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Abstract

Do healthier diets cost more? We estimate a hedonic regression model of the U.S. diet. Given food expenditures and information on dietary intake we infer the marginal cost of improved quality. Meeting the Pyramid recommendations implies decreased expenditures from two of the seven food groups.

Do Healthier Diets Cost More?

Consumers receive information regarding the need to consume a healthier diet from a variety of sources. An important highly visible source of such information is the now familiar Food Guide Pyramid (FGP), which illustrates ways individuals can meet the Dietary Guidelines for Americans developed by the US Departments of Health and Human Services and Agriculture (DHHS and USDA). The Dietary Guidelines and the FGP recommendations are the basis for the primary dietary health education efforts supported by the federal government. The Pyramid recommendations take into account the rich variety of foods available in the U.S. food system as well as the specific nutrients that are required for optimal human health (including vitamins, minerals, and fiber). Very few individuals, however, actually achieve the servings and other recommendations embodied in the FGP (McNamara, *et. al*.). The latest estimates indicate that at least $80 billion in productivity and medical costs are caused by health conditions related to diet (USDA/ERS). While nutritionists and public health professionals have a number of explanations for observed consumption behavior and nutritional and health outcomes, no one has directly addressed an important economic question: Do healthier diets cost more? This paper directly addresses this question.

There is one important study that focuses on the cost of a healthy diet for low-income households. Utilizing constrained programming models, USDA contractors answered the following question in the affirmative: Presuming no increase in the dollar value of the Thrifty Food Plan, the basis for Food Stamp Program benefit amounts, is it possible for low-income households to meet the dietary guidelines (Hogbin, *et. al*.)? This implies that households at all income levels should be able to meet the guidelines. While the research shows it is possible to meet the guidelines, is it probable that consumers will do so? The USDA supported study lacks an economic model that explains actual food expenditure choices of low-income households as they relate to the Dietary Guidelines. Herein, we develop and estimate a hedonic economic model to determine whether healthier diets cost more for the U.S. population, and if so, by how much. We utilize the model results to measure how much consumers are willing to pay to obtain components of a healthier diet. Unlike previous micronutrient hedonic and demand analyses of dietary quality (Cade and Booth, Cook and Eastwood, Lenz et. al), we focus on the FGP categories. Using Pyramid food categories (such as servings of meat per day or fruit servings per day) allows us to measure dietary quality in terms consumers are most likely to recognize, given that consumers are typically more aware of nutritional aggregates than specific micronutrients (see Parato and Bagali or Morgan).

This paper is organized as follows. First we delineate the hedonic modeling framework and discuss why it is appropriate for investigating the cost of a healthier diet. Second, we outline our empirical methods; describing the data we use and specifying our empirical model. Third, we present and discuss the estimation results. Fourth, we infer the policy implication of those results, followed by conclusions and recommendations for future research.

1. A HEDONIC APPROACH TO VALUING DIETARY QUALITY

The seminal research of Lancaster in the area of consumer demand for product characteristics forms the basis of our theoretical approach to valuing dietary attributes. Lancaster's development of a theory of consumer demand for characteristics put forward the idea that characteristics or attributes of goods yielded utility to the consumer through a process where goods (alone or in combination with other goods) produce outputs (consumption services) valued by the consumer. Thus, Lancaster's approach emphasizes the active nature of consumption, as well as the possibility that goods might be combined to produce characteristics that provide utility to the consumer. In this approach, the role of market goods as an input in the production process is emphasized. Assuming consumers value goods for the characteristics they yield, the fundamental insight that Lancaster provides for demand analysis is: The price of a commodity can be decomposed into the sum of the implicit prices for each attribute multiplied by the amount of each respective attribute provided by that good that (Ladd and Suvannunt). While most hedonic analyses that are motivated by the Lancaster approach look at durable goods or specific products, the approach can also be applied to aggregate categories of goods (see Lenz, Mittelhammer, and Shi (1994) for an example). Here we apply the Lancaster approach to the analysis of a set of goods (food) and how the consumer uses these to produce nutritional and other services.

Our approach, like the hedonic analyses of Ladd and Zober (1977), Lenz, Mittelhammer, and Shi (1994), and Shi and Price (1998), builds upon hedonic price theory to develop an approach to measuring the implicit valuation of consumers of dietary characteristics that influence health. The critical insight of our approach is that by analyzing the correlation between household food expenditures and the extent to which individuals meet the FGP recommendations, implicit market valuations of dietary quality can be inferred. These implicit values for dietary attributes (or implicit prices) are estimated holding constant the other factors that affect food expenditures. As measures of consumer willingness-to-pay for dietary quality, the measures can serve a role in guiding nutrition policy. Such implicit prices for dietary quality measure the extent of the challenge facing public health nutrition policy makers, who would like to improve U.S. dietary habits. They might also highlight areas where certain types of market interventions are most likely to be effective (i.e. subsidizing those food groups such as fruits or identifying an food group where excess consumption might respond to a targeted tax).

