Staff Paper

RESEARCH NEEDS IN THE VALUATION OF FOOD SAFETY AND NUTRITION

by

Eileen van Ravenswaay

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Department of Agricultural Economics
MICHIGAN STATE UNIVERSITY
East Lansing , Michigan

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Research Needs in the Valuation of Food Safety and Nutrition, Eileen van Ravenswaay, Michigan State University

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 identitifying 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 is also presents a formidable task since it means exploring a much larger territory than my own comparatively narrow and familar 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 paper 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). 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 are inputs to these activities. Section three raises questions about how unregulated markets might fail to provide these food safety and nutritional informational inputs, and how these failures might change in response to developments in production and consumption technologies. The fourth section identifies some methodological valuation research needs that underly 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 policieis (Gramlich 1981). The objective of this analysis was to improve the allocation of public resources by providing policymakers 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 "biggest bang for the buck." Cost-benefit analysis was thus employed to analyze the consequences of policy alternatives that policymakers 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 were 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). The branch of this research of greatest relevance to food safety focussed on estimating the value of saving anonymous statistical lives (Fisher et al. 1989), with more recent work examining the value of reduced morbidity and symptom days (Cropper and Freeman 1991). 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 focussed 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.

Despite its many critics, probably no field of economics has been characterized by more creativity than nonmarket valuation research. Economists quickly developed the welfare theoretic concept of willingness to pay; that is, preferences for a public good are revealed by individuals' willingness to trade income for the good. Some of the questions addressed in the literature concern the nature of the public goods being produced by policies, the proper specification of demand for those goods, and the proper measure of the effect of changes in the supply on economic welfare. For example, should equivalent or compensating variation be used to derive the estimate of the change in welfare? To estimate demands for nonmarket goods, and, hence, changes in welfare,

economists exploited hedonic and household production models to find ways to reveal preferences for goods from existing market data. When appropriate market data was not available, they invented new ways to simulate market and voting behavior using hypothetical or experimental settings. These new methods raised new types of econometric identification and specification issues. As the body of empirical work grew, economists became interested in the question of the extent to which benefit estimates made in one policy context could be applied to another. For example, would an estimate of the value of reducing mortality risks from an occupational safety program be a valid estimate of the value of reducing mortality risks from a food safety program. This kind of question has come to known as a "benefits transfer" question.

This brief overview of the development of the field of valuation 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 goods are produced by government policies, how should the demand for those goods be estimated, and what is the appropriate measure of welfare change from a change in supply of those goods. Because these goods are not 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 valuation research has focused on providing benefit assessments for cost-benefit analysis, there are two other research areas that occasionally 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 Research Council 1989, Viscusi 1983, Viscusi and O'Connor). 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 new 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. In marketing research, both methods seek to assess consumer behavior toward goods that do not exist in current markets. However, these two methods seek to answer a very different question than valuation research applied to public policy. In marketing research, the questions are what product configuration needs to be produced for different market niches and how large is the market demand for that product. 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. Both types of research might involve estimating the demand for pesticide-free food, but would use different models and derive different types of estimates.

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 differs from environmental issues in terms of the types of institutional failures involved. Moreover, there are complementarities between the three 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 continued 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 incapcitation. 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 incapcitation the damage causes.

Note that these three types of classes of health protection activities affect the utility of the household differently, and thus have implications for modeling and analysis of welfare impacts of policy change. 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. Changes in 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. Changes in 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.

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 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 production activities 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 attibute 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 these types of information, thus creating policy issues which valuation research can help to address.

MARKET FAILURES

Economic logic holds that coercive public action may be justified if voluntary actions in 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 the household requires to produce health maintenance, protection, and rehabilitation. This section explores what some of these market failures might be, or at least raises the question for future reseachers to examine.

Health Maintenance and Market Failure

Information on 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. Obviously, this kind of information is produced through sophisticated research. Will an unregulated market produce and distribute the information that consumers are willing to pay for? 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, to the extent that the accuracy of the information cannot be verified by users, what incentives are there to produce accurate information? The benefits of verification are a public good because it is hard to exclude nonpayers from enjoying them.

