Food Expenditures by U.S. Households: Looking Ahead to 2020. By Noel Blisard, Jayachandran N. Variyam, and John Cromartie, Economic Research Service, U.S. Department of Agriculture, Agricultural Economic Report No. 821.

Abstract

By 2020, the effects of demographic changes and income growth will increase per capita spending on food 7.1 percent. Income growth alone, which will effect spending increases of almost 10 percent on away-from-home foods and 3 percent on at-home foods, will raise per capita food spending about 6 percent. Expansion of the Nation’s population will drive growth in food demand and, combined with rising incomes and other demographic changes, is projected to boost total U.S. food spending 26.3 percent. On a national level, the slow but steady growth of the population will result in little variation among expenditure growth levels of individual food groups. The largest projected increase is for fruits, up 27.5 percent, while the smallest is for both beef and beverages, up 21.1 percent.

Keywords: Household food expenditures, income, demographics, projections, Consumer Expenditure Survey.

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Contents

Summary

Projected demographic changes combined with an assumed increase in inflation-adjusted incomes of 1 percent per year in the United States will increase per capita food spending 7.1 percent between 2000 and 2020. This effect will be due to spending increases of 8.1 percent on food away from home and 5.4 percent on food at home. Among individual at-home foods, expenditures for fruits (up 8.1 percent) and vegetables (up 7.2 percent) would increase the most under this scenario. Beef expenditures (up 2.6 percent) would increase the least of all categories over the 20-year period.

Household expenditure data indicate that higher income households spend more per person than poorer households on most food groups, especially food away from home, fruits, miscellaneous prepared foods, vegetables, and dairy. Americans age 74 or older tend to spend the most on cereal and bakery goods as well as on fruits. Household food expenditures vary regionally, with households in the Northeast spending the most on total food and households in the North Central spending the least. Non-Black households outspend Black households in every category except meats, poultry, fish, and eggs.

Projections of household food expenditures to 2020 based on shifts in age, regional, and racial distribution of the U.S. population, as well as expected changes in diet-health knowledge, income, and population growth show that regional population shifts, racial distribution, and diet-health knowledge will have only small effects on household per capita food expenditures. Income growth will increase away-from-home food expenditures 9.7 percent per capita but at-home food expenditures just 3 percent per capita. The shift toward an older age distribution in the U.S. population is projected to increase total per capita food expenditures just 1 percent over the 20-year period. Among at-home foods, the rising share of elderly will have the most effect on expenditures for fruits (up 3.7 percent), vegetables (up 3.6 percent), and fish and pork (up 3.1 percent).

The most important factor behind the growth in total food demand is the expansion of the U.S. population. Total U.S. food expenditures are projected to increase 26.3 percent by 2020. Away-from-home food expenditures are projected to increase 27.5 percent, compared with 24.3 percent for at-home food expenditures. One effect of the slow but steady growth of the population will be little variation on a national level among expenditure growth levels of food groups. The largest projected increase is for fruits, up 27.5 percent, while the smallest is for beef and beverages, both up 21.1 percent.

Another way to interpret the projections in this study is to view them as scenarios of what would have occurred if projected demographic or income changes were already in place. For example, a relevant question may be as follows: “What would have happened to food expenditures in our base year if the projected changes in the racial mix of the population for 2020 were already in place?” This approach to viewing the projections lessens the potential for misinterpretation by focusing on our underlying assumptions, as detailed in this report. Although we feel this alternative interpretation is the most appropriate, due to the nature of the data, we will use the term “projections” and draw comparisons between the base year, 2000, and a future period as we discuss our results.

This study uses recent Bureau of Census data to project U.S. food expenditures in the years 2000-20. The projections incorporate demographic factors, such as age, race, income, region of residence, diet-health knowledge, season of the year, and number of persons in a household. Total growth in U.S. expenditures is based on per capita shifts due to demographic changes plus growth in the total population.

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Introduction

By 2020, the U.S. population is projected to grow by another 50 million, creating a base of 331 million people to feed. This steady population expansion is expected to fuel a 26-percent increase in U.S. food expenditures between 2000 and 2020. With food spending approaching $800 billion per year, annual food sales by supermarkets, restaurants, fast food outlets, and other retail food establishments will increase $208 billion by 2020.

Aggregate growth in food expenditures driven by population increase, however, is only one aspect of how changing consumer demand will affect the future of the U.S. food system. The demographic profile of the U.S. population in 2020 will differ from today's in ways that have implications for what people will eat, where they will eat, and the product characteristics that will command the consumer's food dollar. These future dietary and food choices will affect not only the health of the U.S. population but also the organizational structure of the food industry and the economic well-being of farmers and other participants in the food production and marketing system.

We can summarize the demographic shifts likely to occur between 2000 and 2020 as follows: the U.S. population will be somewhat better off economically, older, better educated, and more ethnically diverse. Population density will also have shifted somewhat toward the South and West and, consistent with the aging trend, households will be smaller. These demographic shifts, when added together in an economic model, signal important trends ahead for the food sector.

This report focuses on household expenditure patterns for 16 food groups. We used a set of comprehensive behavioral models to isolate the net effect of income and other socioeconomic characteristics on household food expenditures. The models were then applied to explore shifts in consumer food demand that will result from changes in the socioeconomic characteristics of the domestic population. This work is particularly timely, as the projections are based on the most recent (2000) census data.

Theoretical and Empirical Considerations

According to Ernst Engel, a pioneer in analyzing family budgets, "the poorer a family is, the greater is the proportion of the total outgo (total expenditure) which much be used for food." Engel's most important finding, known as Engel's law of consumption, states the following: "As income increases, the expenditure on different items in the budget has changing proportions, and the proportions devoted to urgent needs (such as food) decrease, while those devoted to luxuries or semiluxuries increase."

Many analyses of family budgets conclude that the proportions of income devoted to various groups of commodities not only change with increasing income, as stated in Engel's law, but also vary systematically. Analysts consequently postulate that the expenditure on a given commodity varies with income in accordance with some underlying mathematical law. This observation leads analysts to estimate Engel functions by employing a variety of functional forms to express the underlying relationship between income and expenditures on a given commodity.

Surveys of individual households generally provide the information necessary to study the relationships between commodities, expressed in terms of quantities or expenditures. The framework used to analyze such surveys is based on the classical theory of consumer demand. The theory of the individual is broadened to encompass the vast heterogeneity in households and the differing environments in which they live. Cross-sectional surveys provide information on households of varying sizes, incomes, and consumer-oriented preferences. These households often exist in different economic, social, and regional environments that influence food purchase decisions. To capture these variable factors and to control for them requires an expanded analytic framework.

A number of household socioeconomic characteristics other than income have been shown to influence expenditures, including household size, age distribution of household members, and region of residence (Blisard and Blaylock). Contemporary statistical representations of Engel curves usually include these and other characteristics, such as the seasons of the year, as explanatory variables.

Because household survey data are collected within a span of several days or weeks, researchers generally assume that prices will fluctuate little in such a short period. Observed price differences are usually assumed to reflect variation in product content and quality rather than variation in relative prices for the same product. The influence of item prices on purchase behavior is, consequently, modeled differently in household survey data than in aggregate time series data.

This assumption about prices simplifies the process involved in estimating Engel relationships. Demand equations are functions of income and relevant household characteristics only. Food expenditures and budgeting patterns observed in cross-sectional survey data are snapshots of a wide variety of households in different circumstances. Analysts usually assume that the different circumstances reflect what would occur if the circumstances changed for any particular household. If this assumption is valid, one can then use statistical models to measure the implied behavioral response parameters. Hence, the fact that one does not usually observe a particular household under changing circumstances does not prevent the measurement of these response parameters.

Household food surveys measure consumption in terms of quantity (physical weight) or money value. The quantity measure is related to the physical satisfaction of demand and the need to fulfill certain nutritional requirements (Wold and Jureen). The money value is a measure of consumer satisfaction and economic well-being obtained through the marketplace, in the sense that the prices consumers pay reflect the unit value of the goods. The money value of a purchased product group, such as red meats, is a price or value-weighted sum of the physical quantities used. Viewing expenditures as a value-weighted quantity provides a link between household budget analysis and the traditional theory of consumer demand. Using prices as weight to aggregate items into groups has been shown to be consistent with economic theory when relative item prices are constant (Green). The use of expenditures, or money value, provides a consistent method for aggregating many detailed and heterogeneous items into a manageable number of product groups when using cross-sectional data.

Construction of statistical models requires that one account for those household features that contribute substantially to differences in consumption among households. Income, diet-health knowledge, and household composition are the survey response features that

account for the primary differences in food spending among households in any one period. Other determinants of demand, such as geographic region of household residence and season of the year, are included in the model to improve the measurement and statistical properties of the equations but are of less economic concern. Regional and seasonal variables may also represent price variation. Hence, they are not exact measures of regional taste differences. The omission of a relevant explanatory variable that is correlated with an included variable will bias the estimated parameter of the corresponding included variable. Therefore, to the extent feasible, all relevant determinants of household consumption must be included in the analysis.

Demand Considerations With Observed Zero Expenditures and Model Considerations

Household size, the frequency and mix of product use, and the amount of product consumed per eating occasion influence total household expenditures for various food items. Most expenditure surveys include a large number of households that report detailed information on food spending over 1 or 2 weeks, which is not long enough to represent the average expenditure pattern for any particular household. However, by examining a group of similar households, one can infer how a typical household within the group would behave over a longer period. Inferences can be drawn regarding the average expenditure, the probability of purchasing an item, and the amount spent per household during a given period.

Many households do not purchase or use certain food items during the survey period. Thus, zero values are common in household surveys, and the economic interpretation one should give to these observed values is not always clear. Survey information is usually insufficient to determine whether a zero value represents a household that never consumes the item, does not consume the item given the current values of the household's demand determinants (such as prices and income), or consumes the item infrequently (Maddala).

Assigning a nonconsuming household to one of the above categories has implications for demand analysis. How often and whether or not a particular household uses a given product is not usually reported and, consequently, must be inferred by examining the reported purchases or nonpurchases by many similar households. By assuming that all households will eventually use the product and that no infrequency-of-purchase or nonuse problems exist, we can study consumer behavior in a large sample of households and determine the probability of consumption and relate this probability to a household's characteristics.

If the probability of use or nonuse is determined by the same household characteristics that determine the level of use, and if one discards observations on households not purchasing an item during the survey, then traditional regression procedures will yield biased estimates of behavioral relationships. Thus, valuable information on the probability of use will have been ignored. The statistical model used in this study (Tobit model) assumes that the probability of consumption is related to household income and other selected socioeconomic and demographic features. This estimated probability is based on the assumption that all households will eventually purchase all items under consideration. This is a strong assumption, but the available data do not allow us to determine if zero purchases are due to infrequent purchases, nonuse, or economic circumstances, such as prices or income. Furthermore, we employ a traditional application of the Tobit model without attempting to correct for any statistical abnormalities that might be present. Most variations of this model attempt to correct for a nonnormality in the error term. However, it can be shown that both the error term and the parameters are simultaneously estimated in this model for all observations that have zero expenditures. Hence, any misspecification of the error term will cause the estimated coefficients to be inconsistent estimators of the true parameters (Deaton). Given this outcome, one can choose to use the model we employ, attempt to correct the abnormality of the error term but risk inconsistent parameter estimates, use another variation of the Tobit model, or use a completely different statistical model, such as a median regression. We have chosen to use the traditional Tobit model.