The consumer purchases a bundle of dietary attributes, where the bundle includes nutritional aspects (energy and relative healthfulness of the diet) and non-nutritional aspects (flavor, taste, etc.) of the chosen diet. Consumers make trade-offs among dietary attributes and time use as they assemble their diet in the food marketplace. The attributes are not directly sold to consumers but are bundled in food products that are a part of a given diet.

Consider a consumer choosing a dietary pattern (D) from the set of possible diets offered by the food system. Our theoretical approach assumes the consumer maximizes a utility function,

$$U = U(X, D, t_l), \tag{1}$$

which is a function of consumption of a composite good, X, and a vector of dietary attributes, D, and leisure time, denoted by t_l . The vector of dietary attributes includes measures of adherence to the Pyramid Guidelines.

The consumer is assumed to choose a level of the composite commodity, a vector of dietary attributes, and leisure time taking into account a number of constraints. Each consumer faces a time constraint, so that time spent working in the labor market (t_w) and the leisure time sum to the total time available, T. The consumer also faces a money income constraint, so that total money income equals labor market wages and unearned income (V).

The constraints can be combined through shared terms to form a full-income constraint.

$$\sum_{i=1}^{n} P_i D_i + X + wt_l = wT + V. \qquad (2)$$

The household chooses D, X, and t_l to maximize utility subject to the full-income constraint. The consumer's utility maximization problem may be solved to yield demand relationships of the form

$$D_i = f(P_i, W, V; Z), \qquad (3)$$

where Z is a vector of socio-economic variables that would be expected to shift demand.

Using the demand relationship and assuming that the Lancaster's commodity decomposition (or hedonic) property holds allows the estimation of the implicit prices for dietary attributes (P_i), given observations on dietary attributes, information on the labor market and the value of time and socio-demographic variables.

2. EMPIRICAL METHODS

Before presenting the econometric implementation of this theoretical approach, we begin with a discussion of the data utilized for this study, followed by a discussion of data related issues.

Data

The data utilized for this study are the Continuing Surveys of Food Intakes by Individuals (CSFII) 1994-1996, provided by the U.S. Department of Agriculture. In addition to a host of household level economic and demographic variables, the CSFII collects information about individual household members' food intakes. For each individual surveyed within the household, the number of Food Guide Pyramid servings is calculated for each food group. For more detailed information regarding this survey, see U.S. Department of Agriculture (1998). While we would prefer to have intake data for all household members, intake information was collected from one, some, and sometimes all members of households in the sample. This presented us with our first data-related challenge.

Rather than limit ourselves to households where all members' intakes were collected, we randomly selected one individual from among household members whose intakes were collected. in each household from among those whose intakes were collected. Thus, we have food intakes by FGP food group for one individual in each household, characteristics of that individual, characteristics of the household head, and other household economic and demographic information. After deleting observations missing relevant information, we obtained a sample of 3943 individuals each from a different household in the CSFII. Descriptive statistics for the individual, his or her household, and household head are presented in Tables 1 and 2. The latter focuses on individual food intake information.

The second data-related challenge is embedded in Table 2 in the definitions of the food intake variables. Given our objective of evaluating the cost of achieving a *healthier* diet, we needed to incorporate individual-specific recommended servings and other individual-specific dietary guidelines into our modeling framework. We divide actual individual intakes by individual-specific recommended servings variables for each food group (dairy, vegetables, fruit, grains and meat) and maximum recommended and suggested thresholds for total fat and added sugar intake from the dietary recommendations, respectively. To obtain the recommended or suggested servings, we used the same procedure as in McNamara, *et. al.* While the details are provided in that article, the basic outline of the procedure is as follows: Each individual is categorized into one of three groups, low, moderate and high, based upon their caloric intake. For each food group, each individual then was given a low, moderate or high recommended serving level from the FGP range based upon his or her respective caloric intake group. The suggestions on maximum added sugars (defined in teaspoon of sweetener equivalents) also are assigned based upon which caloric intake group the individual belongs to. The recommendation for total fat consumption is that no more than 30 percent of total calories be from fat. We calculated this maximum for individuals based upon their total caloric intake. Thus the five food group variables in Table 2 are defined relative to the recommended number of servings for each individual. The added sugars and total fat variables are defined relative to the maximum suggested and recommended thresholds, respectively.

Empirical Specification

To implement our theoretical approach econometrically, we make a number of assumptions. First, we assume that sufficient variation in food prices exists across the U.S. so that identification of the implicit price function for dietary attributes is possible. Justification for this assumption includes the simple observation that those areas of the country closest to the sources of fresh fruits and vegetables are likely to have the lowest cost access to these dietary components, solely because of transportation costs. Also, price variation is expected to occur across rural, suburban and urban areas, because of scale economies seen in the larger stores located in suburban areas. A third reason supporting this assumption is that regional price indices exist for food products in the U.S. and the existence of these indices argues for significant price variation in foods as a commodity group across the nation.

