Policy Implications for U.S. Agriculture of Changes in Demand for Food

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Changes in the Nutritive Valuation of Selected Food Products, 1977-78 and 1987-88: Preliminary Findings

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Consumers in the United States have become increasingly aware of and concerned about the amounts of fat, cholesterol, sugar, sodium, and fiber in their food diets. Also of concern is the availability of certain vitamins and minerals in the foods they consume. This trend toward increased nutritional interest is supported by the actions of food producers, processors, and eating establishments, who currently devote a substantial portion of their advertising budgets to stress the nutritional quality of their food products, with the goal of selling their products to consumers.

Coupled with the changing nutritional concerns of consumers are other socioeconomic and demographic trends that directly or indirectly affect the quantity of food consumed and the quality and variety of the diets of the U.S. population. In particular, the size and age-sex composition of the households, the number of households with multiple wage earners, the geographic location of households, the racial and ethnic mix of the population, and per capita incomes have changed. These changes have been accompanied by alterations in the food-eating patterns and dietary status of consumers. Identifying and understanding the factors affecting consumer behavior are keys to rapid and efficient adjustment to changing consumer food demands.

Traditionally, economists have approached the analysis of consumer demand by assuming that the prices of market goods sold at a specific time and place are predetermined. Theoretically, the assumption of predetermined prices is reasonable. For example, the consumer enters a grocery store and decides whether or not to purchase a particular product at the price charged by the grocer. Based on this premise, consumer demand can be estimated with the quantity of a good dependent on prices, income, and sociodemographic information. Unfortunately, this traditional approach to consumer demand provides little insight into the tastes and preferences of consumers. Several economists (e.g., Gorman 1956, Lancaster 1966, and Hanemann 1982) have proposed specifying a utility function with both market goods and the measurable characteristics of the goods as arguments. One of the structural relationships that results from maximization of such a utility function is commonly referred to as a hedonic price function. These functions have the price of a good as the dependent variable, and measurable characteristics of the good, socioeconomic and demographic variables,

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and income (or expenditure) as the independent variables. The coefficient estimates yield information about the implicit values of the characteristics.

Economic theory alone is inadequate in identifying and specifying which characteristics of food to include in a hedonic price function. In the absence of an adequate conceptual framework, food characteristics must be specified and their values interpreted on a purely ad-hoc basis. Therefore, in addition to economic theory, this research will use need theory and learning theory from psychology and concepts from anthropology and nutrition in order to develop models for empirical analysis.

Analyzing food products in the framework of hedonic price function allows producers, processors, and policymakers to focus on specific aspects of a product by identifying the value of food characteristics (e.g., vitamins or minerals). For example, a number of years ago the cereal industry was criticized for producing products with very little nutritional value other than energy. This led to the fortification of cereal products with vitamins and minerals. More recently, concern over fiber in the diet has led to increased emphasis on bran products. The current recommendations to increase the consumption of oat bran in order to decrease cholesterol have led to the introduction of a wide variety of products containing oat bran. By knowing the value of various product characteristics, cereal producers have better insight into the characteristics most important to consumers.

The purpose of this research is to present, interpret, and compare empirical hedonic analyses of the consumer valuation of characteristics in food for three food groups: breakfast cereals, dairy products, and meats. The individual hedonic analyses are based on a general framework for empirically analyzing consumer valuation of characteristics in food. The empirical models will be based on data from the household portion of the 1977-78 and 1987-88 Nationwide Food Consumption Surveys (NFCS).

Theoretical Framework

The conceptual model developed for use in this study is based on a synthesis of the existing body of economic literature pertaining to characteristic-based consumer choice (e.g., Gorman 1956, Lancaster 1966, and Hanemann 1982). A fundamental premise underlying the model is that consumers derive utility, or satisfaction, from the levels of food product characteristics of food product consumed, and not from food products per se. In addition, it is assumed that attitudes regarding the level of need by individuals within a household determine the particular form of that household's utility function

Consumers are assumed to maximize the utility derived from the product characteristics subject to an expenditure constraint and the technical relationship between the product and its characteristics. The solution to this maximization problem yields the following hedonic price function. This function relates the price paid for a food item to the values assigned to the various food characteristics contained in the item as (see Lenz 1989)

$$P_i = \sum_{j=1}^{n_i} b_j(c)z_{ij} + h_i(c) \qquad (1)$$

where

P_i is the price of the ith food item per unit of quantity

z_{ij} is the amount of the jth characteristic contained in a unit of the ith food item

b_j is the implicit value of a unit of the jth characteristic, as perceived by the household

c is a vector of household sociodemographic characteristics used to represent differences in utility functions, and hence in the values of characteristics, across different household types

h_i is a value unique to the particular food item analyzed, representing particular taste, habit, and other characteristic aspects of consuming food item i that are not explicitly represented by the food characteristics z_{ij}, $j = 1,..., n_i$

Several issues must be discussed before a specific hedonic price function can be defined for estimation purposes. First, the term good or product will be used to refer to a food item as it exists for sale in the marketplace (e.g., one gallon of 2 percent milk, Brand x). A commodity is an aggregate bundle of goods that are close substitutes and that have the same quantity measure or can be converted to a common measure (Cramer, 1973) (e.g., fluid milk products). A food group is a collection of commodities (or goods) that are similar from either a nutritional or marketing perspective (e.g., protein sources or dairy products, respectively).

Consider the notion of separability. It is assumed that preferences for food characteristics are separable from preferences for nonfood characteristics. This separability implies that the consumption of food characteristics can be analyzed independently of the consumption of nonfood characteristics. However, "independently" should not be interpreted literally—consumption of nonfood products uses income that takes money away from money available to be spent on products in the group of food products. The essence of the separability assumption is that the household can rank preferences for food independently of preferences for nonfood items. This means that household food consumption can be represented as the outcome of maximizing that portion of the utility function devoted to food characteristics, subject to the household's budget allocation for food consumption. A further issue is whether separability applies to various groups of commodities contained within the overall food group. For example, are meat commodities separable from breakfast cereals? If so, this would imply that the amount of fat consumed from meat commodities would not affect the preference for fat contained in breakfast cereals. In the empirical specification of the model, the issue is whether values assigned to characteristics of food commodities within a certain food group are affected by the levels of food characteristics obtained from consuming food commodities within other food groups.

Another issue is the market context in which commodity and characteristic prices are determined. Since the hedonic price functions are homogeneous of degree one in commodity prices and food expenditures, if all commodity prices and food expenditures were to change by a given percentage, then the characteristic values assigned by a household would change by the same percentage. Thus, if there are regional differences in the prices of food commodities and in the level of food expenditures, regional effects on food characteristic values should be included in the hedonic price equation.

Regional differences in the values of characteristics can also stem from acquired differences in taste, tradition, and culture. Thus, in an interregional hedonic analysis, interregional differences in characteristic valuation should be specified. The functional form of such differences cannot be anticipated and must remain an empirical question.

