Valuing Food Safety and Nutrition

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PART ONE: Setting the Stage: Research Perspectives and Theoretical Models

1. Valuing Food Safety and Nutrition: The Research Needs

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Systematic assessment of research needs requires an understanding of the key questions which define a research field, an assessment of the extent to which existing research has answered those key questions, and an analysis of what research remains to be done. However, it is not so clear what questions define the research field we have come to call "valuation of food safety and nutrition." There are a growing number of studies that employ some type of valuation method to address food safety and nutrition issues, but they are not directed at some commonly accepted and widely recognized set of research questions. Like most research fields, valuation of food safety and nutrition has developed incrementally with no initial defining agenda of research questions. Because it is a relatively new field, it is still in the process of identifying core research questions. This state of affairs gives this author a rather large scope of discretion in staking out an agenda of needed research on valuation of food safety and nutrition. But it also presents a formidable task since it means exploring a much larger territory than my own comparatively narrow and familiar research area.

One obvious approach for identifying valuation research needs would be to identify current issues in food safety and nutrition policy and develop implications for valuation research needs. However, I chose not to take this approach because, by the time an issue is getting serious political or judicial attention, the time for conducting valuation research is usually already passed. It takes years to produce reliable, valid, and accurate research results, so production of these results needs to be timed to occur well before, not after, the period of public attention to policy issues. Thus, a list of current policy issues tells us more about what valuation research results are currently useful rather than what valuation research we should conduct next.

What valuation researchers need is a reasonably reliable way of anticipating potential policy issues. That way, when research is needed in the policy process, it will be available off the shelf. This chapter presents my attempt to develop a framework for identifying potential food safety and nutrition policy issues and the implications for valuation research. I do this by raising exploratory questions about how social institutions, such as unregulated markets, might fail to provide goods related to food safety and nutrition, and how the nature of these institutional failures change over time with changes in production and consumption technologies. Because changes in institutional failures create resource allocation problems, they are potential policy issues. By examining the extent to which existing valuation research has addressed these potential policy issues, I identify needs for research on valuation of food safety and nutrition.

The first section begins by examining the development of valuation research. The section argues that valuation research developed primarily to inform analysis of public policies, and that a central task of that research has been to estimate the demand for nonmarket goods (i.e., goods which unregulated markets fail to provide for some reason). However, nonmarket goods can become market goods through a combination of public policy and private actions, thus creating valuation issues for policy and marketing research. The second and third sections examine what these nonmarket goods are in the case of food safety and nutrition. Section two argues that there are three classes of activities that households engage in to produce health and that certain types of information about food safety and nutrition, as well as food attributes, are inputs to these activities. Section three raises questions about how unregulated markets might fail to provide information and food attributes, and how these failures might change in response to developments in production and consumption technologies, thus creating valuation research issues. The section also points out the extent to which these valuation issues have been examined by economists. The fourth section identifies some methodological valuation research needs that underlie the broader set of food safety and nutrition policy issues. The concluding section summarizes future research directions.

The Purpose of Valuation Research

The concept of "valuation research" grew out of the field of cost-benefit analysis. Beginning in the 1960s, it became increasingly common for economists to conduct cost-benefit analyses of proposed changes in government regulations, programs, and policies (Gramlich 1981). The objective of this analysis was to improve the allocation of public resources by providing policy makers with information about the economic impacts of policy change. Specifically, it was hoped that this type of analysis would improve economic efficiency by encouraging adoption of policies that would give the greatest net

benefits. Cost-benefit analysis was thus employed to analyze the consequences of policy alternatives that policy makers were considering adopting and to identify how existing policies might be improved.

As cost-benefit analysis began to be conducted more widely, it became apparent that while it was relatively obvious how the costs of policy change should be measured (though hardly simple to actually measure them), it was not so evident how benefits should be measured. The problem stemmed from the fact that while there were organized markets for most policy inputs, many policy outputs such as improved environmental quality and safety are goods for which no primary markets exist. With no primary market data, demand curves, and, hence, changes in consumer welfare resulting from a change in supply, could not be estimated. Consequently, other methods for estimating the demand for nonmarket goods needed to be developed if cost-benefit analysis was to provide meaningful information to policy makers. This research came to be known as benefit assessment or nonmarket valuation research, and, since in most cases the private sector had substantially less incentive to accurately document the benefits than the costs of policy change, it was funded primarily by tax dollars.

The majority of nonmarket valuation research grew out of the health, safety, and environmental legislation of the 1960s and the concern with regulatory reform in the 1970s (Asch 1988, Bailey 1980, Bentkover et al. 1986, Braden and Kolstad 1991, Ferguson and LeVeen 1981, Lave 1981). Some of these policies directly reduced human health risks by requiring private and public goods to meet certain health and safety standards while others required the provision of information which individuals could use to make their own health and safety decisions. The branch of this research of greatest relevance to food safety and nutrition focused on estimating the value of preventing deaths or disease in a given population and to some extent, the value of reduced morbidity and symptom days (Cropper and Freeman 1991, Fisher et al. 1989, Viscusi 1993). Applications of these methods to food safety began appearing in the early 1970s (Ricardo-Campbell 1974, Lave 1981), and recent public attention has substantially increased the amount of research in this area. In contrast, valuation research on nutrition policy focused primarily on assessing changes in nutrient intakes and estimating the marginal value of specific nutrients (Capps and Schmitz 1991), rather than on valuing the health effects a change in nutrient intake might produce.