We specify our empirical hedonic food expenditure equation as follows:

$$\text{MFEXP} = \beta_0 + \beta_H X_H + \beta_{HH} X_{HH} + \beta_I X_I + \beta_F X_F + \varepsilon \,, \tag{4}$$

where, as defined in Table 1, the dependent variable (MFEXP) is monthly total household food expenditures, X_H are household variables; X_{HH} are variables relating to the household head; and X_I are variables that relate to the one individual selected from each household. X_F are the individuals' food intake variables, defined relative to the recommendation or suggestion, as in Table 2. The β_i and β_{ii} are coefficients to be estimated and is the error term assumed to be distributed $N(O, \Omega)$.

Four of the variables in X_H and two in X_I require further discussion. First, income is specified using two terms, LNINC and $(\text{LNINC})^2$. We choose this income specification following Banks *et. al.* They find that the second term is insignificant for food in Great Britain. We include it to test whether that insignificance carries through to U.S. data. Second, although not reflected in Table 1, age of the individual in X_I is also specified using two terms, AGE and AGE^2 to allow for likely curvature in the relationship between food expenditures and age. Third, we include two potentially endogenous variables in X_H; PFAST and PFAFH, defined in terms of the percent of MFEXP spent on take out fast food and food away from home, respectively. To check whether endogeneity of these two variables would generate difficulties, we conducted a Hausman test for exogeneity and could not reject the hypotheses that they were jointly exogenous (Gujurati, pp 672-673). Therefore we felt comfortable including PFAST and PFAFH as explanatory variables.

Note that we include Food Stamp Program participation (FSP) and benefits (FS_V) as explanatory variables in X_H. These are also potentially endogenous. Even so, we include them because they are significant in other research (Wilde, *et. al.*) and, at the very least, represent an increase in food purchasing power for those who participate in the program. That study and many others, however, focus on households at or below 130 percent of the poverty line. For that population, one finds the expected significant effect of food stamps on intake or expenditures. Here we are considering households across the entire income distribution, not just low-income households. Therefore questions of endogeneity are less pressing and we hypothesize that FSP and FS_V will have little or no impact on food expenditures on average.

One final note on the estimation technique is required. We were concerned about possible heteroskedasticity in the model. Under heteroskedasticity, the coefficient estimates are unbiased but inefficient. Homoskedasticity should not be assumed, but should be tested. We, therefore, added LIMDEP's heteroskedasticity correction option (White) to our OLS estimates of equation (4).

III. ESTIMATION RESULTS

The estimation results are presented in Table 3. Prior estimates not reported here included binary variables for season and for year. These were shown to insignificantly affect food expenditures and were deleted from the model reported in the table. Details can be obtained from the authors on request. Based upon the Breusch-Pagan chi-square statistic reported at the bottom of Table 3, the hypothesis of homogeneity is rejected. The standard errors reported in the table reflect heteroskedasticity corrected standard errors. We group and discuss the estimates in the following order: age and income effects; demographic, geographic, social and economic characteristics; and willingness to pay for attributes of a healthy diet.

Age and Income

Because the coefficients of age and income in Table 3 are not straightforward to interpret, they are presented in two different formats: First, as marginal effects and elasticities in Table 4 and second, graphically, in Figures 1 and 2.

Consider income first. From Table 4, the elasticity of food expenditures with respect to income is 0.21 evaluated at the sample mean household income of $2311 per month. The Engle curve is illustrated in Figure 1. The shape of the curve is as expected. Food expenditures increase with income, most rapidly at low incomes, *ceteris paribus*, and then increase more moderately beyond the mean income. Note that income terms, LNINC and $(\text{LNINC})^2$ had significant coefficients with the first one negative and the second, positive. The significance of the second term does suggest that U.S. consumers' food expenditures respond differently to income than those from Great Britain.

Now, consider age. The elasticity of expenditures with respect to age from Table 4 is –0.052. That is, as age increases by one percent, *ceteris paribus*, food expenditures decline by 0.05 percent, evaluated at the sample mean age of 45 years. Figure 2 presents the inverted u-shaped effect on food expenditures of age. In the figure, it is clear that Food expenditures increase as age increases up to a maximum at age 30. After that, expenditures decline as age increases, becoming negative at around age 57.

Demographic, Geographic, Social and Economic Characteristics

The regression results show marked differences in monthly food spending among households with differing demographic, geographic, social, and economic characteristics. With respect to race and ethnicity, households headed by a Black person spent significantly less

($35.55 per month less on average) per month on food than households headed by a White person. The negative and statistically significant coefficient estimate for households headed by a Hispanic person means those households spent $22.31 per month less on average than households headed by a White person. Household size also determines monthly food expenditures in a statistically significant manner, with an estimated increase in expenditures of $64.01 per person.

Geographic differences in household food expenditures also are statistically significant at the 10 percent level. Recall that four major geographic regions (West, Northeast, South, and Midwest) are used. Relative to the omitted category (West) households in the Northeast spent $17.61 more on food per month, while Midwest households and Southern households spent $16.62 and $19.32 less per month, respectively, on food expenditures. For people living in central cities, a statistically significant increase in food expenditures of $32.59 was found. A slightly larger effect of $39.57 in food expenditures per month above the reference category of non-metropolitan residents in food expenditures was found for metropolitan residents not living in central cities (suburban).