Another issue is the way in which supply and demand interact to determine characteristic values. If it is relatively inexpensive to produce a given characteristic, that characteristic may have relatively low value from a supply price perspective. For example, it is relatively inexpensive to fortify breakfast cereals with vitamins, and the cost increment to the supply price of cereals would be minimal. However, consumers may place high value on a characteristic, irrespective of its cost to produce. The scarcity or overabundance of the level of a characteristic from the perspective of a given consumer can cause a disequilibrium to exist between the supply price of a characteristic and the implicit valuation of the characteristic by the consumer. Such a disequilibrium is sustainable in the short run, since only a finite variety of goods are available in the marketplace, the goods are generally indivisible and/or sold in predetermined quantities, and goods represent bundles of characteristics in fixed proportions sold at a given price. Characteristics are not priced separately, nor can the good be broken down into characteristics and repackaged to provide characteristics in different proportions. Thus, estimated hedonic "prices" of characteristics should not be interpreted as (implicit) market prices of characteristics per se, but rather are individual consumer valuations of characteristics.

Food characteristics can be divided into two general sets: nutrients and non-nutrients. Nutrient levels are assumed to be objectively measured. For this model, even though nutrient valuations may differ by households, it is assumed that the nutrient content of food products is perceived the same by all households. The relationship between food products and nutrient levels is assumed to be proportional. It is further assumed that nutrients from different foods within a food group are perceived by the household to have a common implicit value, whereas nutrients from foods in different groups may be perceived to have differential values. For example, the value of a gram of protein from a rib roast is perceived by the household to be of equal value to a gram of protein originating from chuck steak, but it is possible that a gram of protein obtained from breakfast cereals is valued differently.

Certain non-nutrient characteristics such as taste or cultural affinity are not easily measured for food products. Others, such as convenience, texture, and type of processing are measurable. Household characteristics are included in the model to control for heterogeneity in the valuation of the non-nutrient characteristics across different household types. This is accounted for by the hi(c) term in the hedonic price equation. The measure of commodity-specific characteristics is related to the concept of specific effects introduced by Pudney (1981).

A final consideration is the level of disaggregation at which the analysis is performed. Data are not available at the good or product level from the consumption survey; that is, observations on the consumption of two percent milk, Brand x, or hot dogs, Brand z, are not contained in the data set. The analysis must therefore be performed at the aggregate commodity level, such as "soft cheese" or "ready-to-eat breakfast cereals." Thus, observations on prices correspond to weighted average prices (or unit values) for aggregate commodities, and observations on food characteristics represent weighted average quantities per pound. Prices of food items that actually affect consumer decisions are at the level of disaggregation that corresponds to the items that households actually choose. The relationship between the theoretical model of the hedonic price function and what is observed within an aggregate commodity is

$$\bar{P} = \sum_{i=1}^{m} w_i P_i = \sum_{i=1}^{m} w_i \left(\sum_{j=1}^{n_i} b_j(c) z_{ij} + h_i(c) \right)$$

$$= \sum_{j=1}^{n_i} b_j(c) \left[\sum_{i=1}^{m} w_i z_{ij} \right] + \sum_{i=1}^{m} w_i h_i(c) \qquad (2)$$

$$= \sum_{j=1}^{n_i} b_j(c) \bar{z}_j + \bar{h}(c)$$

where w_i is the share of the aggregate commodity quantity that is represented by good i. The coefficients of the nutrient variables measure the implicit values of the various nutrients. The non-nutrient characteristic term, $\bar{h}$ (c), measures (non-nutrient) quality differences among the goods within the aggregate food commodity to the extent that quality differences are measured by the differing prices for the goods contained within the commodity. The success of this measure depends on how well the quality of goods within a given food commodity are differentiated by price levels.

Model

The hedonic price function for all food groups contains both nutrient and non-nutrient components. The function for the meat group also includes a quantity component to explicitly model nonconstant marginal utility as the level of consumption of the commodity changes. The model for each food group is estimated using household observations on food items within the aggregated commodity. The dairy and meat food groups contain a number of separate commodities, while the cereals food group contains the single commodity, cereals. This, along with basic differences in the commodities themselves, affects how the non-nutrient characteristics are modeled. For cereals, the non-nutrient characteristics are measured by dummy variables and are included directly in the hedonic price function, whereas for dairy and meat products the non-nutrient characteristics are included indirectly as functions of sociodemographic and economic variables. The specific nutrients included in the models differ across food groups, reflecting the differing relative importance of a nutrient in each of the food groups. Fat and protein are included in all models. The models differ also in terms of the specification of socioeconomic and demographic variables.

Equation (2) is expressed in a general functional form, and the specific functional form used varies by food group. For cereals, nutrients are included as nonlinear terms and interact with selected sociodemographic variables. The model was estimated using the linear method of ordinary least squares (OLS). The models for dairy and meat products are highly nonlinear and are estimated using the method of nonlinear least squares. An important difference between the specifications for dairy and meat food groups is that the latter restricts the non-nutrient component of the function to vary systematically across commodities. A final difference in specification is related to separability. In the cereal and meat models, the food group being analyzed was assumed to be weakly separable from other food groups. The dairy model, however, includes measures of household intake of fat, protein, and calcium from foods outside of the dairy group.

Empirical Analysis

The hedonic function was specified and estimated for the breakfast cereals, and dairy products, as well as the red meats, poultry, and fish products groups separately by using the spring quarter of the household portion of the 1977-78 NFCS data. For each group, the function specified for the 1977-78 NFCS was re-estimated with the 1987-88 NFCS data. The general components of the hedonic function for each food group include: (1) nutrients, (2) non-nutrient product characteristics, and (3) household socioeconomic characteristics.

Breakfast Cereals

The specific nutrients and dietary components included for breakfast cereals were energy, fat, protein, calcium, vitamin C, and a principal component that included riboflavin, thiamine, and niacin. The principal component for the three nutrients was included since these nutrients were highly collinear. Vitamin A and iron were also included in preliminary models estimated with the 1977-78 data, but they were deleted later because of lack of significance. Since the effects of the nutrients were hypothesized to be nonlinear, the square roots of the nutritional variables were used. This resulted in slightly higher R^2 values than the linear form, giving some empirical credence to the hypothesis.

The non-nutrient cereal characteristics include the type of grain, the type of processing (hot or ready-to-eat), variety or regular pack, grits, cooking time for the hot cereals, addition of fruit or nuts, and pre- or nonsweetened. These characteristics represent aspects of both convenience and taste. Cooking time is obviously a measure of convenience. Since the household could add sugar and fruit and/or nuts, this is also an aspect of convenience. It would be time-consuming for the household to duplicate the flavor of many of the presweetened cereals. The other characteristics are aspects of taste.

Any analysis of prices should include as many variables as possible to control for factors causing price variation other than the characteristics of the product. Region and store size are obvious choices. Also, large households are able to use larger packages, which sell at a lower price. Households with higher incomes are better able to purchase smaller, more convenient packages. For this analysis we assume separability between food and nonfood items, and hence the total value of food and not income appears in the hedonic price function. In order to account for variations in the total value of food caused by variations in household size and composition, this variable was placed on an adult equivalent basis, using the scales estimated by Price (1988). Race (black) and Spanish origin were included to measure differences in prices paid by these groups.