Studies on the value of health and safety programs sought to value the ex ante reduction in death or disease within a specified population. The earliest studies used the human capital approach which involved using an estimate of cost savings as an estimate of the value of saving lives. Cost savings were approximated by the present value of foregone earnings net of consumption, plus estimated medical expenses associated with illness or injury. This approach was widely criticized for defining benefits solely in terms of cost savings and for its narrow definition of the relevant costs saved. The approach

has since been modified to incorporate the value of lost leisure time, the opportunity cost of lost household production, and other intangibles. This broader definition of cost savings is commonly referred to as the cost-of-illness approach to estimating the value of health and safety improvements. The cost-of-illness approach has the advantage of being based of actuarial data.

A more theoretically correct measure of the value of health and safety programs is people's willingness to pay for reduced risk of death or illness in a specified population. This is a preferred measure because it represents the full value to the individual of health and safety improvements. Willingness to pay measures have been developed using hedonic and contingent valuation methods. These methods involve observing choices made in an actual or constructed market, and inferring the value of risk reduction based on those choices.

This brief overview of the development of the field of valuation of reduced risk reveals several key questions that valuation research has sought to answer. The unifying question has been an interest in measuring the benefits (and sometimes the social costs) of changes in government regulations and programs. Answering this question has involved answering questions about what benefits are produced by government policies and how they should be estimated. Because public goods are not directly exchanged in private markets, alternative methods needed to be developed to estimate the demand for these nonmarket goods, including exploiting market data on complements and substitutes for those goods or simulating markets for the goods themselves or their complements or substitutes.

Although research on valuing health risk reductions has focused on providing benefit assessments for cost-benefit analysis, there are two other research areas that use methods similar to some nonmarket valuation methods. One of these research areas is program evaluation. Program evaluation addresses the question of the effectiveness of public programs and the extent to which public policy intent is or could be achieved by particular programs. For example, a number of public safety programs, including food safety and nutrition, produce safety and nutritional information for the public. A body of research, some of which includes risk communication, has been conducted in order to test the effectiveness of various types and formats of information delivery (National Academy of Sciences 1989, Magat and Viscusi 1992). This research frequently uses survey methods in which information is presented to subjects and the effectiveness of the information in changing risk perceptions and subsequent risk management behavior is assessed. This methodology is quite similar to methods that might be used to estimate the benefits of providing risk information.

A second research area with similarities to nonmarket valuation research is product marketing research. In fact, some of the techniques used to simulate or construct markets for public goods were initially drawn from the literature on marketing research for new products. In particular, there are parallels between what has come to be known as conjoint analysis in marketing research and

contingent valuation in benefits assessment. Both methods seek to assess consumer behavior toward goods that do not exist in current markets. However, these two methods seek to answer very different questions. In marketing research, the questions are what product configuration needs to be produced for different market niches, what is the market demand for a product, and how is demand affected by factors such as consumer concern about food safety and nutrition. In contrast, valuation research seeks to estimate welfare changes from the demand curves for nonmarket goods. For example, marketing research might ask what the demand is for pesticide-free foods, but policy research would ask what welfare changes would result from an increase in the supply of pesticide-free foods. Similarly, marketing research might seek an estimate of the demand for fat-free foods, whereas policy research might ask what welfare changes would result from improved information on the fat content of foods. Both types of research might involve estimating the demand for pesticide-free or fat-free food, but would use different models and derive different types of estimates.

There is the potential for confusion when these different research areas and objectives are not clearly delineated. For example, research on willingness to pay for reduced risk from pesticide residues in food would be useful to estimate the consumer health benefits that might be associated with reduced pesticide use, but that same research design may not be appropriate for market research aimed at estimating the potential market for pesticide-free foods because of differences in the way the product is designed and assumptions about the amount of advertising effort needed to achieve a given level of product awareness. There is also the point that welfare analysis seeks a measure of how consumers would value a given risk reduction if they were fully informed about the "true" risk, whereas marketing research seeks an understanding of the actual knowledge level and practices of consumers. This does not mean that welfare analysis would not involve measuring consumers' revealed preferences for risks and their valuation of perceived risk reductions, but it does mean that the valuation of a public policy change should be based on objective measures of risk reduction.

Should valuation research encompass all three types of research identified in this section? Valuation research as it is applied to environmental regulation, for example, would probably not include all three types of research (Braden and Kolstad 1991). However, food safety and nutrition issues differ from environmental issues in terms of the types of institutional failures involved. In particular, the benefits of food safety and nutrition policy are a joint product of public and private action. The benefits of food safety and nutrition policies depend on the ultimate changes in food producer and food consumer behavior. Thus, there are complementarities between the three research areas, so perhaps a more encompassing view of valuation research may be in order. Nonetheless, there is the potential for confusion in assessing the progress that has been made in answering the key research questions that each of the three areas of research

has sought to answer. Rather than settle the question, this author hopes only to have alerted readers to a potential source of difficulty in assessing the contributions made by various studies available in the literature on food safety and nutrition.