The percentage of food expenditures dedicated to food purchases away from home and from fast food outlets for consumption at home both are significantly correlated with monthly food expenditures. Recall that our sample households spent on average 7.82 percent of their monthly food expenditures on take out fast food and an average of 19.24 percent of monthly food expenditures on food purchased and eaten away from home. The estimated effect for a one percentage point increase in the fast food expenditures is $1.67, implying that a shift of approximately two standard deviations (19.0 percentage points) would increase monthly food expenditures by $31.73. The estimated effect for food expenditures away from home is $2.26

per percentage point, and a two standard deviation shift (about 34.4 percentage points) in expenditures implies an increase in monthly food expenditures of $77.83.

A number of other explanatory variables are included in the regression model to control for demographic, health behaviors, and economic factors that might affect monthly food expenditures. Of these only the dummy variable indicating exercise habits (DEXE) is statistically significant at the five percent level. A person who exercises two or more times per week is estimated to spend $10.72 more on monthly food expenditures than a person who doesn't exercise at that level. The other explanatory variables are not statistically significant at the 10 percent level. Among those were participation in the Food Stamp Program (FSP) and the value of food stamps (FS_V) as hypothesized.

Willingness to pay for Attributes of a Healthier Diet

The estimated coefficients for the getting closer to the DAIRY and VEG recommend servings are not significantly different from zero, suggesting that individuals are not willing to pay to get closer to the recommending servings level for those two food groups. This is not much of a concern in the case of VEG, because individuals are already very close to the recommended servings level. It is a large concern for DAIRY, however, because individuals are only consuming 0.64 of the recommended guideline on average. The coefficient for FAT is also statistically insignificant. Even though fat over consumption is small, on average (1.04 of the recommendation), it is important to remember that this is measured relative to intakes of a *maximum* of 30 percent of total calories from fat. The implication is that levels of fat intake of less than 30 percent of total caloric intake would be healthier. Consumers are apparently not willing to pay to increase the healthfulness of their diet through a reduction in fat consumption even to the level of 30 percent of calories, let alone less.

The significant positive coefficients for FRUIT and MEAT imply that consumers are willing to pay to increase consumption of these food groups. The negative and significant coefficient for GRAIN suggests that consumers are willing to pay to avoid having to reach the recommended level of grain consumption. The negative significant coefficient for added sugars (ASUG) must be interpreted carefully. The coefficient suggests people are willing to pay to avoid added sugars.

IV. IMPLICATIONS FOR FOOD AND NUTRITION POLICY

In our view, these econometric results yield implications for crafting food and nutrition policy in the U.S., particularly in response to the epidemic of obesity and overweight Americans. First, the magnitude and direction of the estimated willingness-to-pay coefficients for the dietary quality variables imply that consumers on average value some dietary health improvements but not others. For instance, the sample average intake of added sugars is 1.76 times the recommended maximum servings and the estimated implicit price coefficient for added sugars is -4.592. This implies that consumers value moving from 1.76 towards 1.00 in the ratio of intake/recommendation. However, it also implies that such a move is associated with increased expenditures and, although the magnitude of the increase is small, such a move may be associated with increases in other costs such as time required for shopping, search, and food preparation.

The estimated implicit price coefficient for fruit intake/recommendations deserves special consideration, since the fruit intake is particularly low (0.643 ratio of intake/recommendation in this sample on average) and the estimated implicit price coefficient for meeting the fruit recommendation is both positive and statistically significant at a 10 percent level (5.78 percent level). In addition, increasing the fruit intake of Americans has been a primary goal of U.S. nutrition policy, as evidenced by the Five-A-Day campaign and other public health nutrition education efforts. The estimated coefficient of 6.691 translates to an increase in monthly food expenditures of $2.68 to meet the increase in the ratio of intake to recommended servings of 0.4 that is necessary to move the sample average intake to the recommended level. Thus, the estimated implicit price coefficient shows that U.S. consumers do value an improvement in the fruit intake on average, but that the magnitude of the value is relatively small. Conversely, the implied cost of modifying a diet to meet the fruit intake guidelines is small too, which leads us to our second policy conclusion.

Second, the predicted overall cost of moving to a diet that meets the dietary guidelines is fairly small for most people. Table 5 provides four examples of the predicted cost of moving from a diet that does not adhere to the Pyramid Guidelines to a diet that meets the Guidelines. For each individual, the predicted cost of moving to a healthier diet ranges from 5 to 10 dollars per month in additional food expenditures. For an individual with explanatory variable values set at sample means, the predicted monthly food expenditure amount is $370.72, while the predicted value, assuming adherence to the Pyramid Serving Guidelines, is $376.02, only an increase in expenditures of $5.32. As a percentage of monthly food expenditures, this predicted increase only represents about 1.4 percent of monthly food spending. Of the three hypothetical individuals considered in Table 5, only the last person, a 60 year-old Chicago woman has a cost of improving the diet to meet the Pyramid Guidelines that exceeds $10 per month. Her increase appears to be a function of the low meat servings intake (0.65) and the cost of meeting that recommendation ($6.96) per month.