Data Used in the Analysis

The Consumer Expenditure Survey (CES) of the Bureau of Labor Statistics (BLS) for calendar years 1997 and 1998 is the source of data used in this analysis. The CES contains the most recent and comprehensive data available on food spending in U.S. households at the time of this study.

The CES comprises two components, each with its own questionnaire and sample: (1) an interview panel survey in which each of approximately 5,000 households is surveyed every 3 months over a 1-year period and (2) a diary survey of approximately the same sample size in which households keep an expenditure diary for two consecutive 1-week periods.

The diary survey obtains data on small, frequently purchased items that are normally difficult to recall, including foods and beverages, tobacco, housekeeping supplies, nonprescription drugs, personal care products, services, and fuels. The diary survey excludes expenditures incurred while away from home for 1 night or longer. The diary survey is the source of data for this report.

The data used in this report are a subset of the 1997-98 CES. Criteria for inclusion are completeness of reporting and consistency across the 2 survey years. Households that did not report complete income or participate in both weeks of the diary survey were excluded from the analysis. After eliminating these households, the analysis sample consisted of 7,709 households over the 2-year period.

Characteristics of American Households and Their Food Expenditures

Between 1988-89 and 1997-98, American households decreased their budget share of food away from home by 2.3 percentage points (table 1). This decline reversed a trend toward a larger budget share of food expenditures away from home that began in the early 1970s. One theory behind this decrease is that households bought more miscellaneous prepared foods, although expenditures in this category were up just 0.8 percentage points over the decade.

Other at-home food groups that increased in share of U.S. food expenditures include cereals and bakery products (up 0.5 percentage points), sugars and sweeteners (up 0.6 percentage points), and fats and oils (up 1.1 percentage points). In contrast, budget shares of both dairy and nonalcoholic beverages fell 0.4 percentage points. Likewise, the meats, poultry, fish, and eggs group as a whole declined 0.3 percentage points over the decade, mostly as a result of a 0.6 percentage point decline in beef expenditures. Among other foods in this group, the budget share increased for pork (0.2 percentage points) and poultry (0.5 percentage points). Over the same time span, the budget share for fish was unchanged. U.S. households also allocated slightly more of their at-home food budget to both fruits and vegetables. The budget share for fruit increased 0.1 percentage points while the share for vegetables increased 0.2 percentage points.

The inflation-adjusted price of food away from home fell 3.8 percent from 1989 to 1998, while the real price of food at home fell 1.4 percent (table 2). Although a decline in price normally increases consumption, all other variables constant, expenditures increased only for at-home foods over the period. Spending on food away from home declined. Consumers may have cut back on the number of times they dined out, or perhaps the rising number of restaurants over the 1990s put downward pressure on prices. At-home foods with the largest price declines were nonalcoholic beverages (down 9.1 percent), fats and oils (down 7.8 percent), and meat, poultry, fish, and eggs, (down 7.6 percent). In this last category, the price for beef was down 13 percent, poultry was down 9.9 percent, and fish declined 3.7 percent. In contrast, the inflation-adjusted price of fruits and vegetables increased 9.3 percent, while cereals and bakery products increased 4 percent.

A great diversity in household income and household size was found across selected characteristics among sample households (table 3). For example, households in the West had the highest income and the largest household size. Non-Black households had about $14,800 more in household income per year than Black

Table 1—Trends in the allocation of U.S. food expenditures, 1988-98

Food group	Share of food budget	
	1988-89	1997-98
	Percent	
Food away from home	41.1	38.8
Food at home	58.9	61.2
Cereals and bakery products	9.1	9.6
Meat, poultry, fish, and eggs	15.6	15.3
Beef	5.0	4.4
Pork	3.0	3.2
Poultry	2.4	2.9
Fish	2.1	2.1
Dairy products	7.3	6.9
Fruits	5.8	5.9
Vegetables	4.8	5.0
Sugars and sweeteners	2.1	2.7
Nonalcoholic beverages	5.7	5.3
Fats and oils	.6	1.7
Miscellaneous prepared foods	8.0	8.8

Source: Economic Research Service, USDA.

Table 2—Trends in inflation-adjusted food prices, 1989-98

Food group	Relative food prices		Change
	1989	1998	
	Index[1]		*Percent*
Food away from home	102.7	98.8	-3.8
Food at home	100.2	98.8	-1.4
Cereals and bakery products	106.8	111.1	4.0
Meat, poultry, fish, and eggs	97.8	90.4	-7.6
Beef	96.2	83.7	-13.0
Pork	91.3	91.1	-.02
Poultry	107.0	96.4	-9.9
Fish	115.8	111.5	-3.7
Dairy products	93.2	92.5	-.08
Fruits and vegetables	111.3	121.6	9.3
Sugars and sweeteners	96.3	92.1	-4.4
Nonalcoholic beverages	89.8	81.6	-9.1
Fats and oils	97.7	90.1	-7.8
Miscellaneous prepared foods	101.2	101.5	.03

[1]Based on the Consumer Price Index (CPI) for individual food groups divided by the CPI for all urban consumers, 1982-84 = 100.

Source: Economic Research Service, USDA.

Table 3—Annual household income and size by selected demographic groups, 1997-98

Demographic group	Annual income before taxes	Household size
	Dollars	*Number*
All groups	43,050	2.53
Season:		
Winter	43,407	2.54
Spring	43,788	2.56
Summer	43,030	2.54
Fall	41,855	2.48
Region:		
Northeast	44,613	2.42
North Central	43,323	2.45
South	40,359	2.57
West	45,078	2.64
Race:		
Non-Black	44,809	2.49
Black	29,994	2.83
Income quintile:		
I (lowest)	7,349	1.79
II	17,936	2.27
III	31,290	2.45
IV	49,509	2.88
V (highest)	100,353	3.14
Household size:		
1 member	24,183	
2 members	46,094	
3 members	52,096	
4 members	57,602	
5 members	57,362	
6 or more members	45,803	

Source: Economic Research Service, USDA.

households. The mean before-tax income for households in the lowest 20 percent of the income distribution was $7,349 per year, while the mean income for households in the top 20 percent of the income distribution was $100,353 per year. This gap narrows marginally if these figures are adjusted for household size, as lower income households tend to have fewer members.

Table 4 breaks total food expenditures per person into at-home and away-from-home components by selected socioeconomic characteristics, season, and household size. Care is required in interpreting this table because it does not isolate the effect of a single socioeconomic characteristic on expenditures. For example, household size, income, and other factors are not held constant in the breakdown by racial group.

While total food expenditures were nearly the same across the seasons, they were slightly higher in the spring and lowest in the winter. At-home food expenditures were highest in the fall and lowest in the summer. Conversely, away-from-home food expenditures were highest in summer and lowest in fall.

Food spending varied substantially by region, which may have been caused by relative price differences, income disparities, and differences in tastes and preferences. Households in the South spent the least on total food, while those in the Northeast spent the most. The same relative pattern held for food at home and food away from home, with households in the South spending the least and those in the Northeast spending the most.

Table 4—Weekly food expenditures per capita, at home and away from home, by selected demographic variables, 1997-98

Demographic group	Expenditures			Share of food budget, at-home	Share of income spent on food
	Total	At home	Away from home		
	Dollars			*Percent*	
All groups	40.32	24.68	15.64	61.2	10.8
Season:					
Winter	40.13	24.34	15.78	60.7	10.7
Spring	40.46	24.71	15.75	61.1	10.8
Summer	40.27	23.79	16.48	59.1	10.8
Fall	40.40	25.62	14.77	63.4	10.9
Region:					
Northeast	43.32	25.76	17.56	59.5	11.1
North Central	39.38	24.06	15.33	61.1	10.3
South	37.87	23.75	14.12	62.7	10.9
West	42.23	25.72	16.52	60.9	10.9
Race:					
Non-Black	41.32	25.06	16.26	60.6	10.6
Black	31.19	21.25	9.94	68.1	12.8
Income quintile:					
I (lowest)	32.17	21.84	10.33	67.9	35.5
II	35.13	23.50	11.63	66.9	19.3
III	40.30	24.71	15.59	61.3	13.3
IV	42.27	24.58	17.69	58.1	10.8
V (highest)	50.60	28.38	22.22	56.1	7.2
Household size:					
1 member	48.92	27.86	21.05	57.0	10.6
2 members	43.78	27.27	16.51	62.3	9.9
3 members	35.09	21.94	13.15	62.5	10.6
4 members	30.57	20.08	10.49	65.7	11.0
5 members	27.13	18.27	8.86	67.3	12.0
6 or more members	21.32	15.65	5.68	73.4	16.0

Source: Economic Research Service, USDA.

Non-Black households spent substantially more per person on total food, food at home, and food away from home than Black households, probably due to the income disparity between non-Blacks and Blacks and the larger household sizes among Blacks—larger households tend to have lower per capita expenditures.

Higher income households spent more per person for both at-home food and away-from-home food in 1997-98 than households at other income levels. Higher income households also spent a lower share of their food dollar on food at home. Larger households spent less per person for both food at home and food away from home than other households. Smaller households tend to spend more of their food dollars away from home. Because economies of size may be realized in expenditures on food at home but not on food away from home, these results are understandable.

Almost all households (98.7 percent) had some total food purchase every week (table 5). Among this share, 96.2 percent purchased food for at-home consumption, and 86.6 percent purchased food away from home. Among households purchasing individual categories of food at home, 91.4 percent of households purchased cereals and bakery products, and 89.1 percent purchased dairy products. Only 38 percent of all households purchased fish.

Table 5—Percentage of the population purchasing food items in a week, 1997-98

Food group	Share of population purchasing food item
	Percent
Total food	98.7
Food away from home	86.6
Food at home	96.2
Cereals and bakery products	91.4
Meat, poultry, fish, and eggs	87.2
Beef	59.6
Pork	54.6
Poultry	53.3
Fish	38.0
Dairy	89.1
Fruits	84.0
Vegetables	82.2
Sugars and sweeteners	65.8
Nonalcoholic beverages	79.3
Fats and oils	58.8
Miscellaneous prepared foods	84.0

Source: Economic Research Service, USDA.

Model Specification and Variables

In this study, we assume that a person's diet-health knowledge, such as knowing the benefits of eating a high-fiber diet or knowing which foods are likely to contain large amounts of fat, influences his or her expenditures on different food groups. For example, we hypothesize that a household headed by a married couple with a college education or higher is likely to buy more fruits and vegetables than a household whose inhabitants never finished high school. Further, we assume that this knowledge can be introduced as a separate factor into the consumer demand equation for each particular food category. Hence, diet-health knowledge is estimated as a separate equation and as a variable in each individual food expenditure equation.

The diet-health variable was based on participants' responses to health and nutrition knowledge questions in the 1994-96 Diet and Health Knowledge Survey (DHKS), a followup survey to USDA's 1994-96 Continuing Survey of Food Intakes by Individuals (CSFII). Each year of the 3-year CSFII data sets comprises a nationally representative sample of noninstitutionalized persons residing in the United States. From each CSFII household, a randomly selected participant who had provided initial (day 1) intake information and who was age 20 or older was contacted by telephone approximately 2-3 weeks after the CSFII was recorded. The DHKS questions covered a wide range of issues, including self-perceptions of the adequacy of intake levels of nutrients, awareness of diet-health relationships, perceived importance of following the dietary guidance, use and perceptions of food labels, and behaviors related to fat intake and food safety. Out of 7,842 households eligible for DHKS, respondents from 5,765 households, or 73.5 percent, completed the survey.

