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New approaches to food-safety economics: overview and new research directions

Laurian J. Unnevehr[*] and Ruud B.M. Huirne[#]

Introduction

The papers in this volume were first presented at a Frontis workshop on New Approaches to Food-Safety Economics, held at Wageningen, the Netherlands, 14-17 April 2002. The purpose of the symposium was to learn where and how economics can contribute to emerging policies and strategies for food-safety improvement. In the EU, public desire for greater food-safety assurance is evoking response from both the food industry and policymakers. These responses take place within the context of changes in EU membership, in agricultural policies, and in scientific knowledge about risks. In order to frame a research agenda to meet the challenges facing industry and government, invited experts from around the world convened to review the state of the art. The primary focus of the workshop was on food-safety economics for animal products.

The papers in this volume are written on invitation and are organized around the key principles outlined in the EU White Paper on Food Safety, as these will guide future developments in the EU. These principles include a focus on consumer welfare, responsibility for food safety from farm to table, the use of risk analysis to design standards, prevention of hazards through the use of HACCP, implementation of traceability to ensure monitoring, and transparency of standards in international trade.

In the following overview, we provide the highlights and important insights from the presentations and discussions. We conclude with the major research areas identified for future work.

Consumer Health and Welfare

Consumer health and welfare is the ultimate goal of food-safety improvement. There are several approaches to measuring consumer welfare, and to understanding consumer perceptions and behavior. The first group of papers provides an overview of these approaches, drawing on methods from economics, marketing, and public health. How to measure the value of food safety improvements, understand consumer perceptions and market behavior, and how to set public-health goals were among the issues addressed.

In Shogren's paper, the economics literature on benefits estimation is reviewed, with particular attention to WTP estimation. He provides several insights from experimental auctions in the US Consumers tend to underestimate risk; they value

[*] *Department of Agricultural & Consumer Economics, University of Illinois at Urbana-Champaign, USA*

[#] *Farm Management Group, Wageningen University, Wageningen, The Netherlands*

food safety generally but not specific hazards; and negative news has more impact than positive news on consumer valuation. In general, people are willing to pay for higher safety than the market currently provides. The findings lead to some lessons for technical scientists. Economics should be part of risk assessment because economic decisions partly determine risk. The public has different risk perceptions from experts: they underestimate both low-probability and high-probability risks, but overestimate the mid-range of risk probability.

Verbeke reviews several studies that examined how Belgian consumers perceive food safety, how they react to new information, and how they alter food consumption in response to new information. He finds that the established trend towards reduced beef consumption was strengthened by reaction to the BSE crisis and that negative perceptions of poultry resulted from the dioxin crisis. The degree to which consumers watch TV had a major impact on behavior and perceptions. His estimates show that five items of good news are equal in impact to one item of bad news. He proposes that consumer trust may be restored through labeling and traceability.

Henken and his co-authors report estimates of the number of food-borne-illness cases in the Netherlands. These data show that Campylobacter and viruses more important than Salmonella, and warrant more attention. Risk assessment has been carried out for steak tartare and for Campylobacter in the Netherlands. One important issue in such assessments is establishing the dose–response function for microbial pathogens, and he reports substantial progress in their identification. From a public-health perspective, the Disability-Adjusted Life Year (DALY), measures the impact of food-borne illness. The DALYs saved from interventions to reduce risk can be compared with cost to find the most cost-effective interventions.

The conference discussion focused on the issues of communication and perception. The need to understand what information people would like to have and whether they trust certain sources of information are important areas for research. The role of so-called experts was raised, and whether they should be the source of information was questioned. There is no one scientific truth, and furthermore technical experts are not trained in risk communication. The finding that consumers tend to place more weight on bad news than on good news was seen as a challenge for industry. Finally, the issue of whether we should really invest more resources in food safety and how to measure the benefits of further investment was raised.

Traceability and Certification in the Supply Chain

Traceability and certification are processes for managing and marketing food quality, including food safety. While certification has been used by many firms for some time, traceability is a relatively new concept in food safety. The costs and benefits of these two approaches for achieving food safety are not well understood. The papers in this section provide an overview of the current systems in use, and the economic and managerial questions to be answered about such systems.

Meuwissen et al. provide an overview of traceability and certification systems. Regulatory and private standards provide the goals for private firms, which may use traceability systems to help meet those goals. Certification ensures that management systems work as they are supposed to. There are three possible goals for a traceability system, including establishment of consumer confidence, avoidance of liability, and improvement in recall efficiency. There are different ways of organizing traceability systems in terms of how information is shared along the chain, and the choice of system may be influenced by the relative importance of the different goals.