These points suggest that research on the question of market failures in the production of nutritional requirements information and the benefits of public research should get some attention from policy researchers. Today's knowledge about nutritional requirements is by no means complete. For example, recent research has only just discovered that recommended folic acid intake during early pregnancy should be increased and there are proposals under consideration for requiring fortification of some foods. Questions have been raised about the accuracy of Recommended Daily Requirements for several other nutrients such as vitamines E, C, and A. Questions have also been raised about differences in nutritional requirements by gender and age level. If levels of other nutrients are in question, what would be the health benefits 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 could become more important in the future. However, to the best of my knowledge, economists have not analyzed resource allocation issues in the production of nutritional requirements information.

Another side to this issue is household acquisition of nutritional requirements information. To what extent do households acquire information about minimum nutritional requirements or related information on food consumption guidelines such as the food pyramid? What benefits accrue from publicly funded programs to increase acquisition by households? Some research has been directed at these issues, particularly in terms of nutritional educational programs targeted at poor households (Senauer 1982) and marginal valuation of nutrients by households (Capps and Schmitz 1991, Eastwood, Brooker, and Terry 1986, Ladd and Suvanunt 1976, Morgan et al. 1979).

Information on Marginal Nutrient Content of Foods

The second piece of information households need to produce health maintenance is the marginal nutrient contribution of each food. Can the market be expected to produce and provide 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 question still remains to what extent consumers might pay for the information to appear on individual products. To the extent that consumers purchase particular foods in order to ensure that they consumer *minimum* nutritional requirements, such information clearly has value (the value of information on nutrients to be avoided is discussed later).

However, 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 processors which provide high levels of nutrients would have more incentive to provide this information than processors that provide low levels would have the incentive to omit the information. Thus, consumers could to some extent distinguish between those foods that do or do not provide essential nutrients. However, comparison between foods and the construction of a nutritious diet is difficult if producers do not use similar formats or can use misleading formats. Thus, public requirement of a particular format appears to 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, 1990, Jacoby et al. 1977, Padburg 1992, Russo et al. 1986, Zarkin and Anderson 1992).

Health Protection and Market Failure

Information on Negative Health Effects

In order to protect health, households need to have information about the potential negative health effects of microbes, chemicals, and nutrients. For example, they would need to know about the effect of exposure to bacteria such as salmonella and environmental contaminants such as mercury in fish. They would need to know about the level of exposure to chemicals such as pesticides, animal drugs, or food additives that would cause illness. They would need to know about the effect of fat, cholesterol, salt, sugar, caffeine, and alcohol on health. Can the market be expected to produce this health effects information?

As it turns out, there are two different answers to this question, depending on whether the proprietary nature of the substance. Microbes, environmental contaminants, and 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 information when others enjoy the benefits for free, so production of information on the health effects of microbes, environmental contaminants, and food nutrients is a public good. This naturally raises questions about the economics of production of this information. There appears to have been little work on the value of producing health effects information (Hammitt and Caves is one of the few studies), yet there would appear to be great gains from analyzing 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 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, then manufacturers would not have the incentive to produce the health effects information. Indeed, this is why government regulation requires producers to develop this information is 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, but

no work on the value of controls which might reduce fraud.

Information on Marginal Hazard Concentration

Supposing that health effects information were produced for both proprietary and nonproprietary food constitutents. 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 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 large that liability should be in theory has been addressed by some economists in the case of food safety (Falconi and Roe 1991). However, empirical estimates 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 of 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 is 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.

The question of whether the appropriate role of government is with respect to information or providing health protection actions has been answered differently by legislators for potentially harmful nutrients than it has been for food safety hazards. Nutrients must be labeled, but foods with potentially hazardous constituents have been banned by either requiring certain food production practices handling practices and inspection to ensure they have been followed.

The main reason for the difference in treatment appears to lie with the fact that potentially harmful nutrients are often necessary for health at some level. Because of assymmetric information problems, standards for nutrient labeling have been established (Cawell 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). 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, Padburg 1992, Caswell and Padburg 1992).