The diet-health knowledge variable used in this study was constructed from responses to 27 questions in the DHKS. These questions asked about the sources and occurrence of various nutrients in foods ("Which has more saturated fat: butter or margarine?"), the relationship of specific dietary components to specific diseases ("Have you heard about any health problems caused by eating too much cholesterol?"), and the number of servings of various food groups in a healthful diet ("How many servings would you say a person of your age and sex should eat each day for good health from the vegetable group?"). The number of correct answers to these questions given by a respondent provided a direct measure of his or her diet-health knowledge.

The range of the diet-health knowledge variable was 0-27. Based on the estimated proportions using sampling weights for the actual data, 74 percent of the respondents scored 16 or above on the 27-point test. Less than 1 percent answered three or fewer questions correctly. The mean score was 17.6.

The prediction equation for the diet-health knowledge variable in the expenditure equations was estimated using a linear multiple regression model. The diet-health knowledge variable from the DHKS was regressed on a selected set of economic and sociodemographic characteristics of the respondents. These explanatory variables were chosen to ensure that a consistent set of variables was also available in the CES data. For example, detailed racial and ethnic origin information was available in DHKS, but the ethnic origin variable in the CES had a significant proportion of missing values. Therefore, we included only a dummy variable indicating Black racial status in the regression model. After eliminating observations with missing values, a DHKS sample of 5,232 observations was available for estimation. The explanatory variables, their definitions, and means from the weighted data are reported in table 6.

The CSFII-DHKS is a complex survey with a stratified, multistage, probability sample design. Accordingly, the regression model was estimated using sampling weights to compensate for probabilities of selection, differential response rates, and possible deficiencies in the sampling technique. The standard errors of the parameter estimates were adjusted for sample design.

The diet-health knowledge equation had a reasonable fit with an R-squared of 0.2. Except for the proportion of household heads employed and located in a non-Metropolitan Statistical Area, all other variables or their categories had significant influence on diet-health knowledge. Among all variables, educational attainment had the largest effect on diet-health knowledge. Other variables held constant, those who completed college scored 3.12 points higher on the diet-health knowledge test than those who had less than 12 years of education. Based on a mean test score of 17.58, this translates to an 18-percent increase in test scores for college-educated respondents, compared with scores for respondents who did not complete high school.

Table 6—Definitions and sample means of independent variables for diet-health knowledge equations

Variable	Mean	Definition
Diet-health knowledge	17.58	Mean value of diet-health knowledge index in CSFII
Region:		
Northeast	.210	Omitted base region
North Central	.240	Equals 1 if household resides in North Central States, 0 otherwise
South	.340	Equals 1 if household resides in South, 0 otherwise
West	.210	Equals 1 if household resides in West, 0 otherwise
Race:		
Non-Black	.890	Omitted base
Black	.110	Equals 1 if household is Black, 0 otherwise
Income	3.280	Annual household income before taxes measured in hundreds of dollars per week per household member
Metro area	.780	Omitted base
Nonmetro area	.220	Nonmetro region
Female	.530	Omitted base
Male	.470	Household head is male
Female head	.160	Single head of household is female
Male head	.080	Single head of household is male
Employed	.640	Share of household heads employed
No high school	.260	Omitted base
High school	.350	12 years of schooling or GED
Some college	.220	1-3 years of college completed
College	.270	4 years or more of college completed
Household age composition:		
Proportion under age 5	.060	Proportion of household members under age 5
Proportion age 5-9	.050	Proportion of household members age 5-9
Proportion age 10-14	.050	Proportion of household members age 10-14
Proportion age 15-19	.050	Proportion of household members age 15-19
Proportion age 20-29	.130	Proportion of household members age 20-29
Proportion age 30-44	.230	Proportion of household members age 30-44
Proportion age 45-64	.250	Omitted base group
Proportion age 65-74	.110	Proportion of household members age 65-74
Proportion older than age 74	.070	Proportion of household members older than age 74

Source: Economic Research Service, USDA.

Income had a significant influence on knowledge, with an additional $100 in weekly per capita household income increasing test scores by 0.18 points. Among respondents of similar sociodemographics, men scored 1.6 points lower than women and Blacks scored 1.4 points lower than Whites. Adults from households with both a male and female head displayed greater diet-health knowledge than adults from households with only a male head or only a female head. Households with a greater proportion of adults age 75 or older scored lower on the diet-health knowledge test than households with a greater proportion of adults age 45-64.

Estimates of this equation using CES data were similar to initial estimates, which used a different data set. When we used the estimated parameters of the model from the CSFII data with the CES data, we found the predicted mean score to be 17.7. In addition, 82 percent of households in the CES data set scored 16.0 or higher. This score compares with a predicted mean value of 17.2 in the CSFII (this mean is different from the raw data mean due to the weighting of the model), and 86 percent of CSFII households scored 16.0 or higher. We feel the diet-health knowledge equation fits the CES

data very well and will provide reliable estimates for making projections of food expenditures.

As noted earlier, the Tobit model is the econometric procedure used to quantify the relationship of household characteristics and income to the purchase/nonpurchase decision and to the level of purchase. In addition, the diet-health knowledge equation is recursively solved to supply a numerical variable in the expenditure equations. The dependent variable in the food equations is average weekly food expenditures per person. Table 7 lists the household socioeconomic and demographic variables that are used to explain the observed expenditure patterns in the Tobit model, together with descriptions of the variables and their sample means. Table 8 presents the food groups analyzed in this study. The same model specification is applied for each product category.

Variations in size and composition across households are controlled in the model by including the inverse of household size and the proportion of household members in selected age groups. The inverse of household size variable captures the effects of economies of size, while the proportion of members in each age group controls for age composition of the household. Because the inverse decreases, a positive coefficient on this variable indicates positive economies of size. That is, larger households, even after controlling for the age of members, tend to spend less per person than smaller households. A negative coefficient has the opposite effect. The inverse transformation forces the size of the scale effect to diminish as households grow larger. Nine age groups are used to delineate the effects of household composition. However, to avoid estimation problems, the 45-65 age group is not entered directly into the equation.

Income per person, which includes the net value of food stamps, is entered quadratically. This specification has been shown to provide a good statistical fit in models with income and household composition entered in the model (Tomek). The quadratic form also allows the marginal propensity to spend and the income elasticity to vary with the level of income and has been shown to satisfy the adding-up criterion (that is, total expenditures must sum to total income).

Region of household residence, race, and season of the year are entered as a series of binary dummy variables. That is, the variable is assigned the value of 1 if the household has that characteristic and the value of 0 otherwise. The year in which a household was surveyed is also entered as a binary variable to account for changes in expenditures due to a change in relative prices between the 2 years.

Table 7—Definitions and sample means of independent variables for expenditure equations

Variable	Mean	Definition
Diet-health knowledge	17.65	Mean value of diet-health knowledge index
Region:		
Northeast	.182	Omitted base region
North Central	.246	Equals 1 if household resides in North Central States, 0 otherwise
South	.342	Equals 1 if household resides in South, 0 otherwise
West	.229	Equals 1 if household resides in West, 0 otherwise
Race:		
Non-Black	.891	Omitted base
Black	.109	Equals 1 if household is Black, 0 otherwise
Income	3.710	Annual household income before taxes measured in hundreds of dollars per week per household member
Income squared	27.137	Income variable raised to the second power
Season:		
Winter	.253	Equals 1 if winter, 0 otherwise; includes January, February, and March
Spring	.260	Equals 1 if spring, 0 otherwise; includes April, May, and June
Summer	.252	Equals 1, if summer, 0 otherwise; includes July, August, and September
Fall	.235	Omitted base season; includes October, November, and December
Year:		
1997	.502	Omitted base year
1998	.498	Equals 1 if 1998, 0 otherwise
Household size (inverse)	.559	Inverse of the number of household members
Household age composition:		
Proportion under age 5	.037	Proportion of household members under age 5
Proportion age 5-9 years	.047	Proportion of household members age 5-9
Proportion age 10-14 years	.046	Proportion of household members age 10-14
Proportion age 15-19 years	.057	Proportion of household members age 15-19
Proportion age 20-29 years	.145	Proportion of household members age 20-29
Proportion age 30-44 years	.227	Proportion of household members age 30-44
Proportion age 45-64 years	.242	Omitted base group
Proportion age 65-74 years	.103	Proportion of household members age 65-74
Proportion older than age 74	.097	Proportion of household members older than age 74

Source: Economic Research Service, USDA.

Table 8—Food product groups and their compositions included in food expenditures

Food group	Composition
Total food	Food at home and away from home (except food purchased on overnight trips), excluding alcoholic beverages.
Food away from home	Lunch, dinner, breakfast, brunch, snacks, and nonalcoholic beverages at restaurants, vending machines, and carryouts, including tips, board, meals for someone away at school, and catered affairs.
Food at home	Food used in the home, excluding alcoholic beverages.
Cereals and bakery products	Ready-to-eat and cooked cereals, pasta, prepared flour mixes, other cereal products (cornmeal, cornstarch, rice) bakery products (bread, crackers, cookies, biscuits, rolls, cakes, and other specified frozen and refrigerated bakery products).
Meat, poultry, fish, and eggs	Meat, poultry, fish, and eggs.
Beef	Ground beef, roasts, steaks, veal, and other cuts, excluding canned beef.
Pork	Bacon, porkchops, ham (including canned), roast, sausage, and other cuts.
Poultry	Fresh and frozen chicken, duck, turkey, and cornish hens, excluding canned.
Fish	Fresh and frozen fish and shellfish.
Dairy products	Fresh and processed dairy products.
Fruits	Fresh, frozen, and processed fruits, including juices.
Vegetables	Fresh, frozen, and processed vegetables, including juices.
Sugar and sweeteners	Sugar, candy, chewing gum, artificial sweeteners, jams, jellies, preserves, fruit butters, syrup, fudge mixes, icings, and other specified sweets.
Nonalcoholic beverages	Diet and nondiet carbonated drinks, coffee, tea, chocolate-flavored powder, and other specified beverages.
Fats and oils	Margarine, shortening, salad dressings, nondairy creamer, peanut butter, and substitute and imitation milk.
Miscellaneous prepared foods	Frozen prepared foods, canned and packaged soups, potato chips, nuts and other snacks, condiments, seasonings, olives, pickles, sauces and gravies, salads, desserts, baby foods, and canned beef and poultry.

Source: Economic Research Service, USDA.

Empirical Results From the 1997-98 Data

The estimated models for the 16 food groups plus the diet-health knowledge equation allow us to evaluate the proportion of consumers purchasing the relevant item as well as the level of consumer expenditures with a specified set of household characteristics (appendix). For convenience, we present the estimated responses in per capita weekly expenditures associated with changes or differences in household demand factors. The estimated responses are evaluated at the sample means for all variables except the variable examined in the particular table. In other words, all variables in both the diet-health knowledge equation and the food expenditure equation are set to their observed mean values, except for the variable of interest. The variable of interest is set to its actual value if continuous, or to 1 if it is a binary variable.