The dependent variable, price, was measured as price per pound. Since 81 percent of the households used breakfast cereals in the spring of 1977, OLS was used to obtain estimates. One could argue that OLS yields biased estimates with this amount of truncation. However, the techniques used to overcome OLS bias are sensitive to multicollinearity, and multicollinearity among the nutrients is a problem in the model. In order to compare results between the two sample periods, the coefficients for 1977-78 were adjusted by the CPI for cereals, so that estimated implicit prices were on a 1987-88 basis.

The coefficients for all nutrient variables were significant at the 0.07 level for both periods (Table 1). The signs were all positive except for fat (1977-78 and 1987-88) and vitamin C (1987-88). The positive relationships for vitamins and protein were also found by Morgan (1987). However, she found a negative relationship for energy. The exclusion of fat from her model may be one cause of the different results.

The value of energy and vitamin C decreased between the two sample periods, while the value of the principal component of other vitamins increased. The values for fat, protein, and calcium were similar between the two periods.

Interactions between selected nutrients and region were included in the model to measure differences in consumer nutrient evaluations. In 1977-78 there were no significant differences in the regional values for energy. However, with the 1987-88 sample the value of energy was significantly lower in the West than in the other regions. The value of protein was significantly lower in the West in both periods. In 1977-78, the value of calcium was lower in the West and Northeast than in the South and North Central regions; in 1987-88 it was highest in the West

Interactions between energy and household size and between presweetened and household size were also included in the model. Both were statistically significant at the 0.01 level in 1977-78 but neither was significant at the 0.05 level in 1987-88. The increased value of presweetened cereals for larger households (more likely with children) with the 1977-78 sample reflects the common observation that these cereals are preferred more by children than by adults. With the adoption of more of the presweetened cereals by adults by the 1987-88 period, the value of presweetened for the small households increased to a level comparable to that of large households. Energy was valued less by larger households with the 1977-78 sample, but this interaction was not significant with the 1987-88 sample.

The 1977-78 adjusted sample mean price per pound of cereal was 1.65 cents. The contribution of energy was 87 cents. (This was computed for the "average" region and "average" household size). The contribution of the other nutrients was relatively small with protein contributing 5 cents; fat, –3 cents; calcium, 6 cents; vitamin C, 2 cents; and the principal component, 8 cents.

In contrast, the values in 1987-88 were 32 cents for energy, 4 cents for protein, –4 cents for fat, 9 cents for calcium, –3 cents for vitamin C, and 22 cents for the principal component. In the 1977-78 sample the total value for vitamins and minerals was 13 cents; in contrast it was 28 cents with the 1987-88 sample. The values for energy, protein, and fat totaled 89 cents in 1977 and 32 cents in 1987-88.

The finding that the largest portion of the value of breakfast cereal was due to energy's value can be interpreted as satisfying the basic need of hunger. Breakfast may be viewed as a time to obtain the energy necessary to perform the morning activities. The positive values for vitamins and calcium and the negative values for fat reflect concerns for health. The decline in the consumers' valuation over the ten-year period reflects the increased concern over our high calorie intake. One would have expected the value of fat to decline, but as breakfast cereal is typically not a high fat product, fat in breakfast cereal has not received much publicity.

The increased preference for granola type cereals, which have a higher fat content, may have countered the increased concern over high fat intake. This preference may be highest in the West, which would explain the West's zero value for fat.

The value placed on convenience is measured by the estimated positive values for variety pack, and the negative values estimated for the less convenient forms of hot cereal. The coefficients for these variables

Table 1. Comparison of the estimated hedonic functions between 1977-78 and 1987-88 NFCS surveys for cereals

Variable	1977-78 NFCS Coefficient	1977-78 NFCS t-ratio	1987-88 NFCS Coefficient	1987-88 NFCS t-ratio
Intercept	–1.2994	(–3.18)	0.1107	(0.19)
Nutrient:				
Energy	0.0600	(6.08)	0.0243	(1.80)
Protein	0.0211	(1.91)	0.0279	(1.87)
Fat	–0.0285	(–2.79)	–0.0290	(–2.33)
Calcium	0.0108	(4.15)	0.0093	(6.45)
Vitamin C	0.0033	(2.06)	–0.0062	(–3.50)
Principal Component	0.0843	(4.69)	0.2264	(6.07)
Grain:				
Rice	0.4309	(15.17)	0.4791	(18.22)
Bran	0.2316	(4.36)	0.2224	(4.26)
Multigrain	0.2680	(7.89)	0.3117	(9.77)
Oats	0.0828	(–1.55)	–0.1859	(–4.91)
Wheat	0.3011	(8.92)	0.1731	(5.23)
Processing:				
Puffed	0.2809	(8.09)	0.4684	(18.14)
Shredded	–0.1969	(–4.61)	0.1375	(4.93)
Nugget	0.3584	(3.98)	0.8421	(14.64)
Rolled	0.3510	(2.34)	0.3443	(3.69)
Other Cereal Characteristics:				
Presweetened	0.0407	(0.76)	0.2124	(4.50)
Fruit and/or Nut	0.1728	(4.29)	0.0945	(3.82)
Variety Pack	1.5126	(25.98)	2.7549	(27.28)
Hot Nongrits	–0.1040	(–1.22)	–0.0228	(–0.45)
Grits	–0.0645	(–0.79)	–0.1900	(–3.03)
Hot Regular	–0.4330	(–6.03)	–0.7417	(–16.09)
Hot Quick	–0.6486	(–9.82)	–0.7587	(–17.45)
Hot Oats	0.1962	(2.57)	0.2448	(5.48)
Region:				
Northeast	0.4739	(0.13)	0.3029	(0.55)
North Central	0.3268	(0.93)	–0.2698	(–0.52)
West	–0.2107	(–0.51)	1.4426	(2.54)
Household Size	0.5994	(2.49)	0.3358	(0.96)
Store Size:				
Small	0.0707	(2.48)	0.1092	(2.29)
Other	–0.1565	(–4.74)	–0.1182	(–2.42)
Spanish Origin	0.0591	(2.11)	0.1157	(2.86)
Interaction Terms:				
Energy—Northeast	–0.0018	(–0.82)	–0.0065	(–0.51)
Energy—North Central	–0.0088	(–0.30)	0.0112	(0.93)
Energy—West	0.0121	(0.22)	–0.0255	(–1.95)

(continued)

Table 1. Continued

Variable	1977-78 NFCS Coefficient	t-ratio	1987-88 NFCS Coefficient	t-ratio
Protein—Northeast	0.0219	(1.59)	–0.0047	(–0.26)
Protein—North Central	–0.0075	(–0.58)	–0.0243	(–1.41)
Protein—West	–0.0454	(–2.60)	–0.0709	(–3.41)
Fat—North Central	0.0187	(1.48)	–0.0088	(–0.62)
Fat—Northeast	–0.0013	(–0.09)	0.0042	(0.28)
Fat—West	0.0220	(1.53)	0.0331	(1.99)
Calcium—Northeast	–0.0077	(–2.42)	0.0023	(1.38)
Calcium—North Central	–0.0031	(–1.08)	0.0019	(1.24)
Calcium—West	–0.0061	(–1.86)	0.0040	(2.20)
Energy—Household Size	–0.0165	(–2.78)	–0.0098	(–1.16)
Presweetened—Household Size	0.1071	(2.97)	–0.0130	(–0.37)
Value of Food per Adult Equivalent	0.0018	(4.08)	0.0018	(3.46)
	R-square = 0.423		R-square = 0.528	
	F = 75.17		F = 157.60	
	n = 4662		n = 6394	

The 1977-78 hedonic results are inflated by 183.68% to 1987-88 dollar values according to CPI for cereals.
Note: Nutrient values are square roots.

showed an increased value placed on convenience between the two time periods, as expected.