Because the nutrient content of foods has been labeled, a related set of questions concerns the public provision of information about the negative health effects of nutrients. Providing such health effects information would hardly be worthwhile if consumers did not also have information about the marginal nutritional contribution of individual products. 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 1985, Levy et al. 1985). Economic research has focussed 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, 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.

In contrast, most public programs with respect to microbes and chemicals provide health protection services (often called risk reduction) rather than require 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 (Gold and van Ravenswaay 1984, Hammitt 1986, Rae 1987, Roberts 1983 and 1989, Roberts and Frenkle, 1990, Roberts and Pinner, van Ravenswaay 1992, van Ravenswaay and Hoehn 1991a,b,c). 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 (Huang, Misra, and Ott 1990, Jolly 1991, Malone 1990, McGuirk, Preston and McCormick 1990, Misra, Huang, and Ott 1991, Ott 1990, Ott, Huang, and Misra 1991, Weaver, Evans, and Luloff 1992).

Producer benefits 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, feeding programs and food stamps boost demand for some foods. Similarly, limits on hazards in food establish consumer confidence in the safety of 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 and estimate the impact on producers. This research has been done using market data following actual food scares (Joseph Brown 1969, Johnson 1988, Schuker et. al. 1983; M. Smith et al 1988, Swartz and Strand 1981) and survey data in the case of controversial new products (Doutthitt 1990, Florokowski et al. 1989, Halbrendt et al. 1989, Halbrendt et al. 1990, Kaiser et al. 1992, Preston et al 1991). However, no single estimate has been derived to measure producer benefits from increased consumer confidence in the safety of the food supply that is caused by government health protection programs.

Producers may also use health effects information to decide what quality control programs to develop, exposure information to decide where to concentrate quality control, and health protection

information to decide how to reduce exposure. Consequently, information provided by government research may reduce private research costs to food producers. This aspect of the value of food safety and nutrition has not yet been addressed in the literature, but may be important in understanding privately sponsored food safety and nutrition programs.

Information on Protection Provided By Food Nutrients

Some food nutrients may provide health protection services in addition to health maintenance. For example, recent research suggests that some vitamins are antioxidants that may provide protection against cancer-causing free radicals in the diet. This raises questions about the production of this information, its accuracy, and its distribution to consumers. Moreover, there is the question of whether any protective services offered by nutrients should be publicly provide, much like vaccines for infectious diseases. The rationale would be different, of course, since cancer is not infectious. However, given the large involvement of government in providing health insurance, the role of government in providing preventative health services may become increasing controversial. To my knowledge, valuation research has yet to examine these issues.

RESEARCH METHODS ISSUES

This section briefly reviews some of the methodological issues that underly valuation of food safety and nutrition. In general, these issues are different depending on whether valution research is addressing government controls on information provision or government provision of health protection services.

One set of issues that faces studies 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 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 nutritients on health. However, much of the public campaign to educate consumers 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 otherwords, these programs instuct consumers on what types of health protection actions to take, rather than on providing information so that the consumer can use to reach her own conclusions about which health protection 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 food labeling information difficult.

An important methodological issue in examining the value of public health protection services is estimating the value of avoiding 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, the medical expenses of obtaining the maximum possible cure to approximate an ex ante value of preventing illnesss. 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.

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. For example, public health protection services lower the cost to the household of providing its own health protection services. For example, 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 such as reduced pesticide residues, fat and cholesterol, or methods or 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. 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. In each of these areas, the focus is on consumer rather than producer behavior and values. Contingent valuation and methods have been used to project consumer reaction to new food technologies, but little concensus has been achieved yet in how to design appropriate hypothetical market structures.

FUTURE RESEARCH DIRECTONS

This paper has identified general questions that valuation research has typically addressed. By identifying certain types of questions about how unregulated markets might fail to provide information that households need to maintain or protect health, this paper has identified some general categories of questions that valuation of food safety and nutrition might address. The specific issues in each of these categories that are likely to gain public attention depend on changes in food

production and consumption technologies.