Influence of Income

Table 9 shows the per capita effect of a 10-percent increase in weekly per capita income, as well as a 10-percent increase in diet-health knowledge. These effects represent only the so-called direct effects, or direct elasticities. The elasticity is simply the percent change in the dependent variable—in our case, the food group expenditure—divided by the percent change in income or diet-health knowledge. As such, they ignore the effects that occur in the diet-health knowledge equation, the so-called indirect effect. Hence, the direct effects in table 9 may understate or overstate the magnitude of the elasticities.

Income is an important determinant of food expenditures, and all income variables were jointly significant at acceptable statistical levels for all 16 food groups. Also, all calculated income elasticities are positive in table 9, which indicates that food expenditures increase as income rises.

Food groups most responsive to an increase in income are food away from home, miscellaneous prepared food, fruits, dairy products, and sugars and sweeteners. Given a 10-percent increase in income, expenditures rise 4.56 percent for food away from home, 1.63 percent for miscellaneous prepared foods, 1.62 percent for fruits, and 1.14 percent for both dairy products and sugars and sweeteners.

A 10-percent change in diet-health knowledge would be truly extraordinary. However, if diet-health knowledge increased 10 percent, expenditures would rise 12.50 percent for fish, 11.72 percent for fruits, and 8.79 percent for vegetables. In contrast, pork expenditures would decrease 1.12 percent and beef expenditures would decrease 7.84 percent if diet-health knowledge increased 10 percent.

As noted earlier, the market entry response comprises several components that are distinctly different but impossible to identify with our data. Correct interpretation of the market entry response requires an understanding of these components as well as the data. Three points deserve emphasis. First, the CES data are an expenditure, not a use, survey. Consequently, some households did not report any food expenditures during their survey period, but they undoubtedly consumed food from current supplies. Second, sampling units at which occupants were temporarily absent are included in the sample. These two factors will tend to cause the market entry response to be overestimated and possibly misinterpreted, especially for total food and food at home. Third, it is not possible to discern whether zero expenditures may represent nonuse of the commodity or infrequency-of-purchase behavior, as all households reported only for a 2-week period during the survey.

Table 9 also shows changes in expenditures due to market entry by consumers who did not previously purchase the good as well as changes due to the expenditure effect (the effect of those who already purchase the good increasing or decreasing expenditures). For example, if income increased by 10 percent, expenditures on vegetables would increase 1.03 percent. Of this amount, 0.48 percent would be due to households entering the market to make a vegetable purchase, and 0.55 percent would be due to increased expenditures by households that already purchase vegetables.

In terms of an income increase only, products with over 50 percent of the total income response due to market entry include beef, pork, poultry, fish, and sugars and sweeteners. In addition, both nonalcoholic beverages and miscellaneous prepared food are close to 50 percent. Hence, increases in income will benefit these food groups more than others in terms of market entry. Food companies could develop advertising strategies to attract these consumers.

To help understand the effects of income on food expenditures, we simulate average per capita expenditures on

Table 9—Per capita direct effects of 10-percent increases in income and diet knowledge on weekly food expenditures, 1997-98

Food group	Response to income increase			Response to diet-knowledge increase		
	Total increase in expenditures	Market entry effect[1]	Expenditure effect	Total increase in expenditures	Market entry effect	Expenditure effect
	Percent					
Total food	2.76	.69	2.07	2.07	.51	1.56
Food away from home	4.56	2.15	2.41	2.37	1.12	1.25
Food at home	1.25	.38	.87	3.60	1.09	2.51
Cereals and bakery products	1.06	.44	.62	4.85	2.01	2.84
Meats, poultry, fish, and eggs	.72	.34	.38	-2.23	-1.04	-1.19
Beef	.68	.42	.26	-7.84	-4.89	-2.95
Pork	.56	.36	.20	-1.12	-.72	-.40
Poultry	.76	.49	.27	3.05	1.95	1.10
Fish	.65	.47	.18	12.50	9.06	3.44
Dairy products	1.14	.53	.61	5.05	2.36	2.69
Fruits	1.62	.79	.83	11.72	5.73	5.99
Vegetables	1.03	.48	.55	8.79	4.12	4.67
Sugars and sweeteners	1.14	.70	.44	7.70	4.70	3.00
Nonalcoholic beverages	1.05	.52	.53	.95	.47	.48
Fats and oils	.50	.31	.19	3.52	2.16	1.36
Miscellaneous prepared food	1.63	.79	.84	6.22	3.01	3.21

[1]Entry refers to how much of the total effect is due to new market entry or exit by consumers.

Source: Economic Research Service, USDA.

the 16 food groups at selected per capita income levels using the estimated Tobit equations evaluated for an average sample household (table 10). The per capita income levels we chose were the mean ($19,721) and 25, 50, 125, and 150 percent of the mean. This exercise took into account both the diet-health knowledge equation and the expenditure equation.

Expenditures in all categories increase as income increased. Expenditures with the highest income elasticities, such as food away from home and miscellaneous prepared food, generally increase the most as income rises and, conversely, fall the most as income declines from the mean. Expenditures on food away from home fall to about 69 percent of average expenditures when income declines to 25 percent of the mean.

These responses are larger than would be predicted using the elasticities because, as noted, these results include not only the direct effect but the indirect effect of the diet-knowledge equation. Close study indicates that the indirect effect tends to increase expenditures above what would be predicted by the direct income effect. For example, raising per capita income from $19,721 to $24,652 (25 percent) increases average total food expenditures about 8.2 percent, whereas the income elasticity from table 9 would increase expenditures just 6.9 percent.

The most revealing data in table 10 are the small increases in food expenditure, which are exactly in line with our calculated elasticities. If average income increased 50 percent, total food expenditures would increase just 14.8 percent while away-from-home food expenditures would increase 23.6 percent. The reason: American households are already well off and well fed. In fact, it should be noted that these expenditure simulations embody both a quantity and a quality effect. In

Table 10—Simulated weekly expenditure per capita by weekly income level, 1997-98

Food group	Base	Expenditure change			
		25% of base	50% of base	125% of base	150% of base
	$19,721	$4,930	$9,861	$24,652	$29,582
	Dollars	*Percent*			
Total food	41.12	79.9	87.3	108.2	114.8
Food away from home	16.62	68.7	80.3	113.3	123.6
Food at home	25.34	90.3	93.8	103.9	107.1
Cereal and bakery products	4.13	92.3	95.2	103.4	106.1
Meat, poultry, fish, and eggs	6.73	95.5	96.7	100.6	102.2
Beef	1.97	97.0	97.5	100.0	100.5
Pork	1.39	100.0	100.0	100.7	100.7
Poultry	1.23	93.5	95.9	101.6	104.1
Fish	1.03	92.2	94.2	101.0	102.9
Dairy	3.12	91.7	94.9	103.8	106.7
Fruits	2.61	86.2	91.6	105.7	110.3
Vegetables	2.10	90.5	93.8	103.8	107.1
Sugars and sweeteners	1.31	91.6	95.4	103.8	106.9
Beverages	2.29	92.6	95.6	103.5	106.1
Fats and oils	.74	95.9	97.3	102.7	104.1
Miscellaneous prepared foods	3.89	87.9	92.8	105.7	109.8

Source: Economic Research Service, USDA.

other words, a 10-percent increase in expenditures does not translate to a 10-percent increase in quantities demanded. Rather, the increase in food expenditures goes in large part to increased demand for quality factors, such as convenience, packaging, and the substitution of products (for example, steak for hamburger). Because our data are an expenditure survey, separating an expenditure elasticity into its quality and quantity components is not possible. For a discussion of changes in the quantities consumed, see Lin, 2003, the companion report to this study.

Demographic and Seasonal Effects

Household characteristics and factors other than income that influence consumer demand for food include household age composition, region of residence, race, and season. Differences in per capita expenditures associated with these factors are simulated using the estimated Tobit and diet-health knowledge equations evaluated at alternative levels of the particular factor being examined, while other factors are held constant at their respective sample averages. For example, households are grouped into four categories according to their region of residence: Northeast, North Central, South, and West. To simulate expenditures in a region, we determined the overall mean expenditure using the sample mean for all variables in the model, including the mean for all dummy variables. This mean expenditure was compared with the computed expenditure retaining all mean values but including the appropriate dummy variable for the variable of interest.

Household Age Composition

The age composition of a given household tends to have a dynamic effect on household food expenditures. In table 11, the base age group is made up of adults age 45-64. In general, as household age composition increased, expenditures on food at home increased. As household age composition decreased, expenditures on food away from home increased. Households in which the members are age 45 or older tended to spend more on food at home, while those composed mainly of

Table 11—Simulated weekly food expenditures per capita by age group, 1997-98

Food group	Base 45-64	Share of mean weekly expenditures by age (years)							
		Under 5[1]	5-9	10-14	15-19	20-29	30-44	65-74	Over 74
	Dollars	*Percent*							
Total food	45.21	59.2	68.8	78.4	69.2	86.5	97.2	102.7	88.7
Food away from home	15.30	77.1	83.9	108.1	113.9	134.7	128.2	105.5	75.2
Food at home	30.82	54.5	63.5	65.2	47.2	62.8	81.2	100.5	94.3
Cereals and bakery products	4.70	52.6	80.6	76.6	51.7	74.3	84.0	108.3	112.3
Meats, poultry, fish, and eggs	8.64	45.7	53.6	51.6	31.7	55.7	81.0	95.8	85.5
Beef	2.50	59.2	65.6	65.6	35.2	60.4	76.8	89.2	86.0
Pork	1.93	46.1	44.6	37.3	27.5	37.3	72.0	92.2	94.3
Poultry	1.48	50.0	62.8	67.6	40.5	62.1	92.6	95.3	89.2
Fish	1.30	46.9	68.5	39.2	39.2	45.4	83.1	107.7	91.5
Dairy	3.51	85.8	82.3	81.5	55.3	69.8	87.7	103.7	101.4
Fruits	3.09	80.9	79.0	64.4	42.4	60.2	69.3	110.4	120.7
Vegetables	2.74	48.5	48.5	47.4	26.6	49.3	72.6	108.0	97.1
Sugars and sweeteners	1.46	71.9	93.2	92.5	68.5	65.8	82.2	117.8	100.7
Nonalcoholic beverages	2.73	52.0	52.0	72.5	61.2	73.6	95.2	87.5	73.6
Fats and oils	.98	36.7	58.2	56.1	32.7	44.9	71.4	96.9	100.0
Miscellaneous prepared foods	4.52	70.6	71.5	79.2	56.2	70.1	89.2	93.6	92.0

[1]For example, total food expenditures for a child under age 5 would be 59.2 percent of the total food expenditures for an adult age 45-64.

Source: Economic Research Service, USDA.

members under age 45 tended to spend more on food away from home.

In the under-45 age group, households with children under age 14 as well as adults age 30-44 spent more on dairy items. The 30-44 age group also spent more on miscellaneous prepared foods than younger age groups. Households with children age 10-19 tended to spend more on food away from home, as did the 20-29 age group. Also, households with children age 9 or under spent relatively more on fruits than households with older children.