Certification may be required by a customer, may result in better prices, or may be required by financial institutions. It is usually carried out by a third party, and may or may not certify to an accredited standard. Both traceability and certification may have implications for the organization of the supply chain as they are easier to accomplish when there is one chain director or an integrated system.

Schiefer's paper approaches the issues of traceability and certification from a management perspective. Research in this field has shown that quality assurance should be a dynamic forward-looking process seeking to improve quality. But the current proposals for traceability and certification in the agricultural sector are primarily defensive, and not forward-looking. Closed supply chains would provide the basis for higher quality and incentives for continual improvement. Network systems that include all producers build on generally acceptable but low levels of quality and do not provide incentives for improvement. Thus, current initiatives in Germany may not provide for better quality and safety and may ultimately lead to reduced consumer confidence.

Den Hartog presented the agribusiness perspective of a firm involved in fish, poultry, and pig production chains.[i] Agribusiness faces issues arising from recent food-safety incidents, media coverage, and new regulation. While a defensive reaction may be natural, his firm, Nutreco, is approaching food safety in a pro-active manner. Part of establishing reliability is to provide for traceability in their integrated production chains. The poultry production chain from feed to meat is the first place that this system will be implemented. A database will be created to provide information about all of the ingredients and processes used in production. Ultimately this should lead to greater ability to manage safety in an efficient manner.

The discussion opened with concern about how to set the performance standards for traceability and certification systems. Such systems will be meaningless if consumers do not understand what is achieved in terms of food safety. A second important concern was the implication of traceability for small farms, who may be excluded because they have high costs of supplying information. The discussion also explored the issue of liability, and distinguished between certification, which can reduce liability, and traceability, which may make it easier to identify the liable party. The economic value of certification or traceability may arise from being able to reduce costs later in the chain. The ease of implementing such systems may be enhanced by new information technologies. Finally, well organized integrated production chains are seen as the future in animal agriculture.

Farm-to-Table Risk Analysis

The nature of food-borne hazards makes it desirable to analyse risks in a farm-to-table framework. Many food-safety hazards can enter the food production chain at mulitple points and can multiply or cross-contaminate other products once present. Thus a farm-to-table approach allows identification of the most effective points for intervention. Integrating economics into this framework is challenging, but can allow identification of the most cost-effective interventions. The papers in this session provide different perspectives on farm-to-table analysis of risks and costs, and how this might support decision making in the public and private sectors.

Jensen defines the costs of food safety as real resource costs used in hazard prevention, social-welfare losses arising from changes in market prices, and transitional costs arising from firm closings or reorganization. The literature on costs of food-safety improvement, primarily US studies of HACCP for meat and poultry,

shows that there are rising marginal costs associated with higher levels of safety. Because several interventions are often possible, there is a frontier of dominant cost-effective interventions. Analysis of interventions in a farm-to-table framework allows identification of the most cost-effective points of intervention in the supply chain and how later interventions may support earlier ones. Economic incentives to provide food safety are influenced by system connectivity, which spreads breakdowns in safety through the supply network in particular paths. Consideration of these system connections may lead to design of better incentives for food safety.

Lund's paper reports on a holistic effort to analyse the economics of food safety throughout the entire production chain. This is being undertaken for three animal products in Denmark. Through scenario modeling, the implications of alternative marketing strategies and food policies will be understood. Lund identifies several challenges in this analysis, including the difficulty of valuing the benefits of food safety, modeling connections in the food chain, and fully identifying the underlying risk model. In terms of policy, ensuring that feedback mechanisms along the food chain lead to improvement will be a challenge in implementation HACCP from farm to table.

Stark's presentation reviewed the evolution and use of risk analysis.[ii] It has been used in import–export risk management for veterinary applications, and is increasingly applied to food-safety issues. A model developed in Denmark has been used to assess the risk of Salmonella contamination along the pork supply chain and as a decision-support tool for Danish pig producers. Integration of the Danish pork production chain makes it feasible for actions to be undertaken with this systems approach. Stark identified a number of issues in data and methods for building risk-assessment models. A particular difficulty is that such models often must rely on expert opinion. There is a need to elicit such opinions carefully and to follow up through validation of the model with actual surveillance data.