New food production technologies may eliminate some existing hazards. For example, genetic engineering may make some pesticides unnecessary or change the nutrient context 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 desireable. Both types of changes have implications for the type of issues that valuation research should address. Some of these changes can be anticipated by examining developments in food production methods in particular industries and or in food import trends. Other changes can be anticipated by examining developments in food consumption trends.

Changes in science will also create new 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 be investigated. Understanding of microbiological pathogens is still be developed. The range of health effects of chemicals is still full of mysteries. As discoveries are made, policy implications will follow. These policy 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.

REFERENCES

Asch, Peter. 1988. *Consumer Safety Regulation: Putting a Price on Life and Limb*. New York: Oxford University Press.

Bailey, Martin J. 1980. *Reducing Risks to Life: Measurement of the Benefits*. Washington, D.C.: American Enterprise Institute.

Bentkover, Judith D., Vincent T. Covello, and Jeryl Mumpower. 1986. *Benefits Assessment: The State of the Art*. Boston: D. Reidel Publishing Company.

Braden, John B. and Charles D. Kolstad, eds. 1991. *Measuring the Demand for Environmental Quality*. New York: Elsevier Science Publishers B.V. (North-Holland).

Brown, Deborah and L. Schrader. 1990. Information on Cholesterol and Falling Shell Egg Consumption. *American Journal of Agricultural Economics* 72(1):48-55.

Brown, Joseph. D. 1969. Effect of a Health Hazard Scare on Consumer Demand. *American Journal of Agricultural Economics* 51:676-78.

Byrne, Patrick J., Conrado M. Gempesaw II, and Ulrich C. Toensmeyer. 1991. An Evaluation of Consumer Pesticide Residue Concerns and Risk Information Sources. *Southern Journal of Agricultural Economics* 23(2):167-174.

Capps, Jr., Oral and J. D. Schmitz. 1991. A Recognition of Health and Nutritional Factors in Food

Demand Analysis. *Western Journal of Agricultural Economics* 16(1):21-35.

Caswell, Julie (Ed.). 1991. *The Economics of Food Safety*. New York: Elsevier Science Publishing Co., Inc.

Caswell, Julie A. 1992. Current Information Levels on Food Labels. *American Journal of Agricultural Economics* 74(5):1196-1201.

Caswell, Julie A. and Daniel I. Padberg. 1992. Toward a More Comprehensive Theory of Food Labels. *American Journal of Agricultural Economics* 74(2):460-468.

Chang, Hui-Shung Chang and Henry W. Kinnucan. 1991. Advertising, Information, and Product Quality. *American Journal of Agricultural Economics* 73(4):1195-1202.

Cropper, Maureen L. and A. Myrick Freeman III. 1991. Environmental Health Effects. In *Measuring the Demand for Environmental Quality*, eds. Braden, John B. and Charles D. Kolstad, 165-211. New York: Elsevier Science Publishers B.V. (North-Holland).

Daly, P. 1976. The Response of Consumers to Nutritional Labeling. *Journal of Consumer Affairs* 10:170-178.

Douthitt, Robin. 1990. Biotechnology and Consumer Choice in the Market Place: Should There be Mandatory Product Labelling? A Case Study of Bovine Somatotropin and Wisconsin Dairy Products. Presented at the Second International Conference on Research in the Consumer Interest, Snowbird, Utah (August 9-11, 1990). University of Wisconsin, Madison, Department of Consumer Science.

Ferguson, Allen and E.P. LeVeen, eds. 1981. *The Benefits of Health and Safety Regulation*. Cambridge, MA: Ballinger Publishing, Co.

Fisher, Ann, L.G. Chestnut, and D.M. Violette. 1989. The Value of Reducing Risks of Death: A Note on New Evidence. *Journal of Policy Analysis and Management* 8(1):88-100.

Florokowski, W. J., C. L. Huang, and Brian Goggin. 1989. Attitudes Towards Porcine Somatotropin: A Consumer Survey of the Atlanta Metropolitan Area. The Georgia Agricultural Experiment Station, College of Agriculture, The University of Georgia. Research Report 570.