The over-45 age group spent more on food at home than the younger age groups and spent more on cereal and bakery products, meats, dairy, fruits, vegetables, and sugar and sweeteners. The over-74 age group spent the most on cereal and bakery products and fruits and spent the least on food away from home.

Each figure in table 11 approximates the per capita effect that a household member of a given age would have on total household expenditures. Hence, the weekly expenditure of a household composed of a particular combination of members may be readily calculated. For example, a household composed of a child age 7 and two adults age 25 and 32 would have weekly total food expenditures of $114.16 (calculated as 45.21 X (0.688 + 0.865 + 0.972)). This approach enables us to compare expenditures for households of different sizes and/or age composition.

Region

Households in the Northeast generally spent the most on total food, including food at home and food away from home (table 12). While the South spent the least on food away from home, the North Central spent the least on food at home. Households in the Northeast spent the most on cereals and bakery products; meats, poultry, fish, and eggs; dairy; fruits; and vegetables. At the same time, the Northeast spent the least on sugars and sweeteners, nonalcoholic beverages, fats and oils, and miscellaneous prepared foods.

Households in the West spent the most on fats and oils, and miscellaneous prepared foods. Households in the South spent the most on pork, while households in the North Central spent the most on sugars and sweeteners and nonalcoholic beverages.

Race

Non-Black households outspent Black households by 6 percentage points on food at home and by about 25 percentage points on food away from home, all other factors held constant (table 13). Non-Black households had higher expenditures in every major category except meat, poultry, fish, and eggs. In this category, Black households outspent non-Black households by about 15 percentage points. Black households spent substantially more on pork, poultry, and fish and slightly more (about 3 percentage points) on fruits. Both types of households spent the same on fats and oils.

Table 12—Simulated weekly food expenditures per capita by region, 1997-98

Food group	Mean base	Share of mean weekly expenditures, by region			
		Northeast	North Central	South	West
	Dollars	*Percent*			
Total food	41.12	104.8	94.5	94.7	98.5
Food away from home	16.62	106.1	95.2	93.5	96.1
Food at home	25.34	102.6	94.5	96.5	101.0
Cereals and bakery products	4.13	108.7	93.7	90.6	93.5
Meats, poultry, fish, and eggs	6.73	104.9	92.9	97.0	97.3
Beef	1.97	103.6	93.9	98.0	95.9
Pork	1.39	96.4	105.0	107.9	97.1
Poultry	1.23	113.8	84.6	88.6	89.4
Fish	1.03	111.7	108.7	90.3	102.9
Dairy products	3.12	104.2	94.2	96.2	98.7
Fruits	2.61	104.6	93.1	92.3	102.7
Vegetables	2.10	104.8	89.0	95.2	102.4
Sugars and sweeteners	1.31	99.2	103.1	100.0	100.0
Nonalcoholic beverages	2.29	94.8	105.2	104.8	103.9
Fats and oils	.74	97.3	98.6	102.7	104.1
Miscellaneous prepared foods	3.89	88.9	110.0	105.7	115.2

Source: Economic Research Service, USDA.

Table 13—Simulated weekly food expenditures per capita by race, 1997-98

Food group	Mean	Share of mean expenditures	
		Black	Non-Black
	Dollars	*Percent*	
Total food	41.12	88.7	101.2
Food away from home	16.62	77.6	102.5
Food at home	25.34	94.6	100.6
Cereals and bakery products	4.13	88.9	101.2
Meats, poultry, fish, and eggs	6.73	113.8	98.5
Beef	1.97	99.0	100.0
Pork	1.39	120.9	97.8
Poultry	1.23	129.3	96.7
Fish	1.03	130.1	96.1
Dairy	3.12	76.9	102.6
Fruits	2.61	103.1	99.6
Vegetables	2.10	95.2	100.5
Sugars and sweeteners	1.31	89.3	101.5
Nonalcoholic beverages	2.29	87.3	101.3
Fats and oils	.74	100.0	100.0
Miscellaneous prepared food	3.89	80.5	102.3

Source: Economic Research Service, USDA.

Population and Demand Projections: Background and Methods

If we combine the the U.S. Census Bureau's projections of demographic change over the next two decades with the variations found in food expenditures by household income, age composition, region of residence, race, and diet-health knowledge, the results will show that household food expenditures are also likely to change. Several assumptions and limitations underlying the projected expenditures should be noted. First, the following analysis assumes that the relationships of income and demographics to food expenditures stay the same as those found in the statistical analysis of the 1997-98 CES data, implying that relative prices and alternative opportunities for food choices, as well as tastes and preferences, remain unchanged. Second, as their economic and demographic circumstances change, consumers are assumed to acquire the expenditure patterns of individuals already observed in those circumstances. That is, a household that migrates from the Northeast to the West will acquire the expenditure characteristics of households in the West. Likewise, a 5-year-old in 2020 is assumed to have the same food expenditure pattern as a 5-year-old in 1997-98. Third, the models are driven by projected changes in demographics and projected income growth. Hence, deviations from these projections will result in different expenditure patterns. These assumptions may appear unduly restrictive, but the information required to relax them is either unavailable or unreliable.

Another way to interpret the projections is to view them as scenarios of what would have occurred in 1997-98 if projected demographic changes had already been in place. For example, a relevant question may be as follows: "What would have happened to food expenditures in 1997-98 if the projected changes in the racial mix of the population for 2020 were already in place?" This approach to viewing the projections lessens the potential for misinterpretation by focusing attention on the underlying assumptions noted earlier. Although we feel this alternative interpretation is the most appropriate, we will instead use the term "projections" and draw comparisons between the base year, 2000, and a future period as we discuss our results.

Projections of food expenditures in this report are based on projected changes in the age distribution of the population, future regional population shifts, changes in the racial mix of the population, changes in educational attainment (diet-health knowledge), population growth, and inflation-adjusted income growth. Both the isolated and the combined effects on food expenditures are projected for each of these socioeconomic factors. As noted, food expenditure projections are based on census population projections and an assumed annual income growth of 1 percent and are presented on both a per person and a national basis.

Population, household, and education projections used in this analysis come from the census bureau (Hollman et al.; Day, 1996; Day, 2000). The population series includes projections by single year of age, sex, race, Hispanic origin, and nativity (foreign-born or native) out to the year 2100. Educational attainment projections by sex and race are available to 2028. These projections are not intended as forecasts or predictions but represent the results of assumptions about future trends in population change, household formation, schooling, and the economy at large. In the population series, projections are based on assumptions about fertility, mortality, and immigration. Differing assumptions are made to provide three different projection series, representing high, middle, and low alternatives. Our projections are based on the middle series.

Several modifications and extensions were applied to census projections to enable us to obtain the projections for 2020 used in this report. Census projections for education were published for 2003 and 2028, so our numbers represent interpolations between these two dates.

The current population projections provided by the census bureau are based on the 1990 census, as enumerated, and postcensal estimates up through 1999. The number of people counted in the 2000 census was 6 million more than anticipated by pre-census estimates (281 versus 275 million). Various factors undoubtedly contributed to the higher count, including a more complete census count in 2000 than in 1990 and a likelihood of more duplications in 2000. Any statement about the relative importance of different factors at this point is speculative. It is likely that the level of unauthorized immigration, clearly the most difficult component of the population to tabulate, was significantly higher than expected. To account for these discrepancies, population was multiplied by the ratio of the 2000 census result and the 2000 projection. For example, the 2000 census counted 39.9 million people age 24-29 and the projection was 37.4 million, for a ratio of 1.06. We multiplied projections for that age group to 2020 by 1.06.

For the first time, census filers in 2000 were allowed to identify themselves as members of more than one race, and over 6.8 million Americans chose to do so. This segment represents only 2.5 percent of the total population but a much higher share among the overall minority population. Therefore, an additional modification had to be made to assign these people to one race category. We chose to use ratios derived by research into primary and secondary race identification that allow for a fractional assignment of a multiracial group into its component races (Allen and Turner). Research showed, for example, that 61 percent of those self-identified as Black and White would likely choose Black as their primary race. We divided the total number into the two races according to that percentage.

Projected Age Distribution

The proportion of the U.S. population over age 45 is expected to increase, while the proportion under age 45 is expected to decrease (table 14). In 2000, 34.4 percent of the population was over age 45. By 2020, this age group is expected to account for 41.1 percent of the population. In contrast, the under-45 age group represented 65.6 percent of the total population in 2000. By 2020, this group is expected to represent about 59 percent of the Nation's population.

Projected Regional Population Distribution

Based on census projections, the Northeast and North Central are expected to lose population while the South and the West are expected to grow (table 15). The Northeast is expected to decline from 19.0 percent to 17.4 percent from 2000 through 2020. At the same time, the share of the population residing in the North Central is expected to decline from 22.9 percent to 21.1 percent. The South is expected to increase from 35.6 percent to 36.3 percent during 2000-2020, while the West is expected to increase from 22.5 percent to 25.2 percent.

Projected Population of the United States

The U.S. population is expected to increase about 18 percent from 2000 to 2020, from 281.4 million to 331.9 million (table 16).

Projected Racial Distribution

The proportion of the U.S. population that is Black will increase from 12.8 percent of the total population in 2000 to 13.8 percent in 2020.

Projected Educational Attainment

Changes in educational attainment will be applied to the diet-health knowledge equation to determine the effect of these changes on diet-health knowledge and food expenditures. The proportion of the U.S. population with a high school diploma is expected to decline between 2000 and 2020, from 35.2 percent to 32.6 percent. At the same time, the proportion of the population with some college education will increase from 24.1 percent to 27.0 percent, while the share with a college degree or higher will increase from 23.5 percent to 26.4 percent.

Table 14—Projected percentage of population by age group

Age group (years)	Share of population				
	2000	2005	2010	2015	2020
			Percent		
0-4	6.8	6.6	6.7	6.7	6.7
5-9	7.3	6.8	6.6	6.6	6.7
10-14	7.3	7.2	6.7	6.5	6.6
15-19	7.2	7.3	7.2	6.7	6.5
20-29	13.5	13.7	14.0	14.0	13.3
30-44	23.5	21.3	19.4	18.9	19.2
45-64	22.0	24.6	26.2	25.9	24.6
65-74	6.5	6.3	7.0	8.3	9.6
Over 74	5.9	6.0	6.0	6.1	6.9

Source: U.S. Department of Commerce, U.S. Census Bureau.

Table 15—Projected percentage of population by region

Year	Share of population			
	Northeast	North Central	South	West
	Percent			
2000	19.0	22.9	35.6	22.5
2005	18.8	22.3	35.8	23.1
2010	18.4	21.9	36.0	23.7
2015	18.1	21.4	36.1	24.4
2020	17.4	21.1	36.3	25.2

Source: U.S. Department of Commerce, U.S. Census Bureau.

Table 16—Projected U.S. population, percentage of population that is Black, and educational attainment

Age group (years)	Population	Blacks in population	Educational attainment		
			High school	Some college	College
	Millions	*Percent*			
2000	281.4	12.8	35.2	24.1	23.5
2005	294.0	13.1	34.5	24.8	24.2
2010	306.4	13.3	33.9	25.5	24.9
2015	319.1	13.6	33.2	26.3	25.7
2020	331.9	13.8	32.6	27.0	26.4

Source: U.S. Department of Commerce, U.S. Census Bureau.