Role of Food Safety and Nutrition in Household Health Production

If one essential task of valuation research is to estimate the demand for the nonmarket goods produced by food safety and nutrition policies, then a valuation research agenda for food safety and nutrition may be described by identifying the goods these policies produce. Alas, there seems to be little agreement about the nature of these goods in the literature, so this section proposes a preliminary framework.

Obviously, food safety and nutrition policies affect human health, but they do so differently. To see how they are different, let us examine a model of household health production. In such a model, it is assumed that an individual derives utility from health directly, by avoiding pain and suffering, and indirectly, by having increased time available to enjoy leisure and consumer goods. Health also affects an individual's budget constraint by reducing the portion of time available to earn income. Thus, individuals or households may be viewed as engaged in the production of healthy states (Cropper and Freeman 1991).

The production of healthy states involves three classes of activities: health maintenance, health protection, and health rehabilitation. *Health maintenance* involves activities which ensure optimum development and functioning of the physical systems and parts of the human body. These activities include adequate food consumption, sleep, exercise, and the like. *Health protection* involves actions to protect the body from damage from external hazards such as harmful levels of exposure to microbes, chemical toxins, radiation, electricity, and extreme temperatures or forces. Protection activities may be of three different types: (1) averting hazard formation (e.g., sanitation, pasteurization, refrigeration, and heat), (2) avoiding hazard exposure (e.g., destroying contaminated food; reducing consumption of fat, cholesterol, or calories), and (3) increasing resistance to hazards (e.g., vaccinations). *Health rehabilitation* involves activities to mitigate damage or alleviate symptoms or incapacitation. These mitigating activities include the use of drugs, surgery, mechanical aids, and special diets or treatments. Health rehabilitation activities may be undertaken to mitigate the damage from inherited conditions or the damage that occurs when health is not adequately maintained or protected. This damage may vary in terms of its severity, duration, reversibility, and time of onset as well as in terms of the painfulness of the symptoms and degree of incapacitation the damage causes.

Note that these three classes of activities involved in household production of healthy states affect the utility of the household differently, and thus have implications for welfare analysis and marketing research. The first two classes of activities, health maintenance and protection, affect current expenditures and future reductions in utility and increases in time constraints. Health rehabilitation activities affect current expenditures, increases in current and future utility, and decreases in current and future time constraints. The level of a household's health protection activities over time can vary with exogenously determined changes in hazards in the household's environment, whereas household health maintenance can vary with changes over time in household characteristics such as age. A household's health rehabilitation activities vary with a household's choices about health maintenance and protection as well as household characteristics and exogenous changes in hazard exposure. Finally, there are substitution possibilities and potential complementarities across the three activities.

Food safety and nutrition fit into the household's health production activities in different ways. Food safety relates to a household's health protection and rehabilitation activities. For example, food preparation choices can affect exposure to pathogens, and illness caused by foodborne pathogens may need medical treatment. In contrast, nutrition may relate to health maintenance, health protection, or health rehabilitation activities of a household. For example, consumption of an adequate level of nutrients is necessary to maintain optimum health, but too much consumption of nutrients may harm health. In addition, some types of nutrient consumption may be necessary to reverse health problems, such as in the case of malnutrition.

It is important to distinguish among these different types of household activities involved in the production of healthy states because they require different physical and informational inputs. For example, health maintenance activities of households include *obtaining* certain types of food attribute inputs whereas health protection activities include *avoiding* other types of food attributes. Health rehabilitation activities may involve obtaining some and avoiding other food attributes. To obtain desired food attributes, the household must possess two types of information: the type and level of attribute intake necessary to maintain or rehabilitate health and the marginal attribute contribution of each food. To avoid undesirable food attributes, the individual must possess three types of information: the type and level of attribute intake that may impair health, the marginal attribute contribution of each food, and actions that may be taken to reduce the marginal attribute contribution (e.g., washing or cooking). The next section examines how unregulated markets may fail in providing desired levels of food attributes and informational inputs, thus creating policy and food marketing issues which valuation research can help to address.

Market Failures

Economic logic holds that coercive public action may be justified if voluntary actions in unregulated markets fail to produce a desired good and government can redress the market failure (i.e., when government failures such as rent-seeking and bureaucratic supply are not so great as to preclude redress of market failure). However, insofar as individuals possess adequate income, markets do not fail to provide food. What they sometimes fail to provide is the information or food attributes the household requires to produce health maintenance, protection, and rehabilitation. Information includes knowledge of how particular food attributes contribute to maintaining and protecting health, as well as information about the marginal attribute contribution of specific foods. This section explores what some of these market failures might be, identifies the associated nonmarket goods for valuation research, and discusses how changes in food production, food consumption, and scientific understanding of risks may create new valuation research issues.