A third implication for food and nutrition policy is that these results can be interpreted to mean that the main barrier to most U.S. consumers meeting the Food Guide Pyramid recommendations is not the increased money cost of food expenditures necessary to meet the recommendations. Instead, the results imply that significant barriers to meeting the Pyramid recommendations may arise from activity patterns, the time-cost of shopping and meal preparation, and the simple desire for dietary attributes such as total fats. Our regression results include variables to control for the interrelationship between the value of time and dietary choices (Percent Food Away From Home, Percent Fast Food, and employment status) and these results indicate very important roles for those variables (particularly fast food and food away from home). A caveat for this line of reasoning may hold for low-income working families with children or a number of dependents, where the sum of the individual costs of moving to a healthy diet may approach the 5 percent of monthly food expenditures amount and for these cash-strapped families achieving dietary change may pose a financial burden.

A last implication we draw from these results, is that for some food groups, consumer valuations are such that incentive-based food and nutrition policies, including targeted subsidy programs for fruits (for example) or taxes on high-fat snack foods, might be successful in helping consumers move to a healthier diet. Some nutrition advocacy groups and public health policy observers have called for such a "fat tax" or "junk-food tax," and these econometric results lend support to the notion that such incentives might move U.S. diets closer to the Pyramid recommendations.

In drawing implications for public policy, it is important to keep in mind the limitations of a study such as this. The data our analysis employs include self-reported intake data, and some observers have noted the problems that may arise with self-reported dietary intake data (Schoeller). Another limitation of the analysis is the full cost of household production of dietary services is not directly captured in this model. While we control for variables closely related to time costs, such as food away from home, fast food, and employment, we do not have money measures for time-cost in this analysis (nor are we aware of such a full-income approach being implemented in any other study). Thus, we are not able to measure the importance of changes in diet in terms of additional amounts of search activity (transportation and time), food preparation activity, or other non-food expenditure costs associated with a move to a healthier diet.

V. CONCLUSIONS AND RECOMMENDATIONS FOR FURTHER RESEARCH

This paper poses and answers the following question: Do Healthier Diets Cost More? The answer is yes, but not a lot, perhaps between \$5 and \$10 per month per individual in the household. This expense may be difficult for the lowest-income households to finance.

We come to these conclusions by estimating a heteroskedasticity corrected hedonic food expenditure equation, which includes dietary quality attributes, such as the extent to which an individual in a household meets the recommended number of servings of fruit, among the explanatory variables. Holding all else constant, the dietary quality coefficients indicate the implicit price or willingness of the household to pay to get the individual closer to the guideline. The policy implications of this work include: Because consumers value some types of dietary improvements to others, this may be an instance where subsidies or taxes on different food attributes would move the individuals closer to all, not just some of the Pyramid recommendations.

Further research would benefit from two things: (1) a re-specification of the model to allow for interaction effects among some of the food groups; and (2) intake data that also includes the actual value of time. The former would allow for important interactions such as meat and fat or dairy and fat. The latter would allow a much more complete picture of household time use decisions and the importance of convenience in food products and preparation. Both could yield a more complete explanation of why, how, and by how much it costs to purchase a healthier diet.

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Table 1: Variable Names, Definitions and Descriptive Statistics[1]

Variables	*Definitions*	*Mean*	*St. Dev.*
Household			
MFEXP	Monthly food expenditure[2]	370.72	231.38
INC	Total monthly income[3]	2311.44	1880.68
LNINC	The natural logarithm of INC	7.13	1.98
$(LNINC)^2$	LNINC squared	9.77	0.59
PFAST	% MFEXP spent on takeout fast food	7.83	9.52
PFAFH	% MFEXP spent on food away from home	19.22	17.21
HHSIZE	Household size	2.56	1.44
FSP	1 if FSP participant, 0 otherwise	0.11	0.31
FS_V	Food stamp value	17.74	65.99
DCCITY	1 for central city, 0 otherwise	0.31	0.46
DNCCITY	1 for metro, outside central city, 0 otherwise	0.45	0.50
DNE	1 if Northeast, 0 otherwise	0.18	0.38
DMIDWEST	1 if Midwest, 0 otherwise	0.24	0.43
DSOUTH	1 if South, 0 otherwise	0.38	0.48
Household Head[4]			
EMP_HH	Employment status of household head(s)[5]	0.21	0.40
SEX_HH	1 if female, 0 otherwise	0.70	0.46
LTHS_HH	1 if less than high school, 0 otherwise	0.22	0.42
HS_HH	1 high school graduate, 0 otherwise	0.36	0.48
SC_HH	1 if some college, 0 otherwise	0.21	0.40
C_HH	1 if college graduate, 0 otherwise	0.11	0.30
DBLK_HH	1 if Black, 0 otherwise	0.13	0.33
DHISP_HH	1 if Hispanic origin, 0 otherwise	0.09	0.28
Individual			
AGE	Age in years	44.69	22.37
EDU	Grade level	11.16	4.47
DBLACK	1 if black, 0 otherwise	0.12	0.33
DFEM	1 if female, 0 otherwise	0.46	0.50
WKSTAT	1 if work, 0 otherwise	0.46	0.50
BMI_SP	Body mass index	25.50	5.75
AVE_TV	TV watching hours per week	2.85	2.28
DEXE	1 if exercise >= 2 times one week, 0 otherwise	0.45	0.50
DVEGN	1 if vegetarian, 0 otherwise	0.03	0.18