The coefficients for the type of grain and the type of processing show rice and puffed to be valued significantly higher than the excluded categories, corn and flaked. The value of puffed relative to flaked increased over the ten-year period. Rice and puffed are associated with the "light" type of food that has become popular in recent years. This is associated with being thin and active. The value of corn and oat cereal is lower than that for bran, wheat, and multigrain. The decline in the value of oat cereal over the ten-year period was unexpected. The recent publicity over oat bran appears not to have affected the 1987-88 values.

In the 1977-78 sample the value for shredded was significantly less than that for flaked. This has been discussed by Lyman (1989). He found that people like textures that are regular and familiar. However, the 1987-88 sample value showed shredded to be significantly higher valued than flaked. Nugget and rolled cereals also are higher valued than flaked with the relative value of nugget increasing over the ten-year period. Nugget and rolled products are newer types of cereals. These have been portrayed positively by the advertising industry as being the thing for active, healthy people to eat. Overall, the processing coefficients show a decline in the value of flaked relative to the other types. This suggests that consumers are placing a higher value on the traditionally less common types of processing. They value the "new and different."

The value of hot instant cereal is not significantly different than the values of corn and flakes. Hot instant is an excluded category. The difference between hot instant and the excluded values for corn and flakes is measured by the variable, hot nongrits.

However, the value of instant hot oats was significantly higher in both periods. It is obvious from watching TV commercials that advertising attempts to portray oatmeal as a "comfort" or "back to home and mother" food. This attempt appears to have been successful.

Dairy Products

Four dairy commodities were analyzed: (1) beverage milk, consisting of whole milk, low-fat milk, and skim milk; (2) cheddar and American-style cheeses, consisting of both natural and processed cheeses; (3) soft cheeses, consisting of cream cheese, cottage cheese, and cheese spreads; and (4) specialty cheeses, consisting of swiss, parmesan, camembert, limburger, brick, blue, gouda, and mozzarella. At the outset of the modeling effort, we analyzed nutrient characteristics including protein, fat, calcium, and various combinations of vitamins and other minerals. In the final analysis, only protein, fat, and calcium exhibited significant implicit values.

The initial specification of the empirical model included more than 70 sociodemographic and economic variables. The model was estimated using the method of nonlinear least squares utilizing 6,351 observations on household consumption of the four aggregate dairy commodities in the 1977-78 analysis, and 3,115 observations in the 1987-88 analysis. A series of accumulated joint hypothesis tests were performed on the 1977-78 hedonic model, and this culminated in deleting 34 variables from the model using a 0.10 probability of Type I error criterion. The final functional form obtained for the 1977-78 model was also applied to model the 1987-88 data, and hedonic values in the former case were inflated by 152.37%, as indicated by the CPI for dairy products, in order to place the two sets of implicit values on a comparable 1987 dollar basis.

In the non-nutrient segment of the model, the coefficient for black households consuming beverage milk indicates that these households paid a higher price per pound for this commodity in 1977-78 than did nonblack households (Table 2). This price differential became insignificant in 1987-88. The coefficients for black households consuming the cheddar and specialty cheese commodities indicate that these households also paid lower prices per pound for these two commodities than did nonblack households in 1977-78. This may have been due to black households choosing lower-valued products within these aggregates. These price differentials also became insignificant in 1987-88.

The negative value of estimated coefficients on household size (measured as natural logarithm) may indicate the presence of economies of size in consumption for the four aggregate commodities. This effect may also indicate that larger households choose lower-valued cheeses in part because of budget limitations. The commodity for which household size has the smallest negative effect is beverage milk. The individual products within this commodity are generally available in only a limited range of package sizes and exhibit limited quality and price variation. The negative effect is much stronger for the cheddar and specialty cheeses. Significant savings can be realized when larger packages of these types of cheeses are purchased. The estimated household economies of size coefficient for the soft cheese commodity is smaller than those of the other two cheeses. Since the products within the soft cheese commodity are generally available in a relatively small range of package sizes, economies associated with the purchase of larger package sizes are limited. The negative impact of household size on commodity value per pound is uniformly and notably larger in the 1987-88 period for households in the base region-zone compared to the 1977-78 level.

The coefficients of the logarithm of household food expenditures indicate that, as food expenditures increase, higher per-pound prices are paid for each of the aggregate commodities. With other factors held constant, higher food expenditures can be expected to allow for the purchase of higher quality products. The relatively small magnitude of the estimated coefficient for the beverage milk commodity is consistent with the small price differences generally found between regional brands and private labels. Within the cheddar and specialty cheeses, there are many varieties avail-

Table 2. Comparison of the estimated hedonic functions between 1977-78 and 1987-88 NFCS surveys (spring quarters) for dairy products

Variable	1977-78 NFCS Coefficient	1977-78 NFCS t-ratio	1987-88 NFCS Coefficient	1987-88 NFCS t-ratio
Non-nutrient Component:				
Demographic Variables on Beverage Milk				
Intercept	–0.0813	(–3.42)	–0.3569	(–6.22)
Black	0.0218	(5.83)	–0.0068	(–0.80)
Log Household Size	–0.0389	(–4.42)	–0.1041	(–4.89)
Log Food Expenditure	0.0346	(5.73)	0.0726	(5.93)
Demographic Variables on Cheddar Cheese				
Intercept	–0.7042	(–3.39)	–2.9194	(–6.40)
Black	–0.0815	(–1.99)	0.0107	(–0.14)
Log Household Size	–0.3181	(–5.77)	–0.7056	(–7.14)
Log Food Expenditure	0.3212	(6.57)	0.5509	(6.35)
Demographic Variables on Soft Cheese				
Intercept	–0.0113	(–0.08)	–1.2932	(–4.28)
Log Household Size	–0.2403	(–5.02)	–0.4356	(–5.46)
Log Food Expenditure	0.2114	(5.74)	0.3242	(5.53)
Demographic Variables on Specialty Cheese				
Intercept	–0.3155	(–1.05)	–2.7810	(–4.27)
Black	–0.7262	(–3.79)	0.3335	(0.75)
Log Household Size	–0.3158	(–3.37)	–1.2512	(–5.03)
Log Food Expenditure	0.3959	(4.54)	0.8970	(5.36)
Region-Zone Shifters on				
Non-nutrient Component:				
East—Urban	0.3185	(2.77)	0.0839	(0.96)
South—Urban	0.2746	(2.40)	0.0036	(0.02)
East—Nonurban	0.2353	(2.75)	–0.2609	(–2.73)
South—Nonurban	0.3607	(3.81)	–0.0510	(–0.42)
Nutrient Component:				
Demographic Variables on Fat:				
Proportion of Household:				
Age < 10	0.0051	(3.70)	0.0098	(3.83)
Age > 10 and <18	0.0034	(2.54)	0.0098	(4.03)
Age > 18	0.0051	(7.36)	0.0106	(9.54)
Fat Intake/RWA from Dairy	–0.0006	(–2.32)	–0.0007	(–2.18)
Fat Intake/RWA from Others	–0.0004	(–1.45)	0.0005	(1.24)
Meal Planner's Education				
> High School	–0.0004	(–0.98)	–0.0009	(–1.81)
White Collar	0.0004	(0.99)	–0.0008	(–1.81)
Unemployed	0.0015	(2.23)	–0.0000	(–0.14)
Retired	0.0006	(2.76)	0.0002	(0.57)

