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17. Modeling the Costs of Food Safety Regulation

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Modeling the Costs of Food Safety Regulation

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Cost-benefit analysis has long been part of the economist's tool kit. Arising out of the need to provide guidance for decision makers about the optimal level of public investment in public goods and services, the principles of cost-benefit analysis have been used (and, some would argue, abused) for decades. Since much of the use of cost-benefit analysis has been in the realm of public goods, environmental services, and the like, the professional literature on cost-benefit analysis has historically stressed two concerns: (1) the development of benefit estimates for non-market goods, such as the reduction of safety risks or the preservation of natural habitats; and (2) the treatment of temporal effects through the discounting of estimated costs and benefits to present values. Relatively less emphasis has been placed on cost analysis.

This allocation of effort should not be surprising because benefit estimation and discounting each presents a series of difficult analytical issues. In particular, the need to provide benefit estimates for goods where no market exists (or where market failure is pervasive, such as with food safety concerns) has stimulated a rich intellectual growth. By contrast, the principles embodied in cost analysis are well understood; it is in the application that things often go wrong.[2]

Cost-benefit analyses are intended to be used for two related purposes. As Antle (1995) advocates, they can be used in a "gatekeeper" role by an oversight group charged with deciding whether a new regulation ought to be imposed, in which case the goal is to determine whether the regulation's likely societal benefits outweigh the costs. Cost-benefit analysis can also be used in a "rule design" role by a regulatory agency, as a means of structuring the formation of a new rule. The agency would use the analysis to anticipate how firms will react to a new regulation; to assess the several components of a proposal and to ask what each component is expected to do, how the components relate to one another, and whether each component makes sense; and to assess whether the new proposal will actually cause the desired effects to occur.

The U.S. Department of Agriculture (USDA) must apply the principles of cost-benefit analysis more widely in the future. Executive Order 12286 requires economic analyses of "significant" rules and regulations issued by executive branch agencies, containing: (1) a statement of the potential need for the proposed action, (2) an examination of alternative approaches, (3) *an analysis of benefits and costs* (emphasis added), (4) the basis for selecting the proposed action, and (5) a statement of statutory authority. This Executive Order, and those preceding it, essentially use analyses in the gatekeeper role, as a way for the White House to be aware of proposals emanating from executive agencies, and to review the proposals.

Congress imposed a statutory responsibility to perform cost-benefit analyses when it passed the Federal Crop Insurance Reform and Department of Agriculture Reorganization Act of 1994, which requires assessments of all major new Departmental regulations affecting human health, human safety, or the environment, that have an economic impact of at least $100 million in 1994 dollars. For such regulations, the Act requires USDA to conduct a thorough analysis that clarifies the nature of the risk,

alternative ways of reducing it, the reasoning that justifies the proposed rule, and a comparison of the likely costs and benefits of reducing the risk. Congress also established an Office of Risk Assessment and Cost-Benefit Analysis (ORACBA) to implement the Act, and placed it in the Department's Office of the Chief Economist. The language of the Act, as well as the early efforts by ORACBA, suggest an interest in using the Office to encourage the spread of Cost-Benefit as a tool for the design of rules.

We next summarize several key principles in cost estimation for cost-benefit analysis, with some examples to show how they can be applied (and misapplied) to food safety regulation. The following section describes some distinctive features of the health risks associated with foodborne diseases, and discusses how those distinctive features ought to affect regulatory choices.

First Principles in the Analysis of Regulatory Costs

Given the purposes described above, cost-benefit analyses seek to determine whether the benefits of an action outweigh the costs. But "costs" can mean strikingly different things to different observers. Regulatory economists approach the issue with a framework in which costs are the opportunity costs to society; that is, what society gives up by applying resources to meet a regulation. Moreover, we are used to thinking in terms of the marginal changes in benefits and costs. These ideas represent the most fundamental language of economics, but the fundamentals are frequently misapplied or misunderstood in regulatory analyses, which are often developed by people with little or no training in economics. In somewhat crude terms, it may be fair to state that economists are trained to focus on efficiency aspects of the regulatory decision, while policy makers are more often concerned with distribution of benefits and costs.

