategy. In *Research on Technological Innovation, Management and Policy*, ed Richard S. Rosenbloom, 1-33. Greenwich, CT: JAI Press.

Roberts, Tanya. 1991. A Survey of Estimated Risks of Human Illness and Costs of Microbial Foodborne Disease. *Agribusiness* 9(Spring):5-23.

Roberts, Tanya and Robert Pinner. 1990. Economic Impact of Disease Caused by *Listeria monocytogenes*. In *Foodborne Listeriosis*, ed. A. J. Miller, J. L. Smith, and G. A. Somkuti. Society for Industrial Microbiology.

Roberts, Tanya, Alwynelle Ahl, and Robert McDowell. 1995a. Risk Assessment for Foodborne Microbial Hazards. *Tracking Foodborne Pathogens from Farm to Table: Data Needs to Evaluate Control Options*. USDA/ERS, Miscellaneous Publication No. 1532, December.

Roberts, Tanya, Laurian Unnevehr, and Helen Jensen. 1995b. Summary and Critical Issues in Tracking Foodborne Pathogens. *Tracking Foodborne Pathogens from Farm to Table: Data Needs to Evaluate Control Options*, USDA/ERS, Miscellaneous Publication No. 1532, December.

Tappero, Jordan W., Anne Schuchat, Katherine A. Deaver, Laurene Mascola, and Jay D. Wenger. 1996. Reduction in the Incidence of Human Listeriosis in the United States. *Journal of the American Medical Association* 273(April 12):1118-1122.

Unnevehr, Laurian and Helen Jensen. 1996. HACCP as a Regulatory Innovation to Improve Food Safety in the Meat Industry. *American Journal of Agricultural Economics* 78(August):764-769.

Viscusi, W. Kip. 1989. Toward a Diminished Role for Tort Liability: Social Insurance, Government Regulation, and Contemporary Risks to Health and Society. *Yale Journal on Regulation* 6(1):65-107.

Whiting, Richard. 1995. Speech at the Institute of Food Technologists, IFT, Anaheim, California, June.