The discussion focused on the goals and limitations of risk assessment, and the role of economics. Defining food-safety goals is seen as a challenge for policymakers. Presumably it may be defined as a specific reduction in prevalence, but it may also be defined as a dynamic goal of continuous improvement. Economics can play a role in helping to define goals, by equating marginal costs with marginal benefits. The integration of economics into risk-assessment models may provide decision support for producers to choose between different interventions to meet specific standards. The scope of risk assessment was also discussed. If a risk assessment is truly oriented towards public health, then current models must be extended to include consumer behavior and the actual endpoint of the food chain. This might help in evaluation of consumer-education efforts. Finally, there was discussion of whether a systems approach is practical for either modeling or implementation of control options. Systems approaches require extensive data and increasingly complex models. Implementation of systems approaches for food-safety control may not be possible without an integrated food supply chain.

Transparency in International Trade

International trade in food products is growing rapidly, allowing consumers in many countries greater variety of foods at lower prices. At the same time, such trade can introduce new or different sources of risks. Food-safety standards are increasingly strict in many high-income countries, and can be a non-tariff barrier to trade. The Sanitary and Phytosanitary (SPS) Agreement of the World Trade Organization

(WTO) provides a framework of principles for such standards. While allowing countries to set their own standards, it ensures that such standards do not unduly restrict trade. A key principle is transparency in standards. As noted by Magelhães, this allows government authorities and private firms to identify and deal with potential market-access problems. The papers in this session explore these complex trade issues from different perspectives, including the implications of trade agreements for regulation and the performance of the SPS agreement in ensuring market access.

Marette et al. focus on two forces shaping evolving food-safety regulation. First, consumer trust has been shaken in Europe by food-safety crises. Second, international trade agreements shape new regulations through requirements for science-based risk assessment and transparent standards, as well as the recognition of international minimum standards set through the Codex Alimentarius. In the new EU food-safety law, there is increased emphasis on command and control as well as information-based approaches, such as labeling. More incentive-based approaches, such as product-liability laws, have not been emphasized. Differences between the emerging EU and US approaches are evident in the regulation of GMOs and the establishment of liability. Such differences may lead to further tensions in international markets. Marette et al. propose that the EU should give further consideration to the use of product-liability laws, which are emerging for environmental issues and may be reinforced through the adoption of traceability systems.

Wilson's chapter starts from the widespread observation that domestic regulation may pose non-tariff barriers to trade, and that food safety-regulations have impeded trade. However, as he notes, there are few empirical studies actually measuring the impact of new regulations on traded quantities. He then reviews in depth some selected research literature that measures the impact of food-safety regulations on quantities traded. In general, these studies find that more stringent food-safety regulations tend to reduce traded quantities. The examples include several changes in EU regulations that set more stringent standards than those recognized in the Codex Alimentarius. The impacts tend to be severe for less developed countries, where it may be more difficult to meet higher standards. Thus, there is tension between balancing national interests in higher standards with reducing barriers to trade.

Magelhães' chapter provides background on the meaning of transparency under the SPS agreement and data regarding how well countries have complied with the agreement. An important part of the agreement is the notification system, under which countries are required to post proposed changes in SPS measures. This provides other WTO members with knowledge of pending changes and allows them the opportunity to raise concerns. Statistics on the use of notification systems show that transparency provisions are increasing dialogue and communication among member nations. A specific example explored in the presentation was the reaction of exporting countries to proposed EU revisions in aflatoxin standards.

The discussion began by considering whether or not the SPS agreement leads to improved trade, welfare, and development. Transaction costs of meeting SPS obligations, such as participation in the Codex Alimentarius, are very high for less developed countries. But on the other hand, this agreement has clearly increased transparency among trading partners. More trade ultimately leads to greater wealth, with corresponding benefits for food safety. Another important issue is that meeting higher food-safety standards may be difficult for small farms or small firms. Expanded trade and higher standards may lead to a more concentrated market structure or to increased foreign direct investment in exporting countries. The role of

the private sector, especially European retailers, is very important in setting the private food-safety standards for imports. These private sector actions are beyond the jurisdiction of the SPS agreement, but may determine international trade in the future.

As a result of this discussion, the conference closed with invited presentations from two participants representing different international trade perspectives. De Haan's chapter reviews the efforts to the World Bank to improve food safety in developing countries. These include policy dialogue, institution-building support, and infrastructure support. Such activities are seen as essential to the development of high-valued export industries in developing economies. Nagamatsu and Matsuki provided some perspective from Japan, where concerns about food safety mirror those in other industrialized countries. As in Europe and the US, there are new food-safety laws and expanded food-safety regulation. Japan is seeing the emergence of integrated, certified food supply chains. The development of these supply chains takes place within the traditional framework of producer cooperatives that dominate markets in Japan. These two chapters provide additional context for the other chapters in the book, which primarily cover research carried out in the US and Europe.

