

EMERGING DATA ISSUES IN APPLIED FOOD DEMAND ANALYSIS

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TABLE OF CONTENTS

	<u>Page</u>
Characteristics of Supermarket Scan Data and Their Implications for Applied Demand Analysis. David B. Eastwood.....	1
Uses of Supermarket Scan Data in Demand Analysis. Oral Capps, Jr. ....	21
Pooled Time-Series and Cross-Section Data from the Consumer Expenditure Survey. Wen S. Chern and Ben Senauer.....	46
Current Issues in Consumption Data: Food Away From Home Data. Vickie A. McCracken, David W. Price, and Dorothy Z. Price.....	64
Food Safety/Food Quality Data. Helen H. Jensen and Peter Basiotis.....	91
CSFII and HFCS Data: Issues, Problems and Needs. Mary Y. Hama.....	111
Federal Food and Nutrition Program Data Sources. Margared S. Andrews and David Smallwood.....	122

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#### **EDITORS' NOTE**

This Tennessee Experiment Station Bulletin is the edited collection of seven papers presented by members of the Changing Patterns of Food Consumption (S216 Regional Committee) at a 1993 Workshop held by the Regional Committee. They focus on a variety of emerging issues associated with data sets used in applied demand analysis. These pertain to topics that are not discussed in the extant literature but are quite germane to the extension of empirical models of food consumption.

## FOOD SAFETY/FOOD QUALITY DATA

Helen H. Jensen and Peter Basiotis<sup>1</sup>

The increased scientific evidence that diet choices affect illness risks as well as consumers' expressed preferences for foods which are safe and associated with good health indicate the importance of attributes of food in predicting consumer food choices. Indeed, five of the ten leading causes of death are diet-related (Surgeon General's Report 1988). Thus, food components and attributes related to food safety need to be recognized explicitly in studies evaluating consumption decisions of households. They can be used especially to explain "unexplained" changes in food demand over the last several decades.

For foods, the attributes most often identified to influence consumption decisions are, in no particular order, nutritive value (e.g., nutrients, fiber, cholesterol, fat, etc.), nutritive "qualities" (percent of calories from fat, percent of recommended dietary allowances met, etc.), appearance (without blemish, for example), taste, convenience, packaging, and, recently, safety. The safety attributes include those associated with the product (no detectable pesticide residue) or the production process (organically grown, grown without artificial hormones, no irradiation treatment, etc.).

A recent workshop identified many issues and approaches to measuring and valuing food safety and food qualities for the purpose of obtaining information on consumer demand for the related non-market goods (NE-165). The *Proceedings* volume from the workshop provides a very useful overview of many issues involved in estimating consumers' valuations of food safety, and much of the current research underway related to this topic. The bulk of the research reported in the workshop was based on data from specialized surveys and addressed issues of survey design. For many purposes, conducting specialized surveys is the only feasible way of obtaining needed data. However, for many other purposes, existing surveys of market purchases (expenditures) and similar surveys are appropriate and useful. A recent

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article by Roberts and Smallwood (1991) provides a broad overview of data needs to address economic issues in food safety and includes both the producer and consumer sides of the market.

This presentation is organized around three major uses of consumption data related to food safety and food quality. The approach allows one to distinguish among the unique issues related to data used for different purposes. The three major data uses are

- (1) understanding food choices and food consumption behavior,
- (2) developing and designing regulatory and monitoring programs to assess consumer risk and exposure to food-borne hazards, and
- (3) establishing values for the non-market goods.

Clearly, the three are often closely related uses of data, but the distinction does allow for some structure to an emerging plethora of data. The purpose of this report is to review and evaluate current data sources and approaches to data collection as they relate to food safety and quality.

### **Data on Food Choices and Food Consumption Behavior**

#### **General Issues**

Traditional economic models of demand and consumption behavior explain demand by economic factors (prices and income), household or individual demographics, and underlying preferences, which might be conditioned on factors such as education or region. Economic factors have been found to be important determinants of food demand. In many cases, the traditional models work well for obtaining estimates of traditional demand parameters.