Method of Projections Based on Diet-Health Knowledge and Tobit Models

Consumer demand for food commodities was projected to the year 2020 at 5-year intervals, beginning with the base year 2000. The projections were developed using knowledge about the existing structure of demand from the estimated Tobit expenditure models and the diet-health knowledge equation described earlier. The projections combine the projections of demographic characteristics of the U.S. population and projected income growth with the demand response parameters estimated for the per capita food expenditure and diet-health knowledge models.

In this report, we first simulated age, region, race, diet-health knowledge, and income separately. We then combined age, region, race, diet-health knowledge, and income to make a sixth projection. All six of these projections are per capita. We derived a seventh projection by taking the combined per capita projection and adjusting it by the projected U.S. population estimates. Income is assumed to increase 1 percent per year, which is slightly below historical growth rates but implies an increase in purchasing power of about 23 percent between 2000 and 2020.

We developed per capita projections by evaluating the estimated Tobit models using the average projected demographic characteristics of the population and the assumed annual growth rate for income. Several variables in the Tobit models do not directly enter into the projections and therefore were held constant in all projection scenarios. The dummy variable for 1998 was set equal to its mean value of 0.498. In addition, dummy variables for season were also set to their mean values. Household size was also held constant at its sample average. All variables in the diet-health knowledge equation were set equal to their mean values except those for educational attainment.

Because the Tobit model is nonlinear, the best measure of average expenditures would be developed by projecting expenditures for each possible household type (size, age composition, race, region, and income level) and computing a weighted average of expenditures using weights proportional to the number of households of each type. However, the detailed data required for such a procedure far exceed what is available. As a pragmatic alternative, we estimated average expenditures by evaluating the model for a typical consumer. Like the empirical simulations reported earlier, the diet-knowledge equation was first evaluated and an index value derived. This value was then recursively entered into the appropriate food expenditure equation. The projections are expressed as a percentage of the base year (2000) for ease of interpretation and to minimize any bias introduced by using population averages rather than the entire distribution.

Food Expenditure Projections

This section presents projected per capita effects of individual and combined demographic and income changes on weekly food expenditures per person as well as national effects.

Age Distribution Changes

The projections assume that all demographic factors (except age distribution), relative prices, and income remain constant at 1997-98 levels. As noted before, another way to interpret the projections is to imagine how expenditures in 1997-98 would have changed if the projected age distributions for 2000-20 had already been in place in 1997-98.

All food categories, except for food away from home, show slight increases in food expenditures due to the changing age distribution of the population (table 17). Total food expenditures would be expected to increase just 0.8 percent from 2000 to 2020. Over this time, food-at-home expenditures would be expected to increase 2.2 percent, while food-away-from-home expenditures would decline 1.3 percent.

In the major food categories, expenditures are projected to increase 3.7 percent for fruits and 3.6 percent for vegetables. Fats and oils expenditures would increase 2.9 percent due to changing age distribution while sugars and sweeteners expenditures would increase 2.4 percent. Expenditures on meat, poultry, fish, and eggs would increase 2.5 percent between 2000 and 2020. Within this category, both pork and fish would increase 3.1 percent over the 20-year period. Miscellaneous prepared food would increase the least—just 1.1 percent—due to the changing age distribution.

Regional Distribution Changes

The projections assume that all other factors influencing consumer demand remain constant at 1997-98 levels and that the new residents of a region will assume the expenditure patterns of the present population. Given this assumption, food expenditures would be basically

Table 17—Projected per capita effects of changing age distribution on weekly food expenditures

Food group	2000 base	Change in expenditures			
		2005	2010	2015	2020
			Percent		
Total food	100.0	100.3	100.5	100.8	100.8
Food away from home	100.0	99.6	99.2	99.0	98.7
Food at home	100.0	100.7	101.4	102.0	102.2
Cereals and bakery products	100.0	100.5	101.0	101.5	102.0
Meats, poultry, fish, and eggs	100.0	100.9	101.6	102.2	102.5
Beef	100.0	101.1	101.6	102.1	102.1
Pork	100.0	100.8	102.3	103.1	103.1
Poultry	100.0	100.0	100.0	100.8	100.8
Fish	100.0	101.0	102.1	102.1	103.1
Dairy	100.0	100.3	100.7	101.0	101.3
Fruits	100.0	101.2	102.0	102.8	103.7
Vegetables	100.0	101.0	102.1	103.1	103.6
Sugars and sweeteners	100.0	100.8	100.8	101.6	102.4
Nonalcoholic beverages	100.0	100.5	100.9	100.9	100.5
Fats and oils	100.0	101.4	101.4	102.9	102.9
Miscellaneous prepared food	100.0	100.3	100.5	100.8	101.1

Source: Economic Research Service, USDA.

unchanged from the base year (table 18). The three main aggregates, total food, food at home, and food away from home, are unchanged over the 20-year period. In fact, expenditures only change for miscellaneous prepared foods and meats, poultry, fish (up 0.5 percent), and eggs (up 0.1 percent) over the 20-year period.

Racial Distribution Changes

Changes in the racial mix of the population, all other variables held constant, are also expected to have minor effects on food spending (table 19). Total food and food at home spending would be expected to decline about 0.1 percent from 2000 to 2020. Expenditures on food away from home would decline 0.2 percent over the same period. Both dairy and miscellaneous prepared food would have the largest spending declines: just 0.3 percent between 2000 and 2020. More significant shifts in spending might be seen by looking at a more disaggregated racial breakdown or by looking at food quantities rather than food expenditures. For an alternative approach using quantities, see Lin, 2003.

Diet-health Knowledge Changes

The diet-health knowledge equation is a function of many variables, including region, income, household type, age distribution, and educational attainment. In this simulation, all variables in this equation were held at mean 1997-98 levels, except for educational attainment. Using the projected level of educational attainment, we derived a value for diet-health knowledge. This value was then inserted into the Tobit expenditure equations, with all other variables set at mean levels.

Changes in diet-health knowledge are projected to have little effect on food expenditures (table 20). Total food expenditures would increase just 0.3 percent over 20 years, with food away from home rising 0.3 percent and food at home rising 0.4 percent. Among individual at-home categories, fruits would have the largest increase in expenditures, 0.8 percent, while expenditures for meats, poultry, fish, and eggs would decline 0.1 percent. In this category, pork expenditures would decline 0.7 percent while beef expenditures would decline 0.5 percent. Expenditures on fish would increase 1 percent over the 20-year period. Spending on sugars and sweet-

Table 18—Projected per capita effects of changing regional population distribution on weekly food expenditures

Food group	2000 base	Change in expenditures			
		2005	2010	2015	2020
		Percent			
Total food	100.0	100.0	100.0	100.0	100.0
Food away from home	100.0	100.0	100.0	100.0	100.0
Food at home	100.0	100.0	100.0	100.0	100.0
Cereals and bakery products	100.0	100.0	100.0	100.0	100.0
Meats, poultry, fish, and eggs	100.0	100.0	100.1	100.1	100.1
Beef	100.0	100.0	100.0	100.0	100.0
Pork	100.0	100.0	100.0	100.0	100.0
Poultry	100.0	100.0	100.0	100.0	100.0
Fish	100.0	100.0	100.0	100.0	100.0
Dairy	100.0	100.0	100.0	100.0	100.0
Fruits	100.0	100.0	100.0	100.0	100.0
Vegetables	100.0	100.0	100.0	100.0	100.0
Sugars and sweeteners	100.0	100.0	100.0	100.0	100.0
Nonalcoholic beverages	100.0	100.0	100.0	100.0	100.0
Fats and oils	100.0	100.0	100.0	100.0	100.0
Miscellaneous prepared food	100.0	100.3	100.3	100.3	100.5

Source: Economic Research Service, USDA.

Table 19—Projected per capita effects of changing racial distribution on weekly food expenditures

Food group	2000 base	Change in expenditures			
		2005	2010	2015	2020
		Percent			
Total food	100.0	100.0	100.0	99.9	99.9
Food away from home	100.0	99.9	99.9	99.8	99.8
Food at home	100.0	100.0	100.0	100.0	99.9
Cereals and bakery products	100.0	100.0	100.0	100.0	100.0
Meats, poultry, fish, and eggs	100.0	100.1	100.1	100.1	100.1
Beef	100.0	100.0	100.0	100.0	100.0
Pork	100.0	100.0	100.0	100.0	100.0
Poultry	100.0	100.0	100.0	100.0	100.0
Fish	100.0	100.0	100.0	100.0	100.0
Dairy	100.0	100.0	99.7	99.7	99.7
Fruits	100.0	100.0	100.0	100.0	100.0
Vegetables	100.0	100.0	100.0	100.0	100.0
Sugars and sweeteners	100.0	100.0	100.0	100.0	100.0
Nonalcoholic beverages	100.0	100.0	100.0	100.0	100.0
Fats and oils	100.0	100.0	100.0	100.0	100.0
Miscellaneous prepared food	100.0	100.0	100.0	99.7	99.7

Source: Economic Research Service, USDA.

Table 20—Projected per capita effects of changing diet-health knowledge on weekly food expenditures

Food group	2000 base	Change in expenditures			
		2005	2010	2015	2020
		Percent			
Total food	100.0	100.1	100.1	100.2	100.3
Food away from home	100.0	100.1	100.2	100.2	100.3
Food at home	100.0	100.1	100.2	100.3	100.4
Cereals and bakery products	100.0	100.2	100.2	100.5	100.5
Meats, poultry, fish, and eggs	100.0	100.0	100.0	100.0	99.9
Beef	100.0	100.0	100.0	100.0	99.5
Pork	100.0	100.0	100.0	99.3	99.3
Poultry	100.0	100.0	100.0	100.0	100.0
Fish	100.0	100.0	100.0	101.0	101.0
Dairy	100.0	100.0	100.3	100.3	100.3
Fruits	100.0	100.0	100.4	100.4	100.8
Vegetables	100.0	100.0	100.0	100.5	100.5
Sugars and sweeteners	100.0	100.0	100.0	100.0	100.0
Nonalcoholic beverages	100.0	100.0	100.0	100.0	100.0
Fats and oils	100.0	100.0	100.0	100.0	100.0
Miscellaneous prepared food	100.0	100.3	100.3	100.3	100.5

Source: Economic Research Service, USDA.

eners, nonalcoholic beverages, and fats and oils would remain the same between 2000 and 2020.

Income Changes

Changes in income are projected to have a relatively large effect on food expenditure patterns, particularly food away from home. Under this scenario, food-away-from-home spending would increase 9.7 percent, while food-at-home expenditures would increase 3.0 percent (table 21). Among individual at-home foods, fruit would have the largest percentage increase in expenditures from 2000 (up 4.2 percent). Expenditures on miscellaneous foods would be expected to increase approximately 3.8 percent, while spending on vegetables would increase about 3.3 percent. Expenditures for cereals and bakery products, dairy, sugars and sweeteners, and nonalcoholic beverages would all increase about 2.5 percent between 2000 and 2020. The smallest spending increase occurs for meats, poultry, fish, and eggs—up just 1.3 percent over the 20-year period. The largest spending increase within this category occurs for fish, up 1.9 percent, while the smallest increase is for beef, up just 0.5 percent, over the same period. These expenditure changes tend to be larger than the corresponding quantity changes because consumers purchase better quality products as income rises, not more of each product.