New Research Directions Identified

Future directions for research were identified in all four areas. A unifying theme is the need for cooperation between technical and social scientists to answer important questions. There is some degree of overlap among the four research topics, reflecting the integrated nature of risk along the food supply chain. Thus, continued exchange of ideas will provide better solutions to food-safety problems. This includes exchanges among social and technical scientists, as well as among researchers working at different aspects of the food system.

Risk communication

Conference participants were particularly concerned about the inability of technical scientists and economists to understand some aspects of consumer behavior. There is a need for integration of emerging fields in psychology and consumer marketing with economic analyses of market behavior and WTP. Such research might address how and why consumers choose food products and food supply sources; how and why they undertake risk-mitigation measures in preparing or choosing food; and how best to tailor risk-reduction activities to reduce the incidence of food-borne illness. The latter questions relate the need identified for extending risk-assessment models that they truly encompass the system from farm all the way to table.

Developing guidelines for traceability systems

In order to facilitate the development of traceability systems, research is needed to develop the guidelines for such systems, including the design of incentives and establishment of liability. Cost–benefit analysis of traceability systems would be part of this research, to see whether the costs are justified. As part of such analysis, benefits would be broadly defined to include reductions in transaction costs, reductions in administrative costs of regulation, and gains in system efficiency. The need for differentiated systems, such as a government-mandated minimum system and stricter private systems, would be explored. Such research might compare the experiences in countries such as the United Kingdom, where the Food Safety Act of 1990 spurred supply-chain coordination, and Germany, where coordination is less well developed. Such research might also draw on the expertise in economics of

animal health in the Netherlands, where traceability has long-established use in animal-disease control.

Integrating economics into farm-to-table risk assessment

Research is needed to understand the costs and benefits of different levels of food safety or among alternative standards. In order to accomplish this, an economic model will be integrated into an existing risk model. This would also allow identification of the distribution of intervention costs along the production chain. Exploring the integration of economics into risk models will also provide insight into how economic factors such as farm size influence risk and whether it is necessary to consider them in risk assessment. An extension of this work would compare the costs and benefits of food safety in alternative production and supply chains. This might compare conventional production with organic production or with an integrated chain. Insights into trade issues might be gained from comparing costs and benefits in the chain from a third-country supplier to EU consumers with the domestic production chain.

Encouraging pro-active risk management in international trade

As international trade grows, the nature and incidence of risks in the food system become a shared concern among countries. Thus, risk reduction may be an international public good. There may be value in coordinated activities to reduce risks, which could promote both trade and food safety. Economists can provide analysis of where such coordination has value and how to address issues arising from the distribution of costs and risks among countries. This is closely tied to the concerns raised in discussion about the value of international standards and the impact of new regulations on developing countries. For example, are harmonized standards the best way to facilitate both trade and risk reduction? Should importing countries compensate exporting countries for investments that reduce food hazards? These types of questions have not been explored in the international trade literature and would facilitate the market adjustments and trade negotiations currently underway in response to higher food-safety standards.

Conclusions

The papers in this volume show the depth and breadth of this emerging field in agricultural economics. Three themes are demonstrated. First, a wide variety of existing economic methods can be applied to different questions in food-safety economics. These include experimental auctions, market models, simulation models, and welfare analysis. Thus, the scope of food-safety issues demands the application of many different kinds of economics methods.

Second, the benefits of multi-disciplinary collaboration are clear. Such collaboration is not new to agricultural and resource economists, but food-safety issues will further challenge economists. Understanding food safety within complex biological and market systems will require new investments in the development of data and appropriate models that integrate technical and social science. Experiences from past efforts in modeling animal health and non-point-source pollution will be relevant, and provide examples for food-safety economics.

Third, these papers demonstrate that parallel trends are underway in the industrialized countries. Consumers are increasingly concerned about food-safety issues, new regulations are emerging to raise standards, and food suppliers are responding with increased quality control and certification. As these trends continue,

economists can aid decision makers in understanding the emerging costs, benefits, and trade-offs. International co-operation among researchers will enhance the ability of economists to provide meaningful answers, and in this context, the workshop reported here represents an important step forward.

[i] This presentation is not included in this volume.
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