Over the last twenty-five years or so, however, the traditional economic demand models have done less well at explaining food consumption patterns and demand, particularly when food attributes appear to play a role in the food choices. Attempts to address this situation have included nontraditional models to explain food consumption patterns. These nontraditional models include Lancaster's product characteristics (1966), Becker's household production models (1965), or models out of the social-psychological disciplines (e.g., Azjen-Fishbein 1980). These theoretical frameworks address

more directly the process of choice where food attributes are important determinants in food demand. In fact, the food attributes themselves may enter directly into the consumer's utility function (Lancaster).

A result of increased attention to food attributes has been renewed interest in defining, measuring, and maintaining data on the attributes of interest in order to explain food demand and food-related behaviors. This includes the ability to group retail foods by product characteristics (convenience meats, low-fat cuts of meat, etc.), as well as specific attributes of interest (pesticide-free produce, saturated fat in product groups).

Economists' interest in foods of different qualities is not a new phenomenon. Work by Waugh in the 1920s evaluated price differentials for different grades of vegetables. Nor is food safety a new consumer issue. What does appear to be new, however, is the confluence of new models and a new focus on noneconomic determinants of food demand and food choices, particularly related to food quality and safety characteristics.

As mentioned earlier, the importance of diet in maintaining good health and preventing costly diet-related diseases has been long recognized. The links to diet have received considerable attention in recent times, as the population ages and health has, and will probably continue to command, a growing share of the gross national product. The linkages among food choices and outcomes are often complex, and the government has a vested interest in providing good nutrition-related information to consumers.

If, for example, people avoid eating some foods because of a false perception that they are not safe, they could be making a costly mistake, both in personal and social terms. Consuming a variety and relatively large quantities of vegetables, for example, may decrease the risk of some cancers, but the public may be concerned at the same time because of media stories of pesticide residues. On the other hand, if people are consuming food that rightly poses a health risk, because of inadequate information or ability to assess the risks correctly, then, again, the result may be costly both to the

individual and to society. This is a major reason for the increased public attention to the consumer's food choice process. A good example is the recent report by the National Academy of Science on the risks facing children especially to pesticide exposure (National Research Council). Such attention leads to greater public awareness of the food safety issue and the need for more and better dietary data related to pesticide intake.

#### **The CSFII and DHKS**

Data sources which contain information on both dietary, health or food safety concerns and actual dietary intakes and other food behaviors, are uncommon. In addition to specialized, small-scale surveys, a newly available national data source is the USDA's Continuing Surveys of Food Intakes by Individuals (CSFII) which measure food and nutrient intakes, and their concomitant Diet and Health Knowledge Surveys (DHKS), which measure knowledge and attitudes related to diet and health, including food safety concerns, attitudes and practices.

The first of these combined surveys was conducted in 1989. It continued to 1990 and 1991. The survey design was such that each year's data would be nationally representative and could be used independently. The three years combined would provide a larger sample size. The three year combined sample should be available early in 1994. The 1994-96 CSFII/DHKS is scheduled to go into the field in January of 1994. It will be similar to the 1989-91 CSFII/DHKS but with some considerable evolutionary changes.

Because of the importance of these relatively new surveys, this data set is considered in greater detail here. A brief description of the types of information that are available in the data sets is provided, and some of the food safety related questions asked of respondents are presented.

The CSFII provides ongoing data on food and nutrient consumption with a yearly sample of about 2,000 households or about 5,000 individuals. In the 1989-91 CSFII, three days of food and nutrient intake data were obtained along with relevant demographic, economic, and health-related data. In particular, the usual cost of food for the three months prior to the interview was



obtained.

The DHKS is a follow up to the CSFII. The person identified as the main meal planner/preparer in each household participating in the CSFII was contacted by telephone about six weeks after the food intake data were collected. About 1,900 main meal planner/preparers participate in the DHKS. They answer a 30-minute questionnaire related to their nutrition knowledge, attitudes, and food safety concerns. About 80 percent of the DHKS sample is female, and about 20 percent male. In the 1989-91 DHKS there were several specific questions relating to food safety.