Foster, William and Richard E. Just. 1989. Measuring Welfare Effects of Product Contamination with Consumer Uncertainty. *Journal of Environmental Economics and Management* 17:266-283.

Gramlich, Edward M. 1981. *Benefit-Cost Analysis of Government Programs*. Englewood Cliffs, NJ: Prentice-Hall, Inc.

Halbrendt, Catherine, Conrado Gempesaw, Richard Bacon, and Lesa Sterling. 1991. Public Perceptions of Food Safety in Animal-Food Products. *Journal of Agribusiness* 9(1):85-96.

*****CHECK VOL #Halbrendt, Catherine, L. Sterling, C. Gempesaw, W. Florkowski, and C.L. Huang. 1989. Public Attitudes in the Northeast Region Toward Recombinant Porcine Somatropin. *Journal of Food Distribution Research* February: 153-163.

Halbrendt, Catherine, W. Florkowski, L. Sterling, C. Huang. 1990. Socioeconomic Determinants of Attitudes Toward the Use of Bioengineered Products in Food Production. Department of Food and Resource Economics, University of Delaware.

Hammitt, James. 1986. *Organic Carrots: Consumer Willingness to Pay to Reduce Food Borne Risks*. Santa Monica: The RAND Corp. R-3447-EPA.

Hammitt, James K. and Jonathan A. K. Cave. 1991. *Research Planning for Food Safety: A Value-of-Information Approach*. Santa Monica, CA: The RAND Corp.

Hammonds, Tim. 1985. Public Attitudes Toward Food Safety. *Agribusiness: An International Journal* 1(1):33-43.

Heimbach, James T. 1981. Yesterday, Today and Tomorrow: Consumer Perceptions of Food Safety. Washington, D.C.: Division of Consumer Studies, Bureau of Foods, U.S. Food and Drug Administration.

Huang, Chung L., Sukant Misra, and Stephen L. Ott. 1990. Modeling Consumer Risk Perception and Choice Behavior: The Case of Chemical Residues in Fresh Produce. Presented at the Second International Conference on Research in the Consumer Interest, Snowbird, Utah (August 9-11, 1990). Division of Agricultural Economics, College of Agriculture, University of Georgia, Faculty Series FS-90-17.

Ippolito, Pauline M. and A. D. Mathios. 1990. Information, Advertising, and Health: A Study of the Cereal Market. *Rand Journal of Economics* 21(3):459-480.

Jacoby, Jacob, R. W. Chestnut, and W. Silberman. 1977. Consumer Use and Comprehension of Nutritional Information. *Journal of Consumer Research* 4:119-128.

Johnson, F. Reed. 1988. Economic Cost of Misinforming About Risk: The EDB Scare and the Media. *Journal of Risk Analysis*. 8:261-269.

Jolly, Desmond A. 1991. Differences Between Buyers and Nonbuyers of Organic Produce and Willingness to Pay Organic Price Premiums. *Journal of Agribusiness* 9(1):97-111.

Kaiser, Harry M., C. W. Scherer, and D. M. Barbano. 1992. Consumer Perceptions and Attitudes towards Bovine Somatotropin. *Northeastern Journal of Agricultural and Resource Economics* 21(1):10-20.

Kramer, Carol S. 1990. Food Safety: The Consumer Side of the Environmental Issue. *Southern Journal of Agricultural Economics* 22(1):33-40.

Lave, Lester B. 1981. *The Strategy of Social Regulation: Decision Frameworks for Policy.* Washington, D.C.: The Brookings Institution.

Levy, Alan S., O. Mathews, M. Stephenson, J. E. Tenney, and R. E. Schucker. 1985. The Impact of a Nutrition Program on Food Purchases. *Journal of Public Policy and Marketing* 4:1-13.

Malone, John. 1990. Consumer Willingness to Purchase and Pay More for Potential Benefits of Irradiated Food Products. *Agribusiness: An International Journal* 6(2):163-178.