[1]Source: Continuing Survey of Food Intakes of Individuals 1994-96, USDA
[2]All food expenditures were deflated by quarterly food price indices, base quarter Winter 1994.
[3]Income was deflated using the All Items CPI with base year 1994.
[4]Because households chose up to two household heads, when one head was chosen the characteristics of that individual were utilized, when two heads were chosen, we utilized the female head's characteristics.
[5]When one head was chosen, this variable =1 if the head works full-time, 0 otherwise. When two heads were chosen, this variables =1 if both heads work full-time, 0 otherwise.

Table 2: Individuals' Food Group Intake Variables, Definitions and Descriptive Statistics[1]

Variables	*Descriptions*	*Mean*	*St. Dev.*
Total Servings Relative to the Dietary Guidelines			
GRAIN	Grain servings / recommended servings	0.872	0.355
VEG	Veg. servings / recommended servings	0.972	0.583
FRUIT	Fruit servings / recommended servings	0.643	0.808
DAIRY	Dairy servings / recommended servings	0.677	0.586
MEAT	Meat servings / recommended servings	0.874	0.501
ASUG	Added sugar / maximum suggested	1.764	1.139
FAT	Total fat / maximum recommended	1.036	0.386

[1]Source: Continuing Survey of Food Intakes of Individuals 1994-1996, USDA
[2]The method for calculating recommended or suggested servings is described in the text. It is also described in much more detail in McNamara, et al.

Table 3: Hedonic Food Expenditure Estimates with Correction for Heteroskedasticity

Variable	*Coefficient*	*Standard Error*	*b/St.Er.*	*P[|Z|>z]*
Constant	36.81737413	29.311004	1.256	.2091
LNINC	-59.98950800	4.5040504	-13.319	.0000
$LNINC^2$	9.77176666	.59046293	-16.549	.0000
AGE	0.75128119	.76363623	.984	.3252
AGE^2	-0.013265793	.00750451	-1.768	.0771
AVE_TV	-1.690946998	1.1696296	-1.446	.1483
BMI_SP	-0.403067330	.59978954	-.672	.5016
C_HH	-5.638600452	14.126002	-.399	.6898
DBLK_HH	-35.55136343	8.8897010	-3.999	.0001
DHISP_HH	-22.31648519	11.244386	-1.985	.0472
DEXE	10.72390537	6.1069843	1.756	.0791
DFEM	.769898055	7.5641722	.102	.9189
DNE	17.60603226	10.188013	1.728	.0840
DMIDWEST	-16.61708561	8.6410836	-1.923	.0545
DSOUTH	-19.31585369	7.8702490	-2.454	.0141
DCCITY	32.58585293	7.5652862	4.307	.0000
DNCCITY	39.57341441	7.0384385	5.622	.0000
DVEGN	-5.132591676	14.261965	-.360	.7189
EDU	-.1837949198	1.2331650	-.149	.8815
EMP_HH	-8.865526435	8.6574215	-1.024	.3058
FSP	-6.129004188	12.381817	-.495	.6206
FS_V	.0292975805	.070005	.419	.6756
HHSIZE	64.00944693	3.0799773	20.796	.0000
PFAFH	2.265457129	.19568747	11.577	.0000
PFAST	1.673259668	.33494755	4.996	.0000
LTHS_HH	-6.519382976	14.961745	-.436	.6630
HS_HH	-7.819696986	12.083785	-.647	.5176
SC_HH	3.454799358	12.272859	.281	.7783
SEX_HH	-1.778095320	7.9694366	-.223	.8234
WKSTAT	-10.53105284	8.0433705	-1.309	.1904
ASUG	-4.592017631	2.7018130	-1.700	.0892
DAIRY	-2.926887452	5.4273963	-.539	.5897
FAT	10.48342510	9.4639644	1.108	.2680
FRUIT	6.691805668	3.5270759	1.897	.0578
GRAIN	-15.44579616	9.0105475	-1.714	.0865
MEAT	19.87961108	7.1616538	2.776	.0055
VEG	7.855186690	5.2953691	1.483	.1380

N = 3943, R-squared = .423296, Adjusted R-squared = .41798
Model test: F[36,3906] = 79.64
Prob value = .00000
Log-L = -25975.1638, Restricted(b=0) Log-L = -27060.3301
LogAmemiyaPrCrt.= 10.356, Akaike Info. Crt.= 13.194
Durbin-Watson Statistic = 1.90906, Rho = .04547
Breusch-Pagan chi-squared = 869.3954, with 36 d.f.