Combined Demographic and Income Changes

Projected per capita expenditures based on all demographic projections (changing age, regional, diet-health knowledge, and racial distributions) combined with an assumed 1-percent growth in annual income show increases in all food categories (table 22). Total food expenditures are projected to increase 7.1 percent. Food-away-from-home spending is projected to increase 8.1 percent, while food-at-home spending is projected to increase 5.4 percent between 2000 and 2020.

Among major at-home food categories, expenditures increase the most for fruits (up 8.1 percent), vegetables (up 7.2 percent), and miscellaneous prepared food (up 5.3 percent). Expenditures for several categories of food are expected to grow between 4 and 5 percent over the 20-year period, including cereals and bakery products (up 4.3 percent), fats and oils (also up 4.3 percent), meats, poultry, fish, and eggs (up 4.1 percent), and dairy (up 4.0 percent). Within the meats, poultry, fish, and eggs category, expenditures will increase 6.2 percent for fish and just 2.6 percent for beef.

National Effects

To derive the total effect on the Nation's food expenditures of a 1-percent growth rate in income coupled with the effects of age, regional, diet-health knowledge, and racial distributions, we multiplied the total projected per capita expenditure in table 22 by the expected change in the U.S. population. The most important factor driving growth in total food demand between 2000 and 2020 is the expansion of the U.S. population. The census bureau projects a U.S. population increase of nearly 50 million over the 20-year period.

Total food expenditures are projected to increase 26.3 percent (table 23). Food-away-from-home expenditures are projected to increase 27.5 percent, compared with 24.3 percent for food-at-home expenditures. Because the individual food groups represent at-home food expenditures only, these projections understate total food expenditure growth for the individual food groups to the extent that the away-from-home market grows for particular foods. One effect of the slow but steady growth of the population is that the variation of growth levels between food groups is less than that exhibited by the per capita projections. The largest projected increase in expenditures is for fruits, up 27.5 percent, while the smallest is for both beef and nonalcoholic beverages, up 21.1 percent. Expenditures for meats, poultry, fish, and eggs are projected to increase 22.8 percent. Within this category, beef spending will increase 21.1 percent while fish will increase 25.2 percent. Clearly, the biggest boost to food demand in the future will come from population growth.

Table 21—Projected per capita effects of a 1-percent increase in annual income on weekly food expenditures

Food group	2000 base	Change in expenditures			
		2005	2010	2015	2020
		Percent			
Total food	100.0	101.4	102.9	104.5	106.2
Food away from home	100.0	102.2	104.6	107.0	109.7
Food at home	100.0	100.7	101.4	102.2	103.0
Cereals and bakery products	100.0	100.5	101.0	101.7	102.4
Meats, poultry, fish, and eggs	100.0	100.3	100.6	100.9	101.3
Beef	100.0	100.0	100.0	100.5	100.5
Pork	100.0	100.0	100.0	100.0	100.7
Poultry	100.0	100.8	100.8	101.6	101.6
Fish	100.0	100.0	101.0	101.0	101.9
Dairy	100.0	100.6	101.3	101.9	102.6
Fruits	100.0	100.8	101.9	103.1	104.2
Vegetables	100.0	101.0	101.4	102.4	103.3
Sugars and sweeteners	100.0	100.0	100.8	101.5	102.5
Nonalcoholic beverages	100.0	100.0	101.3	101.7	102.6
Fats and oils	100.0	100.0	101.4	101.4	101.4
Miscellaneous prepared food	100.0	100.8	101.8	102.8	103.8

Source: Economic Research Service, USDA.

Table 22—Projected per capita effects of combined demographic changes and a 1-percent increase in annual income on weekly food expenditures

Food group	2000 base	Change in expenditures			
		2005	2010	2015	2020
		Percent			
Total food	100.0	101.7	103.5	105.4	107.1
Food away from home	100.0	101.7	103.6	105.8	108.1
Food at home	100.0	101.5	102.9	104.3	105.4
Cereals and bakery products	100.0	101.0	102.0	103.3	104.3
Meats, poultry, fish, and eggs	100.0	101.3	102.4	103.5	104.1
Beef	100.0	101.1	101.6	102.1	102.6
Pork	100.0	101.5	102.3	103.1	103.8
Poultry	100.0	100.8	101.7	102.5	103.4
Fish	100.0	102.1	103.1	105.2	106.2
Dairy	100.0	101.0	102.0	103.0	104.0
Fruits	100.0	102.0	104.0	106.1	108.1
Vegetables	100.0	101.5	103.6	105.7	107.2
Sugars and sweeteners	100.0	100.8	102.4	103.1	104.7
Nonalcoholic beverages	100.0	100.9	101.8	102.3	102.7
Fats and oils	100.0	101.4	102.9	104.3	104.3
Miscellaneous prepared food	100.0	101.3	102.7	104.0	105.3

Source: Economic Research Service, USDA.

Table 23—Projected national effects of combined demographic changes and a 1-percent increase in annual income on weekly food expenditures

Food group	2000 base	Change in expenditures			
		2005	2010	2015	2020
		Percent			
Total food	100.0	106.3	112.7	119.5	126.3
Food away from home	100.0	106.3	112.8	120.0	127.5
Food at home	100.0	106.0	112.0	118.3	124.3
Cereals and bakery products	100.0	105.5	111.1	117.1	123.0
Meats, poultry, fish, and eggs	100.0	105.8	111.5	117.3	122.8
Beef	100.0	105.6	110.6	115.8	121.1
Pork	100.0	106.1	111.4	116.9	122.5
Poultry	100.0	105.4	110.7	116.3	121.9
Fish	100.0	106.6	112.3	119.2	125.2
Dairy	100.0	105.5	111.0	116.8	122.6
Fruits	100.0	106.6	113.3	120.3	127.5
Vegetables	100.0	106.1	112.8	119.8	126.5
Sugars and sweeteners	100.0	105.3	111.5	117.0	123.5
Nonalcoholic beverages	100.0	105.4	110.8	116.0	121.1
Fats and oils	100.0	106.0	112.0	118.3	123.1
Miscellaneous prepared food	100.0	105.9	111.8	117.9	124.2

Source: Economic Research Service, USDA.

Conclusions

Our food expenditure projections are based on several assumptions. First, the relationships of income and demographics to food expenditures will stay the same as those found in the statistical analysis of the 1997-98 CES data. Second, as economic and demographic circumstances change, consumers will acquire the expenditure patterns of individuals already observed in those circumstances. Third, the estimated models are driven by projected changes in demographics and projected income growth. These assumptions are extremely restrictive, but the information required to relax them is either unavailable or unreliable.

It is important to stress an alternative way to view the projections: as scenarios of what would have occurred in 1997-98 if projected demographic changes had already been in place. For example, a relevant question may be as follows: "What would have happened to food expenditures in 1997-98 if the projected changes in the racial mix of the population for 2020 were already in place?" This approach to viewing the projections lessens the potential for misinterpretation by focusing attention on the underlying assumptions described earlier in this report.

Based on our projections, changes in regional makeup, diet-health knowledge (educational attainment), and racial distribution will have little effect on U.S. per capita food expenditures. The changing age distribution of the U.S. population between 2000 and 2020 will also have minimal impact. Under this scenario, total food expenditures will increase just 0.8 percent. This projected increase is due to food-away-from-home expenditures declining 1.3 percent and food-at-home expenditures increasing 2.2 percent. The isolated impact of income growth had a larger effect on spending than projected demographic variables. A 1-percent increase in inflation-adjusted income would increase total food expenditures 6.2 percent between 2000 and 2020. This effect is due to a 9.7-percent increase in food expenditures away from home and a 3-percent increase in food expenditures at home.

When demographic changes and income growth were combined in a composite projection, we found that total per capita food expenditures were expected to increase 7.1 percent. This effect is due to an 8.1-percent increase in food-away-from-home expenditures and a 5.4-percent increase in food-at-home expenditures. By taking into account projected increases in the U.S. population between 2000 and 2020, we used our composite projections to derive a total national effect. Total national food expenditures are projected to increase 26.3 percent over the 20-year period. This effect is due to a 27.5-percent increase in expenditures for food away from home and a 24.3-percent increase in expenditures for food at home.

The effect of demographic and income changes on demand for food can be separated into two possible components—demand for quantity and demand for quality. The demand for quantity typically describes the demand for undifferentiated basic commodities, while the demand for quality describes the demand for a wide array of food characteristics, such as taste, nutritional content, safety, and convenience.

Increased demand for quality can be manifested through purchases of higher valued items within a food group or through purchases of new food types. For example, within the red meat food group, more affluent consumers may choose steaks instead of hamburgers. More affluent consumers may also expand their food choices to include luxury items, such as lobster or truffles, or new convenience foods, including away-from-home foods. As incomes rise, consumers may also increase their demand for processed foods that meet particular safety requirements, such as pasteurized eggs, or foods with preferred nutrition attributes, such as leaner meats.

Our analysis supports the hypothesis that consumers may demand quality over quantity in the future, especially as real incomes increase. Among the major food groups, the net effect of income growth and demographic change is projected to have its largest percentage effect on per capita expenditures for fruits, vegetables, miscellaneous prepared foods—a category that captures a vast array of processed foods—and food away from home. This effect suggests that processors may want to continue developing new products that are convenient, safe, nutritious, and easy to prepare.

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Appendix

The statistical model used in this analysis uses information from both consuming and nonconsuming households. The censored normal regression model, commonly referred to as the Tobit model, is used to obtain expenditure estimates when some households purchase and others do not purchase in a given time period.

The Tobit model can be expressed, for a typical household, as:

$$Y_i = X_iB + \varepsilon_i \text{ if } X_iB + \varepsilon_i > 0;$$

$$Y_i = 0 \text{ if } X_iB + \varepsilon_i \leq 0.$$

Where i = 1, 2. …, n; n is the number of households; Y_i is item expenditure; X is a vector of explanatory variables; B is a vector of coefficients; and ε_i is an independently and normally distributed random disturbance term with a mean of zero and constant variance, σ^2. The level of expenditures for the i^{th} household is determined by the combination of a nonstochastic component, $X_i\beta$, and a stochastic component, ε_i. The determinate or nonstochastic portion of the model is a linear function of household characteristics and their respective response parameters. Expenditures differ among households due to both the determinate portion of the model and to the stochastic element, which embodies the unobserved factors and idiosyncrasies of individual households. For a more detailed discussion of the Tobit technique, see Blisard and Blaylock.