While this is a unique data source over this period for food safety information, some questions on the DHKS questionnaire were changed for each year of the survey. Questions were added, dropped or modified. As a result, the numbering of questions on each year's questionnaire was affected, and, of course, it becomes more difficult to track directly changes in knowledge, attitudes, and information over the period. The DHKS (record type 50) file format was designed to fit all three years of data. In order to provide a unique naming convention, the questions were re-numbered and somewhat re-ordered. In cases where the text of a question was modified only slightly between years and the meaning was deemed to be the same, the response was placed in the same position on the record.

Appendix A includes copies of the specific questions and data related to food safety in the 1989-91 DHKS and of specific food safety questions from the 1994 DHKS. The type of questions on food safety are similar to those on nutrition and diet-health linkages. As can be seen from the questions reported in Appendix A, the first section relates to consumer attitudes about the adequacy of current food safety protection from health risks, attitudes about the importance of food safety, use of product labels and how the consumer seeks out information. In 1989 there was a set of questions on natural and organic meat products and household food handling procedures. These last two areas of questions were replaced with related, though different, ones in 1990 and 1991.

The important feature of the CSFII/DHKS data is that all of this information on the food safety and quality aspects can be linked to information on the household composition and demographics and individual food and nutrient intakes.

Although the 1994 DHKS contains more limited food safety information than the earlier surveys, it contains new information on food handling practices related to fruits and vegetables (included as the last page of Appendix A), and the 1994 CSFII contains information on whether each food consumed by individuals was home grown. (This unique information is extremely important as a risk factor in exposure assessment. The only other national surveys to contain this type of information were the 1977-78 and the 1987-88 Nationwide Food Consumption Surveys, but only for food disappearing from the household food supply.) Those interested in obtaining information on the current and planned DHKS/CSFII can contact Dr. Ellen Harris or Dr. Lori Borrud of the Human Nutrition Information Service, USDA (301-436-8485).

### **Caveats**

The newly available CSFII/DHKS data sets can provide a wealth of new and useful information. A few noted problems or cautions are in order, however. First, the information in the 1989-91 DHKS is collected only from one individual in the household (the main meal preparer). Although there is food and nutrient intake data available for all members of the household, totally satisfactory models or methods for explaining or linking the attitudes and information of one person in the household to all individuals are not available. The "gate keeper" notion provides some rationale for this linkage, but existing studies of intra-household distribution of food in the United States have been inconclusive (e.g. Montalto 1992).

A second problem is that these national data surveys are designed to monitor and describe food patterns in the general population. If the need is to obtain data on very specific food items (e.g., kumquats) or for a subpopulation (African-American teenagers, young children), the sample size and reported information may not be sufficient. In these cases, appropriate

information is more likely to come from a specialized survey. Of course, this will be more costly.

Finally, some types of information which are useful to analysis of consumer behavior are not available. For example, the lack of detailed questions on subjective evaluations of relative risks may limit the application of some economic models of choice under uncertainty.

There are a few other related food safety surveys to mention. One, by Market Facts, Inc. in 1990 included questions on foods and food ingredients related to health and cancer (what foods and specific ingredients might make someone more likely to get-or not get-cancer). This survey is not public and does not include detailed food intake data. Another survey, not yet available, is the Food and Drug Administration's 1993 Survey of Consumer Food Handling Practices and Awareness of Microbial Hazards.

#### **Regulatory and Monitoring Program Uses**

The purpose here is not to review all types of data used for regulatory and monitoring uses, but rather, to highlight some of the data-related issues in food safety and food quality which are tied to complementary uses of data for the purpose of regulatory or monitoring programs. First, effective regulatory or monitoring programs related to food consumption or food safety require good information on food related behaviors. That is why there is considerable research underway both inside and outside of government to understand consumer food choices and behaviors. Here, one good example is understanding how consumers use food labels (e.g., who reads them, do they affect food choices). This is a reason why the government collects such information, as shown in Appendix A from the 1989-91 DHKS.