(continued)

Table 2. Continued

Variable	1977-78 NFCS Coefficient	1977-78 NFCS t-ratio	1987-88 NFCS Coefficient	1987-88 NFCS t-ratio
Demographic Variables on Protein:				
Proportion of Household:				
Age < 10	0.0107	(4.38)	0.0349	(5.26)
Age > 10 and < 18	0.0077	(3.03)	0.0264	(4.97)
Age > 18	0.0062	(2.87)	0.0225	(5.59)
Protein Intake/RWA from Dairy	–0.0016	(–2.77)	–0.0022	(–2.04)
Protein Intake/RWA from Others	–0.0019	(–3.87)	–0.0041	(–5.07)
Meal Planner's Education				
> High School	0.0010	(1.72)	0.0007	(1.16)
White Collar	–0.0010	(–1.72)	0.0007	(1.17)
Unemployed	–0.0019	(–2.24)	–0.0000	(–0.14)
Retired	0.0005	(2.76)	0.0001	(0.57)
Demographic Variables on Calcium:				
Proportion of Household:				
Age < 10	0.0250	(0.33)	–0.3150	(–1.42)
Age > 10 and < 18	0.1787	(2.20)	–0.2476	(–1.40)
Age > 18	0.1641	(3.29)	–0.1889	(–2.07)
Calcium Intake/RWA from Dairy	0.0328	(1.59)	0.0163	(0.45)
Meal Planner's Education				
> High School	0.0000	(1.77)	0.0000	(1.13)
Region-Zone Shifters				
Nutrient Component:				
Midwest—Urban	0.0595	(2.18)	–0.0803	(–3.19)
South—Urban	0.0608	(2.01)	0.0054	(0.10)
West—Urban	0.1023	(3.56)	–0.0177	(–0.60)
East—Nonurban	0.0401	(1.69)	–0.0721	(–1.82)
South—Nonurban	0.0500	(1.95)	0.0018	(0.04)
West—Nonurban	0.1056	(3.82)	–0.0121	(–0.65)
	(3.822)			
	R-square = 0.846 F = 805.88 n = 6351		R-square = 0.845 F = 399.36 n = 3115	

Note: All the parameter estimates except those related to region-zone shifters in 1977-78 hedonic model were inflated by 152.37% according to the CPI for dairy products in order to convert the 1977 dollar value to 1987 dollar value for comparison purpose. Proportion Age = proportion of household members of certain age; FAT INTAKE/RWA, PRO INTAKE/RWA, CAL INTAKE/RWA = household's intake of fat, protein, and calcium from dairy products or other sources relative to recommended weekly allowances, respectively; EDUC > HS = 1 if meal planner has education beyond high school, = 0 otherwise; White collar, Unemployed, and Retired refer to occupational status of household head; Region-Zone Shifts are interpreted as proportional increases (positive) or decreases (negative) in all nutrient or non-nutrient characteristics valuation, respectively, given the region of domicile of the household.

able at retail, and thus there appears a substantial variation in per-pound prices. The coefficients on food expenditures reflect choices of higher-priced, higher-quality products within the cheddar and specialty cheeses as food expenditure increases. The coefficient for the soft cheese commodity can also be viewed as a quality effect. The relatively smaller magnitude of this coefficient may indicate a lesser range of qualities for this commodity. The positive relationship between the price paid for dairy products purchased (an indicator of quality) and food expenditures indicates that lower need levels for the sample households have been satisfied. And, the positive impact of food expenditure level on commodity value per pound is uniformly and notably larger in the 1987-88 period for households in the base region-zone.

For the non-nutrient segment of the model, some statistically significant region-zone differences were present in the 1977-78 model. These effects may reflect partially a greater emphasis on non-nutrient factors in the valuations of the dairy products under study and reflect partially higher price levels for dairy products in these four areas relative to the Midwest-nonurban base. In 1987-88, the region-zone effects were statistically insignificant except for the East-nonurban region, which had a negative impact on commodity value relative to the base value.

Regarding the nutrient segment of the model, fat has a positive value in dairy products. In dairy products, fat content is positively related to "taste." With respect to need theory, the cheese products with a higher fat content are more prestigious and tend to be used to satisfy the higher need levels. This positive relationship between fat and the higher need levels is apparently strong enough to overcome the negative relationship between fat content and health concerns. Household age composition had a distinct effect on households' implicit fat valuations in 1977-78. Fat valuation for households with growing children was nearly equal to those with no children, each being approximately fifty percent greater than the values for households with teenagers. The smaller fat value for households with teenagers may reflect a taste and/or attitude difference. Also, food requirements for teenagers are relatively large, and households with teenagers may be more concerned with the basic physiological needs and, therefore, purchased more of the low cost, lower-fat dairy products. Variation in household age composition had relatively little impact on differences in fat valuation in 1987-88.

The estimated, implicit protein values were positive but declined with the age of household members in both periods. This pattern is consistent with declining protein requirements, in grams per kilogram of body weight, as reported by Snyderman (1980). In other words, there is a declining physiological need for protein. Even accounting for region-zone effects, the protein values by age category were notably higher in 1987-88 than in 1977-78, as was the case for fat. In contrast, the estimated, implicit calcium values by age category were positive in 1977-78, but the value was much smaller and not statistically different from zero for households with children less than ten years of age than for other households. It may have been that growing children generally consumed milk products in quantities sufficient to supply their calcium requirements, so that the marginal value of additional calcium was low. In 1987-88, the marginal value of calcium was negative for all age categories, and this fact suggests that households may consider that levels of calcium consumption are more than adequate to meet their needs in this latter period.

The estimated coefficients of the ratios of total household fat intake from dairy products and total household fat intake from nondairy foods [both measured relative to the household-specific recommended weekly allowance (RWA) for fat] show that fat values decreased with increased fat consumption in 1977-78. The same phenomenon occurred with protein. These same effects continued in the 1987-88 period, with the exception of fat intake from nondairy sources, which had an insignificant impact on overall dairy value. The estimated coefficients of total household intake of calcium from dairy products (relative to the household-specific RWA for calcium) for both periods are both positive, but not statistically significant.

Higher education levels are associated with a negative valuation of fat, and positive effects on the valuations of protein and calcium. This is expected since education beyond the high school level is generally associated with greater understanding of nutritional matters.

The estimated coefficients on white collar, unemployed, and retired household head variables indicate higher fat valuations by each of these household types compared to households with a blue collar head in the 1977-78 period, although the white collar effect was statistically insignificant. This set of marginal effects may be due to a number of interrelated factors including lifestyle, tastes, nutritional awareness, and income allocation. In the 1987-88 period, only the white collar effect was statistically significant, and the effect was negative. For protein, households with either a white collar or unemployed head had lower implicit dairy protein values than households with a blue collar, employed head in 1977-78. This may reflect preferences for sources of protein other than dairy products. A retired household head was associated with a higher protein value than a blue collar head. Dairy products are an economical, easily digestible, and convenient source of protein relative to other sources, which could be important to retirees. In the 1987-88 period, none of the employment or occupation variables had a significant differential impact on protein valuation.