We see several key components of the framework that need to be understood in application. Those components are universality, incrementalism, the identification and treatment of transfers and substitution, causation, treatment of alternatives, and uncertainty. *Universality* refers to the need to take all relevant costs into consideration, including the costs of enforcement and monitoring for the regulator, as well as the cost of compliance for the regulated entity. *Incremental* analyses require the analyst to consider the additional costs and benefits generated by variations in the stringency of a proposed rule; incrementalism is important in health and safety studies because of the common finding that stringency often generates extraordinarily high costs at the margin. Analysis should focus on costs as the use of resources, and aim to separate *transfer and substitution* effects, that shift resources from one group to another, generating changes in social surplus in related sectors that are not always apparent. Analyses should identify costs that are *caused* by the regulatory change, as distinct from those that may have been incurred with or without the regulation. Next, analysts should be alert to the possibilities for *treatment of alternatives*: other ways of reaching the desired regulatory goal. Finally, cost estimates are often quite crude, but agency analyses rarely identify the range and likely sources of *uncertainty* in those estimates.

Each of these components are part of the standard toolbox employed by regulatory economists, but they are often misused or ignored in agency (and intervenor) regulatory assessments. Consider, for example, USDA's Hazard Analysis and Critical Control Point (HACCP) proposal for meat and poultry inspection. The proposed rule contained a regulatory impact analysis that estimated the present value of the costs of the program to be $2.2 billion. However, the cost analysis avoided the principle of universality, in that it included only those steps directly mandated by the rule: costs for training personnel in HACCP principles, developing HACCP plans, developing and maintaining HACCP record keeping systems, and testing carcasses for pathogens. The plan had an admirable degree of flexibility, in that it did not specify how plants were to go about reducing the incidence of pathogens in meat. But regulators apparently decided that if specific steps were not called for in the rule, then costs incurred as part of pathogen reduction need not be included in estimates of the costs of the regulation. But in order

to meet HACCP goals, plants will actually have to expend resources; moreover, no benefits of pathogen reduction will occur unless plants expend the resources. In order to make appropriate decisions, regulators need to take account of all costs incurred as a result of regulatory decisions.[3]

Now consider the treatment of transfers. If we aim to measure the opportunity costs of a rule, then we need to assess the value associated with resources used in meeting the rule. But some regulations may impose costs on a regulated firm, that are not true opportunity costs to society because they do not use up resources. For example, if a rule is likely to lead to lower prices because it improves the workings of markets, those lower prices will be a cost to sellers who find lower profits as a result. But lower prices are directly transferred as gains to buyers: There is no reason to class this as a cost to society. The opportunity costs of the action involve resource use: capital, labor, or materials used to implement the regulation and make the market work better.

This issue arose in analyses of a meat labeling controversy: the definition of "fresh" poultry. USDA's Food Safety and Inspection Service (FSIS) proposed new and more restrictive rules for labeling poultry products as "fresh," meaning that some output that had previously been labeled as fresh could no longer be so labeled. Representatives of companies whose product would be relabeled argued that the rule would impose substantial costs. Their prices and profits would fall. Note that nothing happened to the product itself. In this case, if price declines on the relabeled product, that would represent pure transfers to buyers. Profit losses, with no associated resource effects, are not costs to society as a whole.

A related issue is substitution among products. Measurement of social costs and benefits within a regulated market usually does not tell the entire story. Consider again our example of proposed HACCP regulations for meat and poultry processors. If we assume for the sake of argument that the net effect of the regulations is significantly to increase costs to producers of processed meat and poultry products, this would also therefore change relative prices and encourage substitution by consumers in their food purchases. This, in turn, could set off a second-order set of adjustments as markets move to a new equilibrium, with further feedback effects on demand for and supply of meat and poultry products. These general-equilibrium adjustments will generate changes in producer and consumer surpluses, the net sum of these changes reflecting a different calculation of welfare change than seen in the partial-equilibrium measurements in the meat and poultry processing sectors alone.[4] Of course, estimation of these multi-market effects raises the difficulty of estimating costs and benefits to a new level, although recent developments in the use of computable general equilibrium models and social accounting matrices as empirical tools offers some promise that this task may be made easier in the future.[5]