Other types of information are needed to compare risks among alternative sources of risk. For regulatory purposes, often choices need to be made between alternative "risky" exposures. Not only is good scientific evidence needed, but also the consumer's subjective evaluation of the alternative risks. In many cases, consumers' ranking of risks differs from the scientific evidence. In these cases, ways of better informing consumers, or weighing the

respective rankings and evaluations are needed for decisions about regulations and alternative risk strategies.

And finally, for some needs, and here especially in food safety, good data which allow monitoring or identifying exposure levels from intake of specific foods or food components are often not available. In part, this is because the survey design or sample size required is too large or costly to conduct on a recurring basis. When the data are required, for example for intake of seafood products, special surveys may be designed and conducted (National Marine Fisheries Service 1986a and 1986b). Also, many of the exposure etiologies are very complex and would be very demanding on any survey. For example, salmonella risk may depend not only on eating patterns related to poultry products, but the individual's age, physiological state, the source of the poultry, food handling both before and after the retail purchase, and cooking. Diet-health relationships are also quite complex. Especially in the food safety area, neither the data needs nor the required data collection procedures are well identified.

#### **Valuation Uses**

As mentioned earlier, the recent workshop on "Valuing Food Safety and Nutrition" directly addressed the different methods and data sources used to obtain values for these non-market goods. When product attributes are important determinants of food choices, Lancaster's model, or hedonic estimation techniques have often been used to distill values associated with product characteristics. Where applicable, the hedonic methods are quite useful because they use market transactions to value the food attributes. Application of hedonic methods requires objectively measured attributes associated with the food products.

Often the attribute of interest is not observed directly...such as the safety of a food (or chance that this food will cause health problems). In this case, data on self-protective activities (including time costs of self-protective food preparation, for example) might be used. Most of such data would come from specially designed surveys.

Another type of valuation methodology is obtained through contingent valuation exercises. Again, this is often used in specially designed surveys where the respondent is asked to value how much he or she would be willing to pay for pesticide free product, etc. The designs have grown to be quite sophisticated. The difficulty, however, is that the framing of questions about the problem or nonmarket good and the hypothetical nature of the design often lead to the respondents not revealing true preferences, including inconsistent, and possibly inflated values. Experimental methods have been introduced recently which allow the researcher more direct experimental control over the respondents' resource allocation and information. Recent examples in the food area are Buhr et al. (1993), Menkhaus et al. (1992), and Shogren et al. (1994).

The data valuing food safety are extremely valuable for comparing the benefits and costs of various government programs and regulatory initiatives. They can help in determining the allocation of research and regulatory resources. However, again, because of the specialized nature of the specific question, and because the data on self-protective or time use are not available (to date) in on-going national surveys, the data available here are most often through specialized, one time surveys. A major problem with such an approach to data collection is that the information may not be able to be replicated, nor calibrated with other data sources. Furthermore, often the numbers estimated are in fact grossly out of line when extrapolated to the regional or national levels.

Currently, there is a great need for clarifying the data required and approaches to obtaining the necessary data to value food safety and food qualities. A good source of guidance in doing this may be earlier developments in valuing natural resources and the use of related nonmarket goods. However, it is apparent from evidence available in studies on food safety that there continues to be a unique need for data and information about how consumers make choices when evaluating alternative (and daily) risks and benefits from diets.

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## Appendix A

## 1989-91 DHKS QUESTION NUMBERING REFERENCE

		QUESTIONNAIRE NUMBER		
		1989	1990	1991
F7J	Current laws adequately protect me from eating foods with dangerous amounts of pesticide residues in them	-	8j	8j
F7K	The health risks of pesticide residues in food are well understood	-	8k	8k
F7L	Pesticides should not be used on crops grown for food because the risks are greater than the benefits	-	8l	8l
	1 - Strongly disagree			
	2 -			
	3 -			
	4 -			
	5 -			
	6 - Strongly agree			
	When shopping for food, how important is?	17	20	23
F21A	Product safety	17a	20a	23a
F21B	Nutrition	17b	20b	23b
F21C	Price	17c	20c	23c
F21D	How well the food keeps	17d	20d	23d
F21E	Ease of preparation / how easy the food is to prepare (1991)	17e	20e	23e
F21F	Taste	17f	20f	23f
	1 - Not at all important			
	2 -			
	3 -			
	4 -			
	5 -			
	6 - Very important			