Health Maintenance and Market Failure

Two types of information are needed for a household to choose its food consumption and preparation activities so as to maintain optimum health. One type of information is nutritional requirements for achieving a particular health state. The second is which foods in the market meet these nutritional requirements. These two types of information are complements since both are required to affect food choice and preparation. This section examines potential market failures in the production of information or food attributes that contribute to health maintenance. These market failures identify valuation research opportunities.

Nutritional Requirements. In order to maintain health, households need to know which nutrients need to be consumed and what level of consumption results in health maintenance. This information may be more or less detailed and accurate. At a minimum, a household needs to know what foods must be consumed and in what quantities to produce health. An example of this type of information is the food pyramid developed by the USDA. More detailed information involves knowledge of specific nutrient requirements such as calories, carbohydrates, proteins, fats, vitamins, and minerals. Will an unregulated market produce and distribute the level of detailed information that consumers are willing to pay for?

Human nutritional needs information has public good attributes. Once produced, use of this information by one household does not diminish the quality or quantity available to others, so nutritional needs information is a nonrival good. Moreover, nutritional needs information is often not product specific, so

competitive pressures would be unlikely to encourage the production of this information. In addition, to the extent that the accuracy of the information cannot be verified by users, what incentives are there to produce accurate information? Indeed, there may be incentives for unregulated food sellers to produce inaccurate nutritional needs information to the extent that the demand for their product is affected negatively or positively by the information. The benefits of verification of nutritional requirements information are a nonmarket good because it is hard to exclude nonpayers from enjoying them.

These points suggest that the market may fail to produce the efficient level of information on human nutritional needs, and thus the value of publicly sponsored research should get some attention from valuation researchers. To what extent is the nutritional requirements information being produced by public and private dollars? What safeguards are there to ensure accuracy of research results, and what is the value of accuracy? The value of verification of the healthfulness of nutrients such as beta carotene, vitamin E, and others is an area virtually untouched by economists. If levels of these and other nutrients are in question, what would be the value of additional public research? If public funds are not used, what incentives do private research providers face? Given continuing increases in health care costs, such questions should become more important in the future. However, to the best of my knowledge, economists have not examined the value of producing nutritional needs information and whether current levels of research funding are efficient.

Another aspect of this issue is the distribution of nutritional needs information and its use by households. Obviously, only those households that receive the information can benefit from it. This raises the question of the value of publicly funded or mandated programs to increase understanding of nutritional needs by households. For example, how much benefit is to be gained from consumers knowing about the food pyramid or more detailed knowledge of nutritional requirements? Some research has been directed at these issues, particularly in terms of nutritional educational programs targeted at poor households (Senauer 1982). To establish the value of nutritional needs education programs, valuation research should determine the extent to which consumers' knowledge of nutritional needs affects food demands. For example, have consumers increased their consumption of foods high in fiber (Ippolito and Mathios 1991), beta carotene, and other compounds that have been found to provide health benefits? This type of research can be useful in marketing food products. For example, research on the marginal valuation of nutrients by households can help food producers design products that better meet consumers' preferences. There has been some work on this latter question (Capps and Schmitz 1991, Eastwood et al. 1986, Ladd and Suvannunt 1976, Morgan et al. 1979), but more is needed, for example, on antioxidants, fiber, and other health-promoting nutrients. However, in the U.S., over-nutrition rather than under-nutrition may be the more relevant issue, and is discussed below.

Marginal Nutrient Content of Foods. The second piece of information households need to make wise food consumption and preparation decisions that maintain health is the marginal nutrient contribution of each food. Can the unregulated market be expected to produce and distribute this information? The production of nutrient content information has both public and private good aspects. To the extent that all raw ingredients (milk, meat, grains, vegetables) possess essentially the same nutrient content, this information has public good characteristics, and, indeed this kind of information has been publicly available to both producers and consumers. But the long held assumption that different varieties of a raw food do not differ substantially in nutritional content may no longer hold. For example, organic food is alleged to have higher nutritional content than conventionally grown foods. Animal drugs, such as pST, alter the leanness of pork. Biotechnology may result in foods that differ greatly in nutritional content. In these instances, would an unregulated market produce the nutritional information and would it be accurate? The same type of incentive problems would probably apply here as discussed earlier. Producers would have the incentive to overstate the nutrient level if they perceived it to increase the demand for the variety. Thus, there is a potential research issue on the value of nutritional content even for raw foods.