The coefficients for the region-zone variables indicate that households' implicit nutrient values varied significantly by these variables in 1977-78. Two factors may account for this. First, the variations may relate to price and expenditure level differences among regions and zones. Second, the variations may also reflect interlocational differences in attitudes toward fat, protein, and calcium obtained from dairy products. Only location in Midwest-urban and East-nonurban regions continued to have a significant differential impact on nutrient valuation in 1987-88, with both values changing to negative relative to the base valuation (Midwest-nonurban).

The relationship between dairy product characteristics and need level is complex since dairy products themselves are heterogeneous. Fluid milk may be consumed to satisfy the basic need of hunger, which is consistent with the positive value estimated for protein and to some degree the positive value for fat. Fluid milk may also be used to satisfy health concerns since it contains important amounts of vitamins and minerals. The results show that the implicit value of calcium was high in 1977-78, although this source of value appears to have declined substantially by the 1987-88 period.

The positive value found for fat in dairy products may indicate conflicts in need levels. Before the concern for weight and health problems was related to the consumption of animal fats, fat in dairy products was highly valued. High-fat dairy products could be seen as satisfying the higher need levels with no conflict with safety needs. With increased education regarding nutritional matters, fat might not be expected to command the premium that it once did. However, high-fat products may still retain some degree of prestige because of "learned" tastes. Consequently, on the one hand, increasing concerns with health should lead to a decrease in the value consumers place on dairy products. On the other, these high-fat products have a preferred taste suggesting an increase in the value placed on fat. The empirical results suggest that the net effect of these factors is a positive marginal valuation of the fat component of dairy products in both periods of analysis.

Overall, comparisons between the 1977-78 and 1987-88 empirical results suggest that valuation of both nutrient and non-nutrient components of dairy products is becoming more homogeneous across household types. In particular, race, location of domicile, and employment or occupation status had substantially less (or no) effect on valuation of dairy product characteristics in 1987-88, whereas these factors were important sources of value differentials ten years earlier.

Red Meat, Poultry, and Fish Products

An hedonic price function was estimated for five aggregate red meat, poultry, and fish commodities: (1) beef, (2) pork, (3) poultry, (4) fish, and

(5) luncheon meats. These products are important sources of fat, food energy, iron, and the B vitamins. The B vitamins were measured using an index instead of including each B vitamin separately because consumers are more likely able to identify products that are generally good sources of B vitamins than to recognize the level of each in a specific product. Food energy was not included as a separate dietary component, as it is highly related to fat and protein in the diet.

The commodity aggregates used in the analysis (e.g., beef) reflect consumer decisions at the good or product level (e.g., ground beef, steaks, roasts). The nutritional and non-nutritional characteristics of the meat commodities selected by consumers have changed in general between 1977-78 and 1987-88 (Table 3). For example, the aggregate poultry commodity consumed by the 1977-78 and 1987-88 samples contained 18.9 grams and 40.6 grams of fat per pound of poultry, respectively. In contrast, the fat content of the average fish commodity decreased from 36.3 grams to 12.4 grams of fat per pound of fish between the two time periods. These changes can either indicate an increased demand for high- (or low-) fat poultry (or fish) products or merely reflect consumption of commodities with less (or more) waste per pound, since the nutrients are measured per pound of commodity consumed. The latter appears to be a more plausible explanation for the meat commodities in this study. The protein content of the commodities was fairly stable. The vitamin B content increased for beef, pork, and luncheon meats, and decreased for fish. Interestingly, the iron content of all commodities except fish decreased. The observed sample changes in quantities (per person) consumed of each of the commodities (e.g., beef decreased, chicken and fish increased, and pork was stable) between the two time periods are fairly consistent with changes indicated by aggregate U.S. per-capita utilization data. As the hedonic model developed for use in this study does not explicitly account for consumers' decisions in defining the aggregate commodity that they consume, some of the difference found in the hedonic model between the 1977-78 and 1987-88 sample might reflect differences in the aggregate commodity chosen.

In adapting the generic specification of the hedonic price function [Eq. (2) earlier] for the analysis of red meat, poultry, and fish products, it was assumed that nutrient valuations varied across groups of consumers (defined by socioeconomic and demographic variables) but not by commodity. The nutrient component was also assumed to vary systematically across urbanization categories. In order to allow for declining marginal (non-nutrient) utility as consumption of a commodity increases, a quantity variable for the commodity was included in the hedonic equation. The non-nutrient component of the hedonic function, h(c), was assumed to affect price systematically across commodities in order to preserve degrees of freedom and alleviate multicollinearity.

A number of socioeconomic and demographic variables were initially hypothesized to affect the nutrient and non-nutrient characteristic valuations for food. This model was estimated using nonlinear least squares. The final, or reduced, model was obtained from the original model by a series of Wald chi-square hypothesis tests, separately for the 1977-78 data. This final model specification was then estimated separately for the 1987-88 data. The results for both data sets are reported in Table 4.

In the nutrient component of the model, dummy variables were included to systematically or proportionately shift the hedonic price function, given the location of the residence of the observation. The estimated coefficients for the sociodemographics reported in the table represent their influence on the indicated nutrient for nonmetropolitan households (the urbanization dummy was omitted from the model to avoid perfect multicollinearity). The influences for other households can be obtained by multiplying the specific sociodemographic coefficient by the appropriate urbanization shifter coefficient. For simplicity, unless otherwise noted, the following discussion focuses on the results for nonmetropolitan households.

Table 3. Comparison of the average nutrient content, prices, and quantities, by meat, poultry, and fish commodities, between 1977-78 and 1987-89 NFCS (spring)

	Fat (grams)		Protein (grams)		Iron (mg)	
Commodity	1977/78	1987/88	1977/78	1987/88	1977/78	1987/88
Beef	90.7	88.6	80.2	81.5	12.0	8.1
Pork	169.6	141.5	56.5	59.5	8.3	3.1
Poultry	18.9	40.6	65.2	70.9	5.5	3.9
Luncheon Meat	119.0	115.9	62.8	59.2	9.8	7.0
Fish	36.3	12.4	86.4	83.2	4.7	4.8

	Vitamin B Index		Price ($)		Quantity (Per Person/Per Week)	
Commodity	1977/78	1987/88	1977/78	1987/88 (Deflated)	1977/78	1987/88
Beef	.61	.93	1.20	.97	1.81	1.56
Pork	.60	.78	1.37	1.23	1.10	1.10
Poultry	.51	.50	.80	.89	1.15	1.47
Luncheon Meat	.85	.93	1.31	1.13	.50	.54
Fish	1.22	1.04	1.60	1.29	.66	.82

Note: All nutrients and prices are measured per pound of commodity. The 1987/88 commodity prices are deflated to spring 1977 level, using specific commodity consumer price indexes.