McGuirk, Anya M., W. P. Preston, and A. McCormick. 1990. Toward the Development of Marketing Strategies for Food Safety Attributes. *Agribusiness: An International Journal* 6:297-308

Misra, Sukant K., C. L. Huang, and Stephen Ott. 1991. Consumer Willingness to Pay for Pesticide-Free Fresh Produce. *Western Journal of Agricultural Economics* 16(2):218-227.

Morgan, Karen J., E. J. Metzen, and S. R. Johnson. 1979. A Hedonic Index of Breakfast Cereals. *Journal of Consumer Affairs* 6:67-75.

National Research Council. 1987. *Regulating Pesticides in Food.* Washington, D.C.: National Academy Press.

National Research Council. 1989. *Improving Risk Communication.* Washington, D.C.: National Academy Press.

Okun, Mitchell. 1986. *Fair Play in the Marketplace: The First Battle for Pure Food and Drugs.* Dekalb: Northerm Illinois University Press.

Ott, Stephen L. 1990. Supermarket Shoppers' Pesticide Concerns and Willingness to Purchase Certified Pesticide Residue-Free Produce. *Agribusiness: An International Journal* 6(6):593-602.

Ott, Stephen L., C.L. Huang, S.K. Misra. 1991. Consumer Perceptions of Risks from Pesticide Residues and Demand for Certification of Residue-Free Produce. In *The Economics of Food Safety*, ed. Julie Caswell, 175-188. New York: Elsevier Science Publishing Co., Inc.

Padburg, Daniel. 1992. Nutrition Labeling as a Policy Instrument. *American Journal of Agricultural Economics* 74(5):1208-1212.

Preston, W.P., A.M. McGuirk, and G.M. Jones. 1991. Consumer Reaction to the Introduction of Bovine Somatotropin. In *The Economics of Food Safety.* Julie Caswell, 189-210. New York: Elsevier Science Publishing Co., Inc.

Putler, Daniel S. 1987. The Effect of Health Information on Shell Egg Consumption. University of California, Berkeley, Department of Agricultural and Resource Economics Working Paper.

Putler, Daniel S. and Elizabeth Frazao. 1991. Assessing the Effects of Diet/Health Awareness on

the Consumption and Composition of Fat Intake. In *Economics of Food Safety*, ed. Julie Caswell, 247-270. New York: Elsevier Science Publishing Co., Inc.

Rae, Douglas. 1987. Risks of Consuming Pesticide and Fungicide Additives: Perceptions and Behavior of Organic Food Consumers. Final Report to the U.S. Environmental Protection Agency Benefits Staff. (Douglas Rae, 36 Gage Street, Neecham, MA 02192).

Ricardo-Campbell, Rita. 1974. *Food Safety Regulation: A Study of the Use and Limitations of Cost-Benefit Analysis*. Washington, D.C.: American Enterprise Institute for Public Policy Research.

Roberts, Tanya. 1983. Benefit Analysis of Selected Slaughterhouse Meat Inspection Practices. University of Wisconsin, Agricultural Experiment Sation, NC-117 Working Papers Series.

Roberts, Tanya. 1988. Salmonellosis Control: Estimated Economic Costs. *Journal of Poultry Science* 67:936-943

Roberts, Tanya. 1989. Human Illness Cost of Foodborne Bacteria. *American Journal of Agricultural Economics* 71(2):468-474

Roberts, Tanya, and J. K. Frenkle. 1990. Estimating Income Losses and Other Preventable Costs Caused by Congenital Toxoplasmosis in People in the United States. *Journal of the American Veterinary Medicine Association* 96(2):249-256.

Roberts, Tanya and Eileen van Ravenswaay. 1989. Effects of New Scientific Knowledge on Food Safety Policy. *Agricultural-Food Policy Review: U.S. Agricultural Policies in a Changing World*. Washington, D.C.: Economic Research Service, U.S. Department of Agriculture. Agricultural Economic Report No. 620.