Table 4: Selected Marginal Effects and Elasticities

Variable	*Marginal Effect*	*Elasticity of Food Expenditures*
Household and Individual Characteristics		
Age	-0.434	-0.052
Income	0.064	0.214
HHSIZE	64.010	0.443
Food Expenditure Characteristics		
PFAFH	2.265	0.117
PFAST	1.673	0.035
Food Category		
ASUGDIF	-4.592	-0.022
FRUIT DIF	6.692	0.012
GRAINDIF	-14.446	-0.034
MEATDIF	19.880	0.047

Table 5: Predicted Monthly Food Expenditures With and Without Adherence to the Pyramid Guidelines for Selected Individuals

	Dietary Intake in Pyramid Servings								
Description of Individual	***Grains***	***Fruit***	***Vege-tables***	***Meat***	***Dairy***	***Total Fats***	***Added Sugars***	***Cost Without Adherence***	***Cost With Adherence***
Sample Average Individual with Variable Values from Sample Means	0.87	0.64	0.97	0.87	0.67	1.04	1.76	$370.72	$376.04
Woman in a household with two children, $1100 per month income, $110 per month Food Stamp received, 25 years old, New York City resident, 11 years schooling, employed, Black_Household Head	0.90	0.60	0.90	0.90	0.50	1.08	2.00	$374.34	$380.54
85 Year Old man, living in the rural South, $2300 per month income, living alone, 10 hours of tv per week, BMI=25.496, does not exercise twice a week, 1 year junior college education (13 years education) 7% food exp. spent on Food Away from Home, 5% food exp. spent on Fast Food	0.80	0.80	1.00	0.70	0.50	1.10	1.75	$185.57	$190.72
60 Year Old Chicago single woman, $3000 per month income, 10 hours of tv per week, BMI=27, does exercise twice a week, college education (16 years education) 25% food exp. spent on Food Away from Home, 10% food exp. spent on Fast Food, employed	0.80	0.70	0.90	0.65	0.60	1.20	2.50	$299.19	$309.47