Appendix table 1—Tobit model for food expenditures, 1997-98: parameter estimates and statistics

Independent variables	Total food	Food at home	Cereals and bakery	Meat, poultry, fish, and eggs	Beef	Pork	Poultry	Fish	Dairy
Constant	11.30	14.13	1.81	10.86	5.44	5.68	0.83	-4.48	0.54
	(4.59)	(3.22)	(0.70)	(1.35)	(0.80)	(0.65)	(0.56)	(0.95)	(0.63)
Diet knowledge	0.98	0.80	0.16	-0.08	-0.16	-0.20	0.05	0.25	0.15
	(0.26)	(0.18)	(0.04)	(0.08)	(0.05)	(0.04)	(0.03)	(0.05)	(0.04)
North Central	-4.03	-2.13	-0.56	-0.80	-0.17	0.32	-0.55	-1.31	-0.43
	(1.02)	(0.72)	(0.16)	(0.30)	(0.18)	(0.15)	(0.13)	(0.21)	(0.14)
South	-3.52	-1.51	-0.73	-0.40	-0.08	0.35	-0.42	-0.47	-0.26
	(0.96)	(0.67)	(0.15)	(0.28)	(0.17)	(0.14)	(0.12)	(0.20)	(0.13)
West	-0.68	0.55	-0.41	-0.35	-0.22	-0.17	-0.35	0.19	-0.04
	(1.00)	(0.70)	(0.15)	(0.30)	(0.18)	(0.14)	(0.12)	(0.20)	(0.14)
Race	-4.16	-0.55	-0.40	1.25	-0.26	0.37	0.88	1.44	-0.89
	(1.17)	(0.82)	(0.18)	(0.34)	(0.20	(0.16)	(0.14)	(0.24)	(0.16)
Income	3.41	0.95	0.14	0.10	0.03	0.04	0.04	0.01	0.12
	(0.19)	(0.14)	(0.03)	(0.06)	(0.03)	(0.03)	(0.02)	(0.04)	(0.03)
Income squared	-0.05	-0.01	-3.39-e3	5.63-e3	3.50-e3	-3.29-e4	3.61-e4	3.00-e3	-2.73-e3
	(0.01)	(4.75-e3)	(1.03-e3)	(1.20-e3)	(1.15-e3)	(9.96-e4)	(8.15-e4)	(1.28-e3)	(9.47-e4)
Winter	-0.33	-1.12	0.11	-0.03	0.24	-0.21	-0.15	0.59	-0.37
	(0.89)	(0.62)	(0.14)	(0.26)	(0.16)	(0.13)	(0.11)	(0.18)	(0.12)
Spring	0.22	-0.73	0.02	-0.04	0.48	-0.24	-0.19)	0.13	-0.24
	(0.89)	(0.62)	(0.14)	(0.26)	(0.16)	(0.13)	(0.11)	(0.18)	(0.12)
Summer	-0.02	-1.75	-9.99-e3	-0.38	0.18	-0.26	-0.20	-0.02	-0.37
	(0.89)	(0.63)	(0.13)	(0.26)	(0.16)	(0.13)	(0.11)	(0.19)	(0.12)
Year	1.84	-0.43	-0.20	-0.10	-0.03	-0.06	-0.11	0.18	-0.10
	(0.64)	(0.45)	(0.10)	(0.19)	(0.11)	(0.09)	(0.08)	(0.13)	(0.09)
Household size (inverse)	10.50	0.97	-0.37	-2.65	-2.65	-2.34	-1.69	-2.56	-0.06
	(1.38)	(0.97)	(0.21)	(0.41)	(0.25)	(0.21)	(0.18)	(0.30)	(0.19)
Proportion age 0-4	-19.76	-15.54	-2.74	-6.28	-2.00	-2.20	-1.48	-2.07	-0.63
	(3.35)	(2.35)	(0.51)	(0.99)	(0.58)	(0.47)	(0.41)	(0.69)	(0.46)
Proportion age 5-9	-14.85	-12.24	-1.07	-5.39	-1.72	-2.30	-1.09	-1.15	-0.76
	(2.97)	(2.08)	(0.45)	(0.87)	(0.51)	(0.42)	(0.36)	(0.60)	(0.41)
Proportion age 10-14	-10.41	-11.89	-1.35	-5.59	-1.68	-2.52	-0.98	-2.40	-0.84
	(3.01)	(2.11)	(0.46)	(0.88)	(0.52)	(0.42)	(0.36)	(0.61)	(0.41)
Proportion age 15-19	-15.35	-18.45	-2.87	-7.85	-3.05	-2.84	-1.81	-2.51	-2.13
	(2.29)	(1.63)	(0.36)	(0.71)	(0.43)	(0.36)	(0.30)	(0.52)	(0.32)
Proportion age 20-29	-6.13	-12.45	-1.42	-5.14	-1.98	-2.59	-1.13	-2.08	-1.34
	(1.31)	(0.92)	(0.20)	(0.39)	(0.24)	(0.20)	(0.17)	(0.29)	(0.18)
Proportion age 30-44	-0.87	-6.09	-0.85	-2.23	-1.19	-1.20	-0.21	-0.58	-0.49
	(1.20)	(0.84)	(0.18)	(0.36)	(0.21)	(0.18)	(0.15)	(0.25)	(0.17)
Proportion age 65-74	1.22	0.08	0.47	-0.47	-0.51	-0.29	-0.16	0.28	0.16
	(1.38)	(0.96)	(0.21)	(0.40)	(0.24)	(0.20)	(0.17)	(0.28)	(0.19)
Proportion age 75 and older	-3.56	-0.37	0.57	-1.36	-1.01	-0.62	-0.14	0.14	0.37
	(1.52)	(1.06)	(0.23)	(0.45)	(0.27)	(0.22)	(0.19)	(0.32)	(0.21)
Sigma	28.21	19.72	4.29	8.19	4.57	3.67	3.15	4.86	3.82
Direct income elasticity	0.27	0.12	0.09	0.07	0.07	0.06	0.08	0.05	0.10
Probability of purchase	0.92	0.89	0.80	0.75	0.52	0.48	0.49	0.32	0.75

Appendix table 2—Tobit model for food expenditures, 1997-98: parameter estimates and statistics

Independent variables	Fruits	Vegetables	Sugars and sweeteners	Nonalcoholic beverages	Fats and oils	Miscellaneous prepared food	Food away from home
Constant	-2.54	-0.12	-0.62	1.87	0.44	-1.32	-12.58
	(0.57)	(0.43)	(0.49)	(0.51)	(0.29)	(0.83)	(3.48)
Diet-health knowledge	0.28	0.17	0.11	0.01	0.03	0.24	0.61
	(0.03)	(0.02)	(0.03)	(0.03)	(0.02)	(0.05)	(0.20)
North Central	-0.53	-0.53	4.17-e3	0.21	-0.04	0.51	-1.91
	(0.13)	(0.10)	(0.11)	(0.11)	(0.06)	(0.19)	(0.77)
South	-0.42	-0.20)	-0.01	0.22	0.06	0.44	-2.19
	(0.12)	(0.09)	(0.10)	(0.11)	(0.06)	(0.17)	(0.72)
West	0.20	0.12	0.03	0.18	0.08	1.12	-1.05
	(0.12)	(0.09)	(0.11)	(0.11)	(0.06)	(0.18)	(0.75)
Race	0.53	0.09	-0.13	-0.43	0.04	-0.82	-4.68
	(0.15)	(0.11)	(0.13)	(0.13)	(0.07)	(0.21)	(0.90)
Income	0.16	0.07	0.07	0.10	0.02	0.24	2.77
	(0.02)	(0.02)	(0.02)	(0.02)	(0.01)	(0.04)	(0.15)
Income squared	-3.70-e3	-1.55-e3	-1.81-e3	-2.46-e3	-6.30-e4	-5.57-e3	-0.04
	(0.8.57-e4)	(6.44-e4)	(7.24-e4)	(7.67-e4)	(4.38-e4)	(1.22-e3)	(0.01)
Winter	-0.02	0.02	-0.42	-0.13	-8.49-e3	-0.18	0.72
	(0.11)	(0.08)	(0.10)	(0.10)	(0.06)	(0.16)	(0.67)
Spring	0.27	0.06	-0.61	0.18	0.02	-0.24	1.07
	(0.11)	(0.08)	(0.10)	(0.10)	(0.06)	(0.16)	(0.67)
Summer	0.23	-0.05	-0.72	0.02	-0.10	-0.63	1.79
	(0.11)	(0.08)	(0.10)	(0.10)	(0.06)	(0.16)	(0.67)
Year	-0.03	0.05	9.97-e3	-0.12	-0.07	-0.05	2.76
	(0.08)	(0.06)	(0.07)	(0.07)	(0.04)	(0.12)	(0.49)
Household size (inverse)	-0.33	-0.86	-0.98	-0.25	-0.82	-0.05	7.16
	(0.17)	(0.13)	(0.15)	(0.15)	(0.09)	(0.25)	(1.04)
Proportion age 0-4	-0.74	-1.84	-0.73	-1.82	-1.14	-1.77	-4.56
	(0.41)	(0.31)	(0.36)	(0.37)	(0.21)	(0.60)	(2.53)
Proportion age 5-9	-0.76	-1.81	-0.13	-1.81	-0.73	-1.66	-3.03
	(0.37)	(0.28)	(0.31)	(0.33)	(0.18)	(0.54)	(2.25)
Proportion age 10-14	-1.46	-1.89	-0.19	-1.04	-0.78	-1.24	1.78
	(0.37)	(0.28)	(0.32)	(0.33)	(0.19)	(0.54)	(2.27)
Proportion age 15-19	-2.53	-2.74	-0.87	-1.46	-1.23	-2.78	2.71
	(0.30)	(0.23)	(0.26)	(0.26)	(0.15)	(0.43)	(1.72)
Proportion age 20-29	-1.55	-1.77	-0.87	-0.99	-0.98	-1.73	7.45
	(0.16)	(0.12)	(0.14)	(0.15)	(0.09)	(0.24)	(0.98)
Proportion age 30-44	-1.17	-0.92	-0.42	-0.17	-0.49	-0.56	6.12
	(0.15)	(0.11)	(0.13)	(0.13)	(0.08)	(0.22)	(0.90)
Proportion age 65-74	0.42	0.29	0.46	-0.47	-0.06	-0.42	1.07
	(0.17)	(0.13)	(0.15)	(0.15)	(0.09)	(0.25)	(1.04)
Proportion age 75 and older	1.44	0.23	0.23	-0.98	0.07	-0.01	-3.89
	(0.19)	(0.14)	(0.16)	(0.17)	(0.09)	(0.28)	(1.16)
Sigma	3.42	2.58	2.85	3.04	1.63	5.01	20.84
Direct income elasticity	0.15	0.10	0.11	0.11	0.05	0.15	0.44
Probability of purchase	0.72	0.75	0.55	0.72	0.54	0.73	0.74

Appendix table 3—Diet-health knowledge equation

Independent variables	Diet-health knowledge
Constant	16.19
	(0.27)
North Central	0.78
	(0.18)
South	0.07
	(0.27)
West	-0.21
	(0.24)
Nonmetro	0.01
	(0.17)
Income	0.18
	(0.03)
Male	-1.57
	(0.17)
Black	-1.44
	(0.36)
Male head	-0.64
	(0.22)
Female head	-0.80
	(0.17)
Employed	0.24
	(0.19)
High school education	1.46
	(0.21)
Some college	2.51
	(0.19)
College	3.12
	(0.22)
Proportion age 0-4	-0.25
	(0.54)
Proportion age 5-9	-0.46
	(0.60)
Proportion age 10-14	-0.19
	(0.70)
Proportion age 15-19	0.25
	(0.65)
Proportion age 20-29	-0.52
	(0.31)
Proportion age 30-44	-0.50
	(0.31)
Proportion age 65-74	0.10
	(0.21)
Proportion age 75 and older	-2.00
	(0.35)

R-squared = 0.20

F(21,23) = 48.4

N = 5,232