Once the nutritional content of raw foods is produced, the question still remains whether the unregulated market would provide the information on raw products or whether consumers might be willing to pay for the information to appear on individual products. To the extent that varieties of raw foods do not vary in terms of nutrient content, provision of this information on raw foods has a public good quality. If one variety contains the same information as all others, and more than one variety is sold, there is no incentive for producers of the other varieties to incur the cost of the label. Thus, we would not expect nutrient labeling of raw varieties to occur. To the extent that consumers purchase particular foods in order to ensure that they consume *minimum* nutritional requirements, such information clearly has value. Consumers can buy books with the nutritional values listed for various raw foods. But it is unknown what consumers would be willing to pay for this information on each raw food package or how this value might change with the development of new varieties with altered nutritional characteristics

In contrast, the nutrient content of processed foods depends on the ingredients, and that information is known only to the food processor. The theory of asymmetric information suggests that unregulated processors that provide high levels of desirable nutrients would have an incentive to provide this information, whereas unregulated processors producing foods with low levels of such nutrients would have the incentive to omit or inflate the information. Thus, consumers could to some extent distinguish between those foods that do or do not provide essential nutrients. Moreover, competitive pressures among firms would increase the amount and truthfulness of nutrient labeling of food

(Ippolito and Mathios 1991). However, comparison between foods and the construction of a nutritious diet is difficult if producers do not use similar formats or can use misleading information. Thus, a public requirement of a particular format and enforcement of accuracy appears to be beneficial. The extent of the benefits of required labels is still a debatable question among researchers (Caswell 1992, Caswell and Padberg 1992, Daly 1976, Ippolito and Mathios 1991, Jacoby et al. 1977, Padberg 1992, Russo et al. 1986, Zarkin and Anderson 1992). The federal Nutrition Labeling and Education Act of 1990 has mandated standardized and complete nutrition labeling, and regulations promulgated under this act included a benefit-cost analysis. These labels require information on both daily nutritional requirements and the marginal nutrient contribution of a serving of the labeled product.

The presumption in the previous paragraphs is that a fully informed, competent adult makes better health maintenance decisions than one who is not. Obviously, labeling of the marginal nutritional content of foods is not useful or valuable to people who are illiterate, unable to process the information, or are ignorant of the role of nutrients in protecting health. To the extent that a significant portion of the population falls into these categories, the regulated market fails in that individuals do not make the nutrient consumption decisions they would make if they were fully informed. In this case, either public programs to educate people about nutritional needs must be offered or the nutrient content of foods must be regulated. Indeed, U.S. food regulations still require nutrient fortification of bread, milk, and salt. Whether such regulations are still worth the cost is a potential valuation issue.

Health Protection and Market Failure

Three types of information are needed for a household to choose its food consumption and preparation activities so as to protect health from external hazards. One type of information is about potential hazards. For example, what substances are potentially hazardous to health and at what level of exposure? The second type of information is which foods in the market contain hazardous attributes and to what extent. The third type of information is actions such as washing or cooking that households may take to avoid foodborne hazards. The first two types of information are complements, whereas the third type of information may in some cases be a substitute for the other two (e.g., thoroughly cook all chicken and pork). This section examines potential market failures in production of these three types of information and their associated food attributes.

Health Hazards. In an unregulated market, households need to have information about the potential harmful effects of microbes, chemicals, and nutrients in order to make food consumption and preparation decisions that protect health. This information would include the effect of exposure to bacteria

such as *Salmonella* and environmental contaminants such as mercury in fish, and the level of exposure to nutrients such as fat, cholesterol, salt, sugar, caffeine, and alcohol that may harm health.

Can the unregulated market be expected to produce this health effects information? As it turns out, there are two different answers to this question, depending on the proprietary nature of the substance. Microbes, environmental contaminants, and excessive food nutrients are not proprietary. They may be present in foods or other vectors of human exposure, and food nutrients may be present in a wide range of foods. Thus, no one individual—producer or consumer—would be willing to produce the hazard information when others enjoy the benefits for free, so production of information on the hazards from microbes, environmental contaminants, and excessive intake of food nutrients is a nonmarket good. This naturally raises questions about the value of public production of food hazard information. There appears to have been little work on the value of public funding of research designed to produce health hazard information (Hammitt and Cave 1991 is one of the few studies), yet there would appear to be great gains from analyzing the value of public investment in this type of research.

In contrast, pesticides, animal drugs, and food additives are proprietary. They are developed and sold for intentional use in food production. Thus, the question is whether the unregulated manufacturer has an incentive to develop health effects information. The answer is they do, but only up to a point. To the extent that exposure to any of these substances has acute health effects, human experience with any product containing amounts sufficient to produce acute effects would quickly spoil the market, assuming, of course, that tort laws would apply to recoupment of damages. However, to the extent that exposure would produce substantially delayed health effects for which it would be extremely difficult to hold manufacturers accountable for damages, unregulated manufacturers would not have the incentive to produce the health risk information. Indeed, this is why government regulations requiring producers to develop this information are in place. An interesting and important question is to what extent this form of regulation actually produces reliable information. There have been media reports of fraud in animal testing of the chronic effects of pesticides, for example, suggesting that it would be useful to conduct research on the value of controls which might reduce fraud or negligence.