First principles call for the inclusion of all costs incurred because of a new regulation. However, it is sometimes hard to untangle the causal effect of regulation. For an example, continue to consider development of HACCP proposals for meat plants. The proposals did not appear out of a vacuum. A 1985 National Academy of Sciences (NAS) report, as well as two later NAS studies and a series of Government Accounting Office (GAO) reports, recommended that FSIS should introduce scientifically based systems of microbial hazard detection and control. Several internal FSIS studies reached the same conclusion. These documents all relied on scientific work that had appeared over a period of years prior to publication of the documents. Finally, continuing outbreaks of salmonellosis, attributed to the consumption of contaminated meat and poultry products, as well as a serious outbreak of illness caused by *E. coli* O157:H7 in cooked ground beef, focused widespread public attention on food safety risks associated with microbial hazards.

The widespread public attention to microbial health hazards had two interrelated effects. First, some slaughter and processing firms moved to implement HACCP systems in plants, and to invest in pathogen control and removal systems.[6] Second, regulators moved to develop proposals for mandatory adoption of HACCP plans in all slaughter and processing plants. When the FSIS proposals are promulgated, then other plants will incur costs to comply with the new regulations. It is clear, in this case as in other cases of health and environmental regulation, that some expenditures would have been incurred even if there were no regulatory changes. The challenge for analysts is to estimate the size of the costs that would not have been incurred, absent the regulation.

There are usually a variety of alternative ways to meet most health, safety, and environmental goals, and food safety is no exception. If we seek to reduce the health risks from consuming foodborne pathogens, we can do it by altering animal production and transportation systems, changing slaughter and processing techniques, and changing food preparation methods. We can typically try to achieve each of those changes through direct regulations, or indirectly, by providing information and letting market players respond. Food safety policymakers are aware of the wide set of alternative approaches to realizing food safety, and are generally sensitive to the problems that may ensue if regulation forces a particular approach. The problem is that great uncertainty surrounds the cost and benefit estimates for most alternatives. Analyses may often offer rather mechanical sensitivity computations for benefit estimates, but rarely do they aim to identify the source and nature of cost side uncertainties, let alone attempt to quantify them. The importance of cost side uncertainties can be seen in the experience with a market for trading emissions permits among electric utilities. Market prices, which should reflect incremental costs of pollution control, have turned out to be much lower than anyone had forecast.

What's Distinctive About Food Safety Regulation?

The available regulatory alternatives in food safety, and hence the analyses of costs and benefits associated with those risks, are constrained by the distinctive nature of food safety risks and food production. We can best illustrate those distinctive characteristics by comparing them to a simplified textbook analysis of emissions control in environmental regulation. Economic analyses of health, environmental, and safety regulation often call for reliance on performance standards, in place of process standards, as more efficient methods of regulation. In textbook examples of environmental regulation, for example, a performance standard would apply to the volume of emissions of a certain type of pollutant from power plants, while a process standard would specify the means of reaching a chosen volume of emissions. Because plant fuels, production processes, and output mixes differ widely, different plants may have widely different least-cost methods of reaching a particular performance standard; that is, there's often great plant heterogeneity. Imposition of common process standards (forcing all plants to reduce emissions in the same way) can sharply raise the total costs of emission control. In these circumstances, many regulatory economists would favor a performance standard, such as a system of marketable emissions permits. The standard would emphasize the immediate performance goal, reduction of emissions, while the method of regulation (marketable permits) would provide incentives for regulated firms to realize the performance goal while minimizing the resource costs of doing so.

The principle health risk currently associated with food consumption, and the focus of current regulatory initiatives, concerns pathogen contamination of food products. At first glance, there appears to be a clear version of the textbook performance standards for emissions control, applied instead to food safety regulation: the use of microbiological tests for the presence of pathogens. In principle, one could simply specify standards for pathogen incidence in products, and leave it to producers to find the most cost-effective means of getting there.