Russo, J. Edward, R. Staelin, C. A. Nolan, G. J. Russell, and B. L. Metcalf. 1986. Nutrition Information in the Supermarket. *Journal of Consumer Research* 13:48-69.

Schucker, R. E., R. C. Stokes, M. L Stewart, and D. P. Henderson. 1983. The Impact of the Saccharin Warning Label on Sales of Diet Soft Drinks in Supermarkets. *Journal of Public Policy and Marketing* 2:46-56.

Senauer, Benjamin. 1982. The Current Status of Food and Nutrition Policy and the Food Programs. *American Journal of Agricultural Economics* 64(5):1009-1016.

Smith, M.E., E.O. van Ravenswaay, and S.R. Thompson. 1988. Sales Loss Determination in Food Contamination Incidents: An Application to Milk Bans in Hawaii. *American Journal of Agricultural Economics* 70(3):513-520.

Sporleder, Thomas L., Carol Kramer, and Donald J. Epp. 1983. Food Safety. In *Federal Marketing Programs in Agriculture: Issues and Options*, eds. Walter J. Armbruster, Dennis R. Henderson, and Ronald D. Knutson, 269-304. Danville, IL: The Interstate Printers and Publishers.

Swartz, D.G. and I.E. Strand, Jr. 1981. Avoidance Costs Associated with Imperfect Information: The Case of Kepone. *Land Economics* 57:139-150.

Zarkin, Gary A. and Donald W. Anderson. 1992. Consumer and Producer Responses to Nutrition Labeling Changes. *American Journal of Agricultural Economics* 74(5):1202-1207.

van Ravenswaay, Eileen. 1992. Public Perceptions of Food Safety: Implications for Emerging Agricultural Technologies. In *Volume 2: An New Technological Era for American Agriculture--OTA Commissioned Background Papers, Part E: Food Safety and Quality*, ed. U.S. Office of Technology Assessment. Springfield, VA: National Technical Information Service.

van Ravenswaay, Eileen O. and Marion S. Gold. 1984. *Methods for Assessing the Economic Benefits of Food Safety Regulations: A Case Study of PCBs in Fish*. East Lansing, MI: Michigan State University, Department of Agricultural Economics, Agricultural Economic Report No. 460.

van Ravenswaay, Eileen O. and John P. Hoehn. 1991a. The Impact of Health Risk on Food Demand: A Case Study of Alar and Apples. In *The Economics of Food Safety*, ed. Julie Caswell, 155-174. New York: Elsevier Science Publishing Co., Inc.

van Ravenswaay, Eileen O. and John P. Hoehn. 1991b. Contingent Valuation and Food Safety: The Case of Pesticide Residues in Food. East Lansing, MI: Department of Agricultural Economics, Michigan State University, Staff Paper No. 91-13.

van Ravenswaay, Eileen O. and John P. Hoehn. 1991c. Willingness to Pay for Reducing Pesticide Residues in Food: Results of a Nationwide Survey. East Lansing, MI: Department of Agricultural Economics, Michigan State University, Staff Paper No. 91-18.

van Ravenswaay, Eileen O., Jennifer Wohl, and John P. Hoehn. 1992. Michigan Consumers' Perceptions of Pesticide Residues in Food. East Lansing, MI: Department of Agricultural Economics, Michigan State University, Staff Paper No. 92-56.

Viscusi, W. Kip. 1983. Predicting the Effects of Food Cancer Risk Warnings on Consumers. *Food Drug Cosmetic Law Journal* 43:283-307.

Viscusi, W. Kip and and Charles O'Connor. 1984. Adaptive Responses to Chemical Labeling: Are Workers Bayesian Decision Makers. *American Economic Review* 74:942-956.

Viscusi, Kip, W., Wesley A. Magat. and Anne Forrest. 1988. Altruistic and Private Valuations of Risk Reduction. *Journal of Policy Analysis and Management* 7(2):227-245.

Weaver, Robert D., David Evans, and A.E. Luloff. 1992. Pesticide Use in Tomato Production: Consumer Concerns and Willingness-to-Pay. *Agribusiness: An International Journal* 8(2):131-142.