Even if the information on negative health effects is produced, it does not mean that it will be delivered to consumers or that they will be able to understand it. One of the key questions this raises is how effective the provision of information on the negative health effects of nutrients has been. Some studies have examined the effect of nutrition education programs on perceptions of the relationship between diet and health problems such as cardiovascular disease (Heimbach 1981, Levy et al. 1985). Economic research has focused on measuring the effects of negative information about nutrients such as fat and

cholesterol on food consumption (Brown and Schrader 1990, Capps and Schmitz 1991, Chang and Kinnucan 1991, Ippolito and Mathios 1991, Putler 1987, Putler and Frazao 1991). I am not aware of any estimates of the value of public provision of negative health effects information, however, with the exception of programs targeted at the poor.

Marginal Hazard Concentration. Suppose that health effects information were produced for both proprietary and nonproprietary food constituents. Can unregulated food markets be expected to distribute that information to consumers? The answer to this question hinges on the usefulness of the information to the consumer, which in turn depends on the availability of information about whether and to what extent particular foods contain each of the potentially harmful constituents. In other words, it is not particularly useful to know that *Salmonella* may make you ill if you cannot determine which foods are contaminated with *Salmonella*. Thus, the question becomes whether unregulated food markets will produce and provide information about the extent to which particular foods contain microbial contaminants, chemical additives, and potentially harmful nutrients.

The theory of asymmetric information suggests that the answer to this question is yes when consumers can link health problems to the food producer and no when consumers cannot make the link. In other words, since tort law will ensure that victims who can identify the guilty party will be able to make them pay, most accidents will be deterred, assuming that liability is sufficiently large. The question of how liability affects firm behavior has been addressed by some economists in the case of food safety (Caswell and Johnson 1991). However, estimates of the value to consumers of changes in liability for food safety are yet to be developed. Given recent cases of bacterial contamination of hamburger and dairy products this topic would seem to be a fruitful line for valuation research. One interesting question that arises in this area is the extent to which actual guilty parties can be identified given the increasing complexity of the food system.

Because the answer to the question is no in the case where health effects are delayed, hard to prove, or too minor to justify individual legal action, government involvement in information provision may be justifiable. However, there is the question of whether the type of government involvement should be to require food labeling or to require the establishment and enforcement of standards. The distinction between these two types of approaches to dealing with food safety and nutrition issues is important because they produce different types of goods, and, thus different types of benefits. Labeling requirements produce consumer information, and the benefits of this public action are determined by the value of the information to consumers. In contrast the establishment and enforcement of safety standards involves the public production of health protection, and the benefits of this public action are determined by the value of this health protection action to households. This value depends on the

health protection practices households would take in the absence of government regulation.

The question of whether the appropriate role of government is with respect to information or providing health protection actions has been answered differently for potentially harmful nutrients than it has been for food safety hazards. Nutrients must be labeled, but foods with potentially hazardous constituents have been subject to performance standards, process standards, and bans.

The main reason for the difference in treatment appears to lie with the fact that potentially harmful nutrients are necessary for health at some level. Because of asymmetric information problems, standards for nutrient labeling have been established (Caswell and Padberg 1992). An interesting question here is to what extent such labeling can be expected to be honest. Will adequate private enforcement of truth-in-labeling be forthcoming? If not, how much should be invested in public enforcement? To my knowledge, few studies have been conducted on this issue (Ippolito and Mathios 1991). While there has been some research on consumer utilization of label information, only a few studies have sought to examine the value of that information (Morgan et al. 1979, Padberg 1992, Caswell and Padberg 1992).

In contrast, most public programs with respect to microbes and chemicals provide health protection services (often called risk reduction) rather than requiring producers to provide consumers with information about product safety. The main justification for this approach is that it would be too costly to enforce the accuracy of the safety claims compared to directly controlling food handling practices and use of certain inputs such as pesticides. Consequently, a number of studies have sought to evaluate the benefits of public safety standards (Eom 1991, Gold and van Ravenswaay 1984, Hammitt 1986, Rae 1987, Roberts 1983, 1988, 1989, Roberts and Frenkel 1990, Roberts and Pinner 1990, van Ravenswaay 1992, van Ravenswaay and Hoehn 1991a, 1991b, 1991c). In the case of microbes, these standards are process or manufacturing standards that protect against microbe formation (note however that home food handling practices are addressed through public education programs). In the case of chemicals, these standards are generally tolerance levels that establish the safe dose. Other studies have sought to examine potential market implications of safety concerns (Jolly 1991, Malone 1990, McGuirk et al. 1990, Misra et al. 1991, Ott 1990, Ott et al. 1991, Weaver et al. 1992).

Producer benefits also result from any increase in consumer food demand that may result from public provision of health protection services. The increased demand results in a larger producer surplus. For example, limits on hazards in food establish consumer confidence in the safety of the food supply and increase demands for foods where scandals would have otherwise occurred. In fact, modern federal food safety laws are often attributed to efforts of the meat industry to restore demand following publication of Upton Sinclair's novel *The*

Jungle (Okun 1986, Sporleder et al. 1983). Several studies have attempted to estimate the impact of a loss of confidence on food demand in particular markets and estimate the impact on sales. For example, time series analysis of market demand data covering the period preceding and following food scares have sought to determine the impact of government actions on sales, and in some cases, consumer and producer welfare (Brown 1969, Foster and Just 1989, Johnson 1988, Schuker et al. 1983, Smith et al. 1988, Swartz and Strand 1981, van Ravenswaay and Hoehn 1991a). Purchase intention data from surveys have been used to estimate the potential impact on product demand of utilizing new animal drugs such as bST and pST (Douthitt 1990, Florkowski et al. 1989, Halbrendt et al. 1989, Halbrendt et al. 1990, Halbrendt et al. 1991, Kaiser et al. 1992, Preston et al. 1991). Many improvements on these methods are still needed to increase their usefulness in both welfare analysis and marketing research (see section below). Future research needs will depend on developments in food production and processing such as bioengineering.