In the 1977-78 sample, households whose meal planners had less than high school education placed a higher value on fat present in the red meats, poultry, and fish food group, relative to comparable households with higher levels of education. Though their numbers were statistically insignificant, these 1977-78 households valued protein and iron less than other otherwise similar households. Likewise, in 1977-78, households whose meal planners had less education valued the B vitamins in this food group more highly than did the more-educated meal planners' households. The results for the 1987-88 sample, while similar in terms of the direction of these relationships, were not in any case significant. These findings suggest that level of education was positively a relatively less important factor in distinguishing consumers in 1987-88. This might reflect the success of nutritional education efforts in targeting less-educated consumers in the period following 1977-78.

The blue collar coefficients indicate a negative impact on protein valuation and a positive impact on vitamin valuation by households whose heads are employed in blue collar jobs for the 1977-78 sample. These blue collar households may have been consuming more meats and fewer fruits and vegetables, so that the intake of protein would be higher and the intake of vitamins lower than in other households. These findings are consistent with a declining marginal value of nutrients. The 1987-88 results for the blue collar coefficient were similar in terms of sign but were not statistically significant.

Table 4. Comparison of the estimated hedonic functions between 1977-78 and 1987-88 NFCS (spring) for meat, poultry, and fish products

Variable	1977-78 NFCS Coefficient	1977-78 NFCS t-ratio	1987-88 NFCS Coefficient	1987-88 NFCS t-ratio
Nutrient Component:				
Fat				
Education < High School	0.0003	(1.77)	0.0005	(1.58)
Blue Collar	0.0001	(0.52)	–0.0001	(–0.70)
Black	0.0006	(2.68)	0.0010	(3.15)
Retired	0.0005	(2.26)	0.0005	(1.74)
Ln (Food Expenditure)	0.0014	(0.16)	0.0055	(0.44)
Proportion of Household:				
Age < 13	–0.0001	(–0.21)	–0.0000	(–0.03)
Age 13-18	0.0005	(0.98)	–0.0002	(–0.22)
Age > 18	–0.0001	(–0.28)	–0.0011	(–3.10)
Protein				
Education < High School	–0.0056	(–1.12)	–0.0084	(–1.39)
Blue Collar	–0.0011	(–3.66)	–0.0004	(–0.72)
Retired	–0.0006	(–1.57)	0.0006	(–1.23)
Ln (Food Expenditure)	0.0307	(4.35)	0.0472	(3.92)
Proportion of Household:				
Age < 13	0.0085	(6.89)	0.0057	(3.53)
Age 13-18	0.0091	(5.14)	0.0035	(1.43)
Age > 18	0.0065	(10.36)	0.0064	(7.11)
Iron				
Education < High School	–0.0056	(–1.12)	–0.0084	(–1.39)
Ln (Food Expenditure)	0.0255	(5.51)	0.0464	(3.99)
Proportion of Household:				
Age < 13	0.0095	(0.92)	–0.0145	(–0.98)
Age 13-18	–0.0008	(–0.07)	–0.0337	(–1.05)
Females 19-50	0.0224	(3.49)	–0.0114	(–1.44)
Other	0.0211	(3.49)	–0.0110	(–1.56)
North East—Suburban	0.0512	(2.40)	0.0265	(0.96)
South—Central City, Suburban	–0.0650	(–3.76)	–0.0158	(–0.62)
South—Nonmetro	–0.0681	(–4.55)	–0.0581	(–2.53)
Commodity Shifters				
Pork	0.9942	(5.51)	0.9168	(5.96)
Poultry	–0.2616	(–3.54)	0.2410	(2.72)
Luncheon Meat	0.7333	(4.96)	0.7223	(5.75)
Fish	1.0048	(3.50)	0.3258	(3.34)

Note: The 1987-88 prices are deflated back to spring 1977 dollar values based on the CPIs for different meat products. Variables used in the model are defined as follows: (Education < High School) = 1 if meal planner has education less than high school, 0 otherwise; (Education > College) = 1 if meal planner has education above high school, 0 otherwise; Black, Blue Collar, and Retired refer to the race, occupation, and employment status of the household head; Ln (Food Expenditure) is the logarithm of the households per capita weekly value of food at home (measured in $10/week); Proportion (Sex) Age—proportion of household members (differentiated by sex) of certain age; commodity dummies indicate the commodity to which an observation pertains; Commodity Shifts are interpreted as proportional increases (positive) or decreases (negative) in non-nutrient characteristics, respectively, given the commodity to which an observation pertains.

The positive coefficient associated with the black and retired indicator variables for fat valuation in both samples are consistent with prior expectations. Surprisingly, however, the magnitude of the coefficients (for the nonmetropolitan household) increased between 1977-78 and 1987-88. Despite the recent publicity concerning the detrimental effect of high levels of dietary fat, culture and habit play an important role in food choices. Many meat products that have been a part of black culture (possibly selected initially for economic reasons) are relatively high in fat. Given the cultural ties to these products, they may remain an important part of the diet of many blacks. These meats may be used to satisfy security and love and belonging needs. Retired household heads, usually older than their nonretired counterparts, have likely established eating habits in their early years, habits which include meat products high in fat. In addition, fattier meat products tend to be easier to chew. Those in retired households are likely to be slow in changing their eating habits, despite strong recommendations from the health profession to make changes.

Household composition was measured by the proportion of household members in indicated age or age-sex categories. The magnitude of the estimated coefficients for a nutrient indicates the relative importance of the age (and sex) categories in determining a household's nutrient valuation. For example, the coefficient estimates for protein in the 1977-78 data indicate that children have greater effect on household protein valuation than do other household members, while in the 1987-88 data adults have the greatest impact. In a similar manner, adults had the greatest impact (negative) on fat valuation in the 1987-88 sample. This significant relationship reflects a major change from the 1977-78 sample, where adults had the smallest (negative, insignificant) impact on fat valuation. In 1977-78, adult females (18 to 50 years of age) had the largest impact on iron valuation, consistent with the greater iron requirement for women in their childbearing years. In the 1987-88 results, all of the household composition variables negatively (though insignificant) impacted iron valuation. This change in iron valuation might also reflect the lower iron content of the average red meat, poultry, and fish commodities selected, as previously discussed.

Food expenditure, measured as the logarithm of per capita weekly food value, significantly and positively affected protein and iron valuation, in both time periods. This study did not include variety meat products such as liver and kidneys, items that are typically low-priced and high in iron. Hence, this positive impact is not necessarily in conflict with other studies in which iron was found to have either no influence or a negative influence on meat and related products (Hagar 1985, Ladd and Savannunt 1976, respectively).

Regarding the quantity component of the model, the negative estimated coefficients for beef, pork, chicken, and luncheon meats in both samples support the hypothesis of declining marginal utility of meat and poultry consumption. These coefficients were relatively stable between the two time periods, except for the coefficient for poultry, which exhibited a large absolute increase between 1977-78 and 1987-88. This change could be related to the large increase in poultry consumption during the last decade, and hence, associated decline in marginal utility. The fish quantity was included in the final model in quadratic form. The quadratic terms for the other commodities were included in the original model specification. The results for both data sets indicate that increases in fish quantity are associated with increases in price, but at a decreasing rate (for most quantities observed in the data sets).