## 1989-91 DHKS QUESTION NUMBERING REFERENCE

		QUESTIONNAIRE NUMBER		
		1989	1990	1991
	How often do you use the following information from labels?	-	21	24
F23A	List of ingredients	-	21a	24a
F23B	Statements about health benefits	-	21b	24b
F23C	Calories per serving	-	21c	24c
F23D	Sodium content	-	21d	24d
F23E	Vitamin or mineral content	-	21e	24e
F23F	Fiber content	-	21f	24f
F23G	Fat content	-	21g	24g
F23H	Cholesterol content	-	21h	24h
F23I	Sugar content	-	21i	24i
F23J	Defrosting instructions	-	21j	24j
F23K	Cooking instructions	-	21k	24k
F23L	Recipes	-	21l	24l
F23M	Storage instructions	-	21m	24m
	1 - Often			
	2 - Sometimes			
	3 - Rarely			
	4 - Never			
F24	How often do you compare nutrients for different brands of the same food?	19	22	25
	1 - Always			
	2 - Sometimes			
	3 - Rarely			
	4 - Never			
F25	When comparing nutrients, are differing serving sizes a problem?	20	23	26"
	1 - Very much a problem			
	2 - Somewhat of a problem			
	3 - Not at all a problem			



## 1989-91 DHKS QUESTION NUMBERING REFERENCE

		QUESTIONNAIRE NUMBER		
		1989	1990	1991
F26	In general is your concern about food safety?  1 - Higher now than a year ago 2 - Lower now than a year ago 3 - About the same as a year ago	-	24	27
	When buying food items do you?	21	-	-
F27A	Read the ingredient list when buying the item for the first time	21a	-	-
F27B	Read the ingredient list when you've bought the item before	21b	-	-
F27C	Read the ingredient list when the label changes on an item that you've bought before  1 - Always 2 - Sometimes 3 - Rarely 4 - Never	21c	-	-
F28	Have you ever asked what the ingredients of already prepared foods are?  1 - Yes 2 - No 3 - Never buy prepared foods	22	-	-
F29	Have you ever written or called a manufacturer of a meat or poultry product for information not on the label?  1 - Yes 2 - No 3 - Never eat meat or poultry	23	-	-

## 1989-91 DHKS QUESTION NUMBERING REFERENCE

		QUESTIONNAIRE NUMBER		
		1989	1990	1991
	In your opinion, what is the difference between natural (version 1) or organic (version 2) meat and meat not so labeled?	25	-	-
F30A	Natural/organic meat is more nutritious	25a	-	-
F30B	Natural/organic meat has less fat	25b	-	-
F30C	Natural/organic meat has nothing artificial added	25c	-	-
F30D	Natural/organic meat has been grown with no hormones or other drugs	25d	-	-
F30E	Natural/organic meat has not been processed or has been processed only a little	25e	-	-
F30F	There is no difference	25f	-	-
F30G	Natural/organic animals are grain fed or fed natural/organic products	25g	-	-
F30H	Natural/organic is a nonmeat product or not "real meat"	25h	-	-
F30I	Something added	25k	-	-
F30J	Other	25i	-	-
	1 - Yes 2 - No			
	How often do you follow suggestions on the labels of raw meat or poultry products for?	26	-	-
F31A	Defrosting suggestions	26a	-	-
F31B	Cooking suggestions	26b	-	-
F31C	Recipes	26c	-	-
	1 - Always 2 - Sometimes 3 - Rarely 4 - Never			

## 1989-91 DHKS QUESTION NUMBERING REFERENCE

		QUESTIONNAIRE NUMBER		
		1989	1990	1991
F32	How often do you follow storage suggestions on the labels of processed meat or poultry products?  1 - Always 2 - Sometimes 3 - Rarely 4 - Never 5 - Do not buy processed meat products	27	-	-
F33	How important is to you to know how much water has been added to meat or poultry products?  1 - Very important 2 - Somewhat important 3 - Not at all important	28	-	-
F34A	Have you eaten a hot take-out meat dish in the last seven days?  1 - Yes 2 - No	29	-	-
F34B	Source of the last take-out meat dish?  1 - Fast-food restaurant 2 - Other restaurant 3 - Delivery service 4 - Supermarket or grocery store 5 - Specialty store 6 - Convenience store 7 - Other	30	-	-
F34C	How long after you got it did you eat it?  Response is actual time in minutes	31	-	-