Avoiding Hazards. It may be possible for consumers to reduce the marginal hazard concentration in foods. For example, pathogens in food such as *Salmonella* or *Trichina* may be destroyed by thorough cooking and exposure to those pathogens prior to cooking may be reduced by proper food handling. Fat may be removed during cooking. Some pathogens or pesticide residues on raw fruits and vegetables may be reduced by thorough washing. Moreover, some hazards in food may be created in the household and, thus, avoided by modified food handling. For example, refrigeration may be used to avoid growth of harmful bacteria, and proper heating can reduce bacterial contamination of home-canned and -frozen foods.

Production and provision of information on how a household may take actions to avoid and prevent hazards in food have public good attributes, unless they are associated with the purchase of hazard-reducing goods by the household. In the latter case, private incentives to produce and/or provide such information exist because the information boosts demand for the hazard-reducing good (e.g., use of bleach to sanitize cooking surfaces which reduces exposure to foodborne bacteria). Thus, unregulated production and distribution of this information may or may not be inefficient. This leads to questions about whether public production and distribution of this information is efficient, and, thus, to valuation research issues.

Implications of Changes in Food Production, Food Consumption, and Science

By identifying how unregulated markets might fail to provide information and food attributes that households need to maintain or protect health, researchers can identify generic categories of questions that valuation of food safety and nutrition might address. However, the specific research issues relevant at any point in time depend on changes in food production and

consumption technologies, as well as scientific understanding of the relationship between food attributes and health (Roberts and van Ravenswaay 1989).

New food production technologies may eliminate some existing hazards. For example, genetic engineering may make some pesticides unnecessary or change the nutrient content of some foods. Likewise developments in sensing and computing technologies may create new options for households in making dietary and food selection choices. But new hazards may be created as well as food markets become increasingly global and food more highly processed. These trends may make some existing food safety and nutrition programs unnecessary and new programs desirable, as well as alter the demand for food attributes and products. Both types of changes have implications for the type of policy and food marketing issues that valuation research should address. Some of these changes can be anticipated by examining developments in food production methods in particular industries and in food import trends. Other changes can be anticipated by examining developments in food consumption trends.

Changes in science will also create new research issues. Much is still to be learned about the relation between diet and health. The possible positive and negative effects of various nutrients on health is still being investigated. Understanding of microbiological pathogens is still being developed. The range of health effects of chemicals is still full of mysteries. As discoveries are made, policy and food marketing implications will follow. These policy and food marketing implications can be anticipated by examining developments in knowledge of health effects, incidence of food contamination, and human exposure in each of the different areas comprising food safety and nutrition.

Research Methods Issues

This section briefly reviews some of the methodological issues that underlie valuation of food safety and nutrition. In general, these issues are different depending on whether valuation research is addressing government regulation of market information and food attribute provision, government provision of nonmarket goods, or private marketing of information and food attributes.

One set of issues in examining valuation of improved information is the separation between information on health effects and information on the marginal attribute contribution of individual foods. The value of the latter type of information depends on possession of the former type of information. For example, requiring nutritional labeling does little good if consumers know nothing about the effects of nutrients on health. However, much of the public campaign to educate consumers (e.g., the food pyramid) has sidestepped these issues by directing consumers to consume certain types of food (fruits and vegetables) and avoid others (red meat and fried foods). In other words, these

programs instruct consumers on what types of health maintenance and health protection actions to take, rather than provide information that consumers can use to reach their own conclusions about which actions are best. Thus, there may be a connection in some consumers' minds between certain health risks and particular foods, rather than between food health risks and particular food attributes. This makes measurement of the benefits of improved nutrition labeling difficult since consumer behavior will be affected by both government actions.

An important methodological issue in examining the value of public health protection services is estimating the value of avoiding the illness or death of statistically anonymous individuals in the protected population. One question is whether it is reasonable to use savings in ex post costs such as pain and suffering, lost wages, and the medical expenses of obtaining the maximum possible cure to approximate an ex ante value of preventing illness. A second question is whether reliable measures of the ex ante value of preventing illness or death can be obtained from hedonic or contingent valuation studies. A key issue here is what health risk perception motivates health protection actions by households in the actual or contingent markets. For many food safety and nutrition issues, morbidity is more an issue than mortality. Yet the economic valuation literature has concentrated on mortality (Fisher et al. 1989, Cropper and Freeman 1991, Viscusi 1993). Research in the food safety and nutrition area will have to develop new methods to address morbidity risks.