The non-nutrient component of the hedonic price function was modeled such that the commodity shifts represent systematic or proportionate increases (positive) or decreases (negative) in the non-nutrient characteristics, given the commodity type of the observation. The estimated coefficients for the sociodemographics as reported in the table represent their influence on the price of beef, the commodity whose dummy was omitted from the model. For example, the negative coefficients for black households in 1977-78 (–0.0826) and in 1987-88 (–0.1135) indicate that, other things being equal, black households paid lower per-pound prices for beef than did nonblack households. The negative coefficients for retired households in 1977-78 (–0.0445) and in 1987-88 (–0.1016) also indicate that retired households paid lower per-pound prices for beef products than did their nonretired counterparts.

To interpret the sociodemographic coefficients for commodities other than beef, each coefficient in the table needs to be multiplied by the sum of one (representing the intercept) and the appropriate commodity shift (dummy variable) coefficient. For example, in the 1977-78 model the negative coefficients for the black household (–0.0826) and poultry commodity (–0.2616) variables along with the intercept indicate that black households paid lower per-pound prices for poultry products (i.e., –0.082590*[1 + (–0.261610)] = –0.060980) than did nonblack households. The 1987-88 results indicate that the sample black households also paid lower per pound prices (–0.1408) for poultry products. This is consistent with the study of Smallwood, Haidacher, and Blaylock (1989) that found heads of black households purchase the lower-priced cuts of red meat, poultry, and fish. Similarly, the results suggest that retired households paid marginally lower per-pound prices for poultry products, partially reflecting the type of poultry products purchased by retired households who, due to habit, may be purchasing low-priced whole birds rather than high-priced parts.

The effect of less than a high school education for the meal planner on per-pound price was negative (but insignificant) for all commodities, other things equal. Households with less formal education may be operating at a lower need-level than more educated households. They may, therefore, be purchasing low-priced products.

The coefficients relating to the household composition variables for the 1977-78 sample indicate a declining (absolute) impact on price paid per pound with age of its members, with the exception of adult females. This pattern is reversed for the 1987-88 sample. The shifters for pork and luncheon meat were relatively stable between the two time periods but changed considerably for fish and poultry, with the poultry coefficient becoming positive in the 1987-88 data (relative to beef).

The negative coefficients associated with the household size variable (measured in logarithms) indicate that economies of size in consumption exist for red meat, poultry, and fish products. The magnitude of these coefficients was similar for the two time periods (for beef). These economies may reflect either price discounts for purchasing larger volumes or that larger households choose low- priced meat products. It is not feasible for small households to purchase some of the low-priced, large size cuts of beef, for example.

The estimated coefficients indicate a variety of positive and negative variations in non-nutrient valuations relative to the reference Northeast-nonmetropolitan group in 1977-78. These region-zone effects also were modeled to vary systematically across commodities. For example, households in the Northeast, central city areas, and suburban areas paid the highest per-pound price for beef products but the lowest per-pound price for chicken products, reflecting either the level of prices faced by this group of Northeasterners or their different taste and preferences for beef and chicken products. In the 1987-88 sample, some region-zone differences still existed in non-nutrient valuations as indicated by the coefficients reported in Table 4. For the most part, however, the differences relative to the reference Northeast-nonmetropolitan group were not significant.

In U.S. society, meat has traditionally been such an important food group that most meals are identified by the type of meat served. Hence, unlike cereals, which are consumed mainly at breakfast and tend to satisfy lower-level needs, meat may be related to a range of need levels. The inexpensive products relate more to physiological and security needs while the more expensive products such as steak and shellfish can satisfy self-esteem and self-actualization needs. The importance of meat in the diet also leads to a natural relationship with love and belonging needs.

Meat products served in childhood bring back memories of family and friends and cultural or ethnic identifications.

The value of fat in meat products shows a conflict in need levels. High-fat products are negatively related to health but may be positively related to prestige and taste. Learning theory suggests that the relatively recent publicity concerning the negative aspects of fat in meat may have less effect on retired households and households with low education levels. The empirical results agree with this hypothesis.

Conclusions

Hedonic functions for dairy products, meats, and breakfast cereals were estimated using the 1977-78 and the 1987-88 USDA Nationwide Food Consumption Surveys. For consumers participating in the survey, the values of food characteristics depend on the specific time, place, and food item. A change in consumer preference for a specific food item will lead to a change in the value placed on the characteristics both for that item and for the broader commodity and food group to which that item belongs. For example, an increase in preferences for chicken relative to beef (for non-nutritional reasons such as taste or convenience aspects) may lead to a difficulty in identifying the implicit value for the nutrients that are relatively higher in chicken than in beef (i.e., nutrient and non-nutrient characteristics may be highly correlated). The problems of confounding the values of nutritional and non-nutritional characteristics can be minimized but not eliminated by analyzing specific commodities rather than broad food groups.

One question with important policy implications is the change in the value of the nutrient components of food. One of the most important issues concerns changes in the value of fat over time. For meats, the value of fat was positive among black and retired households, and it increased slightly over the ten-year period. Among blue collar workers, the value of fat changed from positive to negative. The value of fat also decreased in households with a high proportion of adults. For dairy products, the value of fat for white collar, unemployed, and retired households decreased relative to blue collar households. The value of fat in breakfast cereals overall was unchanged. These results suggest there is a need to educate the general population on the limitations of fat in the diet with special emphasis on particular groups, such as households with older or black heads.

Energy was an important component in the value of breakfast cereals in 1977-78, but its value decreased substantially over the ten-year period. This is one indication that the public has become more aware of the problems of excess calorie intake and has altered its food consumption behavior.

There has been a concern over the low level of calcium in the U.S. diet in recent years. Dairy products are an important source of this nutrient. The value placed on calcium in dairy products, however, decreased over the ten-year period. This phenomenon could be the result of a successful education program that has led to increased calcium consumption by households, and hence, a lower marginal value being assigned to further increments in calcium consumption. The value of calcium in breakfast cereals was constant in the South, but there was some evidence of an increase in the other regions.

There has also been concern over the low levels of iron in the diet. The value of iron was analyzed only for the red meat, poultry, and seafood group. Iron's value generally remained unchanged over the ten years, but it should be noted that there was a decrease in the iron content of the meats consumed.

Protein was included in hedonic price functions for all three food groups. Its value increased in dairy products, while remaining constant in breakfast cereals. In meats, the value of protein was negative for blue collar workers in 1977-78 but was positively valued in 1987-88.

The valuations placed on non-nutrient characteristics have some important implications. These values generally exhibited fewer differences among races and among regions and zones of the country in 1987-88 than they did in 1977-78. The non-nutrient value of poultry relative to beef increased over the ten-year period. One explanation is that poultry products became available in more convenient product forms over this period. The value of the most common form of breakfast cereals, flaked, decreased relative to the other forms over the ten-year period. This suggests that consumers are placing higher value on the newer type of products. The aforementioned increase in the value of poultry also gives some support to this contention.

While there was some indication that consumers placed higher value on the important nutrient characteristics of food, the increase was not universal among all consumers, all nutrients, or all products. Nutrient levels are correlated with other characteristic levels of food. When products with preferred non-nutrient characteristics have a lower nutritional quality and replace higher nutritional foods in that diet, the nutritional quality of the diet decreases.

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