## 1989-91 DHKS QUESTION NUMBERING REFERENCE

		QUESTIONNAIRE NUMBER		
		1989	1990	1991
F34D	Before eating it, where did you keep it?	32	-	-
	1 - At room temperature			
	2 - Refrigerator			
	3 - Warm place			
	4 - Other place			
	Do you consider the following safe or not safe?	33	25	28
F35A	/ Foods that have been treated with radiation	33a	-	-
	\ Foods that have been treated by irradiation	-	25a	28a
F35B	Meat from animals that have been given antibiotics at approved levels	33b	25b	28b
F35C	Meat from animals that have been given hormones at approved levels	33c	25c	28c
F35D	Foods made at home with raw eggs such as homemade ice-cream or mayonnaise	33d	25d	28d
F35E1	Eating raw beef	33e	-	-
F35E2	Eating very rare beef	-	25e	28e
F35F	Meat that has nitrite	33f	25f	28f
F35G	Meat that has been both cooked and refrigerated at the store	33g	-	-
F35H	Foods grown using pesticides at approved levels	-	25g	28g
F35I	Fruits and vegetables that have been coated with wax	-	25h	28h
F35J	Foods that may contain pesticide residues in legal amounts	-	25i	28i
F35K	Foods containing additives or preservatives	-	25j	28j
F35L	Foods with artificial coloring	-	25k	28k
F35M	Imported foods	-	25l	28l
F35N	Cooked fish	-	25m	28m
F35O	Raw shellfish like oysters and clams	-	25n	28n
	1 - Safe			
	2 - Not safe			

## 1989-91 DHKS QUESTION NUMBERING REFERENCE

		QUESTIONNAIRE NUMBER		
		1989	1990	1991
F36	Which of the following concerns you the most?  1 - Drug residues in animal products 2 - Pesticide residues on fruit and vegetables 3 - Bacteria and parasites in foods 4 - Food additives 5 - Not concerned about any of the above	-	26	29
F37A	Do you ever buy store-prepared foods containing meat or poultry from supermarkets?  1 - Yes 2 - No	34	27	30
F37B	How much does the cleanliness of a store influence your purchase of such foods from that store?  1 - A lot 2 - A little 3 - Not at all	35	-	-
F37C	How safe do you consider store-prepared compared with home-prepared foods?  1 - More safe 2 - As safe 3 - Less safe	36	28	31

## 1994-96 DHKS FOOD SAFETY RELATED QUESTIONS

38. Before you eat fresh fruits and vegetables, do you or does someone else wash them always, sometimes, rarely, or never?

ALWAYS (ALMOST ALWAYS)	. . . . .1
SOMETIMES	. . . . .2
RARELY	. . . . .3
NEVER.	. . . . .4
DON'T KNOW	. . . . .8
DO NOT EAT FRESH FRUITS/ VEGETABLES.	. . . . .0 (Q42)

89. When you eat fresh fruits with peels that can be eaten, do you eat the peel always, sometimes, rarely, or never?

ALWAYS (ALMOST ALWAYS).	. . . . .1
SOMETIMES	. . . . .2
RARELY	. . . . .3
NEVER.	. . . . .4
DON'T KNOW	. . . . .8

40. When you eat fresh vegetables with peels that can be eaten, do you eat the peel always, sometimes, rarely, or never?

ALWAYS (ALMOST ALWAYS)	
SOMETIMES.	. . . . .2
RARELY	. . . . .3
NEVER.	. . . . .4
DON'T KNOW	. . . . .8

41. Do you eat the outer leaves of leafy vegetables like lettuce and cabbage?

YES.	. . . . .1
NO	. . . . .2
DON'T KNOW	. . . . .8
DO NOT EAT LEAFY VEGETABLES.	.0