Another important methodological issue in examining the value of public health protection services is identifying the range of benefits they provide. For example, reduced pesticide residues might have environmental benefits as well as food safety benefits. Public health protection services lower the cost to the household of providing its own health protection services. Reduced bacterial or pesticide contamination of foods means that households can dispense with certain preventative practices. Public health protection services also have benefits to food producers by increasing public confidence in the safety of their products. Measurement of these benefits involves examining the effect of public programs on changes in risk perceptions that ultimately affect food demand.

Valuation research conducted to inform marketing research seeks to answer questions about market demand for certain product attributes (e.g., reduced pesticide residues, fat, or cholesterol) or methods of production (e.g., organic or biotechnology). Marketing research questions may focus on estimating willingness to pay for these attributes, the size of the market, the type of product desired by food consumers, or the identity of different consumer segments. Demand for product attributes may be motivated by an underlying consumer choice problem regarding health protection services or it may be motivated by a number of other factors. For example, the demand for organic food may be affected by product quality, travel costs, environmental concerns, or health concerns related to both pesticide residues and nutrients. Demand for milk from

cows treated with bST may be affected by concerns about animal welfare, the survival of small family farms, or health. Demand for reduced pesticide residues may be motivated by concerns about the environment, farm worker safety, or health. Because demand for product attributes may be based on a number of factors, it is difficult to specify an underlying household production or consumer choice model. However, given the nature of the marketing questions such research seeks to answer, it may be enough to learn, for example, that consumers are or are not willing to pay for an increase or decrease in a particular food attribute, and not necessary to know why consumers are willing to pay. In this case, a model of consumer choice of product attributes may be adequate, especially if consumer tradeoffs among attributes, such as quality versus safety, are of interest.

Market research on food safety and nutrition issues currently falls into several categories. The largest category examines possible consumer reaction to new technologies such as irradiation, new animal drug use (e.g., bST and pST), and transgenic plants and animals. Another segment looks at the impact of concerns about fat and cholesterol on market demand for certain foods. Yet a third type of research has examined market demand for organic foods. Contingent valuation and related methods have been used to project consumer reaction to new food technologies, but little consensus has been achieved yet in how to design appropriate hypothetical market structures.

Conclusions

Systematic assessment of research needs requires an understanding of the key questions which define a research field and the extent to which existing research has answered those questions. This chapter sought to develop a description of the key questions that research on the valuation of food safety and nutrition should address and discussed some of the research that has been conducted to answer these questions. The key questions were identified by first examining the general questions that existing valuation research have sought to answer. Three types of research areas were identified: (1) benefit-cost analysis, (2) program evaluation, and (3) food demand and marketing analysis. The first area has concentrated on estimating the benefits of changes in food safety and nutrition policy. The second research area has focused on estimating the effectiveness of existing programs. The third area has looked at the impacts of changes in health and risk information on demand for existing and new food products.

Next, the chapter attempted to identify the types of issues that lead to the need for research in these three areas. The concept of market failures was used to identify generic ways in which our economic institutions create food safety and nutrition issues for consumers. To identify specific types of market failure,

the chapter examined the household production framework that has been used by researchers to understand how human health concerns impact the economic behavior of households. Three different types of health production activities were distinguished: health maintenance, health protection, and health rehabilitation. Each of these type of activities affects the utility of the household differently. More importantly, each of the activities requires different types of inputs in terms of information about food or actual physical attributes of food.

Unregulated markets can fail to efficiently provide these informational and physical inputs, thus, creating research issues on valuation of food safety and nutrition. For example, health maintenance activities require households to obtain certain types of food attributes, while health protection activities require the avoidance of certain food attributes. To obtain or avoid food attributes the household must have information about the health effects of food attributes needed to maintain or protect health and the marginal attribute concentration of each food. To avoid undesirable food attributes, the individual also needs information on actions that may be taken to reduce the marginal attribute concentration. The unregulated market may fail to provide efficient levels of food attributes or information. Market failure can occur because of the public good aspects of information as well as asymmetric information between producers and consumers. The specific ways that markets fail depend on the extent to which varieties of similar foods vary in attribute content and the degree to which a food is processed before reaching the consumer. The specific nature of market failures change over time as consumption and production technologies change. Furthermore, changes in scientific information can change the type of activities that households need to carry out in order to maintain or protect health. Thus, to identify future research needs, economists need to anticipate how changes in consumption, production, and science may affect the performance of food markets.

To address the different categories of valuation research, methodological improvements are needed. One methodological issue is determining the type of good that we want to value. For example, the value of some types of information depends on the availability of other types of information. Another methodological issue is the validity of willingness to pay measures when consumers are not fully informed. For consumer behavior in actual or contingent markets to reveal willingness to pay, we need to be able to measure the food attributes that consumers believe they are valuing rather than assume we know what they are valuing. This is particularly important in consumer decisions involving health risks, and, thus, a key issue for valuation research on food safety and nutrition.

Note

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