Figure 1: Monthly Food Expenditures by Monthly Income, Ceteris Paribus

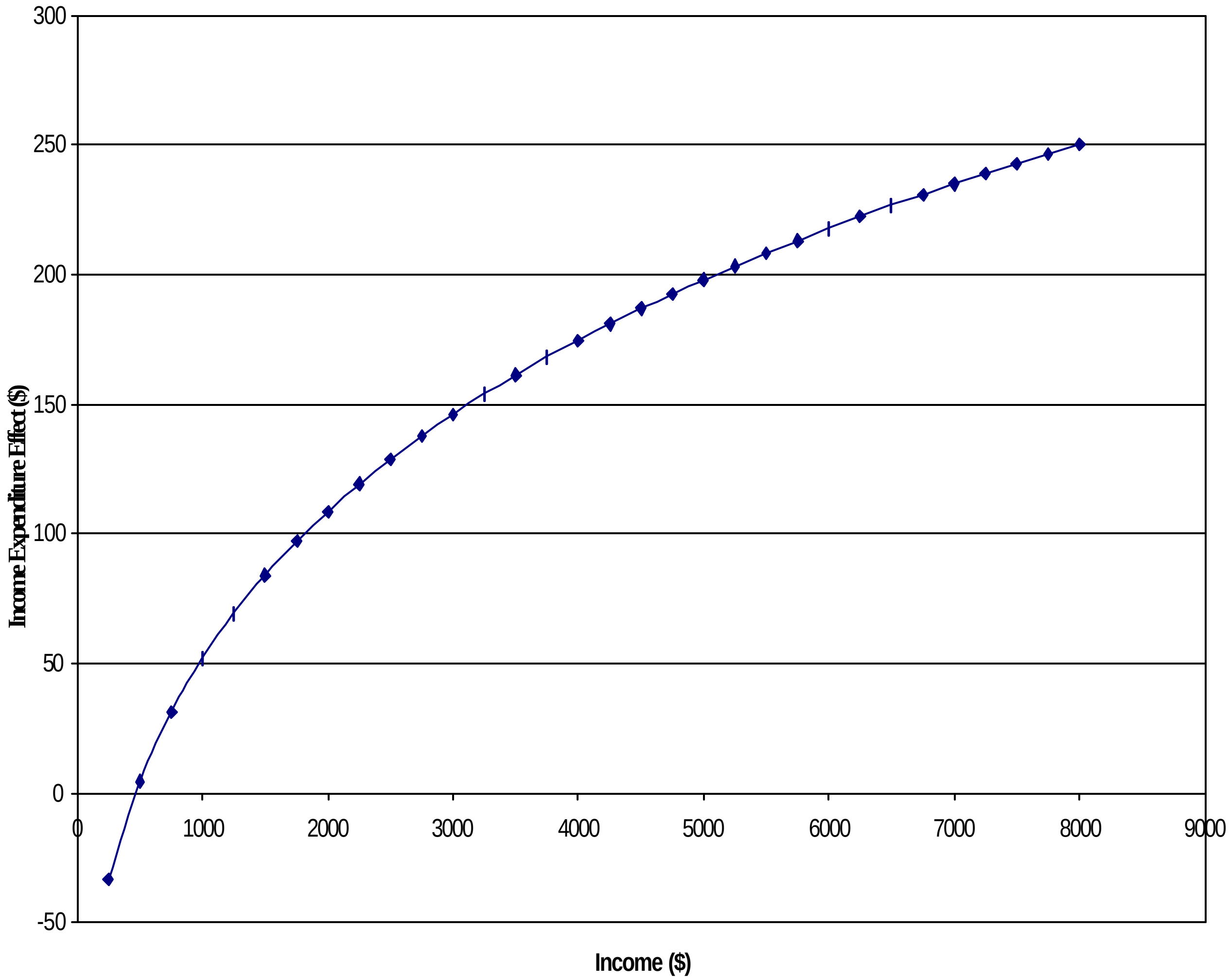
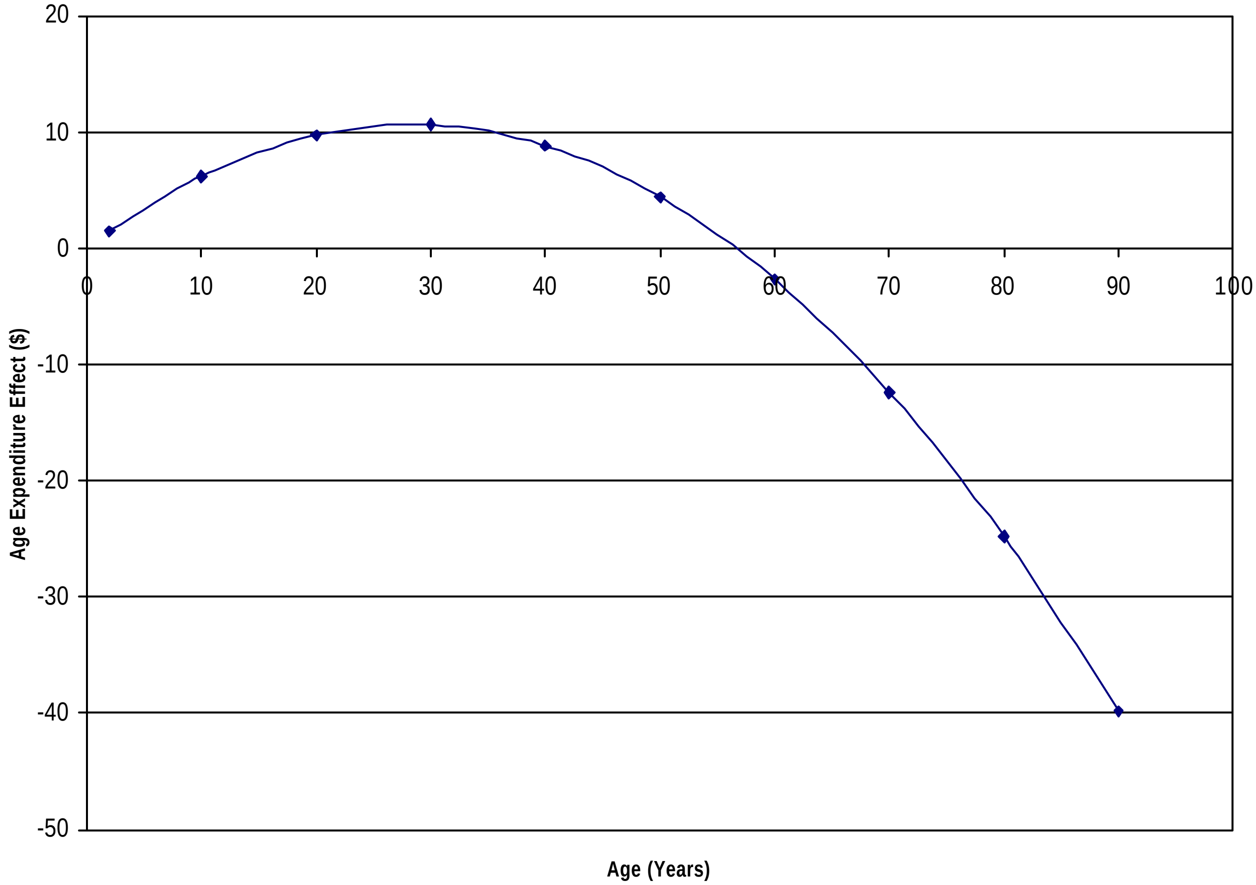


Figure 2: Monthly Food Expenditures by Age, Ceteris Paribus



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