But the textbook analogy does not apply particularly well to food safety regulation, because at present there is no reliable indicator organism that could be used as the basis of a testing strategy. The lack of such a reliable indicator means that testing would have to be extensive, and hence expensive.

For meat and poultry, microbial contamination can occur at any stage in the food chain—from the farm to the consumer's table. Farm livestock and poultry can become infected if they eat contaminated feed, drink contaminated water, or come into contact with infected animals introduced into the herd or flock. Contact with infected rodents, cats, and farm personnel can also spread contamination. Once infected with microbial pathogens, animals may expose other animals by excreting pathogens, pathogen cysts, or larvae.

Contamination can frequently occur at the slaughter stage. There, the processes of slaughtering, defeathering and hide removal, chilling, and further processing all provide opportunities for cross-contamination of carcasses and fabricated products. For example, accidental puncture of the intestinal tract during slaughter can lead to widespread contamination of carcasses all along the slaughter line. Cross-contamination can occur in processing when meat from many carcasses is combined, as in ground beef production. Food handlers, whether in wholesale, retail, or home food preparation, can also contaminate products if they use improper food preparation, cooking, and storing techniques.

Once a live animal or meat product is contaminated, pathogen growth (and the risks of human illness) can be affected by temperature controls, the length of time until consumption, and the incidence of further cross-contamination. Because of the opportunities for pathogen growth and cross-contamination, pathogen removal at one stage does not necessarily ensure pathogen absence at the next stage.

Regeneration and cross-contamination mean that testing would have to be performed at several points in the chain of production. Moreover, foodborne diseases can arise from multiple pathogens, which would require separate tests. Because many pathogens have a fairly low incidence, reasonable goals for test power would require fairly large sample sizes.

Hence, there has been widespread interest in the application of inexpensive tests for "indicator organisms," which are not in themselves dangerous, but which might be associated with the presence of pathogens. However, the scientific literature suggests that at present no reliable indicator organism has been found.[7] Consequently, regulatory systems that set performance goals based on microbial testing of products are quite costly.[8]

HACCP systems have been proposed precisely because of the expense of testing and the recurrent nature of the pathogen hazard. HACCP systems establish means by which individual establishments identify and evaluate the hazards that can affect the safety of their products, institute controls necessary to keep those hazards from occurring, monitor the performance of those controls, and routinely maintain records of that monitoring. In principle, a livestock slaughter or processing plant operating under an effective HACCP program will identify those points in the production process where prior contamination can be identified or where cross-contamination of products is likely to occur, and will take steps to monitor those points and to treat (or eliminate) the risks at those points. A scientifically designed program will monitor the identification and control processes in order to evaluate their effectiveness. In this framework, the regulator's role is to ensure that the firm has established a HACCP system, and that it is maintaining the system; in that case, the regulator focuses on the plant's record keeping systems, rather than direct inspection.[9]

HACCP-based systems do not eliminate plant heterogeneity, which is the reason for interest in performance standards, and that creates a particular tension for regulators as well as for the regulatory analysts. Consider the meat and poultry industries that are the object of the recent FSIS HACCP proposal. There are currently about 6,200 federally inspected meat and poultry plants in the United States. We say "about" because most of these plants are small (less than 50 employees) and small facilities typically show high rates of turnover; about 10 percent of existing small plants disappear each year, while the entry rate is modestly lower. Most of these plants are processors and produce a bewildering variety of products from a wide variety of meat and nonmeat material inputs.

Most livestock slaughter, as distinct from meat processing, occurs in a little over 400 large cattle, hog, lamb, broiler, and turkey plants. But even among the most homogeneous parts of the meat industry, large plants that slaughter the same species, plants may produce different product mixes and may identify different hazards and different control techniques for the same hazard. The description outlined above places the responsibility for identifying and controlling hazards on plant managers.

If a group of plants exhibits a diverse array of input mixes, output mixes, and production processes, then we may expect to observe a diverse mixture of hazards and a diverse set of HACCP plans. Regulators will be hard pressed to distinguish effective from ineffective plans, and to distinguish compliance with noncompliance, when faced with a wide array of hazards and control plans. They may

as a result fall back on more prescriptive behavior, by limiting plants to a more limited set of approved templates for HACCP plans. In that case, regulation will come to consist of a set of prescribed process controls.

Process controls aren't the favored form of regulation for economists (Antle 1995), but performance based product alternatives may be infeasible because of information costs. The challenge, when analyzing regulatory costs, is to recognize that limiting the set of acceptable HACCP plans does not limit the industry's heterogeneity. Some process control may impose exceptionally high costs on some categories of plants and relatively low costs on others. Good cost analyses need to recognize heterogeneity and take steps to identify the separate cost impacts, so decisionmakers can decide if the separate benefits are worth the costs.

Finally, the reliance on HACCP process control systems highlights the importance of information in food safety regulation. HACCP regulation will be more effective as reliable and low-cost tests for various types of contamination are developed. Moreover, private concerns over liability and lost sales are leading major fast food providers to write product quality standards into supply contracts with major meat suppliers; such standards are likely to begin appearing in retail and food service contracts in the future, and may be applied to relations between feedlots and slaughterhouses. Suppliers will be better able to demonstrate compliance with private product standards, and more precisely focused contractual incentives can be designed, if participants can apply effective microbiological tests as part of their HACCP systems. More effective testing and information systems will in turn require investments in pathogen research and testing methods.

Notes

[1]The authors are, respectively, Senior Economist and Branch Chief, USDA Economic Research Service, Food and Rural Economics Division. The opinions expressed are the authors', and not necessarily those of USDA. They wish to thank Tanya Roberts, Margaret Malanoski, and Jean Buzby for helpful comments on an earlier draft. Reprinted with permission from the *American Journal of Agricultural Economics* 78(1996):1285-1290.

[2]See, for example, Section IV ("Benefit-Cost Analysis and Measurement") in Dorfman and Dorfman's well-known book of readings; all eight articles emphasize benefit evaluation.

[3]Our example is taken from the regulatory impact assessment (RIA) offered by FSIS as an attachment to the proposed rule (Docket No. 93-016P, "Pathogen Reduction, Hazard Analysis and Critical Control Point (HACCP) Systems," Federal Register, February 3, 1995). The final rule will differ in important respects from the proposed rule. Widely cited reviews and critiques of the proposal (GAO 1996; Knutson et al. 1995) used the same framework as the RIA, and ignored costs of pathogen removal. The HACCP rule making began prior to passage of the requirement for comprehensive cost-benefit analysis of USDA rules, and so is not subject to the requirement.

[4]For an excellent review of this issue, see Just et al. (1982), Chapter 9.

[5]ERS has recently started a project to use the tool of social accounting matrices to evaluate the economy-wide impact of HACCP.

[6]Growing export opportunities, particularly for boxed beef, also stimulated packer investments in testing and control systems designed to extend product shelf-life by limiting the extent of bacterial growth. To an important extent, pathogen control and extended shelf lives are joint products for large slaughter firms.

[7]See the discussion in *Food Chemical News*, April 22, 1996 ("FSIS Literature Review Underscores the Difficulty of Choosing Indicator Organisms").

[8]Further, a single pathogen standard may not be desirable from the consumer's perspective either. Susceptibility of consumers to pathogen-related foodborne illnesses varies widely across the population. Certain sub-populations, such as the elderly, the very young, pregnant women, and those with compromised immune systems (chemotherapy patients, persons with HIV/AIDS) are far more likely to develop a debilitating or fatal illness than healthy adults. Setting a pathogen standard consistent with protecting the "average" consumer may result in excessive levels of foodborne disease (and the associated costs of illness) in the at-risk population. On the other hand, setting a strict pathogen standard (zero-tolerance, for example) in order to protect the at-risk population may prove to be an excessive burden on the industry.

[9]The current FSIS proposal retains existing systems of animal and carcass inspection alongside a new system of HACCP plans. The agency is proposing to alter other aspects of the regulation, through elimination of prior approval standards for equipment, while streamlining prior approval standards for product labels.

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